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OPERABLE UNIT 1 SUBMITTAL OF DRAFT PRELIMINARY ENGINEERING PACKAGE

10/23/95

DOE-0084-96
DOE-FN EPAS
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REPORT

Department of Energy
Fernald Environmental Management Project
P. O. Box 398705
Cincinnati, Ohio 45239-8705
(513) 648-3155

OCT 23 1995

DOE-0084-96

Mr. James A. Saric, Remedial Project Director
U.S. Environmental Protection Agency
Region V - 5HRE-8J
77 W. Jackson Boulevard
Chicago, Illinois 60604-3590

Mr. Tom Schneider, Project Manager
Ohio Environmental Protection Agency
401 East 5th Street
Dayton, Ohio 45402-2911

Dear Mr. Saric and Mr. Schneider:

OPERABLE UNIT 1 SUBMITTAL OF DRAFT PRELIMINARY ENGINEERING PACKAGE

Reference: Letter, J. Reising to J. Saric and T. Schneider, "Integrated Remedial Planning," dated October 12, 1995.

In accordance with the approved Remedial Design Work Plan (RDWP) for Operable Unit 1 (OU1), this letter transmits the Draft Preliminary Engineering Design for review and comment. The submittal contains the following seven elements identified in the approved RDWP for OU1:

- Plant Facilities Design Criteria Document;
- Plant Facilities Engineering Description;
- Equipment Specifications;
- Site Improvement Plan;
- Construction Schedule;
- Excavation Plan; and
- Transportation and Disposal Plan.

Recycled and Recyclable

The RDWP for OU1 also called for the submittal of a Site Restoration Plan. However, in accordance with agreements and understandings concerning the Integration of Remedial Actions at the Department of Energy, Fernald Area Office (DOE-FN), (Ref 1), an overall Site Restoration Plan will be submitted pursuant to the design process presented in the forthcoming Operable Unit 5 (OU5) RDWP.

The DOE-FN is continuing its ongoing work to refine and complete this design. The EPA comments will be addressed in a Comments Response Document (CRD) and incorporated as appropriate into the Pre-Final Design submittal scheduled for March 21, 1996.

If you have any questions or comments, please contact Dave Lojek at (513) 648-3127.

Sincerely,

Johnny Reising

FN:Hall

Johnny W. Reising
Fernald Remedial Action
Project Manager

Enclosure: As Stated

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Operable Unit 1 Remedial Design
Preliminary Design Package I

Fernald Environmental Management Project
Fernald, Ohio
Fernald Area Office

October 1995

United States Department of Energy

0163

Operable Unit 1 Remedial Design
Preliminary Design Package I

Fernald Environmental Management Project
Fernald, Ohio
Fernald Area Office

October 1995

United States Department of Energy

000004

ROADMAP

E_0163

Department of Energy
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P. O. Box 398705
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M. Yates, FERMCO

OU1 Preliminary Design Package Contents

Deliverable	Components	Content
PACKAGE I		
PLANT FACILITIES DESIGN CRITERIA PACKAGE	Design Criteria Document (DCD)	Documents the specific criteria which affect the design, including all pertinent DOE orders, engineering design codes, standards and requirements, etc.
	ARARs and TBC Requirements Tables (Appendix A of DCD)	Discusses how the ARARs and TBCs are addressed through the design.
	Results of the Studies/Tests Relevant to Remediation System Design (Appendix B of DCD)	Summarizes the results of studies, reports, and/or evaluations in support of the design. (Does not include detailed results from DEEP; these are included in the Preliminary Technical Summary of DEEP Test Data).
PLANT FACILITIES ENGINEERING	Process Description	Describes the operation and process used to treat the waste, including wastewater handling as shown on the Process Flow Diagrams.
	Control Philosophy	Covers the general operating and control philosophy for the design, including a description of the instrumentation concept, operation, and process control on a system-by-system basis for each process shown on the Process Flow Diagrams.
	Mass and Energy Balances	Includes Mass Balances for Pit 6 (which are also included on the Process Flow Diagrams). The other Mass and Energy Balances will be included in the Pre-final Design Package.
	Process Flow Diagrams	Includes process flow diagrams for waste retrieval, waste preparation, drying and off-gas treatment, and dried waste blending and loadout. Also includes mass balances for Pit 6.
	Material and Equipment List	Currently includes a listing of the equipment associated with the process. Subsequent issues will include material as appropriate.
	General Arrangement Drawings	Includes a civil conceptual site plan, a civil conceptual utility plan, and material handling plans and sections for the pit waste remediation area, waste preparation area, the drying facility, and the blending and rail loadout facility.
EQUIPMENT SPECIFICATIONS	Shredder	Includes the performance specification for the shredder, motor and associated electrical materials. These specifications are currently being finalized for procurement.
	Indirect Dryer	Includes the performance specification for the indirect rotary dryer, motor, electrical materials, piping, pipe supports, and insulation These specifications are currently being finalized for procurement.
	Off-Gas Control System	Includes a discussion on the basis of the Off-Gas Control System, and draft performance specification for the various components of the Off-Gas Control System.
	Waste Loadout System	Includes the waste loadout system specification basis. Additional information will be provided in the Pre-final Design Package.
SITE IMPROVEMENT PLAN	Description of Site Preparation Activities	Presents the contents of the Site Improvement Plan and their interrelationship.
	Site Plan	Drawing depicting the general improvements to the site.
	Grading Plan and Details	Drawings depicting the grading plan in support of the construction of the remediation facilities.
	Utility Plan	Drawing showing the location of subsurface utilities.

Preliminary Design Package Contents (Continued)

Deliverable	Components	Content
PACKAGE I (Continued)		
SITE IMPROVEMENT PLAN (Continued)	Civil Specifications	Contains construction specifications to support the site improvement activities.
	Utility Requirements	Preliminary estimate of utility needs for the proposed OU1 remediation facilities.
	Design of On-Site Rail Improvements	Description of on-site rail improvements, including a layout drawing showing the rail upgrades and construction required to support on-site operations, along with a description of the logistics associated with receiving, loading, storing, and moving full and empty cars.
	Off-Site Rail Upgrades	Discussion of the work to be performed by CSXT to repair or upgrade the rail system from the FEMP to Cottage Grove, Indiana.
CONSTRUCTION SCHEDULE	Construction Schedule	Estimate of the time required to complete the remedial action activities including an identification of the major construction tasks and subtasks.
PACKAGE II		
Deliverable	**Components**	**Content**
EXCAVATION PLAN	Waste Excavation Plan	Description of processes to be used in the excavation of waste from each of the various waste units and transfer to the processing facility, the basis of which will be reflective of the results of the Dewatering Excavation Evaluation Program. Discussion will also be provided on stormwater management, dust and fugitive emissions control, and monitoring during excavation, although specific sampling and analysis details will be identified in the Remedial Action Work Plan. The plan will also discuss needed coordination with Operable Unit 5 (OU5) related to soils excavation, and with Operable Unit 3 (OU3) for the management of oversized debris.
	Materials Management (Appendix A of Excavation Plan)	Discusses various forms of materials which can be expected to be generated through the OU1 excavation activities, and special waste handling needs associated with some of these materials (i.e., those which could potentially go to OU3 or OU5 for disposal in the on-property disposal facility).
	Conceptual Drawings (Appendix B of Excavation Plan)	Provides drawings of various excavation plans, sections, and civil details.
	Preliminary Technical Summary of DEEP Test Data	Provides a summary of the results of the various phases of DEEP, which have been completed to date.
SITE RESTORATION PLAN - Although identified in the RDWP, this design activity is no longer within the scope of the OU1 design, but will be more appropriately covered on a site-wide basis as an aspect of the OU5 design process.		
TRANSPORTATION AND DISPOSAL PLAN	Transportation and Disposal Plan	Description of plan for shipping waste to the PCDF and as required to NTS, including discussion of rail transportation concepts, shipment containers, plan for tracking of shipments, emergency response plan, and waste characterization testing and analysis requirements associated with meeting the waste acceptance criteria of the PCDF.

Roadmap to FEMP OU1 Preliminary Design Package

1.0 Purpose of Documents

The documents described in Sections 4 and 5 constitute the Preliminary Design submitted to the United States Environmental Protection Agency (US EPA)/Ohio Environmental Protection Ageny (Ohio EPA) for the remediation of the Fernald Environmental Management Project (FEMP) Operable Unit 1 (OU1) facilities. The documents are in varying stages of completion according to the design schedule. An insert presenting a quick reference to the OU1 Preliminary Design Package contents is included at the beginning of this section.

2.0 Background

2.1 Facility Description

The FEMP site is a 425-hectare (1,050-acre), government-owned facility located approximately 29 kilometers (18 miles) northwest of the city of Cincinnati, Ohio. It is situated on the boundary between Hamilton and Butler Counties. The FEMP, which operated under the name of the Feed Materials Product Center, produced high purity uranium metal products for the United States Department of Energy (DOE) and its predecessor agencies from 1952 to 1989. Former uranium processing operations at the FEMP were limited to a fenced, 55-hectare (136-acre) tract, closed to public access, known as the former Production Area. Production activities ceased in 1989 due to a declining demand for uranium feed products. In June 1991, the site was officially closed for production by an act of Congress. The Fernald site was included on the Comprehensive Environmental Response, Compensation, and Liability Act National Priorities List in 1989. The current mission of the site is the safe environmental restoration of the site in accordance with all applicable requirements.

OU1 is a well-defined, 15.3-hectare (37.7-acre) area located in the northwest quadrant of the FEMP site. Large quantities of liquid and solid wastes that were generated by various chemical and metallurgical processing operations were stored or disposed in six waste pits and the Clearwell, or burned in the Burn Pit. These waste pits are located in a portion of the FEMP Waste Storage Area and are contained within the boundaries of OU1. A detailed discussion of each waste pit's construction, contents, and volume of waste material is provided in the Remedial Investigation Report for Operable Unit 1 (DOE 1994c).

2.2 Remediation Strategy

Remediation of OU1 is based on the final Record of Decision (ROD) for Remedial Actions at Operable Unit 1 (DOE 1995), signed by the US EPA on March 1, 1995. The overall goal of the OU1 remedial action is to safely remediate all the OU1 components in a timely, efficient, and cost-effective manner, ensuring compliance with all Applicable or Relevant and Appropriate Requirements (ARARs), and protecting human health and the environment. Additional detail may be found in the enclosed documents and in the Final Remediation Design Work Plan (RDWP) for Remedial Actions at Operable Unit 1 (DOE 1995). The selected remedy presented in the OU1 ROD is excavation of the waste pit contents, waste processing and treatment by thermal drying (as necessary to remove free water), and off-site disposal at a Permitted Commercial Disposal Facility (PCDF).

3.0 General Structure of Preliminary Design Packages

This submittal consists of the following elements as defined in the Final RDWP for Remedial Actions at Operable Unit 1 (DOE July 1995). The information is divided into two packages.

1) Package I addresses the equipment and facilities directly associated with the processing of the waste and the plan which describes site preparation activities necessary to support processing.

2) Package II addresses the operational plans associated with waste excavation, site restoration, and waste transportation and disposal.

To the extent possible, the various documents reference each other instead of repeating detailed information.

In accordance with the approach presented in the DOE Proposal for Integration of Sitewide Planning (submitted to the US EPA and Ohio EPA by letter of August 18, 1995), the Site Restoration Plan, a design deliverable, is intentionally not included in this design package. Site restoration is more appropriately covered on a sitewide basis in a sitewide design package submitted pursuant to the OU5 remedial design process and therefore is deferred from the OU1 Remedial Design documentation.

4.0 PACKAGE I CONTENTS

4.1 Plant Facilities Design Criteria Package

The Design Criteria Document is the controlling element of the Plant Facilities Design Criteria Package. It summarizes the specific criteria which affect the design including all pertinent DOE Orders, engineering design codes, standards, and requirements. It relates how the various elements of the

Conceptual Design of the remediation plan and facilities address the ARARs and To Be Considered (TBC) requirements. The document includes a summary of the results of studies, reports, and/or evaluations in support of the design and a synopsis of the engineering tests. (The actual test data are included in other documents.)

Note: This document will include the results of physical property and other tests performed at the site or on OU1 materials. However, some of the test data were not available in time for incorporation in the preliminary issue of this document (October 1995). The remaining data will be incorporated in the Pre-Final Design Package to be issued in March 1996. Other elements of the Plant Facilities Design Criteria Package include the Dewatering, Excavation, and Evaluation Program (DEEP) Data Report and other reports and/or evaluations in support of design.

4.2 Plant Facilities Engineering

The Plant Facilities Engineering package contains a description of the operation and process used to treat the waste, and handling of wastewater. This provides the conceptual engineering information that forms the basis for developing the preliminary design. Discussion of the material handling concepts is included in the Process Description and the Excavation Plan (Package II).

4.2.1 Process Description

This document describes the operation and process used to treat the waste, including wastewater as shown on the Process Flow Diagrams. It provides an explanation of the processes shown on the Process Flow Diagrams including a reference to the appropriate stream numbers.

4.2.2 Control Philosophy

This document covers the general operating and control philosophy for the design, including a description of the operation and process control on a system-by-system basis for each process shown on the Process Flow Diagrams.

4.2.3 Mass and Energy Balances

The Mass Balances for Pit 6 are included on the Process Flow Diagrams. The other Mass and Energy Balances will be included in the Pre-Final Design Package.

Note: The material balance, and process designs are based on the physical property data for the pit waste available June 15, 1995. Process design will be revised to incorporate additional data in the Pre-final Design Package to be issued on March 24, 1996.

The loadout and storage system design concepts were recently modified and are still under development.

4.2.4 Process Flow Diagrams

This set of drawings includes the process flow diagrams for waste retrieval, waste preparation, drying and off-gas treatment, and dried waste blending and loadout. The material balances for Pit 6 are also included on the drawings.

4.2.5 Material and Equipment List

The Material and Equipment List currently provides a listing of the equipment associated with the process used to treat the waste as shown on the Process Flow Diagrams. Subsequent issues will include material as appropriate.

4.2.6 General Arrangement Drawings

The General Arrangement Drawings include a civil conceptual site plan, a civil conceptual utility plan, and material handling plans and sections for the pit waste remediation area, waste preparation area, the drying facility, and the blending and rail loadout facility.

4.3 Equipment Specifications

Performance Specifications are included for the major equipment items as noted below. These specifications will be used to competitively procure items requiring longer lead fabrication times.

4.3.1 Shredder

Development of the shredder performance specification is nearing completion. Incorporation of final comments remains to be completed.

4.3.2 Indirect Dryer

Development of the indirect dryer performance specification is nearing completion. Incorporation of final comments remains to be completed.

4.3.3 Off-Gas Control System

A description of the Basis of the Off-Gas Control System and preliminary specification technical sections are included. The specifications are available in draft form at this time. They will be refined for procurement purposes with the appropriate data sheets, cover pages, and approval pages, and presented in the Pre-Final Design Package.

4.3.4 Waste Loadout System

Section 02111 of the Waste Loadout System specification is included. This section describes the system functions and major components. Most of the equipment associated with this system is standard rail equipment that is readily available.

4.4 Site Improvement Plan

4.4.1 Description of Site Preparation Activities

The Site Improvement Plan comprises the drawings and specifications for the initial civil improvements necessary to prepare the site for the construction and operation of the OU1 treatment system. This initial civil work is primarily site grading and stormwater control-related work. The plan includes a general description of the site preparation activities and the following technical documents.

4.4.2 Site Plan

These depict the general improvements to the site including: Site clearing and grading, access roads, stormwater management pond and 100-year storm spillway, and the embankment for the new rail spur. Railcar washdown station and control point, warehouse, changeout facility, diesel fuel station and other associated improvements, along with remaining OU1 remedial facilities are also shown, but not included in the initial design work.

4.4.3 Grading Plan

These two drawings show the grading for the berms for the stormwater management pond, culverts, and fencing. Detail drawings are also included.

4.4.4 Utility Plan

This drawing shows the location of subsurface utilities. Utilities, including fuel gas, wastewater, and process water that are installed in overhead pipe racks are shown in the Plant Facilities Engineering package.

4.4.5 Civil Specifications

The following construction specification sections are included:

1) Site Clearing, Section 02110
2) Earthwork, Section 02200
3) Erosion Control, Section 02270
4) Boring and Jacking, Section 02300
5) Asphaltic Concrete Paving, Section 02510
6) Site Water Lines, Section 02667
7) Detention Pond Geosynthetics, Section 02713
8) Site Drainage, Section 02720
9) Pump Station, Section 02733
10) Chain Link Fences, Section 02831
11) Soil Preparation and Seeding, Section 02900

4.4.6 Utility Requirements

This is a description of the utilities required to support the waste treatment process.

4.4.7 Design of On-Site Rail Improvements

These describe the rail upgrades and construction required to support the shipment of treated waste. It includes the logistical concepts associated with receiving, loading, storing, and moving of full and empty rail cars.

4.4.8 Off-Site Rail Upgrades

These describe the work to be performed by CSX to repair or upgrade the rail, switches, trestles, and culverts and other features from the FEMP to Cottage Grove, Indiana.

4.5 Construction Schedule

The construction schedule shows all of the construction elements required to initiate operation of the OU1 Remediation Facility. A 10-Year Plan has been developed by the DOE which describes an approach for the remediation of the FEMP within an overall 10-year period commencing in Fiscal Year (FY) 1996 and ending in FY 2005. The projected completion date for the remediation of OU1 by the second quarter of FY 2005 is consistent with the 10-Year Plan.

The major elements addressed are:

1) Off-site upgrade of the FEMP to Cottage Grove branch rail line

2) On-site infrastructure development associated with the storage, maintenance, and logistics of railcar management on the site

3) Construction of the treatment facilities (dryer, shredder, material handling facilities, etc.)

4) Site preparation activities

The schedule only addresses development of the first phase of remediation facilities for OU1.

Phase I features single dryer operation with a nominal capacity of 22 tons per hour processing rate. Although the 10-Year Plan envisions the operation of a second dryer in FY 2001, the need for this has not yet been established. The design provides space for installation of the additional capacity, although the activities required to install the additional capacity are not shown on this construction schedule.

5.0 PACKAGE II CONTENTS

5.1 Excavation Plan

The Excavation Plan includes a description and evaluation of the waste excavation method and transfer to the processing facility. It addresses stormwater management, monitoring, dust and fugitive emissions control, and sequencing of the excavations. Drawings and sections are included that depict the excavation method for Pits 3 and 5. It also includes a discussion of coordination among the various other FEMP operable units (OU2 and OU5 are involved in soils disposal while coordination is required with OU3 for debris management). Additional data will be incorporated in the Pre-Final Design Package.

Note: This document includes the results of physical property and other tests performed at the site or on OU1 materials. Some of the test data was not available in time for incorporation in the preliminary issue

of this document (October 1995). The remaining data will be incorporated in the Pre-Final Design Package to be issued in March 1996.

5.2 DEEP Test Data

The Preliminary Technical Summary of DEEP Test Data presents a summary of all information from the DEEP tests planned and conducted to determine waste pit material geotechnical properties. The Excavation Plan incorporates waste strength properties. Basic geotechnical properties for moisture content and density are used in the mass balances (although the most recent data have not been received for mass balance updating). There is also brief discussion of dewatering results that could bear on waste drying requirements.

The DEEP Test Data will be reissued as a final draft when all final DEEP data and laboratory results are available. Future results of this report may impact the preliminary and/or final design of the facilities.

5.3 Transportation and Disposal Plan

The Transportation and Disposal Plan describes the logistics of rail transportation, and provides objectives and criteria to be implemented in the detailed design phase. This plan highlights operational aspects of waste transportation to demonstrate that wastes can be transported safely in accordance with all applicable regulations.

Design Criteria Document for the Operable Unit 1 Remediation System Design

Fernald Environmental Management Project
October 1995
Revision 0

Submitted by:
U.S. Department of Energy
Fernald Area Office
P.O. Box 398705
Cincinnati, Ohio 45239-8705

Design Criteria Document for the Operable Unit 1 Remediation System Design

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LIST OF ACRONYMS AND ABBREVIATIONS

ASNT	American Society for Nondestructive Testing
AASHTO	American Association of State Highway and Transportation Officials
ACGIH	American Conference of Government Industrial Hygienists
ACI	American Concrete Institute
AFBMA	Anti-Friction Bearing Manufacturers Association
AGMA	American Gear Manufacturers Association
AISC	American Institute of Steel Construction
ALARA	As Low As Reasonably Achievable
ALTER	Accelerated Life Testing and Environmental Research Facility
ANS	American Nuclear Society
ANSI	American National Standards Institute
API	American Petroleum Institute
ARAR	Applicable or Relevant and Appropriate Requirement
ARI	American Refrigeration Institute
ASCE	American Society of Civil Engineers
ASHRAE	American Society of Heating, Refrigeration, and Air Conditioning Engineers
ASME	American Society of Mechanical Engineers
ASTM	American Society for Testing and Materials
AWS	American Welding Society
BAT	Best Available Technology
CBR	California Bearing Ratio
CDP	Conceptual Design Package
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CFR	Code of Federal Regulations
CRU	CERCLA/RCRA Unit
D&D	Decontamination and Dismantlement
DCD	Design Criteria Document
DEEP	Dewatering and Excavation Evaluation Program
DOE	United States Department of Energy
DOT	United States Department of Transportation
ERDA	Energy Research and Development Administration
F	Fahrenheit
FEMP	Fernald Environmental Management Project
FERMCO	Fernald Environmental Restoration Management Corporation
fpm	feet per minute
FSAR	Final Safety Analysis Report
ft^2	square foot (feet)
gpm	gallons per minute

LIST OF ACRONYMS AND ABBREVIATIONS (Continued)

HEPA	High-Efficiency Particulate Air
hr	hour
HVAC	Heating, Ventilation, and Air Conditioning
Hz	Hertz
IEEE	Institute of Electrical and Electronics Engineers
IES	Illuminating Engineers Society
kg	kilogram
kV	Kilovolt
kVA	Kilovolt-Ampere
kW	Kilowatt
lb	pound
m^2	square meter
MBMA	Metal Building Manufacturers Association
MCC	Motor Control Center
MEI	Maximally Exposed Individual
mrem	millirem
MSS	Manufacturers Standardization Society
NAD	North American Datum
NEMA	National Electrical Manufacturers Association
NESHAP	National Emission Standards for Hazardous Air Pollutants
NETA	National Electrical Testing Association
NFPA	National Fire Protection Association
NP	Nonplastic
NPDES	National Pollutant Discharge Elimination System
NPH	Natural Phenomena Hazard
NTS	Nevada Test Site
OAC	Ohio Administrative Code
OBBC	Ohio Basic Building Code
ODOT	Ohio Department of Transportation
Ohio EPA	Ohio Environmental Protection Agency
OSHA	Occupational Safety and Health Administration
OU	Operable Unit
PC	Performance Category
PCDF	Permitted Commercial Disposal Facility
pcf	pounds per cubic foot
pCi/L	picocuries per liter
psf	pounds per square foot
psi	pounds per square inch

LIST OF ACRONYMS AND ABBREVIATIONS (Continued)

PVC	Polyvinyl Chloride
RCRA	Resource Conservation and Recovery Act
RI	Remedial Investigation
ROD	Record of Decision
S/RID	Standards/Requirements Identification Document
SAE	Society of Automotive Engineers
SCS	Soil Conservation Service
sec	second
SSC	Structure, System, and Component
STD	Standard (DOE)
TBC	To Be Considered
TEMA	Tubular Exchanger Manufacturers Association
UBC	Uniform Building Code
UCRL	University of California Research Laboratory
UL	Underwriters Laboratories
US EPA	United States Environmental Protection Agency
V	Volt
WAC	Waste Acceptance Criteria
yd^3	cubic yard
yr	year

SECTION 1

PROJECT DESCRIPTION

1.1 Project Scope

As part of the June 1990 Consent Agreement and the December 1991 Amended Consent Agreement between the United States Environmental Protection Agency (US EPA) and the DOE, the DOE agreed to remediate the Fernald Environmental Management Project (FEMP). The consent agreement divided remedial areas at the FEMP into five operable units. This DCD addresses OU1, which is Waste Pits 1 through 6; the Burn Pit; the Clearwell; and berms, liners, and soil within the operable unit boundary. Figure 1-1 shows the boundaries for OU1.

This Design Criteria Document (DCD) establishes the Operable Unit 1 (OU1) remediation system functional requirements. In addition, it defines the design criteria that the design engineers must follow during preliminary and detailed design activities. The word "shall" is used in this DCD to denote criteria derived from a law, regulation, engineering code or standard, United States Department of Energy (DOE) Order/standard, or site policy. If additional requirements are identified during the detailed design phases, this document will be revised and reissued. This DCD is a portion of the Design Criteria Package described in the *Final Remedial Design Work Plan for Remedial Actions at Operable Unit 1* (DOE 1995b).

1.1.1 Background

The waste pits were constructed beginning in 1952 for the storage or disposal of large quantities of liquid and solid wastes generated by various chemical and metallurgical processing operations. Wastes generated at the FEMP, as well as some waste shipped from other DOE facilities, were disposed of on the property. The *Remedial Investigation Report for Operable Unit 1* (DOE 1994b) provides OU1 characterization data, as well as size, shape, construction, contents, and operation of the waste pits.

The selected remedy, discussed in Subsection 1.2, addresses the OU1 environmental and health threats by removing the waste materials and contaminated soils to health-based levels, and treating the waste materials and soils to meet the waste acceptance criteria (WAC) of the appropriate disposal facility. Subsection 1.3 describes the WAC for the On-Property Disposal Facility, Envirocare (which is the representative permitted commercial disposal facility [PCDF]), and the Nevada Test Site (NTS).

The OU1 remediation system design will be comprised of four basic components: waste retrieval, waste preparation drying and off-gas treatment, and dried waste blending and loadout. A description of the project components is provided in the *Process Description of the Remediation System Design* (PARSONS

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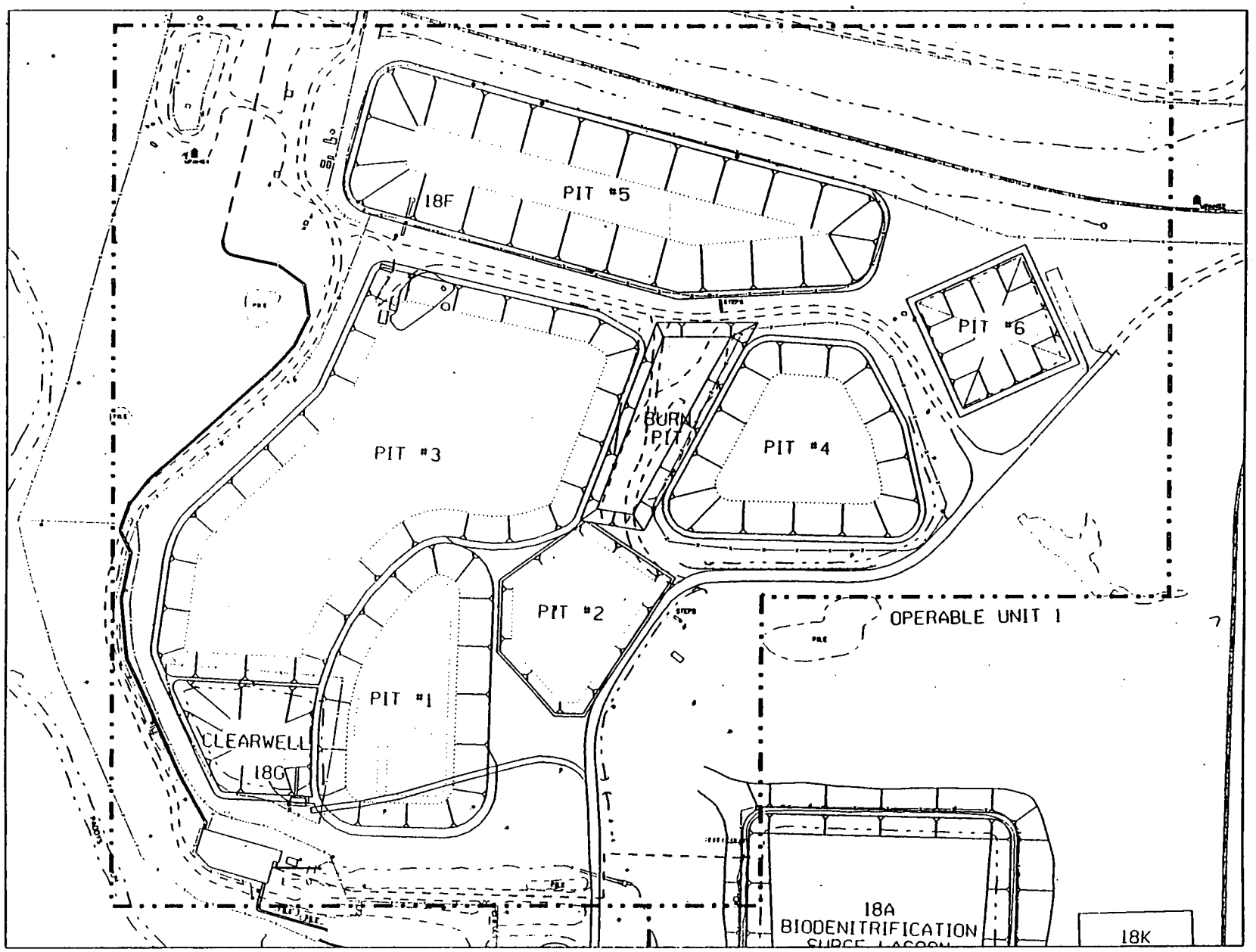

Figure 1-1 - OU1 Boundaries

1995d) and shown on the process flow diagrams in the Plant Facilities Engineering Package. Subsection 2.1 presents the functional and regulatory requirements for the remediation facilities.

An indirect fired rotary dryer will be used to reduce the moisture content of the waste. This treatment will allow the waste material to meet the WAC for the off-site disposal facility. The initial system design will leave space for installation of additional equipment or expansion of the facilities. Space equivalent to that required for a second dryer and the associated off-gas treatment system will be provided. Utilities will be provided for a two dryer system. In addition, a reserve capacity of 25 percent will be provided for utilities where appropriate. Should design development or operating experience identify the need for supplemental facilities, the DCD will be revised to reflect any design criteria changes.

1.1.2 Proposed Facility Location

Figure 1-2 shows the area planned for the OU1 remediation facilities. This area will cover open space between the road on the east side of Waste Pits 2, 4, and 6, the Biodenitrification Surge Lagoon, and rail spur 12. The site improvement package will include a topographic map. The following monuments will be survey control points for the OU1 area:

1) M-1 - N 482,600.0, E 1,346,400.0
2) M-2 - N 481,025.0, E 1,347,100.0
3) P-1 - N 482,223.87, E 1,348,384.18
4) 9008 - N 481,809.07, E 1,348,436.33

The proposed OU1 remediation facilities will be located in close proximity to the waste pits and the incoming/outgoing rail system. As indicated on Figure 1-2, the proposed new rail spur will connect the existing rail system and the waste loadout area.

The proposed facility location will extend across the eastern limit of the OU1 area and into an area designated as OU5. Subsection 1.1.4 discusses the soil volume project constraint resulting in the necessary coordination of OU1 and OU5 remedial activities.

1.1.3 Design Criteria Document Interfaces

This subsection outlines the interfaces between this DCD and other OU1 documents. The following documents were used to develop the design criteria presented in this DCD.

1) The *Remedial Investigation Report for Operable Unit 1* (DOE 1994b) provides characterization data for the OU1 waste. These data are used as input for the design calculations.

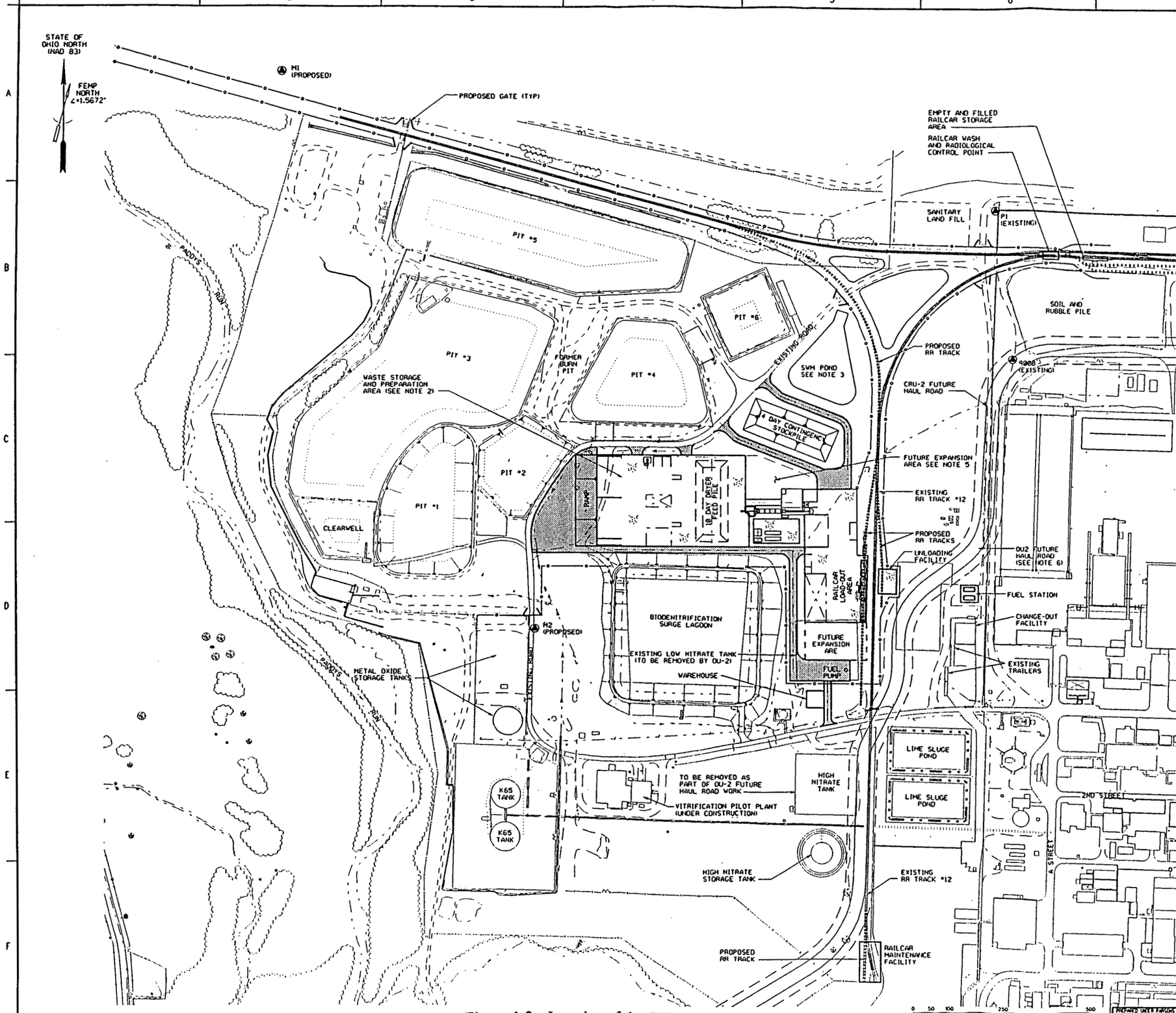

Figure 1-2 - Location of the OU1 Remediation Facilities

NOTES

1. EXISTING CONDITIONS SHOWN ON THIS DRAWING WERE PREPARED FROM FEMP SITE PROVIDED DATA FROM THE DOCUMENTS LISTED BELOW.

   EXISTING SITE DATA SOURCE (IN PLANT FILES)
   FEMP 1992 FLYOVER SURVEY
   FEMP CONTRACTOR PROJECT DESIGN DOCUMENTS

2. FOR DETAILED EQUIPMENT LAYOUT, SEE MATERIAL HANDLING SKETCHES SK-M-03917, SK-M-03919 AND SK-M-03921.

3. STORMWATER MANAGEMENT (SWM) POND SIZED TO MANAGE THE 25-YEAR, 24 HOUR STORM, WITH A 100-YEAR STORM EMERGENCY OVERFLOW TO PADDYS RUN. SEE CONCEPTUAL UTILITY PLAN, SK-C-03666.

4. 14 DAY CONTINGENCY STOCKPILE TO BE OPEN SIDED ROOF COVERED.

5. IF ADDITIONAL FUTURE EXPANSION AREA IS REQUIRED, 14 DAY CONTINGENCY STOCKPILE AND THE ACCESS ROAD JUST SOUTH OF THE STOCKPILE WILL BE REMOVED.

6. COORDINATION OF OU2 HAUL ROAD CONSTRUCTION AND UNLOADING RAILROAD SPUR IS REQUIRED.

LEGEND

EXISTING		PROPOSED
	ROAD/PAVEMENT	
	RAILROAD	
	STRUCTURE	
	FENCE	
	SURVEY MONUMENT	
	CONCRETE PAD	

REF DWG NO.	DRAWING TITLE
SK-M-03917	FEED PREPARATION AREA
SK-M-03919	DRYING FACILITY
SK-M-03921	BLENDING AND RAIL LOADOUT FACILITY
SK-C-03666	CONCEPTUAL UTILITY PLAN

PRELIMINARY
NOT FOR CONSTRUCTION

REV. NO.	ISSUE OR REVISION PURPOSE - DESCRIPTION	A-E	FEMCO	DATE
B	ISSUED FOR CONCEPTUAL DESIGN (CLIENT COMMENTS INCORPORATED)			
A	ISSUED FOR CONCEPTUAL DESIGN			

INITIALS AND 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
OU1 REMEDIATION SYSTEM DESIGN

DRAWING TITLE
CIVIL
CONCEPTUAL SITE PLAN

DRAWN BY	DATE	LEAD ENGINEER	DATE	CHECKED BY	DATE
Y. AFSHAR	9-22-95			K. GERARD	9-25-95
PLANT/BLDG NO		FLOOR		SCALE 1"=100'	CLASS
SUBMITTED FOR APPROVAL		FEMCO CRU APPROVAL			

A-E PROJECT NO.	DATE	FEMP PROJECT NO.	DATE	DRAWING SHEET CODE NO.	SHEET NO.	REV. NO.
		VBS 1.1.1.1.1.3.1 00-90701		SK-[illegible]	[illegible]01	B

10/23/95, 6:42am, Rev. No.: 0

2) The *Feasibility Study Report for Operable Unit 1* (DOE 1994c) describes the remedial alternatives, including the final selected remedial alternative.

3) The Record of Decision (ROD) (DOE 1995a) defines the selected remedial alternative and regulatory requirements for OU1 remediation, forming the basis for the design.

4) The *Remedial Design Work Plan for Remedial Actions at Operable Unit 1* (DOE 1995b) presents the activities required to develop the final design plans, construction plans, specifications, and procurement documents for the implementation of the OU1 selected remedy.

The following documents are related to this DCD:

1) The *Process Description of the Remediation System Design* and the *Control Philosophy of the Remediation System Design* provide detailed information on the remediation facilities for OU1. This DCD provides the functional requirements and design criteria behind these documents.

2) The *Transportation and Disposal Plan* (Foster-Wheeler 1995) provides detail on rail upgrades that will be required to support OU1 remedial activities. Subsection 2.3.5.2 notes the national codes, standards, and requirements for the rail upgrades; however, the *Transportation and Disposal Plan* (Foster-Wheeler 1995) discusses the rail upgrades in detail.

3) The *Waste Excavation Plan for the Operable Unit One Remediation System Design* describes the excavation process. This plan also provides detail on stormwater controls and fugitive dust suppression used during excavation of the pits.

4) A Safety Assessment, which is based on this Preliminary Design Package, will establish the preliminary hazard category for these facilities. This preliminary hazard category will contribute to setting performance grades and quality levels for the Systems, Structures, and Components (SSCs) which comprise the facility. These activities will be completed in 1995, and, when approved, will become a part of this DCD and will guide further engineering, procurement, construction, and operation of the remedial facilities.

1.1.4 Project Constraints and Limitations

The following nonregulatory constraints and limitations are included as criteria for the design of the OU1 remediation facilities.

1.1.4.1 Integration with Operable Units 2, 3, 4, and 5

The following discussions reflect constraints and limitations on the OU1 remediation activities as a result of coordinating OU1 remediation activities with those of the other FEMP OUs.

A general integration issue relates to the need to factor into the OU1 remediation facility design the coordinated shipment of materials from other OUs. Specifically, other OUs, such as OU2 and OU3, have identified the potential shipment of materials off site, possibly by rail.

Operable Unit 2

The primary integration issue with respect to OU2 activities relates to constraints/limitations associated with the placement of materials in the on-property disposal facility. Specifically, as discussed in Appendix A of the OU1 Excavation Plan, residual contaminated soils and oversized materials, as amenable, will be placed in the on-property disposal facility. Appendix A provides information on constraints/limitations, as they currently exist, with respect to the attainment of contaminant-specific criteria, size criteria, etc., to be factored into the design to ensure such disposal can be performed. As the design of the on-property disposal facility (for which OU2 has been identified as the lead organization) progresses and these WAC are finalized, the OU1 design shall be revised, as necessary, to reflect any changes. In addition, in support of the OU2 on-property disposal facility design, OU1 shall provide estimates of material volumes to be placed in the on-property facility as these estimates are developed.

OU2 is also responsible for the alignment of haul roads on site. This activity, which is currently under development, may create a geographic constraint for the OU1 remediation system design.

Operable Unit 3

Oversized materials removed from the waste pits (i.e., materials not suitable for shredding and treatment in the OU1 remediation facilities) which are amenable to the proposed alternative for OU3 (i.e., acceptable for disposal in the on-property disposal facility) will be segregated from OU1 waste and managed in accordance with planned OU3 remediation activities, as discussed in Appendix A of the OU1 Excavation Plan. As discussed in Appendix A, this activity relates to the management of material for placement in the on-property disposal facility, including decontamination, size reduction, and packaging for transport to the on-property disposal facility.

OU1 remediation activities shall be coordinated with decontamination and dismantlement (D&D) activities being performed by OU3 so as to minimize constraints placed on the implementation of OU1 remediation efforts. For example, it is necessary to perform D&D of the low nitrate tank earlier than has been planned by OU3 in order to ease a potential geographic constraint on the OU1 remediation system design.

In support of the OU3 D&D planning effort, OU1 will provide updates of remediation facility needs to ensure an appropriate sequencing of the D&D. These remediation facility needs will specifically include the identification of the ongoing need for utilities, most of which originate from the former production area. These utility needs will be assessed against the D&D sequencing to identify constraints and limitations, and identify necessary work-arounds to ensure complete, uninterrupted utility services.

Operable Unit 4

The Vitrification Pilot Plant has extended fire, potable water, treated water, and electrical service on Second Street into the Waste Pit Area. As part of the overall utilities coordination efforts, the capabilities of these systems to support all or a part of the OU1 remediation facility needs shall be assessed.

Pursuant to the Final Safety Analysis Report (FSAR) for the OU4 Vitrification Pilot Plant facility, a geographical constraint of 200 meters from this facility has been established, within which no regularly occupied facilities may be established without a revision to the OU4 FSAR.

Operable Unit 5

Ongoing OU5 groundwater remediation will include installing recovery wells and pipelines in the Waste Pit Area; this work will be coordinated with the OU1 remediation system design.

OU5 is responsible for assessing the capabilities of the FEMP's wastewater treatment system. Since stormwater and process wastewater collected during OU1 remediation facilities operation will be sent to the FEMP wastewater treatment system via the Biodenitrification Surge Lagoon for processing, a number of coordination issues arise. The treatment of the additional volume of wastewater will be assessed and coordinated with the operation of the FEMP wastewater treatment system. To avoid overflowing at the Biodenitrification Surge Lagoon, it will be necessary to coordinate the proposed OU1 stormwater management system retention basin outlet controls to the Biodenitrification Surge Lagoon level indicators. The wastewater from pit remediation activities will also be assessed to determine whether pretreatment is necessary prior to transport to the FEMP wastewater treatment system, so as to ensure that the FEMP National Pollutant Discharge Elimination System (NPDES) permit limits and conditions can continue to be met.

The remediation of OU1 contaminated soils (including surface soils, contaminated soils from beneath the excavated waste pits, and some cover soils) shall be consistent with the selected remedy for contaminated process area soils in the OU5 ROD, as is discussed in Appendix A of the OU1 Excavation Plan. In this regard, Appendix A presents final remediation levels which reflect those presented in the OU1 ROD, as well as the OU5 final remediation levels. In accordance with details to be developed through the OU5 design process, excavation will proceed until the remaining soils are below these final remediation levels. Such details will be incorporated into the OU1 remediation efforts as they are developed.

Disposition of the contaminated soils is also discussed in Appendix A of the OU1 Excavation Plan. Consistent with the planned OU5 remediation approach, excavated soils that meet the WAC for the on-property disposal facility will be disposed of therein. As these criteria are finalized, along with the methodology for ascertaining that they have been met, they will be reflected in the OU1 remediation approach. Until such time as the appropriate OU5 design deliverables (addressing management of soils destined for the on-property disposal facility) are approved, soils management will be conducted consistent with the requirements of the US EPA-approved Removal Action 17 Work Plan. Soils that do not meet the WAC for the on-property disposal facility will be managed consistent with the management of OU1 waste materials.

OU5 is also responsible for other sitewide remediation efforts which shall be incorporated into the OU1 remediation approach as they are approved. Specifically, OU5 is responsible for sitewide design efforts associated with the development of final sitewide restoration: grading plans, wetlands mitigation, natural resources management, and ground and surface water monitoring.

1.1.4.2 Tie-in to Site Utilities and Infrastructure

Utilities required by the OU1 remediation facilities will be tied into an existing site utility which has adequate capacity for the additional load and whose availability is consistent with the long-term remediation needs of the site. Specifically, although a tie-in to the closest existing utility may seem most advantageous, the FEMP's long-term remediation goals may dictate that this utility be relocated, thereby requiring that another tie-in be utilized or that an alternative be designed. As the utility needs of OU1 and the other remediation projects are finalized and assessed against the long-term D&D strategy, specific utility tie-in locations will be factored into the design of the OU1 remediation facilities.

Utility needs for the OU1 processing facilities will include natural gas, electric power, fire protection water, and treated water for process use. No potable water supply or sanitary sewer system needs have been identified for the processing facilities themselves. Wash or bathroom facilities for the project will be provided within the support trailers for the remedial action, which have already been installed. The design shall assume that any potable water determined to be necessary within the processing facilities (e.g., eyewash/safety shower) will be provided with portable mechanisms. The *Preliminary Estimate of Utility Requirements* (PARSONS 1995f) discusses utility requirements in more detail.

<u>Natural Gas</u>

Natural gas will fuel the dryer. A new natural gas line is being constructed and will be located on a pipe rack east of Building 51 (FEMP wastewater treatment system). This new line will have sufficient full load capacity to support two dryers.

Electrical

Electrical power for the facility will be from a unit substation(s) connected to the FEMP 13.2 kV distribution system. Unit substation(s) will be sized according to the facility loads.

A standby diesel generator will be provided for process backup power. No safety class equipment requiring generator backup is anticipated. The generator capacity will be sized based on the loads to be served and will start automatically.

Lighting will be provided both in enclosed facilities and for outside areas as required. Lighting levels shall be determined consistent with Illuminating Engineers Society (IES) Handbook values and anticipated occupancies and uses. Battery-backed lighting for emergency egress will be provided. Fire detection and alarm systems and evacuation systems will be provided with ties to the FEMP sitewide fire and evacuation systems. The *Preliminary Estimate of Utility Requirements* (PARSONS 1995f) provides a discussion of electrical utilities.

Fire Protection Water

Tie-ins to existing utilities for fire protection water will be underground.

Wastewater

Wastewater generated by the OU1 remediation activities will be sent to the FEMP wastewater treatment system, via the Clearwell and/or Biodenitrification Surge Lagoon, for treatment prior to being discharged to the Great Miami River. Wastewater disposition is discussed in more detail in Subsection 2.2.1.4.

Roadways

Access to the remediation area will be from existing site roadways. Road access to the OU1 area from the former production area currently occurs at Second Street. A construction gate entrance exists at the west side of Pit 5. The need for roadway improvements outside the remediation facility area will be defined and made part of sitewide integration.

Rail

Numerous on-site rail improvements are planned in support of OU1 remediation activities. The improvements are detailed in the *Design of On-Site Rail Improvements* (FERMCO 1995b) and include modifications to existing tracks, the addition of tracks and switches, the elimination and/or upgrading of crossings, and the construction of miscellaneous facilities to support rail shipping activities.

1.1.4.3 Waste Drying Capacity

The primary process component of the OU1 remediation facilities will be a single indirect-fired rotary dryer, sized to operate at a wide range of processing rates (within maximum practical limits). The two primary capacity limiting factors for this dryer will be a moisture removal rate of approximately 4.2 tons per hour and a raw waste (wet) feed rate of approximately 22 tons per hour. The size of the dryer will be based on the largest proven commercially available dryer. These estimated rates will be verified by the selected dryer manufacturer.

1.1.4.4 OU1 Remediation Facilities System Capacity

The design will provide for a single-dryer facility that can effectively process a large range of waste throughput volumes, which might be expected in the initial years of operations.

The design will provide for the future need to modify the processing facilities to increase processing rates and to modify the process train to reflect enhancements to operations or equipment. Specifically, the facilities design will allow for future expansion to increase the facility's capacity, based on adding a second dryer. Although the design assumption will be that a second dryer similar to the initial dryer would form the basis for this expansion, the need for and makeup of any future expansion will be evaluated as the project progresses, and constraints and conditions change.

The initial design will accommodate subsequent expansion with minimal interference to ongoing waste processing operations. For those portions or components of the system that cannot later be readily or efficiently expanded, the design will reflect anticipated full-scale operations. The full capacity operations that will be in the initial system design are waste preparation, blending, and loadout areas.

1.2 Description of Selected Remedial Alternative

According to the ROD for OU1 (DOE 1995a), the selected remedial alternative includes excavation of the waste pit contents, waste processing and treatment by thermal drying, and off-site disposal at a PCDF. The selected remedy consists of the following key activities:

1) Construction of waste processing and loading facilities and equipment.

2) Removal of water from open waste pits for treatment at the site's wastewater treatment facility.

3) Removal of waste pit contents, caps, and liners, and excavation of surrounding contaminated soil.

4) Confirmation sampling of waste pit excavations to verify achievement of remediation levels.

5) Pretreatment (sorting/blending/shredding) of waste.

6) Treatment of the waste by thermal drying as required to meet the moisture content limits specified in the WAC of the PCDF.

7) Waste sampling and analysis of waste prior to transport for disposal to ensure that the WAC of the appropriate disposal facility are met.

8) Off-site shipment of waste for disposal at a PCDF. It is estimated that over 600,000 cubic yards of waste material will be excavated and disposed of as low-level radioactive waste.

9) As a contingency, shipment of any waste that fails to meet the WAC of the PCDF (up to 10 percent of the total waste volume) for disposal at the NTS will be included.

10) Decommissioning and removal of the drying treatment unit and associated facilities as well as miscellaneous structures and facilities within OU1. Oversized material from the decommissioning that is amenable to the selected alternative for OU3 will be segregated from OU1 waste, decontaminated, and forwarded to OU3 to be managed as construction rubble. This activity is not in the scope of this document, as discussed in Subsection 1.1.4.1.

11) Disposition of remaining OU1 residual contaminated soils will be consistent with selected remedies for contaminated process area soils as documented in the OU5 ROD. Any materials not amenable to the OU5 remedy will be disposed of as waste materials (i.e., shipped off site). Specifics on soil excavation and management, confirmation sampling, and site restoration will be covered on a sitewide basis through the OU5 design process.

12) Placement of backfill into excavation, and construction of cover system. Interim grading will be provided until final grading and restoration are defined through the OU5 design process.

The major components of this design project are waste retrieval, waste transfer, wastewater handling, waste preparation, thermal drying, process off-gas treatment, shredding, blending, loadout, and storage. The *Process Description for the Remediation System Design* (PARSONS 1995d) provides detailed descriptions of the major project components of the process and associated equipment.

1.3 Waste Acceptance Criteria for Disposal Facilities

The subsections below provide the WAC for the on-property disposal facility, the representative PCDF (Envirocare), and the NTS, as it is expected that all three may be used in the remediation of OU1.

1.3.1 On-Property Disposal Facility

The on-property disposal facility will accept contaminated soil and debris from OU1 for burial. The soil will be below the maximum concentrations provided in Table 1-1 for disposal at this facility. Pursuant to the August 1995 draft OU5 ROD, soil containing contaminants that are incompatible with the clay liners or the underlying native clays beneath the liners will not be allowed. Soils exhibiting the hazardous characteristics of reactivity, ignitability, or corrosivity will also be excluded. Section A.4.1 of the *Excavation Plan* identifies other requirements with respect to debris.

1.3.2 Permitted Commercial Disposal Facility

Waste Analysis and Acceptance

The selected representative PCDF's Waste Characterization Plan describes the procedures that the waste generator and the disposal facility must follow to characterize the waste and to verify acceptability of the waste at the facility. A partial list of the conditions in the facility's Radioactive Material License, which may affect acceptance of OU1 material, is presented on Table 1-2. (Note: Table 1-2 is not all inclusive. Refer to the actual license for a complete list of conditions.) The disposal facility is in the process of amending its disposal limits for specific radioisotopes. Table 1-3 provides the maximum radionuclide concentrations in waste for disposal at the PCDF.

Table 1-1 - On-Property Disposal Facility Waste Acceptance Criteria
(from Table 9-6 of the August 1995 *Draft OU5 ROD*)

Constituent of Concern	Maximum Concentration	Constituent of Concern	Maximum Concentration
Radionuclides	**(pCi/g):**	**Organics (Cont.)**	**(mg/kg)**
Neptunium-237	3.12×10^{9}	Heptachlor epoxide[a]	*
Strontium-90	5.67×10^{9}	Hexachlorobutadiene[a]	*
Technetium-99	2.91×10^{1}	Methoxychlor[a]	*
Uranium, total (mg/kg)	1.03×10^{3}	Methylene chloride[a]	*
Organics	**(mg/kg)**	Methyl ethyl ketone[a]	*
Acetone[a]	*	Methyl isobutyl ketone[a]	*
Alpha-chlordane	2.89×10^{0}	4-Nitroaniline	4.42×10^{-2}
Benzene[a]	*	Tetrachloroethene[a]	1.28×10^{2}
Bis(2-chloroisopropyl)ether	2.44×10^{-2}	Toluene[a]	*
Bromodichloromethane	9.03×10^{-1}	Toxaphene[a]	1.06×10^{5}
Carbazole	7.27×10^{4}	1,1,1-Trichloroethane[a]	*
Carbon tetrachloride[a]	*	Trichloroethene[a]	1.28×10^{2}
Chloroethane[a]	3.92×10^{5}	Vinyl chloride	1.51×10^{0}
Chloroform[a]	*	Xylenes[a]	*
Chloromethane[a]	*	**Inorganics (mg/kg):**	
1,1-Dichloroethane	*	Barium[a]	*
1,2-Dichloroethane[a]	*	Boron	1.04×10^{3}
1,1-Dichloroethene[a]	1.14×10^{1}	Chromium VI[a]	*
1,2-Dichloroethene[a]	1.14×10^{1}	Lead[a]	*
Endrin[a]	*	Mercury[a]	5.66×10^{4}
Ethylbenzine[a]	*	Silver[a]	*
Heptachlor[a]	*		

[a] RCRA-based constituent of concern.

* Denotes compounds that will not exceed designated Great Miami Aquifer action level within the 1,000-year performance period, regardless of starting concentration in the disposal facility.

Table 1-2 - Excerpts from the Selected Representative PCDF's Radioactive Material License

9. AUTHORIZED USE . . . The licensee shall not accept low-level radioactive waste generated outside the region . . . unless the provisions of Articles IV and V of the Compact are met. Before receipt of any such shipment, the licensee shall submit to the Utah Division of Radiation Control documentation evidencing compliance . . .

13. The maximum quantity of special nuclear material (enriched or fissile material) which the licensee may possess, undisposed of, at any one time shall not exceed: 350 gams of U-235, 200 grams of U-233, and 200 grams of Pu, or any combination of the . . .

14. License material . . . shall not be placed in a disposal cell unless it has been determined that the concentrations of radionuclides is approximately homogeneous within the physical form of the waste . . .

18 Radioactive waste containing free liquid shall not be accepted for disposal.

38. For the purpose of this license, debris is defined as any radioactive waste for disposal other than soils. Compactible debris is defined as: (A) having a gradation that will pass through a 4-inch grizzly and (B) as having a density greater (sic) than seventy pounds per cubic foot . . . . Contaminated materials, other than soil, not meeting either of these criteria are defined as noncompactible debris.

40. In-place bulk radioactive waste shall be compacted at a moisture content up to three percent above optimum as determined by the Standard Proctor Method ASTM D 698.

41. The licensee shall compact each lift to not less than 90 percent of optimum density.

42. All debris shall be less than 10 inches in at least one dimension, and no longer than 8 feet in any dimension.

43. A lift or any portion of a lift shall be limited to less than 10 percent by volume of debris and the debris shall be uniformly distributed throughout the lift. However, noncompactible debris in the form of concrete, stone, or metal may be placed in the lift up to 25 percent by volume, of the total lift, uniformly distributed throughout . . .

52B. Waste containing more than 0.1 percent chelating agents by weight must be identified . . .

53. The licensee shall not accept radioactive waste for storage and disposal unless the licensee has received a complete "Radioactive Waste Shipment and Disposal Record," (Form #E-100) from the shipper.

Table 1-3 - Selected Representative PCDF Waste Acceptance Criteria

Radioactive Material	Maximum Concentration In Waste for Disposal (pCi/g)
Americium-241	2.3×10^2
Cobalt-60	3.6×10^2
Cesium-137	5.6×10^2
Lead-210	2.3×10^5*
Polonium-210	2.0×10^4
Radium-226	2.0×10^3*
Radium-228	1.8×10^3
Radium-228 (1 year)	1.2×10^3*
Radium-228 (5 years)	6.7×10^2*
Radium-228 (10 years)	5.6×10^2*
Strontium-90	2.0×10^4
Thorium-230	1.5×10^4
Thorium-232	6.8×10^2*
Uranium-234	3.7×10^4
Uranium-235	7.7×10^2
Uranium-236	3.6×10^4
Uranium-238	2.8×10^4
Uranium-natural	1.8×10^4
Uranium-depleted	1.1×10^5

* Daughters are assumed to be present at same concentrations in equilibrium.

Before waste shipment, the disposal facility requires submittal of a waste profile, (including laboratory analyses and completed forms) with five 2-pound or 1-liter analytic samples and one large (50 pound) physical sample to establish a baseline for future shipments. The physical sample is used to determine compaction ratios (Standard Proctor Test). The five analytic samples will be analyzed at the disposal facility's on-site laboratory. The five representative samples are intended to represent the range of expected concentrations of radionuclides. The collection should include two high concentration samples, two low concentration samples, and one intermediate concentration. Analytical results will be compared to the submitted waste profile for consistency. Subsequent waste shipments will be sampled for the

facility's fingerprint analysis and for independent third-party analysis, to confirm received waste is within the range established by the preshipment sampling and analysis. Peak sampling values are permitted to be 10 times the bulk average values. About 6 months are expected to be required to gain initial acceptance for a waste stream (i.e., to perform the analytical tests and to verify consistency with the facility's license conditions).

Debris Content and Limitation

The PCDF's Radioactive Material License with the State of Utah defines the term "debris" as anything other than soil (see Table 1-2, Conditions 38, 42, and 43). In addition, debris shall not exceed 10 percent of the volume of the waste material, and no single piece shall be larger than 8 feet by 8 feet by 10 inches.

In accordance with its license, debris that does not meet the above specification is not acceptable for disposal at the disposal facility. If any such debris is received by the disposal facility, it can either return the debris to the shipper or process the debris to meet its license conditions at an additional cost.

Moisture Content and Limitation

The disposal facility imposes a minimum moisture content of seven percent to minimize dust generation problems at the facility. The OU1 waste treatment process is designed to generate a treated waste product near optimum moisture content. The maximum acceptable moisture content (Table 1-2, Condition 40) is three percent above optimum, as determined by the Standard Proctor test. Additionally, no free liquid is allowed in the waste.

1.3.3 Nevada Test Site

Only low-level radioactive waste that cannot go to the PCDF, or soils which cannot go to the on-property disposal facility or PCDF, will be sent to the NTS. This waste stream will include any uranium metal derbies and highly contaminated nonprocessable debris. Waste cannot contain free liquids per the Paint Filter Liquids Test (US EPA Method 9095).

The NTS has specific packaging criteria for low-level waste. Except for bulk waste and waste packaged in steel drums or SEALAND® containers, the waste package (packaging and contents) shall be capable of supporting a uniformly distributed load of 19,528 kg/m^2 (4,000 lbs/ft^2). This is required to support other waste packages and earth cover without crushing during stacking and covering operations.

All waste packages shall be provided with permanently attached skids, cleats, offsets, rings, handles, or other auxiliary lifting devices to allow handling by means of forklifts, cranes, or similar handling equipment. Lifting rings and other auxiliary lifting devices on the package are permissible, provided they

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are recessed, offset, or hinged in a manner that does not inhibit stacking the packages. The lifting devices must be designed to a 5:1 safety factor based on the ultimate strength of the material. All rigging devices that are not permanently attached to the waste package must have a current load test based on 125 percent of the safe working load.

The container size restrictions for waste at the NTS are as follows: 1.2 m by 1.2 m by 2.1 m (4 ft by 4 ft by 7 ft [4.1 yd^3]), or 1.2 m by 0.6 m by 2.1 m (4 ft by 2 ft by 7 ft [2 yd^3]), or 208-liter (55-gallon) drums. These container sizes allow optimum stacking efficiency in disposal cells; however, other dimensions are acceptable with approval from DOE/Nevada Field Office on a case-by-case basis.

In addition to the weight limits set for specific packaging designs, NTS imposes limits of 4,082 kg (9,000 lbs) per box and 544 kg (1,200 lbs) per 208-liter (55-gallon) drum. Packages exceeding 4,082 kg (9,000 lbs) require crane or large forklift removal and must be approved by the NTS management and operations contractor prior to shipment. Shipment of this type must be in a removable-top or removable-side trailer.

Waste packages shall be loaded to ensure that the interior volume is as efficiently and compactly loaded as practical. High-density loading will allow efficient space utilization and provide a more stable waste form that will reduce subsidence and enhance the long-term performance of the disposal site.

Use of United States Department of Transportation (DOT) Type A packages not previously evaluated under the DOE Type A Package Certification Program (see MLM-3245, etc.) shall not be permitted. NTS also has restrictions on package protection, marking and labeling, bar coding, and on-site transfer.

1.4 Assumptions

The following subsections present the assumptions that will be used in the design of the OU1 remediation facilities. These assumptions will be verified during the design phase. For design purposes, the facility is considered a "Radioactive Solid Waste Facility" under DOE Order 6430.1A, Section 1324, as the facility will store and treat low-level radioactive solid waste.

1.4.1 General Remediation System Design Assumptions

1) Existing personnel support facilities, including restrooms, change rooms, and parking are considered adequate. Existing laboratory capability will be augmented by contract analytical services.

2) Waste size separation and screening will be performed as an initial process step following mechanical excavation of waste. Gross separation (by operator judgment) will be made for oversize debris and visible nonprocessable debris in the pits.

3) The OU1 remediation facilities are assumed to be radiological facilities, with minimal radiation shielding required. Shielding requirements will be verified during detailed design. The hazard category assumption will be validated or adjusted as a result of the Safety Assessment.

4) The remediation system will be designed with conscious attention to waste minimization (e.g., no structures or parts of structures will be constructed unless absolutely necessary to support the process or comply with ARARs).

5) The remediation system will be designed with minimal automation for waste transfer operations to avoid material handling problems. Where possible, waste will be transferred with mobile earth-moving equipment, such as a backhoe.

6) Engineered controls will be developed during design to prevent, during non-operational periods, dispersion of waste from open pit excavating feed piles, etc.

7) Results from sampling analysis for confirming compliance with the WAC will take 6 days.

1.4.2 Process Remediation System Design Assumptions

1) Waste that meets the PCDF WAC for moisture content and has little or no debris as received at the waste preparation area will be transferred directly to the final blending and loadout area. It will not be processed through the dryer.

1.4.3 Mechanical Process Remediation System Design Assumptions

1) The OU1 remediation facilities will require an independent plant and instrument air system. It is assumed that the existing plant air and instrument system does not have sufficient excess capacity.

1.4.4 Piping Remediation System Design Assumptions

No separate assumptions.

1.4.5 Material Handling Remediation System Design Assumptions

1) A drum-opening facility will not be included with the OU1 remediation facilities initial design.

2) The design of feed preparation, blending, and loadout areas will not initially include measures to control radon emissions. Air modeling will be performed for radon emissions to determine the level of confinement necessary. If modeling indicates that secondary confinement of radon is required, the design will be revised accordingly.

3) Water sprays shall be provided for dust suppression.

4) It is assumed that screening operations will not impede waste processing with adequate manual cleaning and unplugging of screens. Calculations and equipment testing will be performed during design phase to determine adequate screening equipment. Future design changes may be required as a result of initial operations.

5) Final product will be loaded into railcars for storage until sampling and analysis is complete. Product failing the WAC (i.e., exceeding maximum radiological concentrations) for the PCDF will be reprocessed. Railcars will not be released until it is confirmed that the disposal WAC are met.

1.4.6 Civil Remediation System Design Assumptions

1) To the extent possible and allowable, utilities will be carried aboveground on pipe racks or poles. Fire protection water lines are assumed to be buried. Aboveground water lines shall be heat traced and insulated.

2) In situ waste dewatering prior to excavation, through use of wells, will not be considered in the remediation system design.

3) For volume calculation purposes, 1.5 feet of soil underlying the pit wastes will be considered contaminated above the WAC for the on-property disposal facility as will be disposed of at the PCDF or the NTS. It is assumed that the next 1.5 feet will meet the WAC for the on-property disposal facility.

1.4.7 Structural Remediation System Design Assumptions

1) All the SSCs for the OU1 remediation system are assumed to be NPH Performance Category 2 (PC-2) per DOE Order 5480.28 and DOE-STD-1021. It is further assumed that there are no safety-class SSCs. These assumptions will be documented in the Safety Assessment.

1.4.8 Architectural Remediation System Design Assumptions

1) The waste preparation area and blending and loadout area will have a roof cover without side walls.

2) Separate enclosed structures will be provided for the dryer (feed and discharge ends), control room, warehouse, and railcar support areas.

1.4.9 Mechanical Utilities Remediation System Design Assumptions

1) Fire protection shall be included in all enclosed areas.

2) Natural gas will be available, and, if acceptable, may be used for space heating.

1.4.10 Electrical Remediation System Design Assumptions

1) The existing site power grid will have capacity available to meet the needs of the OU1 remediation facilities.

2) The proposed standby diesel generator will be sized for equipment that must operate (e.g., the dryer auxiliary drive) following a loss of power. The standby diesel generator will also provide for an orderly shutdown of operations. Additional equipment that may require standby operation will be identified in the design phase.

1.4.11 Instrumentation and Controls Remediation System Design Assumptions

1) Instrumentation and controls for the major equipment suppliers (i.e., dryer, shredder, filter, conveyors, etc.) may be supplied by the equipment vendors or by FEMP procurement. Final design of instrument and control systems will be provided following review of certified vendor data submittals.

2) Instrument design will be provided as input to mechanical specifications or as part of the equipment performance specifications, complete with data sheets prepared in the Instrument Society for Measurement and Control format.

1.4.12 Fire Protection Remediation System Design Assumptions

1) Fire protection required for certain equipment (i.e., shredder, support trailers) will be provided by the equipment vendor.

2) Fire protection water will be obtained from the existing FEMP fire protection water system.

SECTION 2

DESIGN BASIS

2.1 Functional and Regulatory Requirements

2.1.1 Functional Requirements

The OU1 remedial action will consist of the components discussed in Subsection 1.2 - waste retrieval, waste preparation, thermal drying and off-gas treatment, and dried waste blending and loadout. The functional requirements for the project components are presented below. From these functional requirements, the criteria in Subsections 2.2 and 2.3 were developed.

2.1.1.1 General Functional Requirements

1) Off-site shipment of waste will be coordinated on a sitewide basis, with OU1 as lead for rail shipment to the off-site PCDF.

2) Excavation and feed stockpiles will be maintained to facilitate continuous dryer operation.

3) Oversized OU1 materials (i.e., those materials which are not amenable to processing through the OU1 remediation facilities) which meet OU3 criteria for placement in the on-property disposal facility will be segregated and managed in accordance with planned OU3 remediation activities.

4) The remediation of OU1 contaminated soils will be consistent with the selected remedy for contaminated soils in the OU5 ROD.

5) OU1 contaminated soils that exceed the WAC for the on-property disposal facility will be managed consistent with the management of OU1 waste materials.

6) Decisions for OU1 tie-in to existing site utilities will consider capacity and long-term availability.

7) The remediation facility will include provisions to allow for increased processing rates with the future addition of additional dryer(s) and associated equipment.

8) Heating, Ventilation, and Air Conditioning (HVAC) systems shall be provided for buildings to prevent the spread of contamination, protect workers from airborne contamination, and create functional environments for workers and uninterrupted equipment operation.

9) Waste processing equipment air effluent shall be filtered/treated before release to the atmosphere to comply with all Applicable or Relevant and Appropriate Requirements (ARARs) and substantive permitting requirements (discussed in Subsection 2.1.4). All air effluent shall be released through a monitored stack.

10) The project requirements are to provide electrical power distribution, lighting, and fire and evacuation alarm systems of adequate capacity and configuration for the processes and facilities involved, and consistent with the FEMP systems into which they will be connected.

11) Mixed waste treatment will be handled by the PCDF or another FEMP facility. This system will not be designed to treat mixed waste.

12) All wastewater will be pretreated as necessary to allow settling of suspended solids prior to discharge into the FEMP wastewater treatment system.

13) Wastewater effluent will be coordinated with the FEMP wastewater treatment system to prevent overflow of the Biodenitrification Surge Lagoon.

14) Contaminated stormwater will be segregated from uncontaminated stormwater to minimize treatment volume.

2.1.1.2 Waste Retrieval

1) Airborne dust emissions shall be minimized during pit excavation.

2) Mechanical excavation will be the primary method of waste excavation to limit waste dewatering requirements.

3) Large debris will be segregated from the waste in the pits to avoid excessive handling.

4) Debris meeting the appropriate WAC will be sent to the on-property disposal facility.

5) The waste will be handled by conventional material handling equipment.

6) Stormwater controls shall be provided to control water runoff, minimizing the spread of contamination.

7) Excavated waste will be transferred to the process area using conventional material handling equipment.

8) Hydraulically excavated waste shall be transferred from the pits to a tanker truck via hoses or pipes with secondary containment to minimize the spread of contamination during normal and potential abnormal operating conditions.

9) Facilities (i.e., truck washing area) and controls shall be provided at the exit of the controlled area to prevent spread of contamination outside the controlled area.

2.1.1.3 Waste Preparation

1) Uranium metal derbies and nonprocessable debris from the waste feed stream will be removed from the waste before drying to minimize handling.

2) Waste fed to the dryer will be sized to prevent damaging the dryer.

3) Wet material will be stored for a sufficient time to allow evaporation/drainage of excess water. Waste storage areas will be covered to prevent rainwater infiltration.

4) Wet material will be blended with dry material for ease of handling and to optimize dryer operating efficiency.

5) Dust suppression systems shall be used to minimize spread of contamination due to fugitive airborne emissions.

6) Waste storage areas will be protected to prevent potential liquid spills. Appropriate engineered controls will be included to meet environmental safety and health requirements.

2.1.1.4 Drying and Off-Gas Treatment

1) The dryer will be capable of accepting different types of feed.

2) The dryer will be designed to yield a product with a final moisture content of 10 percent (or less) on dry basis.

3) The size of the dryer will be based on the largest proven commercially available dryer.

4) An off-gas treatment system will be required to treat the process off-gases leaving the dryer to remove excess moisture, SO_2, Volatile Organic Compounds, radon, and particulates before discharge to the atmosphere.

5) The relative humidity of the off-gas will be minimized to extend the operating life of the carbon beds and Medium-Efficiency Particulate Air and High-Efficiency Particulate Air (HEPA) filters.

2.1.1.5 Dried Waste Blending and Loadout

1) Dried waste will be blended to optimum moisture content then shipped off site by covered railcars.

2) A minimum of 90 tons and a maximum of 107 tons of product will be loaded in each railcar for economical transport.

3) Samples will be taken from loaded railcars and analyzed for conformance to the PCDF WAC. Railcars will be kept in storage to await results of sampling analysis. Waste will be released for off-site shipment only if it meets WAC. A sampling and analysis plan will be developed in the future to address sampling requirements.

4) Waste that does not meet PCDF WAC will be retrieved from the railcar and blended with other waste or blended with material that has passed the WAC to yield an acceptable product.

5) Loadout facilities shall be designed with provisions for dust suppression to minimize spread of contamination.

6) For bulk loading in railcars or containers, a liner shall be installed before waste loadout. At the end of loadout, the liner will be folded over and taped before the lid is installed.

7) Each railcar and container will be weighed, surveyed, decontaminated (if necessary), and placarded and labeled to meet DOE and DOT requirements prior to leaving the loadout area.

2.1.2 Identification of Standards/Requirements

The FEMP has grouped activities associated with the environmental, safety, health, or business management issues of the facility into 24 functional areas. Each Standards/Requirements Identification Document (S/RID) identifies the activities and baseline requirements for a functional area. The program governing the FEMP S/RIDs considers the purpose of the project and the principal drivers, scope, objectives, and participants. The FEMP S/RID program identifies the baseline requirements for all functional areas that establish responsibilities and authorities under the contract with the DOE; determines the adequacy of these requirements; ascertains a baseline level of compliance with the requirements; and implements a maintenance program that will keep the program current as requirements or compliance levels change. The FEMP S/RIDs are included in *The Management Plan: FERMCO Policies and Requirements Manual* (FERMCO 1995a).

Subsection 3.2 of the Management Plan provides the Functional Area Interface Matrix, which identifies the appropriate interfaces between the various functional areas. The eight functional areas that do not interface with this design activity are not addressed in this DCD but are listed below.

1) Emergency Preparedness and Management
2) Maintenance
3) Operations
4) Human Resources and Industrial Relations
5) Project Control
6) Property Management
7) Public Involvement
8) Financial Management

Many of the requirements specified in the functional areas that interface with engineering design apply to programmatic activities to which the design process (as well as other site activities) must adhere. Since these S/RIDs are implemented by existing departmental procedures and site policies and do not directly affect the engineering design itself, they have not been included in the DCD but are listed below.

1) Configuration Management
2) Research and Development and Experimental Activities
3) Management Systems
4) Quality Assurance
5) Training and Qualification
6) Construction
7) Acquisition

The engineering design and remaining nine functional areas are being reviewed to determine those that will interface with the engineering design functional area are discussed in Subsections 2.1.2.1 through 2.1.2.9. In some cases, a portion of a functional area (e.g., security) is referenced if it pertains to design.

2.1.2.1 Engineering Design (S/RID No. 2)

The engineering design functional area encompasses the design aspects for projects ranging from major to minor modifications of existing SSCs, to the design of facilities, as well as demolition design work associated with any of the identified activities. This functional area applies to architect/engineers who are responsible for design of new facilities or facility modifications, as well as to the plant engineering role of facility operators for ongoing engineering support. The engineering design functional area includes the design process from conceptual design through start-up and preparation of project closeout

documentation. As such, the engineering design S/RID is the primary S/RID governing the OU1 remediation system design and this DCD.

All the requirements in this S/RID are functional requirements for this design project, with the exception of the contractual requirements specified in Subsection 2.3.1 of the Management Plan, which are considered programmatic requirements. Specific design requirements, such as building codes and design standards, are discussed in Subsection 2.3 of this DCD.

DOE Order 6430.1A, Section 1324-2.1 (under Radioactive Solid Waste Facilities) states that "the design objective shall be to ensure that conservatively estimated consequences of normal operations and credible accidents are limited in accordance with the guidelines contained in Section 1300-1.4, Guidance on Limiting Exposure of the Public." Air modeling will be performed to estimate particulate and radon emissions, and if necessary, the design will be changed accordingly.

2.1.2.2 Environmental Protection (S/RID No. 5)

The environmental protection functional area includes the requirements that are protective of human health and the environment. The basic elements of this functional area are:

1) Management and Organization
2) Staffing and Training
3) Monitoring, Surveillance, and Inspections
4) Permits, Pollution Control, and Prevention
5) Record Keeping
6) Reports and Notifications

The scope of the environmental protection S/RID includes programmatic and technical requirements, formal controls, and standards to ensure compliance with applicable laws and regulations. The requirements for environmental protection are specified in various statutes and regulations (Federal and State), DOE Orders, and related documents. The ARARs and To Be Considered (TBC) requirements for the OU1 remediation system design are addressed in this DCD in Subsection 2.1.3 and Appendix A. ARARs address environmental regulations and TBCs address guidance, proposed environmental regulations, and environmental-related DOE Orders.

2.1.2.3 Fire Protection (S/RID No. 6)

The fire protection functional area includes requirements for prevention of a fire or explosion; fire protection and suppression systems; and personnel safety during a fire. These requirements protect the environment, public, and workers from potential fires and prevent property loss.

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All the requirements in the fire protection S/RID apply to this design project, with the exception of Subsection 6.4.4, Fire Protection of DOE Electronic Computer Data Processing System, and Subsection 6.4.5, Fire Protection for Portable Structures.

2.1.2.4 Nuclear and Systems Safety (S/RID No. 9)

The nuclear and systems safety functional area includes the administrative and technical activities that are required to protect the environment and health and safety of the public and to ensure the safe operations of DOE nonreactor nuclear and non-nuclear facilities. Within this scope are requirements for documented safety analysis and review, risk analysis, design, operating limits, facility changes, criticality analysis, and criticality alarm systems.

All the requirements in the nuclear and system safety S/RID are functional requirements for this design project, with the exception of the contractual requirements in Subsection 9.3.1 of the FERMCO Management Plan, which are programmatic requirements.

2.1.2.5 Occupational Safety and Health (S/RID No. 10)

Many of the occupational safety and health functional area requirements do not apply to this design project, as they are programmatic. Requirements 10.3.4 (29 Code of Federal Regulations [CFR] 1910) and 10.3.6 (DOE Order 5480.4) are the only requirements in the Occupational Safety and Health S/RID that pertain to this design.

2.1.2.6 Packaging and Transportation (S/RID No. 12)

The packaging and transportation functional area requirements provide administrative controls and technical guidance for the shipment of all materials from the FEMP. The requirements that apply to this project are:

1) Subsection 12.3.2, 10 CFR 71, "Packaging and Transportation of Radioactive Materials"

2) Subsection 12.3.9, 49 CFR 173, "Shippers - General Requirements for Shipments and Packaging"

3) Subsection 12.3.10, 49 CFR 174, "Carriage by Rail"

4) Subsection 12.3.14, 49 CFR 178, "Shipping Container Specifications"

5) Subsection 12.3.20, 49 CFR 213, "Track Safety Record"

6) Subsection 12.3.22, 49 CFR 215, "Railroad Freight Car Safety Standards"

7) Subsection 12.3.27, DOE Order 1540.2, "Hazardous Materials Packaging for Transport"

8) Subsection 12.3.28, DOE Order 1540.3A, "Base Technology for Radioactive Material Transportation Packaging Systems"

9) Subsection 12.3.39, DOE Order 5480.3, "Safety Requirements for Radioactive Material Transportation Packaging Systems"

10) Subsection 12.3.33, International Atomic Energy Agency, "Safety Series No. 6, Regulations for the Safe Transport of Radioactive Material"

2.1.2.7 Radiological Protection (S/RID No. 14)

The radiological protection functional area requirements identify the elements and programmatic controls necessary to demonstrate compliance with applicable Federal, State, and local laws and regulations, and DOE requirements, while ensuring the following:

1) Any radiation exposure of the work force or the public is maintained As Low As Reasonably Achievable (ALARA).

2) New facilities and modifications to existing facilities shall incorporate design features aimed at maintaining exposures (occupational and public) ALARA.

The requirements in the radiological protection S/RID that apply to this design project are listed below. Refer to the S/RID for the exact reference, including date, of the requirement.

1) Subsection 14.3.1, 40 CFR 61, "National Emission Standards for Hazardous Air Pollutants"

2) Subsection 14.3.3, American National Standards Institute (ANSI) N42.18 - 1980, "Specification and Performance of On-Site Instrumentation for Continuously Monitoring Radioactivity in Effluents"

3) Subsection 14.3.4(a) and (c), DOE Order 5400.1, "General Environmental Protection Program"

4) Subsection 14.3.5, DOE Order 5400.5, "Radiation Protection of the Public and the Environment"

5) Subsection 14.4.2, 10 CFR 835, "Occupational Radiation Protection"

6) Subsection 14.4.8, DOE Order 5480.11, "Radiation Protection for Occupational Workers"

7) Subsection 14.4.11, DOE Order 5480.4, "Environmental Protection, Safety, and Health Protection Standards"

8) Subsection 14.4.15, DOE/EH-0256T, "Department of Energy Radiological Control Manual"

2.1.2.8 Security (S/RID No. 15)

Appropriate levels of protection must be provided at DOE facilities to preclude the loss or theft of government property and to prevent acts of unauthorized access, theft, diversion, sabotage, espionage, or other hostile acts. These acts may cause unacceptable risks to national security or to the health and safety of DOE and contractor employees, the public, or the environment. Specific security requirements are primarily contained in the DOE Order 5600 Series. These directives were reviewed for applicability at the FEMP facility, and the resulting requirements are contained in the security S/RID.

The programmatic aspects of the security S/RID are not included as functional requirements for this design project. However, the design requirements (such as fencing, sign posting, surveillance equipment, etc.) are included and shall be incorporated into the design. Specific requirements in the security S/RID that apply are listed below.

1) Subsection 15.3.4, 10 CFR 1046, "Physical Protection of Security Interests"

2) Subsection 15.3.6, 41 CFR Chapter 101-20.103,"Physical Protection and Building Security"

3) Subsection 15.3.12, DOE Order 5630.11A, "Safeguards and Security Program"

4) Subsection 15.3.19, DOE Order 5632.6, "Physical Protection of DOE Property and Unclassified Facilities"

2.1.2.9 Environmental Restoration and Waste Management (S/RID No. 17)

The environmental restoration and waste management functional area requirements identify the elements and programmatic controls necessary to comply with applicable Federal, State, and local laws and regulations, and DOE requirements. This functional area includes the activities and requirements most directly associated with the FEMP mission - environmental restoration and waste management.

The requirements in the environmental restoration and waste management S/RID that are also ARARs or TBC requirements are functional requirements for this design project. The ARARs and TBC requirements are discussed in Subsection 2.1.3 and identified in Appendix A.

2.1.3 ARARs and TBC Requirements

Appendix A in the *Remedial Design Work Plan for Remedial Actions at Operable Unit 1* (DOE 1995b) contains the ARARs and TBC requirements for the selected remedial alternative for OU1. Tables A-1, A-2, and A-3 in Appendix A of this DCD provide all the OU1 ARARs and contain compliance strategies for each. Specifically, the compliance strategies presented in these tables identify how the ARARs and TBC requirements are addressed through the design. Final demonstration of ARAR compliance will be provided in the *Remedial Action Work Plan.*

2.1.4 Permitting Requirements

The Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), Section 121(e)(1) states that no Federal, State, or local permit is required for the portion of any remedial action conducted entirely on site, where such remedial action is selected and carried out according to Section 121.

Although on-site remedial activities are exempt from the requirement to obtain permit approval, they must comply with the substantive requirements of any permits that would have been required without the CERCLA 121(e) permit exemption. The following subsections have been prepared to:

1) Identify permits that would have been required without the CERCLA 121(e) permitting exemption

2) Identify the standards, requirements, criteria, or limitations required to obtain the permits

3) Explain how the remedial action will the meet standards, requirements, criteria, or limitations of these permits through compliance with permit driven ARARs identified in Appendix A of this DCD.

2.1.4.1 Identification of Permits that Would Be Required Without the CERCLA 121(e) Permitting Exemption

State Permits/Notifications

1) OAC 3745-31-02 - Ohio EPA Permits to Install

Pursuant to OAC 3745-31-02, no person shall cause, permit, or allow the installation of a new source of air pollutants without first obtaining a Permit to Install. Because the dryer meets the definition of an air contaminant source, a Permit to Install would have been required for its installation.

2) OAC 3745-35-02 - Ohio EPA Permits to Operate

Pursuant to OAC 3745-35-02, 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. Because the dryer meets the definition of an air contaminant source, a Permit to Operate would have been required for its installation.

3) NPDES Permit - Ohio EPA NPDES Permit No. 1IO00004*ED

FEMP wastewater discharges to the Great Miami River are regulated under Ohio EPA NPDES Permit No. 1IO00004*ED. Project specific discharges will be treated along with other site wastewaters at the FEMP wastewater treatment system prior to discharge to the Great Miami River. These discharges must comply with the effluent limitations and loading rates at NPDES permitted outfall *4001, and with the general terms and conditions of the FEMP NPDES Permit.

By permit condition, the FEMP must notify Ohio EPA of any activities or changes at the site which have the potential to significantly alter the character of its wastewater stream. A NPDES permit modification may be required if the discharge causes a change in the character of the wastewater stream. OU1 discharges will be evaluated during the remedial design process to determine whether they warrant an NPDES permit modification. These discharges will also be evaluated to ensure they do not violate CWA Section 307 Toxic Notification Levels promulgated in 40 CFR 122.42 or Ohio EPA Water Quality Standards (OAC 3745-1) for the segment of the Great Miami River into which the FEMP discharges its wastewater.

Federal Permits/Notifications

1) National Emission Standards for Hazardous Air Pollutants (NESHAP) - 40 CFR Part 61, Subpart H - Emissions of Radionuclides other than Radon from DOE Facilities

The NESHAP Subpart H Standard promulgated in 40 CFR Part 61.92 specifies that radiological emissions (except radon-222 and radon-220) from DOE facilities must not cause any member of the general public to receive an effective dose equivalent of more than 10 mrem/year.

Pursuant to 40 CFR 61.07 and 61.96, a permit is required for point sources which could cause an annual effective dose equivalent to the nearest off-site receptor in excess of 0.1 mrem/year. Continuous emission monitoring is required by 40 CFR 61.93 (b) for stacks and vents which have the potential to cause a dose in excess of 0.1 mrem/year to any member of the general public. Monitoring is not required for fugitive emission under the NESHAP Subpart H regulations, however, isotopic emission estimates must be prepared for the project to demonstrate compliance with the NESHAP Subpart H Standard.

Both fugitive and point source emissions must be evaluated to ensure compliance with the 10 mrem/year site standard. Emissions from the dryer facility must be evaluated against the 0.1 mrem/year standard to determine permitting and monitoring requirements mandated by 40 CFR 61.07, 61.96 and 61.93 (b). Isotopic emission estimates must be prepared for fugitive emission associated with excavation activities.

2) NESHAP - 40 CFR Part 61, Subpart Q - Emissions of Radon from DOE Facilities

Pursuant to the NESHAP Subpart Q Standard promulgated in 40 CFR Part 61.192, radon-222 emissions from Department of Energy facilities must not exceed a flux rate of more that 20 pCi/m2/sec. In November 1991, the US EPA and DOE signed the Federal Facility Compliance Agreement (FFCA) for the Control and Abatement of Radon-222 Emissions, in which the DOE committed to providing the US EPA with estimates of radon flux from potential sources of radon emissions such as the waste pits.

2.1.4.2 Identification of the Permit Standards, Requirements, Criteria, or Limitations

State Permits/Notifications

1) OAC 3745-31-02 - Ohio EPA Permits to Install

The Ohio EPA issues Permits to Install for new sources provided they: (1) do not interfere with attaining or maintaining applicable air quality standards; (2) do not result in a violation of any applicable laws; and (3) employ best available technology (BAT) to control emissions. BAT requirements for toxic air pollutants are determined using the methodology prescribed under the Ohio EPA's Air Toxic Policy.

2) OAC 3745-35-02 - Ohio EPA Permits to Operate

The Ohio EPA issues Permits to Operate provided the source: (1) is operated in compliance with applicable air pollution control laws; (2) is located or installed according to the terms and conditions of a Permit to Install; and (3) does not violate National Emissions Standards for Hazardous Air Pollutants adopted by the Administrator of the Ohio EPA.

3) NPDES Permit - Ohio EPA NPDES Permit No. 1IO00004*ED

Wastewater discharges associated with the proposed project will be treated at the FEMP wastewater treatment system so that they comply with the effluent limits and loading rates at

NPDES permitted outfall *4001 (MH-176b), and with the general terms and conditions of FEMP NPDES Permit 1IO00004*ED.

By permit condition, the FEMP must notify the Ohio EPA of any activities or changes at the site which alter the character of its wastewater stream. A NPDES permit modification may be required if the discharge causes a change in the character of the wastewater stream. OU1 discharges will be evaluated during the remedial design process to determine whether they warrant an NPDES permit modification. These discharges will also be evaluated to ensure they do not violate CWA Section 307 Toxic notification levels promulgated in 40 CFR 122.42 or Ohio EPA Water Quality Standards (OAC 3745-1) for the segment of the Great Miami River into which the FEMP discharges its wastewater.

Federal Permits/Notifications

1) NESHAP - 40 CFR Part 61, Subpart H - Emissions of Radionuclides other than Radon from DOE Facilities

Pursuant to the NESHAP Subpart H Standard codified in 40 CFR Part 61.92, all activities conducted at the FEMP must not cause a maximum off-site release of more than 10 mrem/year.

Pursuant to 40 CFR 61.07 and 61.96, a notification is required for point sources which could cause an annual effective dose equivalent to the nearest off-site receptor in excess of 0.1 mrem/year. Continuous emission monitoring is required by 40 CFR 61.93(b) for stacks and vents which have the potential release more than 0.1 mrem/year to the general public. The release equivalent is determined by to the methods prescribed in 40 CFR Part 61, Appendix D and the US EPA's CAP-88 modeling program. Monitoring is not required for fugitive emission sources, however, project specific isotopic emission estimates must be prepared to demonstrate compliance with the NESHAP Subpart H Standard.

Both fugitive and point source emissions must be evaluated to ensure compliance with the 10 mrem/year site standard. Emissions from the dryer facility must be evaluated against the 0.1 mrem/year standard to determine permitting and monitoring requirements mandated by 40 CFR 61.07, 61.96 and 61.93 (b). Isotopic emission estimates must be prepared for fugitive emission associated with excavation activities.

2) NESHAP - 40 CFR Part 61, Subpart Q - Emissions of Radon from DOE Facilities

Pursuant to Paragraph 28 of the FFCA for the Control and Abatement of Radon-222 Emission, project specific flux rates must be prepared and approved by the US EPA prior to conducting the proposed activities.

2.1.4.3 Explanation of How the Response Action Will Meet Permit Standards, Requirements, Criteria, or Limitations

State Permits/Notifications

1) OAC 3745-31-02 - Ohio EPA Permits to Install

Permits to Install are required for the dryer without the CERCLA 121(e) permitting exemption. The dryer will be installed so that it does not interfere with attaining or maintaining any applicable air quality standards or cause a violation of applicable laws. The dryer off-gas system will employee HEPA filtration to met BAT requirements.

2) OAC 3745-35-02 - Ohio EPA Permits to Operate

A Permit to Operate would be required for the dryer. The dryer will operate in compliance with applicable air pollution control laws and will be installed according to requirements for Permits to Install. The dryer's operation will comply with the substantive requirements of applicable NESHAP Standards.

3) NPDES Permit - Ohio EPA NPDES Permit No. 1IO00004*ED

Wastewater discharges will be treated at the FEMP wastewater treatment system so that they comply with the effluent limits and loading rates at NPDES permitted outfall *4001 (MH-176b), and with the general terms and conditions of FEMP NPDES Permit 1IO00004*ED.

By permit condition, the FEMP must notify the Ohio EPA of any activities or changes at the site which alter the character of its wastewater stream. A NPDES permit modification may be required if the discharge causes a change in the character of the wastewater stream. OU1 discharges will be evaluated during the remedial design process to determine whether they warrant an NPDES permit modification. These discharges will also be evaluated to ensure they do not violate CWA Section 307 Toxic notification levels promulgated in 40 CFR 122.42 or Ohio EPA Water Quality Standards (OAC 3745-1) for the segment of the Great Miami River into which the FEMP discharges its wastewater.

Federal Permits/Notifications

1) NESHAP - 40 CFR Part 61, Subpart H - Emissions of Radionuclides other than Radon from DOE Facilities

Pursuant to the NESHAP Subpart H Standard codified in 40 CFR Part 61.92, all activities conducted at the FEMP must not cause a maximum off-site release of more than 10 mrem/year.

Pursuant to 40 CFR 61.07 and 61.96, a notification is required for point sources which could cause an annual effective dose equivalent to the nearest off-site receptor in excess of 0.1 mrem/year. Continuous emission monitoring is required by 40 CFR 61.93 (b) for stacks and vents which have the potential to release more than 0.1 mrem/year to the general public. The release equivalent is determined by the methods prescribed in 40 CFR Part 61, Appendix D and US EPA's CAP-88 modeling program. Monitoring is not required for fugitive emission sources, however, project specific isotopic emission estimates must be prepared to demonstrate compliance with the NESHAP Subpart H Standard.

Given these requirements, both fugitive and point source emissions must be evaluated to ensure compliance with the 10 mrem/year site standard. Emissions from the dryer facility must be evaluated against the 0.1 mrem/year standard to determine permitting and monitoring requirements mandated by 40 CFR 61.07, 61.96 and 61.93 (b). Isotopic emission estimates must be prepared for fugitive emission associated with excavation activities.

2) NESHAP - 40 CFR Part 61, Subpart Q - Emissions of Radon from DOE Facilities

Excavation activities have the potential to cause a release of radon gas and therefore, are subject to evaluation against the NESHAP Subpart Q Standard. Project specific flux calculations will be prepared for the project. In addition, real-time monitoring of radon emissions will be conducted throughout the course of the project.

2.1.5 Packaging Requirements

Containers for low-level radioactive material shall meet the requirements of 49 CFR 173.441. Each package, under conditions normally incidental to transportation, shall not exceed 200 mrem/hr at any point on its external surface. The transport index cannot exceed 10.

The transport index is a dimensionless number, rounded up to the first decimal place, that is placed on a package label to designate the degree of control to be exercised by the carrier during transportation. For the waste involved in this project, the transport index will be the maximum radiation level in mrem/hr at 1 meter from the external surface of the package.

Railcars containing radioactive material shall meet the requirements of 49 CFR 174, Subpart K, which requires that railcars be loaded in a manner that avoids spillage and scattering of loose material. The amount of low-level radioactive waste placed into a railcar cannot make the total transport index number greater than 50.

Container and railcar dose rates will be determined during Title Design to derive the transport indices.

2.2 General Design Criteria

2.2.1 Requirements for Waste Streams

The following subsections identify the requirements for the six waste streams that will be generated during construction and operation of the OU1 remediation facilities. These streams include:

1) Untreated pit waste and debris
2) Treated pit waste and debris
3) Air discharges
4) Wastewater
5) Miscellaneous

2.2.1.1 Untreated Pit Waste and Debris

Pit waste and debris will be excavated and segregated into three groups - dry waste and soil, wet waste and soil, and large debris. Pit waste and soil will be screened and dried.

2.2.1.2 Treated Pit Waste and Debris

To meet the PCDF WAC, dried waste and soil shall not contain free liquids. This waste will be bulk-loaded into gondola railcars for shipment to the PCDF. The absence of free liquids shall be verified by US EPA SW-846 Method 9095, the Paint Filter Liquids Test.

2.2.1.3 Air Discharges

The exhaust air from the dryer is a major contaminated airborne effluent discharge that will be generated during normal operations. The presence of radon in the effluent discharge will be examined during Title Design. Emissions will be controlled using Best Available Technology.

Radionuclide emissions, excluding radon, from all facilities/activities at the FEMP shall be controlled to ensure that the maximally exposed individual (MEI) member of the public does not receive a total effective dose equivalent in excess of 10 mrem/yr for the airborne pathway in accordance with 40 CFR 61, Subpart H (radionuclide NESHAP for the DOE). In addition, the exposure of the MEI members of the public as a consequence of all site remedial activities shall not exceed 100 mrem/yr for all exposure pathways (DOE Order 5400.5.II.1a). All radionuclide emissions shall be ALARA.

Should radon be present in emissions from the OU1 remediation facilities, the following shall apply:

1) The annual average Rn-222 concentration for ambient air at or above any location outside the facility site will not exceed 3 picocuries per liter (pCi/L) above background.

2) The annual average Rn-222 concentration for ambient air over the OU1 remediation facilities will not exceed 30 pCi/L above background.

3) The maximum Rn-222 concentration for ambient air at any given point will not exceed 100 pCi/L above background.

4) The average Rn-222 release rate from stored material will not exceed 20 pCi/m^2/sec (per DOE Order 5400.5.IV.6.b.[2]; 40 CFR 61 Subpart Q).

In addition to the Federal requirements identified above, various State requirements, identified as ARARs in Appendix A, also will apply to this project. As required by Ohio Administrative Code (OAC) 3745-17-05, significant and avoidable deterioration of air quality surrounding the OU1 remediation facilities shall be prohibited. Also, visible particulate emissions from stationary sources shall be controlled in accordance with the limits identified in OAC 3745-17-07.

Construction of remediation facilities and excavation, on-site transportation, and storage of pit waste must meet the requirements of OAC 3745-17-08 with regard to fugitive dust emissions. Fugitive dust generated during these activities must be minimized or eliminated.

Air dispersion modeling will be performed to estimate pollutant (particulate and radon) discharges at all OU1 sources (point and area) to determine compliance with air regulations. Results will also be used to identify areas where additional controls may be required to keep occupational and public doses ALARA.

2.2.1.4 Wastewater

Wastewater generated by the OU1 remediation activities will be treated at the FEMP wastewater treatment system prior to discharge to the Great Miami River via manhole 176B. The FEMP NPDES permit governs the discharge from the FEMP wastewater treatment system. All OU1 wastewater is either transferred directly to the Biodenitrification Surge Lagoon or indirectly via the Clearwell prior to entering the FEMP wastewater treatment system.

The five types of wastewater streams generated by the remedial action are waste pit surface water, excavation water from the waste pit area (which includes storm and drainage water), process wastewater, decontamination water, and stormwater from the process area. These wastewater streams are described in detail in the *Process Description for the Remediation System Design* (PARSONS 1995d).

Additional pretreatment (other than removal of suspended solids) of the wastewater may be necessary depending upon the WAC for the FEMP wastewater treatment system. This WAC is currently being developed.

Wastewater shall be managed in accordance with the ARARs identified in Appendix A. In addition to the ARARs, stormwater controls are discussed in Subsection 2.3.5.3 of this DCD as well as the *Waste Excavation Plan for the Operable Unit One Remediation System Design* (PARSONS 1995h).

2.2.1.5 Miscellaneous

Other waste streams that will be generated during remedial activities involve contaminated personal protective equipment and spent activated carbon. Other streams and their disposition will be identified during design.

2.2.2 Human Factors

The appropriate human factors technology will be considered in the design, operation, and maintenance of DOE nuclear facilities. The human factors safety design considerations shall be documented as required by the draft 10 CFR 830.110.

2.2.2.1 Equipment Labeling

Equipment and any parts of the equipment to be used by personnel shall be identified with appropriate labels. The labels shall clearly and concisely indicate the function and purpose of the item being labeled, and the use of abbreviations and/or acronyms shall be minimized. Permanent labels shall be attached so that environmental conditions or usage by personnel will not remove the labels or render them illegible.

2.2.2.2 Workplace Environment

An effective climate control system shall be designed to maintain temperature and humidity at an acceptable level and compatible with the work being performed in enclosed buildings. Acoustic design shall minimize the noise level to ensure that the limits of DOE Order 5480.10 and 29 CFR 1910.95 are not exceeded, verbal communications are not impaired, and auditory signals are readily detectable. Also, auditory distractions that can lead to operator fatigue shall be minimized.

Proper means of egress shall be provided to ensure that workers have an unobstructed path to an exit. The path to an exit shall have a width greater than 3 feet, and a height greater than 7 feet, 6 inches. For overhead equipment hanging in a path of egress, the allowable clearance is 6 feet, 8 inches. Fall protection shall be provided in any areas that exceed 4 feet in height and are accessible to personnel.

Portable eyewash stations and safety showers shall be provided where required.

2.2.2.3 Lighting

Adequate lighting levels shall be provided in all work areas, with glare and/or shadowing conditions avoided wherever possible. When appropriate, lighting design shall consider environmental effects and ensure adequate lighting intensities. Levels shall be consistent with IES Handbook values.

2.2.2.4 Operating Panels and Controls

The arrangement of controls and displays on control panels shall be designed to promote efficient use of task-related components, rapid location of a given component, and maximum operator awareness of plant conditions; and to limit the potential for operator error.

2.2.2.5 Warning and Annunciator Systems

Warning systems shall alert personnel to abnormal conditions and provide sufficient time to respond to annunciated warnings. All warning systems shall be capable of being tested periodically. Standard audible signals shall be used for common nuclear facility events (fire, severe weather) as required by national standards. These systems will be tied into the FEMP sitewide systems.

2.2.2.6 Communication Systems

The communication system will permit users to transmit and receive information accurately and conveniently, with a minimum of distractions from the user's other tasks. This system will be tied into the FEMP sitewide system.

2.2.3 General Nuclear, System Safety, and Worker Protection Requirements

The OU1 remediation facilities shall be designed based on the requirements of a nonreactor nuclear facility under DOE Orders. The facility hazard category shall be determined in accordance with DOE Order 5480.23, DOE-STD-1027-92, and DOE-EM-5502-94.

Health and safety performance objectives to be achieved in the design of DOE facilities include:

1) Protection of the public and all personnel from injury and from exposure to toxic materials, radiation, and other hazards in accordance with DOE requirements and allowable limits

2) Protection of private and public property against damage resulting from DOE operations

3) Continuation of operations by minimization of accident potential

4) Limitation of loss or damage to Federal property, including losses associated with the inability to readily decontaminate or decommission facilities for other subsequent uses

2.2.3.1 Radiation Dose Limits

Table 2-2 provides a summary of occupational radiation dose limits and control levels. Dose rates will be modeled during design to demonstrate compliance with FEMP Control Levels (which were developed to ensure the DOE levels are not exceeded as well as keeping exposures ALARA), and ARAR limits identified in Appendix A.

Table 2-2 - Summary of Radiation Dose Limits and Control Levels

	DOE	DOE Admin. Control Level	FEMP Control Level
Whole Body	5 rem/yr	2 rem/yr	1 rem/yr
Extremities	50 rem/yr	n/a	10 rem/yr
Skin and Other Organs	50 rem/yr	n/a	10 rem/yr
Lens of Eye	15 rem/yr	n/a	3 rem/yr
Embryo/Fetus	500 mrem/gestation period	n/a	400 mrem/gestation period

Operations must be in accordance with the requirements of DOE Order 5400.5, Chapter II involving the DOE public dose limit for all exposure modes and the DOE sources of radiation. The total effective dose equivalent to members of the public is limited to 100 mrem/yr, excluding radon. Radon may be encountered in some of the pits. Therefore, controls for radon emission will be evaluated during Title Design.

2.2.3.2 Facility Design - External Exposure

10 CFR 835.1002 states that optimization methods shall be used to ensure that occupational exposure is maintained ALARA in developing and justifying facility design and physical controls. Also, the design objective for controlling personnel exposure from external sources of radiation in areas of continuous occupational occupancy (2,000 hours per year) shall be to maintain exposure levels below an average of 0.25 mrem per hour and as far below this average as is reasonably achievable. The facility shall be divided into separate areas for limited access (dose rates less than 0.25 mrem/hr) and restricted access

(dose rates greater than 0.25 mrem/hr). The design objectives for exposure rates for potential exposure to a radiological worker, where occupancy differs from the above, shall be ALARA and shall not exceed 20 percent of the applicable standards in 10 CFR 835.202.

Preliminary calculations have indicated that shielding will not be required. This will be confirmed during design. Required shielding shall be designed to limit the total external dose to less than 20 percent of the annual DOE exposure limit values (1 rem/yr) as specified in 10 CFR 835. Projected dose rates will be based on occupancy, duration, and frequency of exposure, and shall not exceed 1 rem/yr as specified in 10 CFR 835. This may require that shielding be provided for areas requiring normal and intermittent access, such as those for preventive maintenance, component changes, or operation/adjustment of systems and equipment. The characteristics of the radiation, structural requirements, flammability requirements, and radiation damage potential will determine the type of shielding. Shielding shall also be installed to minimize nonpenetrating external radiation exposures to the skin and lens of the eye, where required. In most cases, confinement barriers or process equipment provide this function. Where shielding is an integral part of the facility structure, it shall be installed to at least the same level of natural phenomenon qualification as the facility structure.

2.2.3.3 Facility Design - Internal Exposure

10 CFR 835.1002 requires that to control airborne radioactive material, the design objective shall be, under normal conditions, to avoid releases to the workplace atmosphere, and in any situation, to control the inhalation of such material by workers to levels that are ALARA. Control of internal exposures shall be through the use of confinement and ventilation. Eating, drinking, and smoking shall not be allowed in the remediation facilities. In addition, the facilities shall be designed to ensure that the routine use of respirators is not required by on-site personnel during normal facility operations.

2.2.3.4 Codes, Standards, and Regulations

The following will be used as guidance during the design of the OU1 remediation facilities:

1) RM-0021, Safety Performance Requirements Manual (FEMP document)

2) DOE Order 5400.1, "General Environmental Protection Plan"

3) DOE Order 5400.5, "Radiation Protection of the Public and Environment"

4) DOE Order 5480.10, "Contractor Industrial Hygiene Program"

5) 10 CFR 835, Occupational Radiation Protection

6) DOE Order 5480.11, "Radiation Protection for Occupational Workers"

7) DOE/EH-0256T, Radiological Control Manual

8) DOE Order 6430.1A, "General Design Criteria"

9) 29 CFR 1910, Occupational Safety and Health Standards

10) 29 CFR 1926, Safety and Health Regulations for Construction

11) American Concrete Institute 349, Code Requirements for Nuclear Safety Related Concrete Structures

12) American Nuclear Society (ANS) 6.4, Guidelines on the Nuclear Analysis and Design of Concrete Radiation Shielding for Nuclear Power Plants

13) ANS 6.4.2, Specifications for Radiation Shielding Material

14) ANSI N13.1, Guide to Sampling Airborne Radioactive Materials in Nuclear Facilities

15) DOE-STD-1021-93, Natural Phenomena Hazards Performance Categorization Guidelines for Structures, Systems,and Components

16) DOE-STD-1027-92, Hazard Categorization and Accident Analysis Techniques for Compliance with DOE Order 5480.23, "Nuclear Safety Analysis Reports"

17) DOE Order 5480.23, "Nuclear Safety Analysis Reports"

18) DOE Order 5480.28, "Natural Phenomena Hazards Mitigation"

19) DOE-EM-5502-94, Hazard Baseline Documentation

2.2.4 Security

Special security and safeguard measures do not directly apply to the OU1 Remediation System Design because the facility will not process special nuclear material. However, some security and safeguards may be required based on the facility's hazard category. The hazard category, and the required security and safeguards, will be confirmed during design.

Fencing will be limited to that required for safety, physical security, and activity control. Temporary fencing will be used during construction. Radiation control fencing will also be provided. Existing fence material that is to be removed will be salvaged for re-use. New fences and hardware shall be standard chain-link fabric with three strands of barbed wire, with a total fence height of 8 feet. The integrity of site perimeter security fencing shall be maintained. DOE and FEMP standards for fencing shall be followed.

2.2.5 Geotechnical

Several geotechnical investigations have been conducted in the OU1 area. This section provides summary descriptions of the geological, hydrogeological, and geotechnical conditions of the OU1 area waste, and materials pertaining to the design of the preferred remedial alternatives, from the following data sources:

1) *Characterization Investigation Study Geotechnical Evaluation of Waste Pit Material Properties and Boring Logs* (Weston 1988)

2) *CRU-1 Cooperative Remedy Screening Program Final Report* (ALTER 1994)

3) *Remedial Investigation Report for Operable Unit 1* (DOE 1994b)

4) *Preliminary Technical Summary of DEEP Test Boring and Cone Penetrometer Testing (Present Water Conditions)* (PARSONS 1995a)

5) *Interim Report, CRU-1-Dewatering, Excavation, Evaluation Program: Waste Pits 1, 2, and 3,* September 1995 (ALTER 1995)

The DEEP program results will provide necessary geotechnical data. Geotechnical data evaluation from these sources is ongoing and will be used for the following general purposes:

1) Provide design parameters for the remediation facility foundation designs

2) Provide geotechnical data for analysis of slope stability and bearing capacity of equipment during waste pit excavation

3) Provide design parameters for road and pad design

4) Provide waste characteristic data for process design

The following sections discuss some of the specifics regarding OU1 geological conditions, hydrogeological properties, and geotechnical data collection and interpretation, as well as waste characteristics that influence design parameters.

2.2.5.1 Geological Conditions

The cross sections through OU1 presented in the Remedial Investigation (RI) Report (DOE 1994b) show that the glacial overburden is predominantly clay. Within the clay of the glacial overburden are lenses of coarse, nonplastic (NP) sediments, silt, sand, and gravel. These coarse-grained lenses have complex geometries and are difficult to correlate laterally without closely spaced borings.

Prior to construction of the waste pits, small tributaries to Paddys Run eroded surface features of the waste pit area. The waste pits are constructed above and below the original grade. The material that was used to make the above-grade additions was taken from local excavations in and around the waste pit area. Consequently, the fill above the original grade in the cross sections is clay- and silt-dominated strata typical of the glacial overburden.

2.2.5.2 Hydrogeological Properties

This subsection describes groundwater flow in the glacial overburden and in the Great Miami Aquifer at OU1. Groundwater exists in both perched and water table conditions beneath OU1. The groundwater level is seasonal and fluctuates between 518 feet and 522 feet.

Groundwater of the glacial overburden has a radial flow pattern in the area of the pits, with the exception of the Burn Pit. Based on groundwater level contours presented in the RI report, groundwater elevations beneath OU1 range seasonally from 518 to 522 feet above mean sea level. Seasonal variations in groundwater elevation are only a few feet in Waste Pits 1 through 4, but vary up to 10 feet in the Burn Pit (DOE 1994b).

Based on discussions in the RI (See Section 3.4 of the RI Report), horizontal groundwater flow within perched water zones in OU1 is limited in extent to areas of coarse-grained lenses. Two significant areas of coarse-grained lenses have been identified, on the eastern portion of Pit 4 and to the north and east of Pit 6. The potentiometric contours for Type 1 (1000-series) wells, indicates that perched water seepage could occur on the east side of Pit 4. Pits 1, 3, 5, and 6 are low hydraulic conductivity zones. Based on preliminary review of wet trenching activities in Waste Pits 1, 2, and 3, water seepage into test excavations, at the base of porous cap material, was observed. The source of the water is infiltration of rainwater through the cap material.

Infiltration of surface water along Paddys Run into the Great Miami Aquifer affects local groundwater in the waste pit area. During the high precipitation seasons of winter and spring, there is more flow in

Paddys Run, and stream water infiltrates into the Great Miami Aquifer, creating a groundwater mound centered beneath Paddys Run. During the dry season, there is relatively little recharge to the regional aquifer, the mound is not present (DOE 1994b).

2.2.5.3 Geotechnical Design Parameters

Geotechnical Investigations and Testing

Geotechnical testing continues to be conducted to evaluate the characteristics and geotechnical properties of the OU1 waste and surrounding berm materials. The latest results are found in the *Preliminary Technical Summary of DEEP Test Data* (PARSONS 1995a).

In addition to the Clearwell, two of the waste pits have water on their surfaces: Waste Pit 5 (1 to 5 feet water) and Waste Pit 6 (2 feet of water). The Clearwell has 11 feet of water. The remaining waste pits have dry surfaces.

Table 2-3 summarizes geotechnical data by waste pit in two primary categories, the first representing geotechnical parameters used for the design basis for this DCD and the second containing a summary of data ranges from the five data sources listed in Subsection 2.2.6. Table 2-4 summarizes data from composited samples based on material type. Therefore, composited samples could be from different waste pits but of similar geotechnical classification.

Geotechnical data from the OU1 perimeter dikes can be found in the Waste Pits 3 and 5, and Clearwell Stability Analysis Report (PARSONS 1992). Preliminary geotechnical data for the proposed remediation facility foundation analysis and design can be found in the *Preliminary Technical Summary of DEEP Test Data* (PARSONS 1995a). Geotechnical data needed to support material process design include moisture content and dry density. These data will be used to estimate the total amount of liquids and solids that must be handled as part of the waste pit remediation processes.

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Table 2-3 - Preliminary Summary of Geotechnical Data by Waste Pit

Parameters	Pit 1	Pit 2	Pit 3	Pit 4	Pit 5	Pit 6	Burn Pit	Clearwell
Parameters Used for Design Basis[1]								
Estimated Volume of Pit Materials (yds^3)	W=48,500 T=68,400	W=24,200 T=37,400	W=204,100 T=307,500	W=55,100 T=72,800	W=97,900 T=97,900	W=9,600 T=9,600	W=30,300 T=30,300	W=3,700 T=4,300
Dry Density (lb/ft^3)	111	74	59	111	34	79	104	79
Assumed Average Moisture Content (w) (% Dry Basis)	25%	50%	65%	25%	144%	45%	30%	45%
Major Types of Waste (Unified Soil Classification System - USCS Group Name)	NP (non-plastic)	CL (clay) MH (high plasticity silt)	MH	CL, NP	MH	NP, MH, SM (silty sand)	ML (low plasticity silt)	NP, SM, MH
Current Data Base Parameter Ranges[2]								
Estimated In Situ Dry Density (lb/ft^3)	74-120	18-105	25-110	NA	NA	NA	NA	NA
Estimated In Situ Moisture Content (% Dry Weight)	18-47%	24-317%	18-197%	21-62%	NA	NA	43%	NA
Maximum Dry Density (from Compaction Test) (lb/ft^3)	109	86	88	120	62	101	81	NA
Optimum Moisture Content (from Compaction Test) (%)	17.3%	17.5%	26.4%	18.2%	50.4%	23.0%	9.5%	NA

Table 2-3 - Preliminary Summary of Geotechnical Data by Waste Pit (Continued)

Parameters	Pit 1	Pit 2	Pit 3	Pit 4	Pit 5	Pit 6	Burn Pit	Clearwell
Major Types of Waste (USCS Group Name)	ML, ML (NP), GC (clayey gravel with sand)	ML (NP), MH, SM, SC (clayey sand with gravel), CL	SM, MH, ML, CL	CL, ML (NP), ML	MH, ML, ML (NP)	ML (NP), SM, ML, MH	CL, MH, SM	CL, ML, SM
Specific Gravity of Solids	2.62 - 3.15	2.20 - 3.02	2.20 - 2.96	2.62 - 3.63	2.43 - 2.74	2.85 - 3.21	2.35 - 3.74	2.69 - 2.78
Percentage of Material Less Than 200 Mesh (% Silt and Clay)	43 - 96	29.1 - 100	43.4 - 96	55.0 - 94.0	70.0 - 99.8	48.7 - 96.3	36.0 - 71.2	44.5 - 77.0
Undrained Internal Friction Angle (deg)	NA	NA	15.0 - 23.9	NA	NA	NA	NA	NA
Drained Internal Friction Angle (deg)	NA	NA	32.9 - 39.0	NA	NA	NA	NA	NA
Cohesion (psi)	NA	NA	0.0 - 1.5	NA	NA	NA	NA	NA

Notes:

W = Volume of Waste
T = Total Volume
NA = Not Applicable
w = Moisture Content

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Table 2-4 - Preliminary Summary of Geotechnical Composite Samples by Material Type

	ML (NP1) Non-Plastic Silt 1	ML (NP2) Non-Plastic Silt 2	MH1 Elastic Silt 1	MH2 Elastic Silt 2	ML Silt	CL Clay	SM Silty Sand
Pit No.	1,4	5,6	5	2,3	6, Burn Pit	4	2, Clearwell
Standard Proctor Maximum Dry Density (from Compaction Test) (lb/ft^3)	116.3	76.89	65.04	77.78	99.04	118.4	102.3
Optimum Moisture Content (from Compaction Test) (%)	13.4	36.2	56.0	35.4	19.7	18.7	20.1

Pit Excavation Design Parameters

The following geotechnical parameters (determined as part of the DEEP) will be evaluated to determine the appropriate design of the waste pit excavation:

1) Cohesion
2) Internal angle of friction
3) Wet and Dry Density
4) Specific Gravity
5) Soil Classification
6) California Bearing Ratio (CBR)
7) Moisture content
8) Boring logs
9) Cone Penetrometer Test logs
10) Compressibility or consolidation

Remediation Facility Foundation Design Parameters

The following geotechnical test parameters will be determined and analyzed to support the design of the remediation facility foundation:

1) Unconfined compressive strength
2) Consolidated, undrained triaxial compressive strength
3) Perched water conditions
4) Material classification
5) Standard Penetrometer Test data
6) Consolidation data
7) CBR
8) Compaction densities and optimum moisture content
9) Wet and dry density

2.3 Discipline-Specific Design Criteria

Each discipline will use the current revisions, as of the issue date of this DCD, of the codes, standards, and regulations listed in the following subsections.

2.3.1 Process

2.3.1.1 Responsibility

Process will have the responsibility of developing the project conceptual flowsheets, completing heat and material balances, performing initial process equipment sizing, and interacting with Material Handling and Mechanical Process.

Specifically, Process will have sole responsibility for the indirect rotary dryer and associated equipment, and all equipment contained in the treatment system. Process will have joint responsibility, with Material Handling and Mechanical Process, for all other equipment depicted on the flowsheets.

2.3.1.2 Codes, Standards, and Regulations

No specific codes and standards apply to Process design beyond the ARARs and those listed in the sections addressing Material Handling and Mechanical Process.

2.3.1.3 Design Criteria

The design rates and operating periods for the remediation process are presented below. Actual operating rates will depend on the moisture content of the feed stock. Note that the dryer and shredder feeds will vary by material.

Table 2-5 - Process Parameters

Operation	Operating Times	Design Rates
Mechanical Excavation	8 hours/day; 5 days/week	1,200 tons/day
Shredder Feed	8 hours/day; 5 days/week	96 tons/hour (clay)
Dryer Feed	24 hours/day; 7 days/week	22 tons/hour
Dryer Product	24 hour/day; 7 days/week	20 tons/hour
Water to Off-Gas System (Dryer Evaporation Rate)	24 hours/day; 7 days/week	4.2 tons/hour
Loadout	8 hours/day; 5 days/week	120 tons/hour

Various waste piles will require different storage times. Storage times will be determined during design. Dry and wet material will be blended together into a feed pile for processing. The dryer feed pile will be stored prior to treatment. There will also be an contingency stockpile, with both wet and dry material, with a capacity for 14 days of treatment. With the exception of the contingency stockpile, the various storage times are for surge time, drainage, and evaporation of excess moisture in the material.

Natural gas will be used as the combustion fuel for the indirect rotary dryer.

Off-gas exiting the dryer will be sent to a condenser, which will reduce the temperature of the off-gas to 120 degrees F. To accomplish this, 1,142 gallons per minute (gpm) of cooling water at a temperature of 80 degrees F will be required at the condenser (based on Waste Pit 6 energy balances).

Off-gas exiting the scrubbers will pass through a heat exchanger, which will reduce the temperature of the off-gas to 50 degrees F. To accomplish this, 52 gpm of water chilled to 42 degrees F will be required at the heat exchanger.

The material densities and moisture contents presented in Table 2-6 (based on June 15, 1995, DEEP data) will be incorporated into the design:

Table 2-6 - Waste Pit Material Densities and Moisture Contents

Waste Pit	Dry Density	Wet Density	Percent Moisture Content (Wet Basis)
Pit 1	111 lb/ft^3	139 lb/ft^3	20
Pit 2	74 lb/ft^3	111 lb/ft^3	33
Pit 3	59 lb/ft^3	98 lb/ft^3	39
Pit 4	111 lb/ft^3	139 lb/ft^3	20
Pit 5	34 lb/ft^3	84 lb/ft^3	59
Pit 6	79 lb/ft^3	115 lb/ft^3	31
Burn Pit	104 lb/ft^3	135 lb/ft^3	23
Clearwell	79 lb/ft^3	115 lb/ft^3	31

2.3.2 Mechanical Process

2.3.2.1 Responsibility

Mechanical Process will interact with Process during the development of the project conceptual flowsheets and process equipment sizing. Mechanical Process will have joint responsibility with Material Handling and Process for all equipment depicted on the flowsheets.

Mechanical Process will be responsible for the specification of tanks, pumps, air compressors, heat exchangers, filters, and scrubbers, and support will be provided to Process for the indirect rotary dryer.

2.3.2.2 Codes, Standards, and Regulations

1) American Petroleum Institute (API) Standard 620-90, Eighth Edition, Design and Construction of Large, Welded, Low-Pressure Storage Tank

2) API Standard 650-93, Ninth Edition, Welded Steel Tanks for Oil Storage

3) DOE Order 6430.1A, "General Design Criteria"

4) Tubular Exchanger Manufacturers Association, Inc. (TEMA) standards

5) American Society of Mechanical Engineers (ASME) B73.1M-91, Specification for Horizontal End Suction Centrifugal Pumps for Chemical Process

6) ASME Boiler and Pressure Vessel Code Sections VIII and IX

2.3.2.3 Design Criteria

The facility shall be designed to meet the requirements of DOE Order 6430.1A. Design shall consider, and where required, use secondary containment to restrict the movement of radioactive liquid waste that has the potential for human contact or reducing groundwater quality. When necessary to prevent chemical reactions or introduction of contaminants, individual lines shall be used for each waste stream fed to collection tanks. Materials shall be selected for corrosion resistance and ease of decontamination. Provisions shall be made so that liquids can be analyzed prior to transfer.

Tank systems shall be equipped with spill prevention devices (i.e., check valves, dry disconnect couplings) and overfill controls (i.e., liquid level probes, high level alarms, and interlocks to stop flow).

Equipment

Tank design shall meet the requirements of API 620 and/or 650.

Shell and tube heat exchangers shall meet the requirements of TEMA.

Where applicable, pumps shall meet the requirements of ASME B73.1M.

Dryers, receivers, and filter housings shall meet the requirements of the ASME Boiler and Pressure Vessel Code, Section VIII. Welding associated with pressure vessels shall meet the requirements of the ASME Boiler and Pressure Vessel Code, Section IX. Note that the equipment will meet the requirements of the ASME Boiler and Pressure Vessel Code to ensure the quality of welds and fabrication. This does not imply that the equipment must be "stamped."

Process Water

Process water will be obtained from the FEMP's process water system.

Plant and Instrument Air

Plant and instrument air will be required for the off-gas treatment system, laboratory, and maintenance needs. Air compressor(s) will be installed rather than tying into existing site air system. Other needs for air may be identified during design.

Vibration

Rotating equipment will be dynamically balanced in accordance with the manufacturer's standard practice.

Containment, Sump Requirements

Containment systems shall meet the criteria in DOE Order 6430.1A, Paragraphs 1300-7 and 1323-5.

Accessibility for In-Service Inspection

All equipment shall be provided with access, including platforms and ladders (as required), for inspection while in service.

Corrosion Allowance

Stainless steel and epoxy-coated steel tanks will not require a corrosion allowance. Unprotected carbon steel tanks shall have a 1/16-inch corrosion allowance.

2.3.3 Piping

2.3.3.1 Responsibility

Piping will be responsible for the specification of pipes, fittings, valves, pipe supports/anchors, and piping and equipment insulation.

2.3.3.2 Codes, Standards, and Regulations

1) ASME B31.3, Chemical Plant and Refinery Piping

2) ASME Boiler and Pressure Vessel Code

3) American Society for Nondestructive Testing (ASNT) SNT-TC-1A, Recommended Practice

4) American Society for Testing and Materials (ASTM) A-36, Standard Specification for Structural Steel

5) ASTM A-576, Standard Specification for Steel Bars, Carbon, Hot Wrought, Special Quality

6) ASTM B-209, Aluminum and Aluminum Alloy Sheet and Plate

7) ASTM C-533, Calcium Silicate Block and Pipe Thermal Insulation

8) ASTM C-552, Cellular Glass Thermal Insulation

9) American Welding Society (AWS) D.1.1, Structural Welding Code Steel

10) DOE Order 6430.1A, General Design Criteria

11) Manufacturers Standard Society (MSS) SP-58, Pipe Hangars and Support - Materials, Design, and Manufacture

12) MSS SP-69, Pipe Hangars and Support - Skeleton and Application

13) MSS SP-89, Pipe Hangars and Support - Fabrication and Installation Practices

2.3.3.3 Design Criteria

General Criteria

ASME B31.3 and the ASME Boiler and Pressure Vessel Code shall be the basis for the various piping systems designs.

Flexibility

The impacts of dynamic effects (wind and vibration) and weight effects (live loads, dead loads, and test loads) shall be considered in the design so that stresses created by these combined loads do not exceed the allowable stresses as prescribed by ASME B31.3 and, where applicable, the ASME Boiler and Pressure Vessel Code. Seismic and stress analysis calculations will be performed as part of the design.

Double-Walled Pipe

In accordance with DOE Order 6430.1A, Paragraph 1300-7.4, and where required, radioactive or other hazardous materials shall be carried in double-walled pipes where the primary pipe leaves a secondary confinement structure. In areas within the secondary confinement structure, the use of double-walled pipe shall be considered. Use of double-walled pipe will depend on factors such as accessibility, location, and type of waste. Leakage monitoring shall be provided to detect leakage into the space between the carrier (inner) and containment (outer) pipes.

Pressure

Design and test pressures shall comply with ASME B31.3.

Testing

Pipe and piping systems testing shall conform to the requirements set forth in ASME B31.3 and ASNT SNT-TC-1A.

Special Flow Considerations

Slurry pipe flow capacities shall maintain an adequate velocity to prevent settling of solids. Slurry pipe design shall consider internal erosion.

Heat Tracing and Insulation

Heat tracing and insulation shall be provided for all piping, fittings, valves, and equipment which are subject to freezing temperatures, to prevent heat loss and freezing, and for personnel protection.

Insulation

Insulation requirements shall be in accordance with the applicable ASTM insulation and sheeting specifications.

Pipe Supports

Pipe supports shall be spaced in accordance with ASME B31.3.

Pipe hanger material, design, manufacture, selection, application, fabrication, and installation shall be in accordance with MSS, SP-58, SP-69, and SP-89.

Auxiliary steel supports shall be in accordance with ASTM A-36 and S-576.

Welding Requirements

Welding shall be in accordance with ASME B31.3 and AWS D1.1.

Material

Corrosion, abrasion resistance, and ease of decontamination shall be considered when selecting pipe, fittings, valves, and equipment items.

Special Valves

Slurry valves shall be full port.

2.3.4 Material Handling

2.3.4.1 Responsibility

Material Handling will be responsible for the design of solids handling and waste processing equipment such as bridge cranes, excavation equipment, hoppers, apron conveyors, belt conveyors, feeders, shredder systems, product storage and blending system, and railcar handling and loadout system. Material Handling will also be responsible for the design of any specialty equipment.

2.3.4.2 Codes, Standards, and Regulations

Components of the material handling systems shall conform to requirements of the following standards, as applicable:

1) Crane Manufacturers Association of America Spec. No. 70, 1988, Electric Overhead Traveling Cranes

2) ANSI B30.16-93, Overhead Hoists (underhung)

3) ANSI B30.11-88, Monorails and Underhung Cranes

4) ANSI B56.6-87, Rough Terrain Fork Lift Trucks

5) American Gear Manufacturers Association (AGMA) 2001B-88, Fundamental Rating Factors and Calculation Methods for Involute Spur and Helical Gear Teeth

6) AGMA 6017E-86, Rating and Application of Single and Multiple Reduction Double-Enveloping-Worm and Helical-Worm Speed Reducers

7) AGMA 6021-G-89, Shaft Mounted and Screw Conveyor Drives Using Spur, Helical and Herringbone Gears

8) AGMA 6034-B-92, Practice for Enclosed Cylindrical Wormgear Speed Reducers and Gearmotors

9) Anti-Friction Bearing Manufacturers Association (AFBMA) 9-91, Load rating Standard for Ball Bearings

10) AFBMA 11-90, Load Rating Standard for Roller Bearings

11) ASME B29.1M-86, Precision Power Transmission Roller Chains, Attachments and Sprockets

12) Society of Automotive Engineers (SAE) J514-92, Hydraulic Tube Fittings, Standard

13) SAE J516-92, Hydraulic Hose Fittings, Standard

14) SAE J517-91, Hydraulic Hose, Standard

15) SAE J518-91, Hydraulic Flanged Tube, Pipe, and Hose Connections, Four-Bolt Split Flange Type, Standard

16) AWS D1.1-94, Structural Welding Code Steel

17) ASTM A36/A36M-Rev. A-93, Standard Specification for Structural Steel

18) ASTM A53 Rev. A-93, Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless

19) Steel Structures Painting Council SP6-91, Surface Preparation Specification No. 6, Commercial Blast Cleaning

20) ASTM 1-167 Rev. A-94, Standard Specification for Stainless and Heat Resistant Chromium-Nickel Steel Plate, Sheet, and Strip.

2.3.4.3 Design Criteria

General Criteria

Material handling systems will be designed for manual operations, to the maximum extent practicable. Equipment maintenance will be performed manually by hand-held equipment. Operators will wear personal protective clothing as specified in the project-specific Health and Safety Plans. Remotely operated robotics equipment will not be used for operations or maintenance of equipment.

Specific Criteria

1) The on-site transportation of containerized dry pit waste shall conform to the requirements of FEMP Site Policy and Procedure PP-0314.

2) The off-site transportation of containerized dry pit waste shall conform to all applicable Federal regulations. These are discussed in the *Transportation and Disposal Plan* (Foster-Wheeler 1995). The shipment of wastes shall also conform to applicable State and local regulations of the states through which the shipment travels.

3) All packages for transportation of radioactive waste shall conform to the standards identified in Subsection 2.1.5 of this DCD and the *Transportation and Disposal Plan* (Foster-Wheeler 1995).

4) Design of waste processing facilities shall conform to the requirements of DOE Order 6430.1A and DOE/TIC-11603.

5) Waste being processed through the dryer will be limited to a maximum of 4 inches in any direction.

6) Apron feeders, if used for conveyance of materials, will have a maximum speed of 100 feet per minute (fpm).

7) Conventional earth-moving equipment will be used for handling wet, sticky material as well as dry material.

8) Bottom openings of all chutes and hoppers for handling of wet, sticky waste will be as large as possible to accommodate oversize debris. Chutes and hoppers will be lined with 1/2-inch-thick, ultra high molecular weight plastic and shall be designed with minimum 70-degree side slopes. The number of belts, chutes, and hoppers will be kept to a minimum.

9) Provisions shall be made for periodic automatic water washdown of all equipment that processes wet, sticky material. Drip pans shall be provided underneath the equipment for water collection. Floor sumps with sump pumps shall be required for processing of washdown water.

10) Access shall be provided in all areas for removal of equipment for maintenance in case of equipment breakdown.

11) Dust collection and/or dust suppression systems shall be provided at all material transfer points to keep airborne particulates to a minimum.

12) The following bulk densities and angles of repose will be used for sizing storage piles:
    (1) Feed Preparation Area:
        a) Wet waste: 85 pounds per cubic feet (pcf) at 15 degrees (angle of repose)
        b) Dry waste: 135 pcf at 33 degrees (angle of repose)
    (2) Dryer Feed Pile: 90 pcf at 30 degrees (angle of repose)
    (3) Loadout Area
        a) Waste at optimum moisture: 95 pcf at 33 degrees (angle of repose)

13) All components in a hydraulic power system shall be designed for 3,000 pounds per square inch (psi). The associated hydraulic piping and hoses must have a minimum safety factor of four. Maximum operating pressure in hydraulic systems shall be limited to 2,400 psi.

2.3.5 Civil

2.3.5.1 Responsibility

Civil design work will include all utilities (i.e., underground fire protection water, process water lines, natural gas, and routing of electric), stormwater management, floodplain and wetlands management,

excavation, and secondary containment design. Civil will be responsible for the design and specification of:

1) Site clearing and layout
2) Surveying
3) Earthwork (coordinated with Geotechnical)
4) Slope protection and erosion control (slope stability coordinated with Geotechnical)
5) Paving and surfacing
6) Underground utilities
7) Stormwater management systems
8) Geosynthetics (coordinated with Geotechnical)
9) Fences and gates
10) Landscaping and seeding
11) Floodplain and wetlands management
12) Excavation (assistance to Material Handling)
13) Rail upgrades (see the *Transportation and Disposal Plan* [Foster-Wheeler 1995] for scope)

2.3.5.2 Codes, Standards, and Regulations

1) American Association of State Highway and Transportation Officials (AASHTO) GDHS-90 Policy on Geometric Design of Highways and Streets, 1990

2) DOE Order 6430.1A

3) North American Datum (NAD) of 1983

4) North American Vertical Datum of 1929

5) National Fire Protection Association (NFPA) 24, Installation of Private Fire Service Mains and their Appurtenances

6) Soil Conservation Service (SCS) TR-55 Urban Hydrology for Small Watersheds, Technical Release 55

7) TP-40, Rainfall Frequency Atlas of the United States for Durations from 30 minutes to 24 Hours and Return Periods from 1 to 100 Years. National Weather Service.

8) Hamilton County Earthwork Regulations

9) ANSI B31.8, Gas Transmission and Distribution Systems

10) NFPA 54, National Fuel Gas Code

11) Ohio Department of Transportation (ODOT) Standards

12) American Concrete Institute (ACI) Codes

13) American Railway Engineering Association standards

14) CSX Transportation Design and Construction of Industrial Sidetracks manual

2.3.5.3 Design Criteria

Site Clearing

The remediation area will be arranged to reduce the amount of clearing required. Work will be specified to be performed in accordance with ODOT standards. Fence material and topsoil will be removed and salvaged for re-use. FEMP standards for waste material will be specified for material that cannot be re-used and must be removed from the work zone. Fence removed for construction will be salvaged and re-used where possible.

Surveying

A field run topographic and location survey will be performed for the proposed treatment area, storage area, and utility routes. Soil boring locations, elevation benchmarks, and construction control points will be established. All coordinates will be referenced to the NAD 83 State Planar Coordinate System. All survey work shall be to a third order accuracy standard as established by the Standards and Specifications for Geodetic Control Networks.

Topographic contours will be established at 1-foot intervals. Spot elevations will be taken at high and low points of areas, ditch inverts, culvert inverts, and tops of grates or manholes. Roadway centerlines and pavement width will be determined. All utility poles, valve boxes, fences, rail tracks, and other similar surface features will be located.

Earthwork

Earthwork for the facilities shall include all grading, excavation, compaction, trenching, and filling, and shall be specified to conform to ODOT standards. Trenching and open pit excavations shall also conform to Occupational Safety and Health Administration (OSHA) standards, 29 CFR Part 1926. Where feasible, permanent slopes shall be a minimum of 0.5 percent for impervious surfaces, 2 percent for vegetated

surfaces, and no greater than 3 horizontal to 1 vertical (3H:1V). Cut and fill will be planned to achieve a reasonable balance.

Pit excavation activities will minimize the creation of additional wastes and excessive earthwork. Excavated contaminated and clean soils will be segregated. Excavation sequences will ensure that workers and equipment remain off of the waste pits and outside the line of the waste's angle of repose. Temporary slopes shall be stable and maintained and/or covered to minimize erosion. Dewatering and excavation activities will occur simultaneously.

The pit excavations will be backfilled in compacted lifts to minimize settlement. The backfill will minimize infiltration from surrounding soils and from surface waters. The surface will be crowned and vegetated. Grading will be "interim," as OU5 will be responsible for final grading. Clayey common soil will be used, similar to the surrounding soils at the excavation. If potential for contamination exists from surrounding soils or waters, the backfill will be encapsulated to limit this spread; or, possibly, coarser, quick-draining soils could be used as backfill at interface areas. Final topography will be consistent with that identified in the final sitewide topography determination.

Slope Protection and Erosion Control

Slope protection and erosion control will include temporary measures to prevent erosion and control sediment during construction. Some measures will be installed prior to any earthwork being performed. During construction, additional measures will be required, such as around new catch basins. All erosion and sediment control measures will require maintenance during construction. ODOT standards for control measures will be specified. "Water Management and Sediment Control for Urbanizing Areas" (SCS) will be used as a guideline in establishing control measures.

Paving and Surfacing

All paving and surfacing methods, materials, design, and details shall conform to ODOT standards. AASHTO's *A Policy on Geometric Design of Highways and Streets* 1990 (GDHS-90) will be used as a reference in site layout. Unless conditions dictate otherwise, the minimum slope shall be 0.5 percent. AASHTO H-20 loadings shall be used.

Utilities

Civil utility design work will include all proposed underground fire protection water, process water lines, gas, communication, security lines, and routing electric. A field run survey will provide the information necessary to update/correct/supplement the existing FEMP grid utility drawings.

1) Process Water (designated as TW on drawings): All water lines shall have a minimum depth of cover of 3.5 feet for frost protection or be heat traced if carried aboveground. Layout shall minimize the amount of line under pavement. Thrust blocks are required for all lines 2 inches or greater. Gate valves or post indicator valves shall be installed at line intersections and at selected points throughout the distribution system to provide control over the service area in accordance with DOE Order 6430.1A.

2) Fire Protection (designated as FQ on drawings): All water mains supplying fire protection systems, fire hydrants, etc. shall be treated as fire mains and installed in accordance with NFPA 24 and DOE Order 6430.1A. Each fire hydrant within the distribution system must be capable of delivering 1,000 gpm at a residual pressure of not less than 10 psi. Fire hydrant branches (from main to hydrant) shall be at least 6 inches in diameter and no longer than 300 feet. A gate valve shall be installed with each hydrant. Fire hydrants shall be installed at a maximum spacing of 400 feet and shall not be located more than 300 feet from the building nor closer than 50 feet from the building to be protected. A minimum of two hydrants shall protect each building.

3) Natural Gas Distribution (designated as FG on drawings): All gas pipelines, valves, regulators, relief valves, and meters shall be installed as per ANSI B31.8, Gas Transmission and Distribution Piping Systems. The requirements of NFPA 54, National Fuel Gas Code, shall be adhered to during design. The practices of Cincinnati Gas & Electric shall also be followed. The FEMP site area will be considered a Class 4 location, type D construction class.

4) Potable water and sanitary service will not be required for the process facilities.

Storm Sewer and Stormwater Management Systems

At present, the proposed site area is a clean area that drains southwest to Paddys Run. The site will be immediately adjacent to the waste pits' stormwater management system. To control sediment and stormwater discharge from the area during facility construction and excavation activities, the proposed site area will be incorporated into the site stormwater management system. All stormwater from the 25-year, 24-hour storm event will be collected and retained. The proposed stormwater management system for the plant facilities will be permitted to discharge into the Biodenitrification Surge Lagoon. A retention basin will be required to properly control discharge into the Biodenitrification Surge Lagoon and to reduce suspended solids. Stormwater will be sent to FEMP wastewater treatment system from the Biodenitrification Surge Lagoon.

New systems will be designed for the 25-year, 24-hour storm per FEMP site policy. Open channels will use the 5-year storm for evaluating velocity. Stormwater management basins will be designed to safely pass the 100-year, 24-hour storm. Storm drain systems not directly connected to the stormwater management system, with catchments less than 160 acres, may be designed by the rational method.

Those storm drain systems directly connected to the stormwater management system, as well as the stormwater management system, will be designed by SCS methods (e.g., TR-55, TR-20). Design details, construction methods, and materials shall be in accordance with ODOT standards. This section will also include the design of the stormwater management control structure/system. Other disciplines may also have input, depending on the system and discharge requirements.

The stormwater management basin's discharge will be controlled by the Biodenitrification Surge Lagoon capacity. To prevent an overcapacity at the Biodenitrification Surge Lagoon, the stormwater management basin will be able to retain the 25-year storm volume for the 24-hour period.

Landscaping and Seeding

All areas disturbed during construction and reclamation that are not being surfaced will be stabilized with grass or stone, depending on conditions. Sod or stone will be specified if water velocities in channels or other conditions warrant their use. All vegetated surfaces will be on topsoil and will have soil supplements as necessary. Seed and supplement rate and materials shall conform to ODOT standards. Temporary seeding of exposed soil shall be required if the area is not expected to be worked for 30 days, per ODOT standards.

Floodplain and Wetlands Management

The work proposed is not in the 100-year floodplain (PARSONS 1993a). Some utility line routes may run through FEMP designated wetlands. All necessary approvals will be obtained for this work.

Excavation

It is assumed that the waste to be excavated can be sufficiently dewatered (i.e., by drainage) to permit handling by conventional earth-moving equipment. The waste material will be dewatered to a moisture content less than the waste's liquid limit as determined by Plasticity Index testing. The pit waste's natural angle of repose will be determined as part of the geotechnical investigations for the project. Excavation sequences will ensure that the tracks of the excavation equipment remain off of the waste and outside the line of the waste's repose angle. Safety of equipment operators will need special consideration and first priority during design and construction.

Siting

As required by the ARARs in Appendix A, impacts on wetlands and floodplains shall be minimized. Table A-1 of Appendix A discusses these requirements.

2.3.6 Structural

2.3.6.1 Responsibility

Structural will have the responsibility of designing the structures for OU1 remediation facilities.

2.3.6.2 Codes, Standards, and Regulations

Codes, standards, and Orders applicable to the structural design follow:

1) Uniform Building Code (UBC) 1994

2) Ohio Basic Building Code (OBBC) 1995

3) Metal Building Manufacturers Association (MBMA) - Recommended Design Practice Manual

4) ASTM standards as referenced in Subsection 2.3.6.3

5) DOE Order 6430.1A, "General Design Criteria"

6) DOE-STD-1020-94, "Natural Phenomena Hazards, Design and Evaluation Guidelines for DOE Facilities"

7) University of California Research Laboratory (UCRL) 53582, "Natural Phenomena Hazards Modeling Project; Seismic Hazard Models for DOE Sites"

8) American Society of Civil Engineers (ASCE), 7-93, "Minimum Design Loads for Buildings and Other Structures"

9) ACI 318, "Building Code Requirements for Reinforced Concrete"

10) American Institute of Steel Construction (AISC) Manual, 9th edition

11) DOE Order 5480.28, "Natural Phenomena Hazards Mitigation"

12) DOE-STD-1021, "Natural Phenomena Hazards Performance Categorization Criteria for Structures, Systems, and Components"

2.3.6.3 Design Criteria

The design and evaluation of SSCs for Natural Phenomena Hazards (NPHs) due to wind, earthquake, and flood shall be in accordance with DOE Order 6430.1A and DOE-STD-1020 (formerly UCRL 15910).

The SSCs for the OU1 remediation system include engineered buildings, pre-engineered buildings, miscellaneous structural steel supports, and concrete foundations.

Dead Loads

Dead loads shall include all loads that remain permanently in place, including weights of all permanent materials, equipment, self-weights, and provisions for future loads, if required.

The unit weights of materials and assemblies for buildings and other structures may be based on sources of data from manufacturer's drawings and catalogs, Table C1 of ASCE 7-93 and Table 2-7 of this DCD.

Dead loads shall also include weights of all permanent service equipment, including piping, air conditioning equipment, electrical equipment, and fixed furnishings.

Dead loads for partition walls shall be per Section 0111-2.2.4 of DOE Order 6430.1A.

Table 2-7 - Minimum Design Dead Loads

Structure	Load
Pipe racks	Actual load but not less than 35 psf at each level
Electrical raceways	Actual load but not less than 15 psf at each level
Materials and equipment	Actual load

Live Loads

Live loads shall include all loads resulting from occupancy and use of the structures. Live loads may act in any direction. Impact loads, moving loads, and operating loads shall be considered as part of live loads.

Live loads for buildings and other structures shall be as shown in Table 2-8, but not less than the minimum uniform or concentrated loads stipulated in ASCE 7-93.

Roof live loads shall include snow loads, snow drifts, or rain loads as applicable per ASCE 7-93.

Table 2-8 - Minimum Design Live Loads

Structure	Load
Building Floors	125 psf, or equipment load or storage weight if greater
Walkways (other than exitways)	60 psf
Stairs and exitways	100 psf
Equipment platforms	100 psf
Trench covers	16,000 lb wheel load
All other areas	100 psf
Roofs	20 psf where tributary area is less than 200 sf and roof pitch is less than 4:12
Impact loads	In accordance with ASCE 7-93, Subsection 4.7

Wind Loads

Wind load design criteria presented in this section shall be based on the requirements of DOE Order 6430.1A, DOE-STD-1020, ASCE 7-93, and the OBBC. Exposure "C" shall be used for all wind load calculations, per Section 0111-2.4.2 of DOE Order 6430.1A.

The effective velocity pressure q_z at any height Z above the ground shall be calculated using the following equation:

$$q_z = 0.00256\ K_z(IV)^2 \text{ (Section 6.5.1 of ASCE 7-93)}$$

where:

I = Importance Factor = 1.07 (Table 3-1 of DOE-STD-1020)
K_z = Velocity pressure coefficient at height Z (Table 6 of ASCE 7-93)
V = Basic wind speed = 80 mph (Section 1611-3 of OBBC)

Design wind loads shall be based on factors and coefficients stipulated in ASCE 7-93, Table 4.

Tornado Loads

Tornado loadings, tornado missiles, and Atmospheric Pressure Change loads are not applicable for PC-2 facilities per DOE-STD-1020. Tornado loadings, therefore, are not considered.

Seismic Design and Evaluation

The seismic criteria for the design and evaluation of SSCs shall be based on procedures detailed in Section 2.3.1 of DOE-STD-1020, PC-2, and UBC Section 1628.

The earthquake response shall be evaluated in accordance with procedures given in UBC Section 1627.8, using the static force method.

The design base shear using the static force procedure shall be calculated using the following formula:

$$V = \frac{ZIC}{R_w} W$$

where

Z = A seismic zone factor equivalent to peak ground acceleration = 0.13 (based on site-specific seismic hazard curve for the FEMP from UCRL 53582)

I = Importance Factor = 1.25

C = Spectral Amplification Factor = 2.75 (Based on site-specific response spectra for the FEMP from UCRL 53582)

R_w = Reduction factor from UBC Table 16-N or Table 16-P, as applicable

W = Total dead load and applicable portions of their loads as listed in UBC Section 1628.1

The capacities will be evaluated using the strength design or allowable stress design method. The story drift limitations shall be per UBC Section 1628.8.

The SSCs shall meet the UBC Seismic Zone No. 2 detailing provisions in accordance with UBC Section 1631.

Nonbuilding structures shall meet the requirements of UBC Section 1632.

Lateral force on elements of structures and nonstructural components supported by structures shall be in accordance with UBC Section 1630.

Quality assurance and peer review for earthquake evaluation shall be in accordance with Appendix C.8 of DOE-STD-1020 for PC-2.

Other Loads

1) Other loads: Load criteria not specified above shall conform to DOE Order 6430.1A, paragraph 0111-2.8, "Other Loads for Buildings and Other Structures."

2) Cyclic/Dynamic Loads: Consideration will be given to dynamic loading of any vibrating equipment (i.e., pumps, compressors, and shredder).

Other Structural Material/Design Requirements

Design requirements for structural materials and design are as follows:

1) Concrete: Concrete material, design, and construction for buildings and other structures shall be per ACI 318-89. Minimum concrete strength at 28 days shall be 3,000 psi. Concrete exposed to weather shall be a minimum of 4,000 psi.

2) Reinforcement: Deformed billet steel shall conform to ASTM A615, Grade 60.

3) Grout: High strength, nonshrink grout shall be 1 inch minimum thickness under equipment, columns, and pipe support base plates unless otherwise recommended by equipment supplier.

4) Structural Steel: Design, details, fabrication, and erection of structural steel shall conform to the UBC and the AISC Manual, Ninth Edition. The material for structural steel shapes and plates shall conform to ASTM A36. All structural steel and connections, including ladders, handrailing, and grating, shall be painted or galvanized. Connection bolts shall be high-strength ASTM A325 with hardened washer and nut.

5) Field connections: Connections may be bolted or welded connections per AISC.

6) Operating and Maintenance Platforms: These shall be a minimum of 3 feet, 0 inches wide, with walkways 2 feet, 6 inches minimum width.

7) Minimum Headroom Clearance: Clearance shall be 7 feet, 6 inches above nosing line of stairs, and shall conform to OSHA requirements.

8) Masonry: Materials, design, and construction of masonry structures shall be per UBC 94, assuming special inspection. Hollow, non-load-bearing block shall be per ASTM C129. Hollow,

load-bearing block shall be per ASTM C90. Mortar shall be per ASTM C35 or C56, Type M or N.

9) Open Pipe Trenches: Locate tops of walls at the same elevations as surrounding grades/slabs. Slope trench floors at least 1 percent to drains. Cover with grating weighing not over 150 pounds per piece. Size to allow easy access to in-trench pipe and fittings. Allow 3-inch minimum between flanges or pipe, and walls and floor. Provide anchorage and supports for pipe. Supply reinforced concrete or ductile iron covers if heavy trucks will pass over the trenches.

10) Concrete Slabs-on-Grade: Show control joints except where floor covering occurs, preferably in line with faces of foundation pedestals, pilasters, etc., but not more than 20 feet apart. Pour strips to be a maximum of 20 feet wide.

11) Foundations: Per DOE Order 6430.1A, Section 0111-3.4, the provisions of UBC Chapter 18 shall be the minimum requirements for foundation design. Use spread, mat-type, or continuous strip footings placed in the upper natural soils, or properly compacted fill, for an assumed allowable bearing pressure of 2,000 psf at a depth of 3 feet below the adjacent final grade. Allowable soil bearing pressures and any other special foundation requirements will be verified by the site-specific soil report. Allowable stresses may be increased by a value of 1/3 when wind or earthquake forces are included. The minimum embedment depth of foundations in soil shall be 3 feet, 0 inches to prevent problems with frost penetration. Comply with specific requirements based on the site-specific soil report (to be prepared later).

12) Pre-engineered Buildings: Pre-engineered buildings shall comply with MBMA Metal Building Systems Manual and Section 0111 of DOE Order 6430.1A, Structural Design Requirements. Certified shop drawings and calculations will be submitted in accordance with applicable specifications and worked in conjunction with Architectural.

13) Piperacks, doorways, and other means of vehicle exit shall have adequate clearance for vehicle traffic.

Factor of Safety Against Overturning

Per UBC Section 1619.1, the base overturning moment for the entire structure, or for any of its individual primary lateral-resisting elements, shall not exceed 2/3 of the dead-load-resisting moment. For an entire structure with a height-to-width ratio of 0.5 or less in the wind direction and a maximum height of 60 feet, the combination of the effects of uplift and overturning will be reduced by 1/3 (i.e., factor of safety equal to 1.0). The weight of earth superimposed over footings will be used to calculate the dead-load-resisting moment.

Per Section 1611-1-3 of the OBBC, the overturning moment due to wind load shall not exceed 2/3 of the dead load stabilizing moment unless the building or structure is anchored to resist the excess moment (i.e., factor of safety equal to 1.5).

Loading Combinations

Combinations of loads, allowable stresses, and strength requirements for buildings and other structures shall be in accordance with UBC 94, Chapter 16, Section 1603.6.

2.3.7 Architectural

2.3.7.1 Responsibility

Architectural will be responsible for the design and specifications of:

1) Pre-engineered buildings
2) Metal siding for steel buildings
3) Material finishes
4) Insulation
5) Paintings and coatings

2.3.7.2 Codes, Standards, and Regulations

1) DOE Order 6430.1A, "General Design Criteria"
2) OBBC 1995
3) UBC 1994
4) NFPA 101, Life Safety Code
5) NFPA 13, Standard for Installation of Sprinkler Systems
6) MBMA - Recommended Design Practice Manual
7) ASTM as referenced in Subsection 2.3.7.3
8) 40 CFR 101-19.6, " Uniform Federal Accessibility Standards"
9) ANSI, as referenced in Subsection 2.3.7.3
10) Performance Criteria for Roofing Membranes Using Polymer Modified Bituminous Products
11) Recommended Work Procedures for Resilient Floor Covering
12) Architectural Painting and Wall Covering Manual

In case of conflict between the codes and standards, the most stringent will be adhered to.

2.3.7.3 Design Criteria

General Criteria

The dryer discharge and entry enclosures will be pre-engineered, shed type buildings.

Buildings will be categorized as Factory Occupancy, Moderate Hazard (F-1), and classified as Type 2B construction (not to be confused with DOE Order 6430.1A classifications), with an approved fire suppression system throughout in accordance with the requirements of UBC, OBBC, and NFPA 13.

Exits

A minimum of two exits are required on all buildings except the dryer discharge and entry enclosures, leading to the exterior of the buildings. The maximum allowable length of exit access travel for this occupancy with fire suppression system is 75 feet according to NFPA 101 Section 5-11.1.

Ceiling and floor finishes at exit access shall be Class B (minimum) per NFPA 101.

Doors

All exterior personnel doors, interior doors, and special doors shall be hollow metal fabricated conforming to ASTM A366. All exterior doors shall be insulated. Hollow metal door frames shall conform to ASTM A366.

Finish hardware for doors shall include butts, locks, kickplates, closures, doorstops, thresholds, and silencers, and shall follow the requirements of the ANSI A156 Series.

Overhead coiling doors shall be fabricated to resist a wind load of 25 psf. Door tracks shall be of a gage and size to meet door size and wind loading. Doors shall be chain hoist operated with electric motors (code reference - ANSI A216.1).

Materials and Surface Treatment

The interior walls will be either concrete, concrete block, or gypsum drywall.

Modified bituminous roofing shall comply to UBC Chapter 32 for roof covering. Modified bituminous roofing shall comply with American Roof Manufacturers Association's recommended Performance Criteria for Roofing Membranes Using Polymer Modified Bituminous Products.

Exterior insulation and finish systems shall comply with UBC Standard No. 17-6.

Resilient flooring installation shall comply with Resilient Floor Covering Institute's Recommended Work Procedures for Resilient Floor Covering.

Concrete floors are to be sealed with epoxy coating according to Portland Cement Association's Painting Concrete. Coatings will be lead free and have no chromates.

Painting of all surfaces will be in accordance with the recommendations of a single-source manufacturer of the painting system selected. Painting shall comply with the Architectural Painting and Wall Covering Manual.

2.3.8 Mechanical Utilities

2.3.8.1 Responsibility

Mechanical Utilities will be responsible for HVAC, air cleaning, off-gas handling, fire protection, and plumbing for the facility in support of the remediation system design for OU1.

HVAC will be provided for all buildings to prevent the spread of contamination, create suitable environments for workers, and provide uninterrupted equipment operation. Building exhaust fans will exhaust all ventilated air from buildings through prefilters, HEPA filters, and a stack. Airflow shall be controlled and directed from less contaminated areas to more contaminated areas. Air handling units or louvers/backdraft dampers will supply makeup air. Air handling units will be furnished with cooling and heating coils.

For cooling, the following alternatives will be considered: direct expansion type coils with air-cooled condensing units, chilled water coils with chilled water from a chiller, or an air-cooled chiller. These will provide cooling capacity for the process, as well.

For heating, the following alternatives will be considered: space unit heaters, or installation of a heat exchanger in the dryer exhaust air stream (to utilize the heat from the dryer to provide hot water or steam to heating coils in air handling units).

The vendor-supplied support trailers will also have vendor-supplied HVAC systems.

2.3.8.2 Codes, Standards, and Regulations

1) American Air Balance Council National Standards for Total System Balance

2) American Conference of Government Industrial Hygienists (ACGIH) Industrial Ventilation

3) Air Movement and Controllers Association, Inc. 210, Laboratory Method of Testing Fans for Rating

4) ANSI Z358.1, Emergency Eyewash and Shower Equipment

5) American Refrigeration Institute (ARI) 360, Commercial and Industrial Unitary Air Conditioning Equipment

6) ARI 430, Central Station Air Handling Units

7) ARI 460, Remote Mechanical Draft Air-Cooled Refrigerant Condensers

8) ARI 520, Positive Displacement Refrigerant Compressors, Compressor Units, and Condensing Units

9) American Society of Heating, Refrigeration, and Air Conditioning Engineers (ASHRAE) - Handbooks
   (1) ASHRAE 15, Safety Code for Mechanical Refrigeration
   (2) ASHRAE 20, Methods of Testing for Rating Remote Mechanical Draft Air-Cooled Refrigerant Condensers
   (3) ASHRAE 55, Thermal Environmental Conditions for Human Occupancy
   (4) ASHRAE 62, Ventilation for Acceptable Indoor Air Quality
   (5) ASHRAE 90.1-1989, Energy Efficient Design of New Buildings Except Low-Risk Residential Buildings

10) OBBC (mechanical)

11) 29 CFR 1910, Occupational Safety and Health Standards

12) DOE Order 6430.1A, General Design Criteria

13) DOE/TIC 11603-Rev I, Standards and Criteria Guide Non-Reactor Nuclear Facilities

14) ERDA 76-21, Nuclear Air Cleaning Handbook

15) Sheet Metal and Air Conditioning Contractors' National Association 75, Accepted Industrial Practice for Industrial Ducts

16) Underwriters Laboratories, Inc. (UL) 207, US Standard for Safety Refrigerant-Containing Components and Accessories, 1993

17) UL 900, UL Standard for Safety Air Filter Units

18) DOE Order 5480.7A, Fire Protection

19) NFPA
   (1) NFPA 10, Portable Fire Extinguishers
   (2) NFPA 11, Low Expansion Foam
   (3) NFPA 11A, Medium- and High-Expansion Foam Systems, 1994
   (4) NFPA 12, Carbon Dioxide Extinguishing Systems, 1993
   (5) NFPA 13, Installation of Sprinkler Systems
   (6) NFPA 14, Installation of Standpipe and Hose Systems
   (7) NFPA 15, Water Spray Fixed Systems for Fire Protection, 1990
   (8) NFPA 16, Installation of Deluge Foam-Water Sprinkler and Foam-Water Spray Systems, 1991
   (9) NFPA 16A, Installation of Closed-Head Foam-Water Sprinkler Systems, 1994
   (10) NFPA 24, Installation of Private Fire Service Mains and Their Appurtenances, 1992
   (11) NFPA 72, National Fire Alarm Code, 1993
   (12) NFPA 90A, Installation of Air Conditioning and Ventilating Systems, 1993
   (13) NFPA 90B, Installation of Warm Air Hearing and Air Conditioning System, 1993
   (14) NFPA 91, Installation of Exhaust Systems for Air Conveying of Materials

2.3.8.3 Design Criteria

Heating, Ventilation, and Air Conditioning

The design of the HVAC systems shall conform to DOE Order 6430.1A (Section 1550); ASHRAE handbooks, ASHRAE Standards 55 and 62; NFPA 90A, 90B, and 91; ACGIH, Industrial Ventilation Manual; and the OBBC.

Outside design temperature shall be 92° F dry bulb/73° F wet bulb for summer and 1 degree F for winter.

Ventilation exhaust systems design requirements shall be in accordance with DOE Order 6430.1A, Section 1550-1.5. Ventilation air shall be provided to achieve OSHA air quality limits, all the Permissible Exposure Limits established by 29 CFR 1910, and ACGIH Threshold Limit Values or better.

Ventilation exhaust systems shall provide a minimum of six air changes per hour for the process building.

All exhaust air will pass through prefilters, High Efficiency Particulate Air filters, and an exhaust stack before being discharged to the atmosphere in compliance with DOE Order 6430.1A and ERDA 76-21.

The exhaust stack shall be at least 12 feet higher than the nearest building within 500 feet (ERDA 76-21, pg. 130).

All enclosed conveyors shall be provided with an exhaust system to control dust emissions.

All buildings and enclosed conveyors shall be maintained under a negative pressure of 0.1 inches water gage to ensure that there will be no exfiltration of airborne contaminants to the environment.

The ventilation system shall provide airflow from areas of low contamination to areas of higher contamination to prevent cross-contamination. The ventilation system shall permit the filters to be changed easily, with a minimum potential for the release of radioactive materials, and shall minimize worker exposure.

All exhaust duct work shall be designed to maintain a minimum transport velocity of 2500 fpm.

Duct work that will come into contact with radioactive airborne particles shall be constructed of stainless steel. Process off-gas duct work shall be stainless steel if deemed necessary as a result of the off-gas composition analysis. All other duct work will be made from galvanized steel.

Where mechanical ventilation cannot maintain the room temperature within the National Electrical Manufacturers Association (NEMA) equipment rating, mechanical cooling systems shall be provided in compliance with DOE Order 6430.1A, Section 1550, paragraph 1.5.7.

Air conditioning will be provided for the control room.

Air handling and air conditioning equipment will be sized and selected in accordance with ASHRAE handbooks and shall comply with ARI 430 and ARI 360 in compliance with DOE Order 6430.1A, Section 1550, paragraph 2.1.

Air-cooled condensers, chillers, and condensing units shall meet the standards, rating, and testing requirements of ARI 460, ARI 520, and ASHRAE Standard 20, and shall be in compliance with DOE Order 6430.1A, Section 1550, paragraph 2.1.3.

Energy Conservation

An Energy Conservation Report is required for the system per DOE Order 6430 1.A, Section 0110, paragraph 12.8. A waiver of this requirement will be requested since it is not appropriate nor necessary for the OU1 remediation facilities.

Plumbing Systems

For emergency eyewash showers or other potable water requirements, self-contained equipment may be used.

Process-related wastewater drains and water from equipment drains will be collected in a wastewater drainage system.

Fire Protection

Where necessary fire protection will consist of a wet pipe sprinkler and standpipe systems which will supply hose racks and sprinkler heads within the process area and control area in accordance with DOE Order 5480.7A, DOE Order 6430.1A, Section 1530, 19 CFR 1910, and NFPA 13.

Fire extinguishers shall be provided on all mobile heavy equipment for suppression of Class B, Class C, and equipment fires in compliance with NFPA 11, 11A, 12, 15, 16, and 16A.

Fire protection systems and components shall have fail-safe features, and audible and visual alarms for operability and trouble indication.

All fire detection and alarms devised shall have UL-listed components or be Factory Mutual-approved.

Fire water mains, including valves, hydrants, and fittings, shall be installed, flushed, disinfected, and tested in accordance with NFPA 24 and DOE Order 6430.1A.

A standby source of electrical power shall be provided to operate the fire protection system.

The design and installation of the systems will be the responsibility of a qualified fire protection contractor regularly engaged in the installation of fire protection systems. The contractor will obtain the approval or acceptance of all governing authorities, including the insurance underwriter (if any).

A general fire protection design analysis will be made for each building by a cognizant DOE fire protection authority. The analysis shall be made using parameters established in DOE Order 5480.7A. The analysis will be documented in report form, kept with project files, and referenced by the Safety Analysis Report.

2.3.9 Electrical

2.3.9.1 Responsibility

Electrical will be responsible for the electrical power distribution system, electrical power backup supply, grounding systems, lighting, and fire alarm, evacuation, and communication systems.

2.3.9.2 Codes, Standards, and Regulations

The National Electrical Code, NFPA 70-93, the UL Electrical Construction Materials Directory 94, and Division 16 and of DOE Order 6430.1A shall be applicable to all electrical discipline work. The following codes and standards will govern design and installation of the systems for which Electrical will be responsible:

Electrical Power Distribution System

1) ANSI:
   (1) ANSI C37.20.3-87, Rev. 1992, Metal-Enclosed Interrupter Switchgear
   (2) ANSI C37.121-89, Rev. 1995, Switchgear - Unit Substations
   (3) ANSI C57.12.28-88, Correction 1988, Switchgear and Transformers - Pad-Mounted Equipment - Enclosure Integrity
   (4) ANSI C57.12.55-87, Transformers - Dry-Type Transformers Used in Unit Installations, Including Unit Substations - Conformance Standard
   (5) ANSI C2-93, National Electrical Safety Code
   (6) ANSI C80.1-90, Rigid Steel Conduit - Zinc-Coated

2) Institute of Electrical and Electronics Engineers (IEEE):
   (1) IEEE C12.1-88, Code for Electricity Metering
   (2) IEEE C57.12.01-89, Standard General Requirements for Dry-Type Distribution and Power Transformers Including Those with Solid Cast and/or Resin-Encapsulated Windings
   (3) IEEE C57.12.91-79, Standard Test Code for Dry-Type Distribution and Power Transformers
   (4) IEEE C57.13-93, Standard Requirements for Instrument Transformers
   (5) IEEE C57.94-82, Rev. 1987, Recommended Practice for Installation, Application, Operation, and Maintenance of Dry-Type General Purpose Distribution and Power Transformers
   (6) IEEE C62.1-89, Standard for Gapped Silicon-Carbide Surge Arresters for AC Power Circuits.

(7) IEEE 48-90, Standard Test Procedures and Requirements for High-Voltage AC Cable Terminations

(8) NEMA ICS 1-88, Rev. 2-90, General Standards for Industrial Control and Systems

(9) NEMA ICS 2-88, Industrial Control Devices, Controllers, and Assemblies

(10) NEMA ICS 2.3-83, Instructions for the Handling, Installation, Operation, and Maintenance of Motor Control Centers

3) NEMA:

(1) NEMA AB 1-93, Molded Case Circuit Breakers and Molded Case Switches

(2) NEMA TC 3-90, Polyvinyl Chloride (PVC) Fittings for Use with Rigid PVC Conduit and Tubing

(3) NEMA TC 6-90, PVC and ABS Plastic Utilities Duct for Underground Installation

(4) NEMA WC 8-88, Ethylene-Propylene-Rubber- Insulated Wire and Cable for the Transmission and Distribution of Electrical Energy

(5) NEMA ST 20-92, Dry Type Transformers for General Applications

(6) NEMA PB 1-90, Panelboards

(7) NEMA PB 2-89, Deadfront Distribution Switchboards

(8) NEMA PB 1.1-91, General Instructions for Proper Installation, Operation, and Maintenance of Panelboards Rated 600 Volts or Less

(9) NEMA 250-91, Enclosures for Electrical Equipment (1000 Volts Maximum)

4) National Electrical Testing Association (NETA):

(1) NETA ATS-95, Acceptance Testing Specification for Electrical Power Distribution Equipment

5) National Electric Code

(1) NFPA 70

Electrical Backup Power Supply

1) NEMA:

(1) NEMA ICS 2-93, Industrial Control and System Controllers, Contactors, and Overload Relays Rated Not More Than 2000 Volts AC or 750 Volts DC

(2) NEMA ICS 6-93, Industrial Controls and Systems Enclosures

(3) NEMA MG 1-93, Motors and Generators

Grounding Systems

1) UL:

(1) UL 467-93, UL Standard for Safety Grounding and Bonding Equipment

Lighting

1) NFPA:
   (1) NFPA 101-94, Code for Safety to Life from Fire in Buildings and Structures
2) NEMA:
   (1) NEMA WD 6-88, Wiring Devices - Dimensional Requirements
3) ANSI:
   (1) ANSI C82.1-85, Ballasts for Fluorescent Lamps - Specifications
   (2) ANSI C82.4-85, Ballasts for High Intensity Discharge and Low Pressure Sodium Lamps (Multiple Supply Types)
4) IES:
   (1) IES Handbook

Fire Alarm, Evacuation, and Communication Systems

1) NFPA:
   (1) NFPA 72-93, Installation, Maintenance, and Use of Protective Signaling Systems
   (2) NFPA 101-94, Code for Safety to Life from Fire in Buildings and Structures

2.3.9.3 Design Criteria

There are no specific project-related electrical design criteria. The systems under Electrical's responsibility will be designed consistent with normal requirements for these systems in any similar industrial setting, with the normal FEMP requirements and coordination taken into consideration.

The facility power distribution system will include taps of the FEMP 13.2 kV distribution feeders F1B and F4B at electrical manhole EMH 246, a 13.2 kV to 480 V, 1500/2000 kVA unit substation, and 480 V motor control centers (MCCs) and panelboards as required to serve electrical loads such as pumps, fans, HVAC equipment, and building lighting. It is anticipated that the unit substation shall be dry type, cast coil, and that MCCs and distribution panelboards shall be rated 600 amps, 480 V, 3 phase.

A dual incoming 13.2 kV line will provide an alternate feeder in the event that the primary normal feeder loses power. In addition, if power is lost within the facility, a standby diesel generator will allow an orderly shutdown of process equipment and will maintain ventilation and fire protection systems. An uninterruptible power supply will provide for continuous power to the Data Acquisition and Control System during a power loss or system failure. These backup systems are for process-related concerns. No safety-class services requiring emergency generator backup are anticipated.

A grounding grid system will be installed within and around the facility, around substations, and for fences.

High-efficiency, high-intensity discharge lighting will be installed in the process and outdoor areas of the facility. This will include the railcar storage area. High-efficiency, fluorescent fixtures will be installed in offices, electrical rooms, and control rooms. Battery-backed fluorescent and high-intensity discharge quartz fixtures will be provided for emergency lighting.

Fire alarm and evacuation systems will be extended to the new facility from the central command center via existing facilities as directed by FEMP fire protection. The fire alarm system will consist of manual pull stations, other detection devices as required, tamper and flow switches, and audio and visual alarms connecting to a central fire alarm panel located within the new facility. The evacuation system will consist of speakers located throughout the new facility. No special security systems are required. The telephone company will provide detailed design of the communication/telephone system.

2.3.10 Instrumentation

2.3.10.1 Responsibility

Instrumentation will be responsible for the distributed control system and instrument equipment.

2.3.10.2 Codes, Standards, and Regulations

International Society for Measurements and Control

2.3.10.3 Design Criteria

There are no specific project-related instrumentation design criteria. The systems under Instrumentation's responsibility will be designed consistent with normal requirements for these systems in any similar industrial setting, with the normal FEMP requirements and coordination taken into consideration. Instrumentation for specific purchased equipment, which is provided by the major equipment vendors, will be to manufacturer's standard. This information will be required with the vendor bid packages for technical evaluation.

A dedicated distributed control system will be specified for interfacing with the package systems (shredder, conveyor, and rotary dryer), waste preparation, waste dewatering, waste blending, and off-gas treatment. Vendor data information provided from package system suppliers will be required for incorporation into the control system's design. The distributed control system, as a minimum, will include operator interface terminals, hardware, software, and input/output modules.

Instrument data sheets for package systems will be provided with the corresponding performance specification. Instruments will connect to a central control panel for each package system. The control

panel will be provided with instrument and control inputs and outputs via vendor-supplied terminals, designated for use by "others." This will allow for quick installation to the distributed control system without disabling or revising package equipment vendor provided instruments and controls.

Requirements for all other nonpackage instruments (flow, level, pressure, etc.) will be determined during Title Design and provided under separate procurement packages.

SECTION 3

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APPENDIX A

ARARS AND TBC REQUIREMENTS TABLES

TABLE A-1
'LOCATION-SPECIFIC ARARS
(APPLICABLE REQUIREMENTS; RELEVANT AND APPROPRIATE REQUIREMENTS)

Category	Applicable Requirements	Compliance Strategy
Wildlife Protection	16 USC 1531 et. seq., and 50 CFR 17.21, 17.31, 17.61, 17.71, 17.94, 50 CFR 402, and Endangered Species Act All federal agencies must insure that any action authorized, funded or carried out by them is not likely to jeopardize the continued existence of any listed species or result in the destruction or adverse modification of the constituent elements essential to the conservation of a listed species within a defined critical habitat. Additional requirements apply if it is determined that a proposed activity could adversely affect these species or their habitat.	In 1994, updated surveys at the FEMP determined the presence of summer habitat for the federally-listed endangered Indiana bat along Paddys Run including areas adjacent to OU1. This area is not critical habitat. Consultation with U.S. Fish and Wildlife Service will determine restorative measures that may need to be taken during and after remedial actions. If any endangered or threatened species are encountered, the additional requirements of the referenced regulation would be applicable. Efforts will be made during remediation to preserve riparian vegetation, habitat for the Indiana bat, to the maximum practicable extent. Mitigatory requirements will be determined on a site-wide basis and presented as an outcome of the OU5 design process, for appropriate implementation. Subsection 2.3.5.3 of the DCD discusses these requirements.
Wildlife Protection	ORC 1531.25, 1518.02, and 1501: 18-1, Ohio Endangered Species Regulations No person shall take or possess any native species of wild animal, or any eggs, or offspring thereof, that is endangered with state-wide extinction.	Updated surveys in 1993 and 1994 found state-listed threatened Sloan's crayfish populations in sections of Paddys Run, including sections directly adjacent to OU1 area. Wastewater controls will be designed to minimize negative impacts on Paddys Run, to the maximum practicable extent during and after remedial activities. Wastewater will not be discharged to Paddys Run from any OU1 operation. Mitigatory requirements will be determined on a site-wide basis and presented as an outcome of the OU5 design process, for appropriate implementation. The *Waste Excavation Plan for the Operable Unit 1 Remediation System Design* provides detail on the design of stormwater controls. Subsection 2.3.5.3 of the DCD discusses these requirements.
Wildlife Protection	16 USC 66 *et seq.*, Fish and Wildlife Coordination Act Requires consultation with other state agencies for any activities which might affect any body of water for the purpose of conserving fish and wildlife resources.	Remedial activities at OU1 may have the potential to affect wildlife and fish in Paddys Run. Wastewater controls will be designed to minimize negative impacts on Paddys Run, to the maximum practicable extent during and after remedial activities. Wastewater will not be discharged to Paddys Run from any OU1 operation. The *Waste Excavation Plan for the Operable Unit 1 Remediation System Design* provides detail on the design of stormwater controls. Subsection 2.3.5.3 of the DCD discusses these requirements.

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TABLE A-1
(Continued)

Category	Applicable Requirements	Compliance Strategy
Historic Preservation	16 USC 469, Archaeological and Historic Preservation Act Implemented through 36 CFR 800 Requires preservation of artifacts and data associated with archaeological finds.	Historical data and artifacts are not expected to be discovered or destroyed during remedial activities at OU1. Nevertheless, the requirements of the law are applicable.
Historic Preservation	16 USC 470 *et seq.*, National Historic Preservation Act Implemented through 36 CFR 800 DOE must take into account the effect of an undertaking on historic properties and accord the Advisory Council on Historic Preservation a reasonable opportunity to comment. Historic properties are described as any prehistoric or historic district, building, site, structure, or object included in, or eligible for inclusion in the National Register of Historic Places. This term includes artifacts, records, and remains that are related to and located within such properties. Historic properties that are substantially altered or demolished must be recorded for future use and reference.	Areas adjacent to OU1 boundaries will be surveyed pursuant to the programmatic agreement by the DOE, the Advisory Council on Historic Preservation, and the Ohio Historic Preservation Office. The programmatic agreement stipulates what actions are required for compliance with the National Historic Preservation Act. Historic sites listed or eligible for listing in the *National Register of Historic Places* are not present within OU1 nor is it expected that any will be. Nevertheless, the requirements of the law are applicable.
Historic Preservation	16 USC 470 (aa) - 470 (11), Archaeological Resources Protection Act Requires permit for removal of any archaeological resources from federal lands.	OU1 is located on federal land. Although archeological resources are not expected to be encountered on the site, the requirements of the law remain applicable to OU1 remedial activities.
Historic Preservation	16 USC 431-433 and USC 461-467, Antiquities Act and Historic Sites Act. Requires that no person may appropriate, excavate, injure or destroy any historical or prehistoric ruin or monument or any object or antiquity situated or controlled by the U.S. Government without an applicable permit. Also requires the identification and preservation of cultural resources on federal lands.	Although OU1 is not expected to contain cultural resources or natural landmarks of significance, it is located on federal land and the law is applicable should any cultural resources be discovered during remedial actions on site.
Historic Preservation	25 USC 3001, Native American Graves Protection and Repatriation Act Provides for return of human remains and cultural objects from Native American graves to affiliated tribes.	Although OU1 does not contain known American Indian burial grounds, this law would apply should graves and human remains be discovered during excavation of the waste pits.

TABLE A-1
(Continued)

Category	Applicable Requirements	Compliance Strategy
Historic Preservation	42 USC 1996, American Indian Religious Freedom Act Provides for tribal access by native peoples to grave sites and sites of cultural, symbolic, or religious significance.	Although no sites of this nature have been identified at OU1, the law is applicable to federal lands and activities.
Historic Preservation	Executive Order 11593, Protection and Enhancement of Cultural Environment. Requires an inventory of site for potential historic places for eligibility in the *National Register of Historic Places*.	The requirement is applicable to activities at OU1. An updated inventory will be completed prior to remedial action. It is not expected that any sites of this nature will be identified at OU1.
Siting	10 CFR 1022, Protection of Wetlands and Floodplain Management 10 CFR 1022 contains the DOE regulation implementing Executive Order 11990 and 11988. Executive Order 11990 requires that Federal agencies take action to avoid adversely impacting wetlands wherever possible, to minimize wetlands destruction, to preserve the values of wetlands, and to prescribe procedures to implement the policies and procedures of the Executive Order. Executive Order 11988 requires Federal agencies undertaking actions within a floodplain to evaluate the potential the action has for adverse impact on the floodplain. If it is determined that adverse impacts could occur, the effects of the action must be minimized to the extent practical.	Approximately 36 acres of jurisdictional wetlands were identified on the site as the result of the 1993 wetland delineation. Wetland impacts will be minimized during remedial activities by avoiding these areas to the maximum extent possible. Mitigatory requirements will be determined on a site-wide basis and presented as an outcome of the OU5 design process, for appropriate implementation. OU1 is in the immediate vicinity of the Paddys Run Floodplain. Remediation activities will be undertaken while minimizing impacts to the floodplain primarily through minimizing activities within the floodplain which could cause substantial adverse changes to the floodplain. The final topography of the site and its impact on the floodplain will be addressed on a site-wide basis and presented as an outcome of the OU5 design process, for appropriate implementation.
Construction	33 CFR 330, Nationwide Permit Program (33 CFR 323 and OAC 3745-32) The Army Corps of Engineers authorizes discharges of dredge or fill material into wetlands and waters of the United States under its Nationwide Permit (33 CFR 330) or Individual Permit Programs (33 CFR 323). Section 401 State Water Quality Certification (OAC 3745-32) is also required for these types of discharges. Approximately 6.0 acres of jurisdictional wetlands will be impacted as a result of the Operable Unit One Remedial Action and will be subjected to the substantive requirements of these regulations.	Discharges of dredged and fill material associated with the Operable Unit One remedial action will be conducted in accordance with the substantive requirements of Nationwide Permit 26 - Headwaters and Isolated Waters Discharges and its corresponding Section 401 State Water Quality Certification. Wetland mitigatory requirements for Operable Unit One impacts will be addressed under the site-wide wetland mitigation plan currently being developed by DOE as part of the Operable Unit Five Remedial Design Package.

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TABLE A-2

CHEMICAL-SPECIFIC ARARS
(APPLICABLE REQUIREMENTS; RELEVANT AND APPROPRIATE REQUIREMENTS; TBCs)

Category	Applicable Requirements	Compliance Strategy
Surface Water Discharges	OAC 3745-1 Ohio Water Quality Standards It is the purpose of these Water Quality Standards to establish minimum water quality requirements for all surface waters of the State, thereby protecting public health and welfare; and to enhance, improve, and maintain water quality as provided under the laws of the State of Ohio, and ORC 6111.041, the Federal Clean Water Act, 33 U.S.C. Section 1251 *et seq.* Whenever two or more use designations apply to the same surface water, the more stringent criteria of each use designation will apply.	OU1 remediation activities will not result in the direct discharge of wastewater to a water of the State. Wastewater generated by OU1 remediation activities will be pretreated and discharged to the existing FEMP Wastewater Treatment System where it will be combined with other site wastewaters for treatment. Pretreatment of OU1 wastewater will consist of solids removal. The method of pretreatment is discussed in detail in the *Process Description for the Remediation System Design*. Treated wastewaters will be discharged in accordance with the requirements of the FEMP NPDES permit and applicable numeric and narrative water quality standards promulgated in OAC 3745-1. The FEMP NPDES permit will be modified to incorporate OU1 discharges in the event such a change is warranted.

TABLE A-2
(Continued)

Category	Applicable Requirements	Compliance Strategy
Surface Water Discharges	OAC 3745-01-04 Criteria Applicable to All Waters The following general water quality criteria shall apply to all surface waters of the State including mixing zones. To every extent practical and possible as determined by the director, these waters shall be: (A) Free from suspended solids or other substances that enter the waters as a result of human activity and that will settle to form putrescent or otherwise objectionable sludge deposits, or that will adversely affect aquatic life; (B) Free from floating debris, oil, scum and other floating materials entering the waters as a result of human activity in amounts sufficient to be unsightly or cause degradation; (C) Free from materials entering the waters as a result of human activity producing color, odor or other conditions in such a degree as to create a nuisance; (D) Free from substances entering the waters as a result of human activity in concentrations that are toxic or harmful to human, animal or aquatic life and/or are rapidly lethal in the mixing zone; (E) Free from nutrients entering the waters as a result of human activity in concentrations that create nuisance growths of aquatic weeds and algae.	OU1 remediation activities will not result in the direct discharge of wastewater to a water of the State. Wastewater generated by OU1 remediation activities will be pretreated and discharged to the existing FEMP Wastewater Treatment System where it will be combined with other site wastewaters for treatment. Pretreatment of OU1 wastewater will consist of solids removal. The method of pretreatment is discussed in detail in the *Process Description for the Remediation System Design*. Treated wastewaters will be discharged in accordance with the requirements of the FEMP NPDES permit and applicable numeric and narrative water quality standards promulgated in OAC 3745-1. The FEMP NPDES permit will be modified to incorporate OU1 discharges in the event such a change is warranted.
Surface Water Discharges	OAC 3745-1-07, Table 7-1 Numerical and Narrative Criteria for Aquatic Life Habitat and Water Supply Use Designation Surface Waters in the State of Ohio must comply with the maximum concentrations of each contaminant of concern listed in Table I-5 and I-6 in Attachment I for inside and outside the mixing zones of the receiving water to protect warm water aquatic habitats.	OU1 remediation activities will not result in the direct discharge of wastewater to a water of the State. Wastewater generated by OU1 remediation activities will be pretreated and discharged to the existing FEMP Wastewater Treatment System where it will be combined with other site wastewaters for treatment. Pretreatment of OU1 wastewater will consist of solids removal. The method of pretreatment is discussed in detail in the *Process Description for the Remediation System Design*. Treated wastewaters will be discharged in accordance with the requirements of the FEMP NPDES permit and applicable numeric and narrative water quality standards promulgated in OAC 3745-1. The FEMP NPDES permit will be modified to incorporate OU1 discharges in the event such a change is warranted.

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TABLE A-2
(Continued)

Category	Applicable Requirements	Compliance Strategy
Surface Water Discharges	OAC 3745-1-07, Table 7-10, Outside Mixing Zone Maximum Criteria for Water Hardness Dependent Parameters in Warm Water Habitats Table I-7 in Attachment I contains the numerical limits on cadmium, copper, chromium, lead, and silver.	OU1 remediation activities will not result in the direct discharge of wastewater to a water of the State. Wastewater generated by OU1 remediation activities will be pretreated and discharged to the existing FEMP Wastewater Treatment System where it will be combined with other site wastewaters for treatment. Pretreatment of OU1 wastewater will consist of solids removal. The method of pretreatment is discussed in detail in the *Process Description for the Remediation System Design*. Treated wastewaters will be discharged in accordance with the requirements of the FEMP NPDES permit and applicable numeric and narrative water quality standards promulgated in OAC 3745-1. The FEMP NPDES permit will be modified to incorporate OU1 discharges in the event such a change is warranted.
Surface Water Discharges	OAC 3745-1-07, Table 7-11 Outside Mixing Zone 30-Day Average Criteria for Water Hardness Dependent Parameters in Warm Water Habitats Table I-8 in Attachment I contains the average numerical limits for cadmium, copper, chromium, lead, and silver.	OU1 remediation activities will not result in the direct discharge of wastewater to a water of the State. Wastewater generated by OU1 remediation activities will be pretreated and discharged to the existing FEMP Wastewater Treatment System where it will be combined with other site wastewaters for treatment. Pretreatment of OU1 wastewater will consist of solids removal. The method of pretreatment is discussed in detail in the *Process Description for the Remediation System Design*. Treated wastewaters will be discharged in accordance with the requirements of the FEMP NPDES permit and applicable numeric and narrative water quality standards promulgated in OAC 3745-1. The FEMP NPDES permit will be modified to incorporate OU1 discharges in the event such a change is warranted.
Surface Water Discharges	OAC Table 7-12 Inside Mixing Zone Maximum Criteria for Water Hardness Dependent Criteria in Warm Water Habitats Table I-8 in Attachment I contains numerical limits for cadmium, copper, chromium, lead, and silver.	OU1 remediation activities will not result in the direct discharge of wastewater to a water of the State. Wastewater generated by OU1 remediation activities will be pretreated and discharged to the existing FEMP Wastewater Treatment System where it will be combined with other site wastewaters for treatment. Pretreatment of OU1 wastewater will consist of solids removal. The method of pretreatment is discussed in detail in the *Process Description for the Remediation System Design*. Treated wastewaters will be discharged in accordance with the requirements of the FEMP NPDES permit and applicable numeric and narrative water quality standards promulgated in OAC 3745-1. The FEMP NPDES permit will be modified to incorporate OU1 discharges in the event such a change is warranted.

TABLE A-2
(Continued)

Category	Applicable Requirements	Compliance Strategy
Surface Water Discharges	OAC 3745-1-07 Outside Mixing Zone Maximum Criteria for pH dependent Parameters in warm water Aquatic Habitats Table I-10 in Attachment I contains the numerical limits for pentachlorophenol. OAC 3745-1-07 Inside the Mixing Zone Maximum Criteria for pH dependent Parameters in warm water Aquatic Habitats Table I-11 in Attachment I contains the numerical limits for pentachlorophenol.	OU1 remediation activities will not result in the direct discharge of wastewater to a water of the State. Wastewater generated by OU1 remediation activities will be pretreated and discharged to the existing FEMP Wastewater Treatment System where it will be combined with other site wastewaters for treatment. Pretreatment of OU1 wastewater will consist of solids removal. The method of pretreatment is discussed in detail in the *Process Description for the Remediation System Design*. Treated wastewaters will be discharged in accordance with the requirements of the FEMP NPDES permit and applicable numeric and narrative water quality standards promulgated in OAC 3745-1. The FEMP NPDES permit will be modified to incorporate OU1 discharges in the event such a change is warranted.
Surface Water Discharges	OAC 3745-1-07 Lower Miami River Temperature Criteria in Fahrenheit and degrees (Celsius) Table I-12 in Attachment I contains the acceptable monthly temperatures for water discharged to the Lower Great Miami River.	OU1 remediation activities will not result in the direct discharge of wastewater to a water of the State. Wastewater generated by OU1 remediation activities will be pretreated and discharged to the existing FEMP Wastewater Treatment System where it will be combined with other site wastewaters for treatment. Pretreatment of OU1 wastewater will consist of solids removal. The method of pretreatment is discussed in detail in the *Process Description for the Remediation System Design*. Treated wastewaters will be discharged in accordance with the requirements of the FEMP NPDES permit and applicable numeric and narrative water quality standards promulgated in OAC 3745-1. The FEMP NPDES permit will be modified to incorporate OU1 discharges in the event such a change is warranted.
Air Discharges	OAC 3745-17-07 Ohio Ambient Air Quality Standards Visible particulate emissions from any stack may exceed twenty percent opacity, as a six minute average, for not more than six consecutive minutes in any sixty minutes, but shall not exceed sixty percent opacity, as a six-minute average, at any time.	The State standard for particulate emissions is an ARAR because it places a time limit on particulate emissions that may work in tandem with the Federal annual average. Preliminary design indicates that a spray tower and HEPA filter will be provided on the dryer off-gas system to remove particulates. This process is described in more detail in the *Process Description for the Remediation System Design.^I^I^P^CB^P^Q^I^I^P<^R^Z^A^A ^Osolids removal. The method of pretreatment is discussed in detail in the Process Description for the Remediation System Design*. Treatment of the combined wastewaters will be undertaken so as to meet the FEMP NPDES permit limits and conditions.

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TABLE A-2
(Continued)

Category	Applicable Requirements	Compliance Strategy
Radiation	DOE Order 5400.5 Radiation Protection of the Public and Environment DOE Order 5400.5 sets derived concentration guides (DCG) for radioactive emissions to air resulting from DOE activities. The DCG values for internal exposure are based on a committed dose equivalent of 100 mrem for the radionuclides taken into the body during one year. The DCGs comply with 40 CFR Part 61, Subpart H criterion of 10 mrem/year effective dose equivalent. Compliance is demonstrated using the CAP 88PC model as described by EPA. The DCGs are not release limits. They are one step in the process of controlling releases. DOE uses the guides to screen waste streams for application of best available technologies. If the concentration of a contaminant is above the DCG, the best available technology is applied to bring the annual averages of the contaminant below the DCG at the point of discharge. See Attachment I, Table I-21.	Emission estimates will be prepared for fugitive and point-source air emissions to demonstrate that no off-site member of the general public receives an annual effective dose equivalent in excess of the 10 mrem per year standard. Each potential air emission point source will be evaluated (by modeling) prior to placement, to determine the contribution that each source has to the annual release and if continuous monitoring of the point source is required. Point sources with the potential for releases that could exceed the 0.1 mrem per year dose to any member of the general public will be continuously monitored. Point sources with the potential to emit radionuclides below the 0.1 mrem per year dose will be subject to confirmatory periodic sampling. Modeling will be performed to demonstrate compliance with these requirements as discussed in Subsection 2.1.4 of the DCD.
Radiation	DOE Order 5400.5 The DCGs are given for different lung retention classes (noted as D,W, or Y, where D equals a removal half-time of 0.5 days, W equals a removal half-time of 50 days, and Y equals a removal half-time of 500 days). The derived concentration guides can be found in Table I-21 in Attachment I.	Emission estimates will be prepared for fugitive and point-source air emissions to demonstrate that no off-site member of the general public receives an annual effective dose equivalent in excess of the 10 mrem per year standard. Each potential air emission point source will be evaluated (by modeling) prior to placement, to determine the contribution that each source has to the annual release and if continuous monitoring of the point source is required. Point sources with the potential for releases that could exceed the 0.1 mrem per year dose to any member of the general public will be continuously monitored. Point sources with the potential to emit radionuclides below the 0.1 mrem per year dose will be subject to confirmatory periodic sampling. Dose calculations will be provided during Title II design to demonstrate compliance with these requirements as discussed in Subsection 2.2.3.1 of the DCD.

TABLE A-2
(Continued)

Category	Applicable Requirements	Compliance Strategy
Soil Remediation	40 CFR 761.125 Requirements for PCB Spill Cleanup PCBs at concentrations greater than 50 ppm are subject to decontamination TSCA requirements in 40 CFR 761.120(b). PCB containers containing non-liquid PCBs, such as contaminated soil, rags, and debris designated for disposal may be stored temporarily (up to 30 days from the date of removal) in an area that does not comply with the storage building requirements at 40 CFR 761.65 (b). 40 CFR 761.125(c) Soils in non-restricted access areas contaminated by a PCB spill will be decontaminated to 10 ppm PCB by weight, provided that the soil is excavated to a minimum depth of 10 inches. The excavated soils will be replaced with clean soils, i.e., containing 21 ppm PCB, and the spill site will be restored (e.g., replacement of turf) [40 CFR 761.125(c)(4)(v)]. For soils in restricted access areas, decontaminate to 25 ppm PCB by weight [40 CFR 761.125(c)(3)(v)].	Concentrations of PCBs at OU1 are expected to be less than 50 ppm. This regulation would then be considered guidance to be considered. PCB containing/contaminated materials are addressed in various ways within the OU1 remediation activities, and subsequently within the design. The *Waste Excavation Plan for the Operable Unit 1 Remediation System Design* (specifically Appendix A) is the primary design document in which this is discussed, both in terms of debris type materials and soils. Relative to contaminated soils, Section A.4 of the *Waste Excavation Plan for the Operable Unit 1 Remediation System Design* presents the OU1 soils management strategy, including soil remediation levels, and soils disposition. The amount of contaminated soil excavated during the remedial action will be based upon the final remediation levels presented therein. The management of other OU1 materials is discussed in Sections A.2 and A.3 of Appendix A of the *Waste Excavation Plan for the Operable Unit 1 Remediation System Design*. Section A.2 addresses the handling of transformers and intact drums. Section A.3 addresses the handling of oversized materials, including potential placement of such materials in the on-property disposal facility, assuming that established waste acceptance criteria are met.

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TABLE A-2
(Continued)

Category	Applicable Requirements	Compliance Strategy
Radiation	DOE Order 5400.5 Residual plus natural dose limit for public exposure to residual radioactive material are 100 mrem effective dose equivalent per year. Guidelines for residual concentrations of radionuclides in soil shall be derived from the basic dose limits by means of an environment pathway analysis using specific property data where available. Procedures for these derivations are given in DOE/CH-8901. Residual concentrations of radioactive material in soil are defined as those in excess of background concentrations averaged over an area of 100 square meters. Control and Stabilization and Administrative Control features shall be designed to provide to the extent reasonably achievable, an effective life of 50 years with a minimum life of at least 25 years. Groundwater shall be protected in accordance with legally applicable Federal and State standards.	All waste pit material will be removed from OU1. The only residual material will be soil that meets the Final Remediation Levels established by the OU5 remedial action. The OU5 levels have been developed in accordance with this requirement. Compliance will be demonstrated on a sitewide basis following remediation of the entire site by CRU-5. Some material from OU1 will be placed into the On-Property Disposal Facility. The disposal facility will be designed to meet this requirement and demonstration of compliance will be performed by CRU-2.

TABLE A-3

ACTION-SPECIFIC ARARS
(APPLICABLE REQUIREMENTS; RELEVANT AND APPROPRIATE REQUIREMENTS; TBCs)

Category	Applicable Requirements	Compliance Strategy
Radon	40 CFR Part 61, Subpart Q Emission of radon-222 from DOE facilities is limited to 20 pCi/m²s on an annual average.	Each pit meets the definition of a source as defined by 40 CFR 61 Subpart Q, which is an applicable requirement. Therefore, compliance with 40 CFR 61 Subpart Q (as well as 40 CFR 192.32) must be demonstrated for each pit. Flux rates will be calculated. Modelling will be performed to determine radon emissions and public dose rates as discussed in Subsection 2.1.4 of the DCD.
Stormwater Control	40 CFR 122.26 (OAC 3745-38) Discharge of Storm Water Runoff Storm water runoff from landfills, construction sites, and industrial activities must be monitored and controlled. A Storm Water Pollution Prevention Plan (SWPPP) is required for construction activities which result in a total land disturbance of 5 or more acres.	Remedial activities will comply with an approved FEMP SWPPP. Additional stormwater measures are discussed in Subsection 2.3.5.3 of the DCD and Section 5.1 of the *Waste Excavation Plan for the Operable Unit 1 Remediation System Design*.
Hazardous Waste	ORC 3734.02(H) Digging Where Hazardous or Solid Waste was Located Filling, grading, excavating, building, drilling, or mining on land where hazardous waste or solid waste facility was operated is prohibited without prior approval from the Director of the Ohio EPA.	This requirement needs no further discussion relative to attainment, since Ohio EPA concurrence on the ROD has met the intent of this requirement.
Hazardous Waste	OAC 3745-56-51, 54 and 58; Waste Piles Design and Operating requirements, monitoring and inspection, closure and post-closure care.	The requirements for hazardous waste piles are potentially applicable only to waste excavated from Pits 4 and 5. Based on the design described in the *Process Description for the Remediation System Design*, however, this requirement does not apply to the processing of any OU1 wastes. Specifically, these requirements do not apply to the feed piles that are within the OU1 waste processing facility as these piles are neither for long-term storage nor treatment. In addition, although the 14-day contingency stockpile could, at some point, be considered long-term storage, no Pit 4 or Pit 5 wastes will be stored therein.
Well Abandonment	OAC 3745-9-10 Ohio Water Well Standards Abandonment of Test Holes and Wells.	These requirements for closure of test holes and wells at the FEMP are implemented through the *Sitewide CERCLA Quality Assurance Program Plan*.

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TABLE A-3
(Continued)

Category	Applicable Requirements	Compliance Strategy
Air Discharges	OAC 3745-15-07(A) Ohio Air Pollution Control Regulations Describes forms of air pollution nuisances and prohibits their emission or escape.	Both excavation and waste treatment processes have the potential to generate prohibited fugitive emissions. Fugitive and blowing dust carrying contamination will be controlled on excavation faces and spoil piles by standard practices described in the *Waste Excavation Plan for the Operable Unit 1 Remediation System Design*. Shredding and drying activities will take place in enclosures. Preliminary design indicates that a spray tower and HEPA filter will be provided on the dryer off-gas system to remove particulates. This process is described in more detail in the *Process Description for the Remediation System Design*.
Fugitive Dust	OAC 3745-17-08 Control of Fugitive Dust 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.	The implementation of remedial action alternatives will require the movement of dirt and other material likely to result in fugitive dust emissions. Fugitive and blowing dust carrying contamination will be controlled on excavation faces and spoil piles by standard practices described in the *Waste Excavation Plan for the Operable Unit 1 Remediation System Design*. Shredding and drying activities will take place in enclosures with HEPA ventilation.
Air Discharges	OAC 3745-21-02(C) and OAC 3745-21-03(D) Ambient air quality standards and guidelines and methods of ambient air quality measurements (for non-methane hydrocarbons). Mean ambient concentration of non-methane hydrocarbons not to exceed 160 μg/cubic meter (0.24 ppm as carbon) between 6 and 9 a.m.; methods for determining ambient concentration of non-methane hydrocarbons.	During drying, hydrocarbon soil contaminants may be evolved with the steam. An uncontrolled release could lead to a violation of this standard. Preliminary design includes a scrubber to treat off-gas. (discussed in detail in the *Process Description of the Remediation System Design*. Air emissions will be determined during design and appropriate design measures will be included to insure compliance with this requirement. Compliance will be demonstrated during Title II design using air modelling.
Air Discharges	OAC 3745-21-07 (G)(2) Control of emissions of organic material from stationary sources. Emissions of photochemical reactive material from processes, including drying, not to exceed 40 lbs/day, with a peak of 8 lbs/hour.	An off-gas composition determination was performed and it was determined that organics would be present in the off gas. Therefore, a scrubber will be provided to treat the off gas prior to discharge. The off gas composition and scrubber are discussed in the *Process Description of the Remediation System Design*.

TABLE A-3
(Continued)

Category	Applicable Requirements	Compliance Strategy
Air Discharges	OAC 3745-31-05(A)(3) Permit to Install The director shall issue a permit to install if he determines that the installation or modification and operation of the air contaminant source will employ the best available technology.	Although an administrative Permit to Install is not required for alternatives involving treatment, the substantive requirements of this section must be met by employing Best Available Technology (BAT) for treating particulate and off-gas emissions. Condensers and scrubbers will be employed as BAT. Permitting requirements are discussed in Subsection 2.1.4 of this DCD.
NEPA	10 CFR 1021.2 DOE actions must be subjected to NEPA evaluation as outlined by CEQ regulations in 40 CFR 1500-1508.	On June 13, 1994, the DOE issued a revised policy statement on NEPA. The new policy allows DOE, at CERCLA sites, to rely on the CERCLA process to satisfy the procedural aspects of NEPA. NEPA values have been incorporated into the Final Operable Unit 1 Feasibility Study Report. Any further NEPA documentation will be prepared for this project in accordance with established site procedures.

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TABLE A-3
(Continued)

Category	Relevant and Appropriate Requirements	Compliance Strategy
Air Discharges	40 CFR 60.670 Subpart OOO Stack emissions from affected facilities shall not: • Contain particulate matter in excess of 0.05 g/dscm; or • Exhibit greater than 7 percent opacity, unless the stack emissions are discharged from an affected facility using a wet scrubbing control device.	These standards are relevant and appropriate to OU1 remedial activities since they specify requirements for shredder and conveyor systems. The standards will be considered when determining BAT requirements for these systems in accordance with OAC 3745-31-05(A)(3). Shredder and conveyor systems will be enclosed with dust suppression system to meet this requirement. Also, preliminary design includes a spray tower to remove particulates prior to discharge from the dryer.
BMP Program	40 CFR 125.100 and 125.104 Discharge of Treatment System Effluent Best Management Practices Develop and implement a BMP program to prevent the release of toxic or hazardous pollutants 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.	This requirement is programmatic and is met by the approved Best Management Practices Plan currently in place at the FEMP. The FEMP BMP Plan may require revision to include any special circumstances involving this remedial action.

TABLE A-3
(Continued)

Category	Relevant and Appropriate Requirements	Compliance Strategy
Solid Waste	40 CFR 241 Subpart B (OAC 3745-27), RCRA Subtitle D On-Property Solid Nonhazardous Waste Management Facilities Design standards are presented in the following citations: 241.200-2, 241.201-2, 241.202-2, 241.203-2, 241.204-2, 241.205-2, 241.206-2, 241.207-2, 241.208-2, 241.209-2, and 241.210-2.	Land disposal of solid waste will not occur in OU1. Solid waste from OU1 destined for on-site disposal will be sent to the On-Property Disposal Facility. The OU1 selected remedy involves handling residual contaminated soils and oversized materials in accordance with the OU5 and OU3 RODs. Appendix A of the *Waste Excavation Plan for the Operable Unit 1 Remediation System Design*, which discusses disposal of these materials on-site, requires that OU1 generated waste meet the waste acceptance criteria of the On-Property Disposal Facility. The design of the On-Property Disposal Facility, including the establishment of final design criteria, will be handled through the OU2 remedial design efforts, with the impact of any changes to the OU1 design reflected in future OU1 design efforts.
Hazardous Waste	40 CFR 262.11 (OAC 3745-52-11) Hazardous Waste Determinations Any generator of waste must determine whether or not the waste is hazardous.	Excavation, size reduction, homogenization, blending, and drying of pit wastes are process activities which result in generation of a single waste stream. The newly generated waste is the waste stream that will be shipped off-site for disposal and represents the waste that must comply with regulatory requirements and disposal facility waste acceptance criteria. As documented in the OU1 FS/PP and ROD, this waste stream does not contain RCRA listed wastes; and in accordance with USEPA guidance for Superfund sites and 40 CFR 262.11(c), the waste will be sampled for RCRA characteristics only. The statistical methods that will be used to demonstrate compliance with regulatory criteria and WAC will be included in the RA Sampling and Analysis Plan.
Hazardous Waste	Closure 40 CFR 264, Subpart G (OAC 3745-55-(11-16)) Operator must close facility in a manner that: • Minimizes the need for further maintenance • Minimizes post-closure escape of hazardous constituents • Complies with specific unit type closure requirements	As documented in the Draft Director's Final Findings and Orders between Ohio EPA and DOE, demonstration of compliance with substantive closure and post-closure requirements for hazardous waste management units will be documented in remedial design and remedial action deliverables. DOE will provide a cross-reference to Ohio EPA that will contain an index to closure and post-closure requirements within the RD/RA deliverables. The RD/RA deliverables will be submitted for review in accordance with the Amended Consent Agreement.

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TABLE A-3
(Continued)

Category	Relevant and Appropriate Requirements	Compliance Strategy
Air Discharges	40 CFR 264.1030 - 264.1036, Subpart AA Air Emission Standards for Process Vents • Reduce total organic emissions below 1.4 kg/h (3 lb/h) and 2.8 Mg/yr (3.1 tons/yr) • Control device (condenser or absorber) must recover organic vapors with an efficiency of 95 percent or greater.	No regulations have been promulgated for process vents associated with thermal drying; however, 40 CFR 264.1030 - .1036 will be relevant and appropriate but not applicable to air emission standards for process vents associated with thermal drying. Preliminary design includes a scrubber and condenser in the off gas treatment system. The *Process Description for the Remediation System Design* includes a discussion of the off gas treatment system.
Hazardous Waste	Post-Closure 40 CFR 264 Subpart GCFR 264.117 (OAC 3745-55-17) 40 CFR 264.119 (OAC 3745-55-19) Post-closure care and use of property for a period as necessary to protect human health and the environment including: • Access controls • Monitoring Post-closure notices must include deed notation/use restriction.	As documented in the Draft Director's Final Findings and Orders between Ohio EPA and DOE, demonstration of compliance with substantive closure and post-closure requirements for hazardous waste management units will be documented in remedial design and remedial action deliverables. DOE will provide a cross-reference to Ohio EPA that will contain an index to closure and post-closure requirements within the RD/RA deliverables. The RD/RA deliverables will be submitted for review in accordance with the Amended Consent Agreement.
Monitoring	OAC 3745-57-91 and 92, Miscellaneous Methods of Waste Treatment Parts 91 and 92 include requirements for miscellaneous units environmental performance standards and monitoring, analysis, inspection, response, reporting, and corrective action.	This ARAR will be met by the implementation of the other ARARs that are protective of human health and the environment. Releases to the environment will be controlled by using a ventilation system with a spray tower and scrubber and a stormwater/wastewater collection system.
CAMUs	Corrective Action for SWMUs 40 CFR Subpart S 40 CFR 264.552,.553 Corrective Action Management Units (CAMUs) might be designed 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.	As an ARAR, the CAMU designation does not apply to waste disposed off-site; however, it does apply to waste that is managed on-site. OU1 pit wastes will be disposed of at an off-site facility and therefore, must meet all regulatory and disposal facility requirements. CAMUs can apply to residual soils remaining on-site. As such, residual OU1 soils will managed in accordance with the OU5 ROD which designates the FEMP site as a CAMU.

TABLE A-3
(Continued)

Category	To-be-Considered Requirements	Compliance Strategy
Monitoring	DOE Order 5400.1 @ p. iv - 1 Since each DOE facility is unique, the need and level of effort for monitoring programs shall be determined by the appropriate field organization on a case-by-case basis.	Operable Unit 1 is part of a DOE facility and is subject to these orders. The existing FEMP sitewide monitoring program will be used for the remediation facilities. If necessary, the existing program may be modified, but that decision will not be made until later in the project. The *Remedial Action Work Plan* will discuss sitewide monitoring.
Monitoring	DOE Order 5400.1 @ iv - 9, 10 Groundwater that is or could be affected by DOE activities shall be monitored to determine and document the effects of operations on groundwater quality and quantity and to demonstrate compliance with DOE requirements and applicable Federal, State, and local laws and regulations.	As discussed in Subsection 4.4.1 of the OU1 *Remedial Design Work Plan*, the existing FEMP groundwater monitoring program will be used for assessing potential impacts to the groundwater due to planned OU1 remediation activities.
Waste Management	DOE Order 5820.2A @ 1 Radioactive Waste Management DOE 5820.2A III.3h Management of Low-Level Waste, Long-Term Storage Radioactive and mixed wastes shall be managed in a manner that assures protection of the health and safety of the public, DOE and contractor employees, and the environment. 5820.2A III.3h requires achieving performance objectives of DOE. 5820.2A III.3a requires records and documentation be kept for storage of low-level waste and permits the storage of waste until disposal by approved methods.	The treatment and storage of OU1 radioactive wastes, and the other pollutants or hazardous substances they contain, will be accomplished in a manner that complies with all applicable Federal, State and local environmental, safety, and health laws and regulations, and DOE requirements. The *Transportation and Disposal Plan* identifies specific requirements for disposal.

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Results of Studies
/ Tests

APPENDIX B

RESULTS OF THE STUDIES/TESTS RELEVANT TO REMEDIATION SYSTEM DESIGN

Appendix B
Results of the Studies/Tests Relevant to Remediation System Design

A significant number of studies and tests have been completed or are in progress that provide information for remedial design purposes. A summary of the scope of the study or testing work and the results or current status is presented below. Additional detail is available in the referenced material.

B.1 Waste Excavation Plan

This study is under way as a separate task to evaluate and plan a top and bottom-based excavation approach. The plan considers various contingency actions to respond to unexpected conditions and reviews alternative measures that will lead to overall optimization of the top and bottom operations.

For backup information, and to avoid possible later delay, an alternative excavation approach, based on a berm-located dragline, is also being studied. This fallback alternative approach would be chosen if the ongoing DEEP data ruled out the preferred top and bottom-based excavation approach.

The *Waste Excavation Plan* is subject to revision because all necessary DEEP data have not yet been received and evaluated.

B.2 Evaluation of Existing Equipment

This study is also under way as a separate task. Preliminary review has indicated that some potentially useable equipment is available from the FEMP surplus equipment inventory. The preliminary equipment list for the remedial facilities is currently being reviewed to designate what specific, surplus equipment may be available. Following that determination, field reviews will be conducted to further confirm suitable equipment.

The objective and planned schedule is to have a final list of existing equipment designated for use in the OU1 remedial facilities by the end of Title I design.

B.3 Surrogate Waste Drying Testing

The surrogate waste drying tests *Report on Execution of Surrogate Waste Drying Tests* (PARSONS 1994), presents drying test information that has been the basis of the preliminary design of the indirect rotary dryer. That testing was completed with a variety of surrogate blends selected to duplicate the geotechnical properties of the pit wastes. These geotechnical properties are primarily related to particle size and moisture retention capacity as indicated by Atterberg Limits.

Drying rates, dryer operating conditions, heat transfer conditions, retention times, feed conditions, and a variety of other data were collected during the testing. Evaluation of this data has led to the recommended dryer type and the dryer-related information presented in the OU1 remedial facilities conceptual design. Additional information is included in the document *Selection of an Indirect Rotary Dryer* (PARSONS 1995i).

B.4 DEEP Test Results

This program is a phased field and laboratory investigation focusing on the waste geotechnical properties. It will provide basic information on water and solids content of the waste and will provide information to determine preferred waste excavation methods and whether in situ waste dewatering is practical. DEEP includes pre-dewatering tests, dewatering testing, excavation tests, and waste pumping tests.

Pre-dewatering tests included 23 CPT probes and 9 field borings and sampling in Pits 1, 2, and 3. Both undisturbed and disturbed samples were collected. Laboratory testing of the samples is under way for basic geotechnical index and physical properties.

Additional confirmatory borings (five total), sampling, and laboratory testing work have been initiated in Pits 1, 2, and 3 to provide increased confidence in final data. Laboratory testing of the samples is in progress.

Sampling was also completed in Pit 5 (14 locations) and Pit 6 (six locations) to obtain waste samples and data through the entire depth of the pit waste. Testing of these samples for basic geotechnical and physical properties is also in progress. Because of the required sampling method, truly undisturbed samples could not be collected from these pits; however, the testing and data being developed are expected to significantly improve previous available data.

Pre-dewatering test excavations were completed at a total of seven locations in Pits 1, 2, and 3. At these locations a backhoe dug a trench 10 - 15 feet deep in the waste to determine waste digging and handling characteristics.

Dewatering testing has been completed in Pits 1 and 3 to test different well designs and the practicality of in situ dewatering.

Excavation tests will then be completed in Pits 1 and 3 by excavating ramps into the waste and operating equipment on the ramps. A report is being prepared to summarize all the currently available DEEP test activities and results, and including all the boring logs and laboratory testing data and results. The preliminary version of this report is entitled *Preliminary Technical Summary of DEEP Test Boring and Cone Penetrometer Testing (Present Water Conditions)* (PARSONS 1995a). The information from this report will establish revised waste density and moisture content information that will provide final

revisions to mass and energy balances for the waste processing. Also, waste strength data in conjunction with planned test excavations into the waste and dewatering testing results will provide information to finalize excavation plans. The report will be reissued as a final report when all DEEP testing and data are complete.

B.5 Thickening/Settling Test Results

Tests on representative wastes were performed to determine thickening and settling properties of the pit wastes. This testing, in conjunction with the vacuum and pressure filtration tests that follow was used in investigating potential water removal processing steps for wastes that may be excavated hydraulically. Overall, the objective of the testing was to determine whether there were mechanical processing steps that could efficiently remove or reduce the water in the wastes and reduce thermal drying requirements. All testing information (thickening/settling and filtration) will be presented in a final report.

Although not yet published, the thickening and settling test data did not justify including thickening/settling equipment in the remedial facilities design. In situ waste densities are equal to or greater then what could be achieved with thickening/settling. These results indicated that if wastes have to be excavated hydraulically, it will be done without the addition of diluting slurry water.

B.6 Vacuum Filtration Test Results

Vacuum and pressure filtration tests were performed on representative wastes to determine the effectiveness and potential for use of a filtration step in the waste processing operations. This testing indicated a worthwhile increment of moisture removal was possible with a filtration step. The pressure filtration was actually more effective than the vacuum filtration but was not judged as practical because of the heterogeneity of the pit wastes. However, after the report was completed, the decision was made to not use vacuum filtration.

B.7 Solids Flow Testing

Flow properties testing on surrogate wastes was performed to determine bin design parameters for storage of the dried waste product (Jenike & Johanson, Inc., 1994). Minimum bin outlet dimensions and wall angles, and maximum practical moisture contents in the dried surrogates were determined in the testing.

B.8 Waste Densification Testing

A preliminary test has been performed to determine whether densification of the waste product is a cost-effective processing step. Burial costs are based on volume, so increases in density reduce volume and,

as a result, reduce burial costs. Preliminary indications are that densification is possible and that additional study and testing is warranted.

B.9 Shredder Test Results

A debris shredding test was conducted at Komar Industries, Inc. in April 1994. Overall results and conclusions were mixed. There was satisfactory volume reduction but substantial material was not reduced to less than 4 inches in size. Results from this test were used to develop the material size limitations in the DCD. Additional detail is included in the *Shredding Engineering Tests Report* (PARSONS 1994).

B.10 Other Possible Testing

Additional testing may be justified in a few other areas, including the following:

1) Raw waste handling/screening/transfer tests - Such tests could reduce the degree of conservatism in the conceptual design, such as for conveyor belt incline angles.

2) Consolidation tests of Pit 5 wastes - The extremely high moisture content of the Pit 5 wastes raises the question of whether a more cost-effective method of removing the waste entrained water than through thermal drying. Consolidation data would determine if a surcharge and dewatering wells might be cost effective.

3) High-solids-content waste pumping - Previous attempts at water jetting and slurry pumping have not been effective for excavating wastes. In addition, if diluting water is added, it must later be removed from the wastes. Preliminary DEEP data indicate there may be substantial quantities of liquid-like wastes in Pits 5 and 3. If those materials do not drain or dewater, then pumping, at the existing solids content (without water addition), may be the most cost-effective excavation method.

PLANT FACILITIES ENGINEERING

Process Description for the Remediation System Design

Operable Unit 1
Project Order 145

October 1995
Revision C

Environmental Remedial Action Project
Fernald Environmental Management Project
Fernald, Ohio
FERMCO Subcontract No. 2-21487

PARSONS

25 Merchant Street
Cincinnati, Ohio 45246

Process Description for the Remediation System Design

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LIST OF ACRONYMS AND ABBREVIATIONS

DOE	United States Department of Energy
DOT	United States Department of Transportation
ERA	Environmental Remedial Action
FS	Feasibility Study
HEPA	High-Efficiency Particulate Air
MEPA	Medium-Efficiency Particulate Air
OPDF	On-Property Disposal Facility
OU	Operable Unit
PFD	Process Flow Diagram
RI	Remedial Investigation
US EPA	United States Environmental Protection Agency
WAC	Waste Acceptance Criteria
wt%	weight percent

SECTION 1

INTRODUCTION

1.1 Background

The objective of this project is to remove the contents (waste and debris) of Waste Pits 1 through 6, the Burn Pit, and the Clearwell; excavate the contaminated soil underlying the pits, and prepare these materials for final disposal by drying and blending. The type of pit waste material encountered during excavation varies, including standing water, sludge, waste filter cake, raffinate slag, soil, clay, pit caps and liners, and other miscellaneous waste materials. Debris encountered also varies, including 55-gallon drums, scrap metal, wooden pallets, and other miscellaneous debris.

The selection of thermal drying as the preferred remedial alternative proceeded according to the standard Comprehensive Environmental Response, Compensation, and Liability Act process. The first step was to characterize the pit wastes. The Remedial Investigation (RI) report (DOE 1994a) presents the chemical and radiological composition and other physical characteristics of the pit wastes. The University of Cincinnati (ALTER 1994) performed another relevant characterization study. Based on the characteristics of the pit wastes as described in these reports, appropriate treatability studies (DOE 1994b) were performed as the second step in the selection process.

Based on the characterization data and the results of treatability studies, a Feasibility Study (FS) (DOE 1994c) was then performed. The thermal drying alternative was selected from various remediation strategies developed in the FS. This work was performed under the direction of the Fernald Environmental Management Project site contractors who issued the RI and FS reports to the United States Environmental Protection Agency (US EPA). A Record of Decision for this project was signed by the US EPA on March 1, 1995.

Following the selection and approval of the preferred remedial alternative by the US EPA (established in the Record of Decision) and the approval of the Remedial Design Work Plan by the US EPA on June 21, 1995, the next step in this process is the design of the remediation facility.

1.2 Overall Process Description

The following description summarizes the overall process. Detailed process descriptions, based on each of the Process Flow Diagrams, are presented later in this section.

The overall objective of the remediation of Operable Unit 1 (OU1) is to remove the pit wastes and other contaminated materials, treat them so they meet the Waste Acceptance Criteria (WAC) for disposal, load

them into railcars, and ship them to an off-site disposal facility. To achieve this objective, a conceptual remediation process has been designed consisting of waste retrieval and transfer, waste preparation, drying and off-gas treatment, waste blending and loadout, and wastewater handling, as shown in Figure 1-1.

As Figure 1-1 shows, functions such as segregation of debris, blending of waste streams, and handling of drainage water from the pit materials occur in more than one area. The following paragraphs summarize the remediation process.

The majority of the waste materials are retrieved by standard mechanical excavation. During the excavation, the waste is segregated into four categories for processing: dry materials (including pit wastes as well as soils and cap and liner materials), wet materials, processable debris, and nonprocessable debris. This separation of large debris is only an initial attempt performed with the excavating equipment. Further separation occurs in the waste preparation area operations. The wet and dry waste materials are transported by truck to the waste preparation area and the debris is transported to the waste blending and loadout area. As a contingency, hydraulic mining of pit wastes is also available to handle materials not suitable for mechanical excavation. The retrieved slurry is stored in a tank and fed intermittently to the dryer.

The waste preparation area operations consist of (1) receiving and storing the retrieved waste, (2) waste segregation, (3) blending, (4) debris management, and (5) use of a shredder for processable debris. Waste is received and stored in piles of wet waste, dry waste, and a contingency storage pile of both. The material remains in these piles for a few to several days to allow water to drain from the materials. Wet and dry materials are then blended to produce a mixture with physical properties amenable to the downstream screening and material handling operations. The first screening operation is a 12-inch vibrating grizzly. The debris removed during this screening step are mechanically segregated into processable and nonprocessable streams. In addition, uranium derbies are also segregated for separate disposal. The waste passing through the 12-inch grizzly is then sent to a 4-inch trommel screen. The material passing through the trommel is placed in a covered area capable of holding 10 days of storage. The larger material is sent to the waste blending and loadout area, and uranium derbies are removed and disposed of separately.

A portion of the materials from the 10-day storage area are dried to a target moisture content of 10 percent (dry weight basis). Wet (not dried) materials from the 10-day storage pile are then blended with the dried product in a ratio specified to achieve the optimum moisture content of the waste. This material, now at the optimum moisture content, is sent to a 3-day capacity pile in the waste blending and loadout operation.

An indirect rotary dryer heated by combustion of natural gas is used to dry the wastes. The wastes pass through the dryer concurrently with a controlled flow of heated sweep air. The process off-gas consists

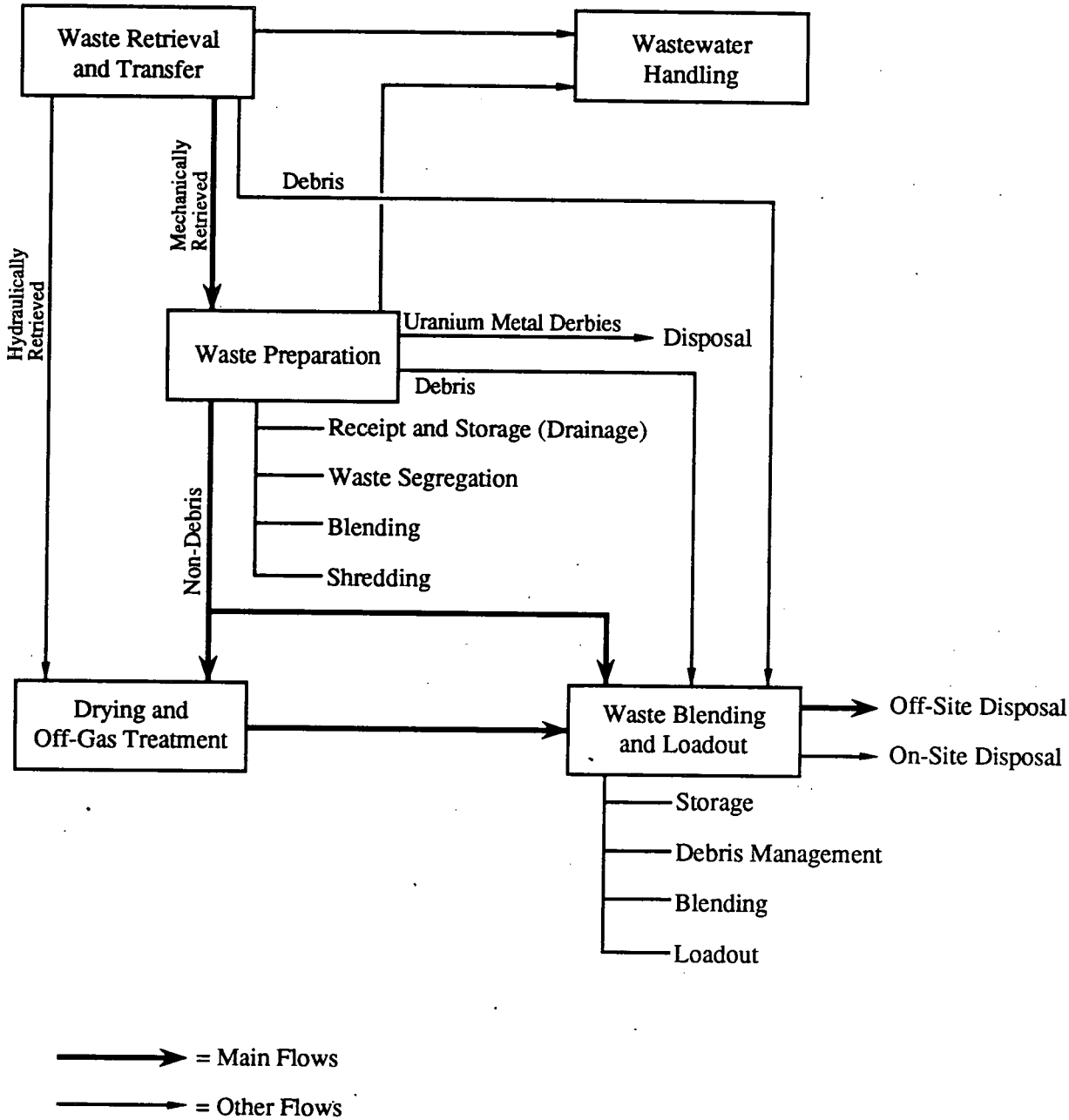

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Figure 1-1 - Overall Process Block Flow Diagram

mostly of water vapor. A cyclone is used to remove the larger particulates from the process off-gas stream. The cyclone is heated to prevent condensation. The combustion gases do not come in contact with the waste. These combustion gases are used as a source of heat which is utilized in a series of heat economizers that provide heated sweep air for the dryer and hot air for heating the cyclone, the off-gas, and buildings (if desired). The cooled combustion gases are then released to the atmosphere through a dedicated exhaust fan and stack.

The process off-gas leaving the heated cyclone passes through the remaining off-gas treatment system, which removes water vapor and other volatiles, particulates, acid gases, and radon. A spray tower removes particulates from the off-gas in order to protect the downstream condenser and other equipment from solids buildup. Some of the water vapor and acid gases are removed from the off-gas in the spray tower, but the majority are removed in the condenser. This much smaller and cooler off-gas is then scrubbed to remove acid gases. To ensure efficient removal of radon from the off-gas, the relative humidity of the off-gas is reduced in a two-step dehumidification process. First, moisture is removed from the saturated off-gas stream by cooling, then the stream is reheated to provide the low relative humidity. The off-gas is filtered with Medium-Efficiency Particulate Air (MEPA) filters prior to entering the carbon beds to avoid fouling of the bed, and the final step is High-Efficiency Particulate Air (HEPA) filtration before release through the exhaust fan and stack.

The final operation in the remediation process is waste blending and loadout. All debris from the previous operations are received by the debris management system. Shredded material is then blended with the oversized material from the 4-inch trommel screen, with dry material, and with material at the optimum moisture content from the 3-day capacity pile. The materials are blended to form a new mixture at optimum moisture content and loaded into the railcars. The nonprocessable debris are separated and sent to one of two different areas. Debris that meet the on-site WAC are sent to on-site disposal. Debris that do not meet the on-site WAC are loaded into the railcar with the other wastes.

Wastewater handling is an important ancillary operation supporting the waste retrieval operation. Successful mechanical excavation depends on control and removal of stormwater from the pits as well as the water that drains from the pit materials during excavation. Drainage water from the pit materials collected in the waste preparation area is also handled by this operation. All of this water is pumped either directly to the Biodenitrification Surge Lagoon, or to the Clearwell and then to the Biodenitrification Surge Lagoon, with ultimate treatment at the FEMP wastewater treatment system.

1.3 Process Design Criteria and Requirements

This subsection presents the process design criteria and design requirements set to perform process operations for the remediation of pit wastes prior to shipment for disposal.

1.3.1 Pit Waste Characterization

1.3.1.1 Waste Composition

Waste composition as used for this project is defined and detailed in *Dryer Off-gas Composition, Operable Unit 1 Remediation System*, Revision A, PARSONS Environmental Remedial Action (ERA) Project, September 1995 (PARSONS 1995a).

1.3.1.2 Waste Physical Characteristics

In situ moisture contents are defined corresponding to each waste pit, as shown in Table 1-1. These data are used for equipment sizing and material balances.

1.3.2 Processing Rates and Operating Times by Process Areas

1.3.2.1 Waste Retrieval (SK-F-03909)

1) Operating Time: 8 hours per day, 5 days per week
2) Retrieval Rate: 1,200 tons per day
3) Waste Transfer: Dump truck; 20 tons per truck

1.3.2.2 Waste Preparation (SK-F-03910)

1) Operating Time: 8 hours per day; 5 days per week

2) Storage capacities
   (1) Wet waste storage: 5 days (drainage water transferred to Biodenitrification Surge Lagoon)
   (2) Dry waste storage: 2 days
   (3) Dryer feed storage: 10 days
   (3) Contingency storage: 14 days (drainage water transferred to Biodenitrification Surge Lagoon)

3) Waste segregation by screening, first stage
   (1) Equipment: 12-inch vibrating grizzly
   (2) Number of trains: two
   (3) Screen oversize: 4.4 weight percent (wt%) of feed
   (4) Screen undersize: 95.6 wt% of feed
   (5) Percent moisture (wet basis) of oversize: 20 percent (assumed optimum)

4) Waste Segregation by Screening, Second Stage

(1) Equipment: 4-inch trommel screen

(2) Number of trains: two

(3) Screen oversize: 2.6 wt% of feed

(4) Screen undersize: 97.4 wt% of feed

(5) Percent moisture (wet basis) of oversize: 31 percent (assumed in situ)

Table 1-1 - Remediation System Design Data

Waste Pit	Total Waste (tons)	Wet Density (lb/ft^3)	Average Moisture Content (% Wet Basis)	Assumed Optimum Moisture (% Wet Basis)
Pit 1	128,592	139.3	20	20
Pit 2	56,100	111.1	33.3	TBD
Pit 3	405,900	97.8	39.4	TBD
Pit 4	136,864	139.3	20	20
Pit 5	110,627	83.7	59	TBD
Pit 6	14,880	114.8	31	20
Burn Pit	55,146	134.8	23	23
Clearwell	6665	114.8	31	TBD
Soil	76,116	140.7	23.1	23.1
TOTAL	990,890			

Note: Wet density and average moisture content data are based on June 15, 1995, DEEP data. Optimum moisture data are based on University of Cincinnati data (ALTER 1994). These values will be revised when all final DEEP data is available.

5) Streams resulting from mechanical segregation of grizzly oversize (+12 inches)

(1) Processable debris

(2) Nonprocessable debris

(3) Derbies (uranium metal)

6) Streams resulting from mechanical segregation of trommel oversize (+4 inches)
   (1) Oversize (+4 inches) wastes/debris
   (2) Derbies (uranium metal)

1.3.2.3 Drying and Off-Gas Treatment Sheet 1 of 2 (SK-F-03911)

1) Operating time: 24 hours per day, 7 days per week

2) Equipment: Indirect rotary dryer with furnace surrounding cylinder

3) Maximum dryer feed rate: 22 tons per hour (wet) (nominal, to be determined by Vendor)

4) Maximum dryer feed size: 4 inches (any direction)

5) Maximum evaporation rate: 4.2 tons per hour

6) Dryer product moisture percent: 10 percent (dry basis)

7) Product temperature: 250 degrees F (maximum)

8) Dryer/furnace fuel: Natural gas

9) Natural gas gross heat value: 1,027 British thermal units/standard cubic foot

10) Natural gas supply pressure: 60 pounds per square inch gauge

11) Natural gas composition: CH_4 (96 percent), C_2H_6 (1.9 percent), N_2 (0.036 percent), other (2.064 percent)

12) Combustion off-gas design flow: 1.15 x normal flow (as specified by vendor)

13) Sweep air design flow: 1.15 x normal flow (as specified by vendor)

14) Economizer #1: Preheats sweep air; provides hot air to heat cyclone

15) Economizer #2: Provides hot air to reheater and to heat buildings (if desired)

16) Stack gas temperature: to be determined during detailed design

1.3.2.4 Drying and Off-gas Treatment Sheet 2 of 2 (SK-F-03912)

1) Operating Time: 24 hours per day, 7 days per week

2) Process off-gas composition is used as defined in *Dryer Off-Gas Composition, Operable Unit 1 Remediation System* (PARSONS 1995a).

3) Extent of contaminant decomposition or reaction: refer to Table 5-1.

4) Radon retained in the pit wastes: refer to Table 5-2.

5) Continuous radon regeneration rate: refer to Table 5-3.

6) Solids removal efficiencies: refer to Table 5-4.

7) Contaminant removal efficiencies: refer to Table 5-5.

8) Process off-gas design flow: 1.15 x normal flow (design).

9) Process off-gas temperature: 350 degrees F (maximum).

10) Stack gas temperature to be determined during detailed design.

1.3.2.5 Dried Waste Blending and Loadout (SK-F-03913)

1) Operating Time: 8 hours per day, 5 days per week

2) Streams blended (to achieve optimum moisture content)
   (1) Product from twin auger mixer (mixed wet and dried waste material)
   (2) Trommel oversize (-12 inches +4 inches)
   (3) Dry waste/soil
   (4) Shredded material

3) Working storage piles are to be provided as follows:
   (1) Shredded debris: 100 tons
   (2) Reject pile: 1 day
   (3) Dry waste: 1 day
   (4) Product from twin auger mixer: 3 days

4) Streams received by debris management
   (1) Nonprocessable waste from excavation
   (2) Processable waste from excavation
   (3) Nonprocessable waste from first mechanical segregation
   (4) Processable waste from first mechanical segregation

5) Streams produced by debris management
   (1) Select nonprocessable waste (for on-site disposal)
   (2) Select nonprocessable waste (for loading into railcar)
   (3) Select processable waste (for shredding)

6) Blending accomplished by material handling equipment

7) Total blending to loadout: 960 tons per day

8) Streams loaded into railcars
   (1) Blended waste
   (2) Nonprocessable waste (from debris management)

9) Operations include railcar loading, lidding/liner replacement, reject unloading/handling, and decontamination

SECTION 2

WASTE RETRIEVAL
(PFD SK-F-03909)

2.1 Waste Retrieval

The overall process for excavation and processing of the OU1 wastes begins with waste retrieval from the waste pits. This waste retrieval process is depicted in the PFD SK-F-03909. For more descriptive details, refer to Section 5.3 of the Excavation Plan (PARSONS 1995c).

Mechanical excavation is the planned excavation method for all pits and will be accomplished using conventional earth-moving equipment, such as track-type loaders and long-reach excavators. The waste and debris removal is depicted on the above PFD as three main streams: dry waste and soil removal (Stream 101), wet waste removal (Stream 102), and large debris removal (Stream 103).

The dry waste and soil (such as cap and contaminated berm material) is excavated on an as-needed basis, placed in dump trucks, then transported for blending with wet waste at the waste preparation area (see PFD SK-F-03910) and at the blending and loadout facility next to the rail loadout area (See PFD SK-F-03913). During excavation of dry materials, water sprays are used to minimize fugitive emissions.

Wet waste, along with some debris that is not visually apparent, is loaded into trucks for transport to the storage bins located in the waste preparation area (see SK-F-03910).

Large debris is excavated from the pits, then visually and manually segregated into processable and nonprocessable debris. The processable debris (Stream 105) is loaded into trucks for transport to the Debris Management Area (See PFD SK-F-03913). The nonprocessable debris (Stream 104) is washed at a pit side area to remove gross contamination, then loaded into trucks for transport to the Debris Management Area.

The PFD-SK-F-03909 also shows a contingency operation for hydraulic waste removal if any wastes are encountered that cannot be mechanically excavated. Hydraulic excavation is used only as necessary, based on the decision of the responsible field engineer. A slurry pump transfers the slurry from the waste pit to a self-unloading tanker truck (Stream 109). This tanker truck transports and unloads the slurry in the agitated slurry surge tank.

2.2 Waste Transfer

Waste is transferred from the pits to the Waste Preparation Area, as depicted on PFD SK-F-03909.

All waste and debris shall be transported from the present excavation area to the waste preparation area by all-wheel-drive, articulating-rear dump trucks. As required by field and waste conditions, trucks are covered with tarps during transportation of dry materials to minimize fugitive emissions to the atmosphere. Haul roads are developed and maintained as necessary to ensure efficient truck operation and material transfer. Water sprays are used throughout to minimize airborne contamination.

Large debris found during excavation is loaded into trucks and transported or possibly moved by skid to a pad at the pit side. If debris cannot be loaded into trucks because of its size, mobile equipment will be used for size reduction. Debris washing at the pit side is employed as necessary, with additional size reduction at that point if necessary for more efficient debris handling.

When uranium derbies are detected during excavation, they are segregated, and ultimately disposed of at the Nevada Test Site (NTS). Any waste disposed of in the On-Property Disposal Facility (OPDF) shall also be water washed to remove any loose contamination and size reduced as necessary before transportation to the facility. The details of materials management and WAC for the OPDF are also described in Appendix A of the Excavation Plan.

The wastewater (precipitation and waste drainage water) handling operations shown on Sketch SK-F-03909 are discussed in Section 7.

SECTION 3

WASTE PREPARATION
(PFD SK-F-03910)

3.1 Waste Receipt/Storage

PFD SK-F-03910 shows the destination of the waste streams from the waste pit area as they arrive (by truck) at the waste preparation area.

The PFD also depicts a 14-day contingency stockpile that is maintained, but not used, on a continual basis. The stockpile location is shown on the project conceptual site plan (SK-G-03936). The stockpile is covered to provide ready access to waste materials if inclement weather (or other factors) restrict excavation in the waste pits. The stockpile incorporates a liner and wastewater collection to remove water draining from the waste. Wet materials are stockpiled to take advantage of natural drainage. Once drained, they are used, allowing other wet materials to be stockpiled and drained.

The primary waste streams (Stream 101, dry waste/soil and Stream 102, wet waste) are dumped into their respective storage bins as shown by the stockpiles on the sketch. General arrangement sketch SK-M-03917 shows the location of the transfer area and storage bins for the primary waste streams. Wet waste is kept in the storage bins for approximately 5 days to allow free moisture to drain before further processing. Handling and destination of wastewater collected at various locations in the waste preparation area is discussed in Section 7.

In the initial preparation step, waste is retrieved from the bins to blend wetter and drier materials to achieve a more uniform waste (Stream 204). This mixing is by operator discretion, with the purpose and objective of preparing a blended working pile suitable for size separation and further processing. Waste retrieval and mixing is accomplished with the front-end loader in the working pile area of the Waste Preparation Area.

3.2 Waste Segregation

The first step in waste segregation is to remove debris larger than 12 inches from the blended waste stream. Waste from the blended working pile is retrieved using front-end loaders and transferred to two separate vibrating grizzlies with 12-inch openings (two grizzlies are provided to meet production requirements). The debris larger than 12 inches is then transferred to a mechanical segregation area, where this material is segregated into three streams: processable debris (Stream 206), nonprocessable debris (Stream 207), and uranium derbies (Stream 208). The processable waste and nonprocessable

debris are further discussed in Subsection 3.3. Uranium derbies found during this mechanical segregation step are put in dump trucks, then transported for disposal at the NTS.

The smaller-than-12-inch material from the grizzly is discharged into a pile, then transferred by front-end loader to skip hoists feeding two rotating trommel screens, which are used to remove the larger-than-4-inch material from the waste (two trommel screens are provided to meet production requirements). The material larger than 4 inches is sent to a mechanical segregation step, wherein any uranium derbies are removed. These derbies join the derbies in Stream 208 and are put in containers for disposal at the NTS. The remaining waste (between 4 and 12 inches in size) is sent directly to final blending and loadout (Stream 212).

The smaller-than-4-inch material from the trommel screen is used to form a 10-day storage pile. A portion of this 10-day storage pile is fed directly to the dryer (Stream 216), which reduces the moisture content in this feed to approximately 10 percent dry wt% (9 percent on a wet weight basis). Another portion of this 10-day storage pile is blended with the dryer product (Stream 215 as shown on PFD SK-F-03911) to achieve the optimum moisture content for that particular pit waste. The wet waste from the 10-day storage pile is transferred to a hopper feeder located above the twin auger mixer, where the wet waste and dryer product are blended.

3.3 Debris Management

The Debris Management Area is located in the waste preparation area and receives the large nonprocessable debris from excavation (Stream 104), the large processable debris from excavation (Stream 105), the processable waste from mechanical segregation (Stream 206), and the nonprocessable waste from mechanical segregation (Stream 207). In debris management, these materials are visually and manually separated, resulting in three separate material output streams: nonprocessable waste to on-site disposal (Stream 501), nonprocessable waste to loadout (Stream 502), and processable waste to the shredder (Stream 503). These streams are shown on PFD Sketch SK-F-03913. Sketch SK-M-03917 shows the Debris Management Area location.

The nonprocessable waste designated for on-site disposal is first washed to remove gross contamination, packaged, and then transported. The nonprocessable waste designated for railcar loading is transferred to the loadout area. At loadout, the nonprocessable waste is placed on top of waste loaded into the railcar from the blending area. This operation is carried out using a front-end loader.

3.4 Shredder

A shredder is provided for any large items received. It is shown on PFD SK-F-03913, but is located in the Waste Preparation Area. The shredder receives processable waste from the Debris Management Area

(Stream 503). A front-end loader feeds the processable waste to a skip hoist, which, in turn, feeds the shredder. Sketch SK-M-03917 shows the general arrangement of the shredder and adjacent Debris Management Area. The shredder reduces the size of incoming material to 4 inches by 4 inches by 4 feet or less. The shredded product is discharged into a container, and the containers are transferred to the final blending and loadout area by a forklift. The shredder is also equipped with a water-spray dust suppression system.

SECTION 4

DRYING AND OFF-GAS TREATMENT SHEET 1 OF 2 (PFD SK-F-03911)

PFD SK-F-03911 depicts operations for waste materials being received from the waste preparation area and processed through the dryer. In addition, this PFD shows the other primary waste processing step wherein the dryer product stream is mixed with wet (not dried) waste to produce a waste material blend at the optimum moisture content. Finally, the PFD shows utilization of waste heat from the dryer and the initial removal of entrained solids from the process off-gas. The following is an operational description of these processes.

An indirectly heated rotary dryer receives and processes wet waste material of various moisture contents, depending on the type of waste. The dryer reduces the moisture content of the waste materials to 10 percent (dry weight basis). Waste materials are fed to the dryer primarily from the 10-day storage pile (Stream 216). Materials from the 10-day storage pile are transferred to a skip hoist, using a front-end loader. The skip hoist dumps into the dryer feed bin located over the feeder, which delivers the material into the dryer. Feed spirals inside the rotating shell of the dryer convey the feed materials quickly into the heated section of the dryer.

Slurry feed to the dryer is provided as a means to accommodate the hydraulic retrieval contingency only, and is not anticipated to be part of the normal operation. However, if slurry feed is required, waste slurry from the slurry tank is pumped directly to the feeder (Stream 110) where it is mixed with the normal feed discharging from the dryer feed bin.

The rotary dryer system consists of a cylindrical shell rotated with a variable speed drive. The rotating cylinder is heated externally by a furnace with adequate length to satisfy heat transfer requirements. Using natural gas as fuel for combustion, heat energy for the indirect drying is produced in multiple furnace zones by a set of burners located in each zone. Burners are operated with adjustable primary air/fuel ratio, and secondary air addition to control the flame temperature so the rotating cylinder does not exceed its design temperature. Exit gases from each furnace zone are collected into a header, where they are transferred through a series of economizers (Stream 308) and eventually discharged through the combustion gas stack. The economizers produce clean, hot air that is used as sweep air and as a source of heat for the cyclones and reheater. Hot air is also available for heating buildings, if desired.

Heat energy from each furnace zone is indirectly transferred to the material advancing inside the rotating shell. This heat transfer from the furnace involves convection, conduction, and radiation. To ensure better mixing and, thus, efficient drying of the material inside the dryer, the shell is equipped with shallow agitating flights (flow disturbers).

The indirect rotary dryer with multiple furnace zones is provided with individual temperature control of each zone. This ability to control the temperature throughout the dryer provides flexibility and simplicity in drying wastes with varying levels of incoming moisture content, to achieve the desired moisture content in the dried product.

The slope and speed of the cylinder's rotation determines the retention time in the dryer. The slope is fixed, but the rotation speed is variable and is used to adjust the retention time as necessary, providing additional control of the drying process.

The preheated sweep air is introduced to the dryer in a concurrent fashion to aid in both heating the waste and carrying the vapors produced during the drying process through the off-gas treatment system. After exiting the dryer, the process off-gas stream is drawn first through the heated cyclone and then through the rest of the off-gas treatment process shown on PFD SK-F-03912. The cyclone removes the larger particulate matter entrained in the process off-gas, while keeping the steam and vapors in the process off-gas from condensing. The captured particulate matter (Stream 318) is blended with the dryer product (Stream 319).

The dryer product is discharged into a bin that feeds the dryer discharge conveyor. The conveyor delivers the dried product to a twin auger mixer, where it is blended with wet (not dried) waste (Stream 215) from the 10-day storage pile in a ratio specified to achieve the optimum moisture content. General arrangement sketches SK-M-03919 and SK-M-03921 depict the dryer, twin auger mixer, and associated equipment and facilities.

SECTION 5

DRYING AND OFF-GAS TREATMENT SHEET 2 OF 2 (PFD SK-F-03912)

SK-F-03912 presents a conceptual design in which the process off-gas is cleaned and released. The condensate and bleed streams from the various off-gas treatment unit operations also are filtered and released.

The process off-gas leaving the dryer originates from five sources: (1) sweep air, (2) vapors from the volatile components (mostly water), (3) gases generated from potential decomposition or reaction of components in the feed, (4) entrained solids from the feed, and (5) radon generated and released during the drying process. This off-gas, which contains air, steam, particulates, and various organic, inorganic, and radioactive contaminants (Stream 316), is scrubbed and filtered before release to the atmosphere.

The composition of the process off-gas was estimated (PARSONS 1995a) for drying each pit based on data reported in the RI report. The RI report includes inorganic, organic, and radionuclide data. For the inorganic constituents, the data are presented as cations and anions; specific compounds are not identified. Therefore, compounds were developed based on the cation and anion data and on process knowledge as described in detail in the referenced report.

For the volatile components (i.e., water, organics), the off-gas composition was determined by performing flash calculations in each zone of the dryer using the METSIM dryer simulation model developed by PARSONS (PARSONS 1995b). Flash calculations determine the distribution of volatile components between the vapor and liquid phases. Volatile components in the vapor phase report to the dryer off-gas. The quantity of sweep air is controlled so that 80 percent of the off-gas volume is water vapor.

It is assumed that some of the inorganic components fed to the dryer decompose due to localized heating at the shell surface or react with steam. These decompositions or reactions form acids and other gases (i.e., SO_x, NO_x, CO_2, HF, HCl, NH_3) to the extent shown in Table 5-1. Although the decomposition of some of the other components is less likely (based on the temperatures given in Table 5-1), these estimates are appropriately conservative at this stage of the design.

The amount of entrained solids in the off-gas (including remaining moisture and organics) is assumed to be 5 percent of the dryer product. This estimate will be revisited during final design of the system based on the drying equipment procured.

Table 5-1 - Extent of Decomposition or Reaction

Component	MP, BP, D Temperatures (°C)	Extent (%)
UF_4	(reaction with steam)	25
NH_4HCO_3	d = 35	100
NH_4NO_3	d = 210	2.5
$BaCl_2$	bp = 2029	0.5
$BaSO_4$	mp = 1580	0.5
$CdSO_4$	mp = 1000	0.5
$CaCl_2$	bp = 1940	0.5
CaF_2	bp = 2510	0.5
$Ca(NO_3)_2$	mp = 561	0.25
$Fe_2(SO_4)_3$	d = 1178	0.5
MgF_2	bp = 2263	0.5
$Mg(NO_3)_2$	d = 129	5
KCl	bp = 1437	0.5
$NaNO_3$	d = 380	2.5
$Th(SO_4)_2$	—	0.5

Notes:

bp = boiling point
d = decomposition
mp = melting point

Due to the radium content of the pit wastes, radon gas also is released to the process off-gas. The radon present in the wastes consists of the radon continuously generated by the material, and the radon that, although previously generated, remains trapped in the material. All of this radon is assumed to be released during the drying process. Both the radon generation rate from the material and the quantity of radon retained by the material are based on an engineering calculation (PARSONS 1994), the results of which are summarized in Tables 5-2 and 5-3. Only radon-222 is considered because of the extremely short half-lives of the other isotopes.

The off-gas treatment system presented is a conceptual design based on the off-gas compositions determined. The final design will be based on the results of air dispersion modeling currently in progress

and the regulatory requirements that apply. Consequently, the off-gas system design will remain conservative until the modeling results are available.

Table 5-2 - Radon Retained in the Pit Wastes

Pit	Retained Radon (pCi/g)
Pit 1	5.06E+01
Pit 2	4.37E+02
Pit 3	1.72E+02
Pit 4	2.34E+01
Pit 5	9.34E+01
Pit 6	3.90E+00
Burn Pit	1.47E+01
Clearwell	7.35E+01

Table 5-3 - Continuous Radon Generation Rates

Pit	Radon Release Rate (pCi/g/s)
Pit 1	1.06E-04
Pit 2	9.16E-04
Pit 3	3.61E-04
Pit 4	4.92E-05
Pit 5	1.96E-04
Pit 6	8.18E-06
Burn Pit	3.08E-05
Clearwell	1.54E-04

The first step in the off-gas treatment system is the removal of large entrained solids in the heated cyclone (shown on PFD SK-F-03911, Stream 316). The off-gas then passes through a spray tower for further removal of solids to protect the downstream condenser and other equipment from solids buildup. A small amount of the volatiles (water and organics) also are condensed in the spray tower. Caustic is added, as required, to the spray tower sump. This neutralizes the spray water that absorbs some of the acid

gases. The bleed from this sump (Stream 412) is transferred to the filter press feed tank. The off-gas from the spray tower is then cooled and condensed (water and organics) in a shell-and-tube type heat exchanger using cooling water. The condensate is collected in the multimedia filter feed tank.

After passing through the condenser (Stream 402), the process off-gas flows through a packed tower scrubber equipped with a demister. The scrubber uses a caustic solution to scrub acid gases. The caustic soda solution is made up as needed in the scrubber sump below the packed tower.

Since the downstream carbon beds must operate at a low relative humidity (~ 15 percent) to be efficient, the relative humidity is lowered by further cooling and condensing (of water and organics) the off-gas in a second shell-and-tube type heat exchanger using chilled water. The off-gas then is reheated using an indirect heat exchanger. This reheater uses hot air from the economizer as its heat source.

The reheated off-gas then passes through MEPA filters (Stream 405) before entering the activated carbon beds for adsorption of radon gas. The remaining (uncondensed) organics are also adsorbed on the carbon beds. Therefore, two trains are provided so that regeneration of the carbon occurs without shutting down the process. Finally, the off-gas passes through a HEPA filter before release to the atmosphere through the fan and stack.

The spray tower bleed is pumped from the filter press feed tank into the filter press or to other processing areas where water needs to be added to the waste material for dust suppression or other recycle use. The filtrate is pumped to the wastewater transfer tank and the filter cake is drummed and transferred to the waste blending and loadout facility.

Both off-gas condensate streams and the scrubber bleed stream flow to the multimedia filter feed tank. The contents of the multimedia filter feed tank are pumped through one of two multimedia filters and into a wastewater transfer tank, from which they are pumped as required to the Biodenitrification Surge Lagoon and thence to the FEMP wastewater treatment system for further treatment. The general arrangement of the process off-gas treatment system is shown on Sketch SK-M-03919.

The equipment will be sized to achieve the solids removal efficiencies shown in Table 5-4 and the contaminant removal efficiencies shown in Table 5-5. Note that the concentration of solid phase radionuclides in the pit waste solids remains fixed throughout the off-gas treatment process. Consequently, these radionuclides are removed at the same efficiencies as the solids as shown in Table 5-4. The radon removal efficiency in the carbon beds is 0.97. As previously discussed, water and organic vapors are removed from the off-gas by condensation as determined by flash calculations. Table 5-6 shows the estimated stack emission rates for Pit 6; Table 5-7 gives the estimated stack-gas composition.

Table 5-4 - Solids Removal Efficiencies

Unit Operation	Solids Removal Efficiency	Cumulative Percent Remaining
Cyclone	0.90	10
Spray Tower	0.95	0.5
Off-Gas Condenser	0.5	0.25
Caustic Scrubber	0.85	0.0375
Off-Gas Heat Exchanger	0.5	0.01875
MEPA Filter	0.95	0.000938
HEPA Filter	0.997	0.00000281

Table 5-5 - Contaminant Removal Efficiencies

	Contaminant					
Unit Operation	SO_x	NO_x	HF	HCl	NH_3	CO_2
Spray Tower	0.6	0	0.5	0.5	0.9	0.6
Off-Gas Condenser	0	0	0.5	0.5	0.9	0
Caustic Scrubber	0.9	0.25	0.9	0.9	0.95	0.9
Cumulative Efficiency	0.96	0.25	0.975	0.975	0.9995	0.96

Table 5-6 - Estimated Stack Emission Rates for Pit 6 (lb/hr)

Solids	0.0000338
- Radionuclides	4.4148×10^{-8}
Gases	-
- Organics	Trace
- Acid Gases	26.57
- Radon	1.781×10^{-14}
Total Off-Gas	3,259 (715 scfm)

NOTES:
1. All radionuclides except radon are included with the solids.
2. U-238 and Th-232 are not included with the radionuclides.

Table 5-7 - Estimated Stack-Gas Composition for Pit 6

Component Name	Chemical Formula	After Treatment (wt%)
SOLIDS		
	Al2O3	4.18707125
	As2O3	0.00469885
	Ba1Cl2	0.03857336
	Ba1O2	0.00020434
	Ba1S1O4	0.03766171
	Be1O1	0.00740972
	Cd1O1	0.00077455
	Cd1S1O4	0.00369624
	Ca1O2H2	16.36563881
	Ca1F2	2.02813438
	Ca1N2O6	1.32198733
	Cr1O2	0.02269101
	Co1O1	0.01546201
	Cu1O1	0.12951947
	Fe2O3	1.83736926
	Pb1O1	0.03022121
	Mb1F2	31.98025467
	Mg1O2H2	5.45186618
	Mg1N2O6	4.40567963
	Mn1O1	0.02118497
	Ni1O1	0.03032161
	K1O1H1	0.36847788
	K1Cl1	0.16265236
	K1F1	0.0635549
	K2C2O3	0.07560323
	Ag2O1	0.07951893
	Na1O1H1	0.38554734
	Na3U1O4	0.0150604
	Na1Cl1	0.1415678
	V1O2	0.07620564
	Zn1O1	0.0297192
	U3O8	10.1406719
	U1F4	9.69635589
	U1O3	10.34147728
	Th1O2	0.00291623
	Th1S2O8	0.00464528
Cs-137	Cs1	1.677 x 10-10
Np-237	Np1	0.00000239
Pu-238	Pu1	3.825 x 10-11
Pu-239	Pu1	0.00000011
Sr-90	Sr1	1.747 x 10-11
Tc-99	Tc1	0.00000666
Th-228	Th1	6.858 x 10-13
Th-230	Th1	0.000001
U-234	U1	0.00040061
U-235\236	U1	0.01265074
	U1O2	1.41810214
	Mg1O1	0.06330507
	Ca1O1	0.00113745

Table 5-7 - Estimated Stack-Gas Composition for Pit 6 (Continued)

Component Name	Chemical Formula	After Treatment (wt%)
ORGANIC		
2-butanone	C4H8O	0
Aroclor-1254	C12H5Cl5	0
bis(2-ethylhexyl)phthalate	C24H38O4	0
dichloromethane	CH2Cl2	0
tetrachloroethene	C2Cl4	0
methyl butyrate	C5H10O2	0
trichloroethene	C2HCl3	0
GASEOUS		
	H2O	0.75699688
	N2	75.59689754
	O2	22.7209359
Rn-222	Rn1	5.464 x 10-16
	CO2	0.00001235
2-butanone	C4H8O	0.0063547
Aroclor-1254	C12H5Cl5	0.00001407
bis(2-ethylhexyl)phthalate	C24H38O4	9.888 x 10-10
dichloromethane	CH2Cl2	0.00327503
tetrachloroethene	C2Cl4	0.09696665
methyl butyrate	C5H10O2	0.00002011
trichloroethene	C2HCl3	0.00311415
	H1F1	0.03006567
	N1H3	0
	N1O2	0.7852943
	H1Cl1	0.00000614
	S1O2	0.0000465

SECTION 6

DRIED WASTE BLENDING AND LOADOUT (PFD SK-F-03913)

6.1 Debris Storage

A debris storage area is provided in the blending and loadout area to receive the -4-inch shredded waste and nonprocessable waste designated for railcar loading for off-site disposal. Sketch SK-M-03921 shows the general arrangement of the debris storage area.

6.2 Blending

The Blending Area receives waste from four different sources: shredded waste (Stream 504), trommel screen oversize (Stream 212), dry material storage (Stream 217), and material from the twin auger mixer (Stream 320). These materials are retrieved from their respective storage with a front-end loader, and blended together on a pad with the same front-end loader for ease of handling and optimum moisture content (determination of blending ratio is dependent upon the operator). After blending, the material is dumped into railcars using the front-end loader (Stream 506).

6.3 Loadout and Storage

Four empty railcars are transferred from north to south into the Loadout Facility by the on-site yard locomotive and decoupled from the engine. At the opposite end of the rail spur, the cars are coupled to a railcar mover. The car mover moves the railcars into the various areas of the facility. (Refer to the dried waste railcar loadout area on the Conceptual Site Plan, SK-G-03936).

The Loadout Facility consists of three discrete areas. Area 1 is the railcar loading area, Area 2 is the lid handling area, and Area 3 is the railcar decontamination area. The facility equipment is located under roof to prevent exposure to precipitation. The facility has a curbed concrete floor, sloped to trenches and sumps to provide confinement for any liquids, such as windblown precipitation, or dust control spray water. Sketch SK-M-03921 shows the general arrangement of the Loadout Facility and entire final blending area.

The first railcar is moved to the second area of the facility, where the lid is removed. Here, operators on adjacent structural steel platforms disconnect the lid latches from both sides of the car. Next, the operator remotely maneuvers the lifting beam with the overhead bridge crane to secure the beam to the

two lifting lugs on the lid. The crane is then actuated to lift the lid from the car and transfer it to the side, where it is stored at grade level.

Next, the operators insert a plastic liner into the railcar. The top of the liner is draped over the side of the railcar to prevent contamination during loading.

The railcar is then moved by the car mover to the first area, where it is loaded with waste via a front-end loader. The blended waste is transferred from the storage area to the railcar with a front-end loader, which travels up gradual inclined ramps to load the railcar. Multiple ramps are provided to more uniformly load the railcar, but the car mover may be required to provide limited car movement to obtain the full capacity of the railcars.

The first area incorporates an integral track scale to provide local indication of the gross weight to determine net weight of the waste load. The net weight is recorded on the shipping manifest along with the serial number of the car.

During loading of the railcar, composite grab samples of the waste are taken for analysis of the waste to ensure compliance with the disposal site WAC and United States Department of Transportation (DOT) requirements. Because the results of the waste sample analysis are not completed until sometime after the car is filled (conservatively estimated at 6 days), the serial number of the car is referenced to the sample, and the car is held on site until this information is obtained and a shipping manifest prepared.

Once the car is filled, the car mover moves the filled car back to the second area. Here, the top of the liner is placed over the waste and sealed. The lid then is replaced by the overhead bridge crane system and secured by latches at four corners.

The car mover then moves the car to the third stage of the facility. Here, the car is decoupled from the train and surveyed to comply with DOT requirements. Any gross surface contamination is removed, and smears are taken and counted to determine the removable contamination level. In addition, the car surface dose rate measurements are taken and recorded. During decontamination of the first car, the car mover stages the second car in the second area for lid removal and liner placement. The sequence continues until the second car is ready for decontamination. At that time, the car mover advances the string of cars, thus coupling the first and second cars, until the second car is positioned in the decontamination area.

The sequence continues for all remaining cars until the train of four cars is completed. Then, the yard locomotive transfers the four-car train to an on-site holding area until the sampling analysis is complete for all the cars and a shipping manifest prepared.

If the waste sampling analysis shows that a particular car does not meet all of the shipping and disposal requirements, then the car is removed from the train and returned by the yard locomotive to the separate unloading spur at the loadout facility. Once the lid is removed, a backhoe or other suitable equipment is used to remove the waste from the car and transfer it back to the blending area via a dump truck (Stream 512). Here, it is reblended with other waste (Stream 513) to meet the shipping and disposal requirements. Details of this unloading facility and equipment will be developed in final design.

Sketch SK-M-03921 shows a potential expansion area at the south end of the loadout facility. If waste sample analysis times can be reduced (to 1-2 days), it may be desirable to hold the waste product before railcar loadout. If so, the expansion area would provide the necessary additional space.

SECTION 7

WASTEWATER, UTILITIES, AND MISCELLANEOUS SYSTEMS

7.1 Wastewater

All wastewater generated by the OU1 remediation activities is treated at the FEMP wastewater treatment system prior to discharge to the Great Miami River via manhole 176B. The FEMP National Pollutant Discharge Elimination System (NPDES) permit governs the discharge from the FEMP wastewater treatment system. The Biodenitrification Surge Lagoon is the receiving basin for any wastewater sent to the FEMP wastewater treatment system from OU1. Table 1 presents the estimated quantity of wastewater from OU1. A description of each wastewater stream and the peak and average discharge rates for each stream also are identified in this table.

Five types of wastewater streams are generated by OU1:

1) Waste pit surface water is the water currently on Pits 5, 6, and the Clearwell. This water is pumped off prior to the start of waste excavation in the pit. This water will be transferred through the Clearwell to the Biodenitrification Surge Lagoon using the system and facilities currently in place.

2) Excavation water includes precipitation directly over the waste pit area excavation and water that freely drains from the waste into the excavation. Stormwater runoff that enters the excavation from the entire 25-acre waste pit area is not included in the estimate in Table 1 because it is presently being received by the FEMP wastewater treatment system as a wastewater stream. However, for conservatism, additional stormwater allowance is included for an assumed 5-acre open excavation area.

   Sketch SK-F-03909 also shows the basic process for removal of stormwater entering the open pit area. Surface water run-in is controlled and minimized to the extent practical. Currently, that surface runoff water enters the Clearwell, ultimately being processed by the FEMP wastewater treatment system. Stormwater directly entering the open excavation is collected in sumps and pumped out of the pits to the Clearwell as quickly as practical. Temporary settling pools are used, prior to transfer to the Clearwell, to reduce sediment loading on the Clearwell.

   Water is expected to continually drain from the excavation faces and will also come from debris washing operations and accumulate at the toe of the waste excavation face. This waste drainage water is also pumped to the Clearwell. Depending on the final estimates for these quantities (to be developed during detailed design), additional water handling systems will be included as

necessary to support excavation. It is advantageous to promote, collect, and remove as much of this waste drainage water as possible to support mechanical excavation. The Excavation Plan presents additional discussion of wastewater management in the pit area.

Water removed from the waste pit area excavation (storm and drainage water) is temporarily retained to reduce suspended solids, then transferred to the Clearwell. From the Clearwell, existing systems transfer the water to the Biodenitrification Surge Lagoon.

3) Process wastewater includes water that free drains from the waste during storage (e.g., in the waste preparation area and contingency stockpile), condensed water vapor, scrubber and chiller bleed water, and water that may drain from the waste during processing. Process wastewater will be collected and transferred directly to the Biodenitrification Surge Lagoon.

Recycle of some of this wastewater (such as the condensate water) for reuse in washing or dust control will be maximized.

4) Decontamination water is water generated from the decontamination of equipment, personnel, and railcars. Nearly all decontamination wastewater will be collected and transferred directly to the Biodenitrification Surge Lagoon.

A small amount of decontamination water is generated at the Waste Pit Area (it may be recycle Clearwell water) which would be handled with the stream discussed in Item 2 above.

5) Stormwater from the new facilities area includes only the stormwater from the new process area (approximately 10.6 acres). Currently this stormwater is clean and now discharges to Paddys Run. As operations begin, this water will have potential to be contaminated, so it must be collected and managed for treatment by the FEMP wastewater treatment facility. This runoff drains to a stormwater management basin that holds a 25-year, 24-hour storm. An overflow spillway for the stormwater management basin discharges excess water (up to a 100-year storm) through a ditch north of Pit 5 to Paddys Run. Except for overflows, all basin discharge will be pumped directly to the Biodenitrification Surge Lagoon. There is potential to separately collect some of this water (e.g., from the 5-acre roof area), which will be clean, and discharge directly. These details will be developed in final design.

Table 7-1 - OU1 Peak and Average Wastewater Discharge to the FEMP Wastewater Treatment System via the Biodenitrification Surge Lagoon

Stream Number		Total Water (gallons)	Discharge Period (days)	Rate Peak (gpm)	Rate Average** (gpm)	Comments
	Waste Pit Surface Water					
1	Water currently on Pits 5, 6, and the Clearwell	2,920,000	15	149	135	Not included in peak or average total since this water would be removed before the pits are processed
	Excavation Water					
2	Precipitation (40"/yr over open pit area (assume open pit area = 5 acres)	5,430,000	275		14	
3	Precipitation (4.8"/day over open pit area for 25-year storm event)	652,000	7	65		
4	Water inflow from waste (estimates based on flows observed during DEEP)			300	50	
	Process Wastewater					
5	Dewatering due to drainage during storage Initial MC = 67% db Final MC = 56% db	15,900,000	1,765	9	6	Discharge period is based on number of days it will take to reduce the MC of Pits 2, 3, 5, and the Clearwell waste down to optimum moisture content with the dryer.
6	Condenser Water (100% of water removed by dryer) Initial MC = 56% db Final MC = 20% db	51,000,000	2,104	25	17	
7	Other process water (i.e., scrubber)			17	11	
8	**Decontamination Water**			5	3	
9	**Stormwater (from New Process Area)**					
	(4.8"/day over 10.6 acres)	1,400,000	7	139		
	(40"/yr over 10.6 acres)	11,500,000	275		29	
	Total			560	130	

* Peak for 24 hours; maximum peak flows would occur when excavating a saturated low permeability area of a pit.
** Maximum average for 1 month; maximum average flows would occur when only Pit 5 is being processed.

MC = moisture content
db = dry basis
gpm = gallons per minute

000166

0163

Table 7-2 shows the routing of the five wastewater streams.

Table 7-2 - Stream Routing

	Clearwell	Stormwater Management Basin	Biodenitrification Surge Lagoon	FEMP Wastewater Treatment Facility
Waste Pit Surface Water	x		x	x
Excavation Water	x		x	x
Process Wastewater			x	x
Decontamination Water	x[1]		x	x
Stormwater (New Facilities Area)		x	x	x

[1] Minor amount

Pretreatment of the wastewater at the OU1 process, in addition to settling for suspended solids, may be necessary, depending on the Waste Acceptance Criteria (WAC) for the FEMP wastewater treatment system. OU5 is currently developing the WAC for the FEMP wastewater treatment system to ensure that the discharge from the FEMP wastewater treatment system will meet the requirements of the NPDES permit.

7.2 Utilities and Miscellaneous Systems

Auxiliary processes and utilities required for this facility include the following:

1) Electrical power and lighting

2) Fuel (diesel and natural gas)

3) Heating, ventilation, and air conditioning (minimal requirements; basic waste processing completed in open-sided, roof-covered areas)

4) Compressed air (instrument, plant)

5) Water (plant treated, cooling, chilled)

6) Dust collection and suppression

7) Chemicals/reagents

8) Fire protection

Mobile dust suppression systems are used throughout the facilities on an as-needed basis to minimize airborne emissions.

To the maximum extent possible, the water needs for this facility are met through recycle of process wastewater to lower the demand for total water input to the process facility. Additional detail for overall utility requirements is presented in the *Preliminary Estimate of Utility Requirements for Proposed Remedial Facilities for OU1 Remediation*.

SECTION 8

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Control Philosophy for the Remediation System Design

Operable Unit 1
Project Order 145

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Revision C

Environmental Remedial Action Project
Fernald Environmental Management Project
Fernald, Ohio
FERMCO Subcontract No. 2-21487

PARSONS

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Control Philosophy for the Remediation System Design

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LIST OF ACRONYMS AND ABBREVIATIONS

AWWT	Advanced Wastewater Treatment
DCS	Distributed Control System
HEPA	High-Efficiency Particulate Air
HOA	Hand-Off-Auto
MEPA	Medium-Efficiency Particulate Air
OCA	Open-Close-Auto
PFD	Process Flow Diagram

SECTION 1

INTRODUCTION

1.1 Objective

This report covers the general operating and control philosophy for the Operable Unit 1 Waste Pits Remediation System Design, which covers remediation of Pits 1 through 6, the Burn Pit, the Clearwell, waste pit caps, and contaminated waste pit soils. Section 2 describes the operation, process control and instrumentation for each process operation as depicted on the Process Flow Diagrams (PFDs). The process operations include waste retrieval and transfer, waste preparation, drying and off-gas treatment, waste blending and loadout, and wastewater handling. Control and instrumentation for miscellaneous systems and utilities are also described, even though the PFD has not been developed (it will be developed during detailed design). For more detailed descriptions on the operations of these systems, refer to the document titled "Process Description for the Remediation System Design."

1.2 Distributed Control System

The remediation system operation is controlled and monitored by a Distributed Control System (DCS). As a minimum, the DCS is capable of performing the following functions:

1) Collection and display of all process parameters (i.e., temperature, density, pressure, etc.); the number of analog and digital input/outputs will be determined during detailed design.

2) Orderly display and information on video monitors. The monitor display program includes graphic features for displaying process parameters.

3) Automatic or manual operation of selected control loops and digital outputs through the operator station interface.

4) Initiation of an audible and/or visual alarm signal when any input parameter, either analog or digital, exceeds a preset limit or status. The DCS also reacts to alleviate alarm situations through the use of software interlocks.

5) Allowance for programs for various data manipulations, trending, and report generation.

6) Automatic printing of alarms on a dedicated printer.

1.3 General Instrumentation and Controls

The following are general statements and apply to all process equipment. (Note: heating, ventilation, fire protection, air conditioning, and sump pumps are not included.)

1) Motor-driven equipment have a local Hand-Off-Auto (HOA) switch. Placing the HOA in the HAND position allows the associated motor to run until the switch is placed in the OFF or AUTO position. Placing the HOA in the AUTO position allows the associated motor to be operated by the DCS until the HOA switch is placed in the OFF or HAND position. The DCS provides indication when the HOA switches are in the AUTO position.

2) Motor-driven equipment have an auxiliary contact input to the DCS. These contacts are used to inform the operator when motors are running and to keep the motors running after the start signal is removed. When the auxiliary contact drops out, the DCS "start" pushbutton must be depressed again after the condition that stopped the motor has been corrected.

3) Motors can be manually started and stopped from the DCS operator's panel. The motors can also be automatically stopped or prevented from starting by the DCS or by hard wiring.

4) Solenoid valves are used to control the instrument air to the pneumatically operated equipment and open/close valves. The solenoid valves are controlled from the DCS, with "run" and "stop" pushbuttons for equipment and "open" and "close" pushbuttons for valves and interlocking functions, as described in Section 2. Each of these solenoid valves has an attached manual operator to allow local operation of the valve or equipment. When the manual operator is disengaged, the control reverts back to the DCS. Pneumatically operated open/close valves have limit switches to provide status information to the DCS.

5) The DCS alarms if a control valve is not in the position the DCS program requires. (A Spectrum Multistation logic is used for graphic display.)

6) Motorized valves have Open-Close-Auto (OCA) switches. Placing the OCA switch in the OPEN position causes the valve to drive open until the internal "open" limit switch is engaged. Placing the OCA switch in the CLOSE position causes the valve to drive closed until the internal "closed" limit switch is engaged. Placing the OCA switch in the AUTO position allows the DCS to control the valve. The DCS provides indication when the OCA switches are in the AUTO position.

SECTION 2

PROCESS FLOW DIAGRAM SYSTEMS

2.1 Waste Retrieval - PFD SK-F-03909

2.1.1 Mechanical Excavation

2.1.1.1 Operation

Mechanical excavation is the planned excavation method for all pits. Waste pits will be excavated using conventional earth moving equipment such as extended reach hydraulic excavators and front end loaders. Approach ramps will be excavated as required for equipment deployment and for transporting waste from the pits. The excavated waste will be loaded into dump trucks and transferred into the waste preparation facility. Processable and nonprocessable debris will also be transported by truck to the debris management area of the waste preparation area. During excavation of dry materials, water sprays will be used to minimize fugitive emissions.

Stormwater and freestanding water will drain into sumps located at the bottom of the pit, then be pumped to the Clearwell, then to the Biodenitrification Surge Lagoon for eventual treatment in the FEMP wastewater treatment facility.

2.1.1.2 Instrumentation and Controls

1) The stormwater collection pump(s) have automatic level controls as well as local manual switches.

2) The stormwater collection sump(s) will contain an automatic level control to start the booster pump.

3) The booster pump outlet to the Clearwell will contain a flow indicator/totalizer.

4) Alarms: To be determined during detailed design.

2.1.2 Hydraulic Waste Removal

2.1.2.1 Operation

The PFD also depicts a contingency operation for hydraulic waste removal if any wastes are encountered that cannot be mechanically excavated. A slurry pump on a boom crane pumps the slurry from the waste pits to a tanker truck. The slurry is transported to and unloaded into an agitated slurry tank. This contingency hydraulic waste removal operation is only used as necessary based on the decision of the retrieval operation supervisor.

2.1.2.2 Instrumentation and Controls

1) The slurry pump has local manual controls and switches.

2) The tanker truck has its own level instrumentation.

3) The tanker truck has its own HOA switches for agitator and pumps.

4) The slurry tank has level instrumentation.

5) The slurry tank rake-type agitator has torque indication.

6) Alarms:
   (1) The tanker truck has a high-level alarm.
   (2) The slurry tank has a high-level alarm.
   (3) The rake-type agitator in the slurry tank has a high-torque alarm.

2.2 Waste Preparation - PFD SK-F-03910

2.2.1 Operation

The waste preparation area consists of wet and dry material storage, debris management, blending area, segregation operations, and shredding.

Waste is transferred by truck to the waste preparation area. Dry and wet material is stored in separate piles, after which some dry material will be blended with the wet material (if adjustment of the wet waste moisture content is required) into a single working pile. This working pile provides feed to the segregation operation which is done in two stages. The first stage (grizzly) separates material larger than 12 inches. The underflow from this first stage (-12 inches) feeds the second stage of segregation

(trommel). Oversize material from the second stage (+4 inches) is passed to a mechanical segregation operation. Oversize from the first stage (+12 inches) is also passed to mechanical segregation. Derbies (uranium) from the mechanical segregation are transferred for separate disposal at the Nevada Test Site. Processable and nonprocessable (+12 inches) debris is passed to the debris management area. Oversize (+4 inches) material from the second stage will be passed to the blending area of the waste blending and loadout facility.

The undersize (-4 inches) material from the second stage is passed to a 10-day storage pile. This storage pile provides both feed to the dryer and material for adjusting dryer product moisture content to the optimum level.

There is a contingency stockpile that will contain enough capacity to allow for 14 days of waste processing in the event of inclement weather or other problems with excavation. This pile will contain both wet and dry material.

2.2.2 Instrumentation and Controls

1) Skip hoists have standard instrumentation/controls as supplied by the vender.
2) Trommel screen has a variable speed drive to adjust throughput capacity.
3) Traffic lights are provided to control truck and loader traffic.
4) A high torque controller on the shredder shuts down the operation until the problem is alleviated.
5) The dust suppression system to the shredders is provided with local flow indication.
6) The shredder is equipped with an automatic fire protection system that is linked to the DCS.

2.3 Drying and Off-gas Treatment Sheet 1 of 2 - PFD SK-F-03911

2.3.1 Operations

The dryer receives waste materials with various moisture contents depending on the type of waste. Waste materials are fed into the dryer primarily from the 10-day storage pile. Some of the waste materials are also fed intermittently as a slurry from the slurry tank (only as a contingency method). Both of these materials are metered into the dryer with the dryer feeder and dried to 10 percent moisture content (dry weight basis).

The rotary dryer system consists of a cylindrical shell rotated with a variable speed drive. The rotating cylinder is heated externally by a furnace with adequate length to satisfy heat transfer requirements. Using natural gas as fuel for combustion, heat energy for the indirect drying is produced in multiple furnace zones by a set of burners located in each zone. Burners are operated with adjustable primary

air/fuel ratio, and secondary air addition to control the flame temperature so the rotating cylinder does not exceed its design temperature.

The drying operation is controlled by adjusting the temperature conditions in each zone of the dryer, the feed rate into the dryer, and the retention time in the dryer. The retention time is controlled by varying the speed of rotation of the dryer shell. The feed rate is controlled by a variable rate feeder, and the temperature conditions are set in each zone of the multiple-zone furnace. Product moisture content and temperature are monitored and used as feedback data for manual control of the drying operation.

The product moisture content is targeted at 10 percent so that the optimum moisture content of the waste can be achieved by mixing the dryer product with wet (not dried) material from the 10-day storage pile in the twin auger mixer. Knowing the moisture content and flow rate of the dried product, and the moisture content of the wet material, the flow of the wet material is controlled to achieve the desired optimum moisture content.

The economizers utilize the heat available in the combustion gases exiting the dryer to preheat the sweep air and to provide hot air for heating the cyclone, reheater, and the building (if desired). Measurement of stream temperatures and control of the hot air flows are used to control these units. The cyclone is heated to prevent condensation of the steam and organics.

A more complete explanation of the operation is available in the Process Description.

2.3.2 Instrumentation and Controls

To support and control the operation depicted in PFD SK-F-03911, the following major controls and instrumentation are implemented.

1) A burner management system ensures safe operation of the dryer. The safety-interlock logic ensures that the required limits and conditions (as specified by the vendor and standard burner management/safeguard practice) are satisfied prior to permitting start-up, continued operation, or shutdown of the dryer. If the limits and conditions of the logic are not met, the management system does not allow startup of the burners, or shuts them down if in operation.

2) The burners in each zone are controlled to maintain the selected shell temperatures. The shell temperatures are selected manually by the operator.

3) The fuel/air ratio of each burner is controlled by a pressure balanced regulator or a fully metered electronic control integrated with a programmable microprocessor as determined by the vendor.

4) The temperature of the sweep air and other hot air streams are controlled by varying the flow rate of air passing through the economizers.

5) The skip hoists, feeders, mixers, and other equipment are provided with standard controls as specified by the vendors.

6) Temperature instrumentation is provided in the following locations: primary and secondary combustion air to burners, dryer shell temperature in each zone, combustion gases in each furnace zone in various locations in the annular space between the furnace wall and the dryer shell, combustion gases exiting each furnace zone, air to and from the economizers, combustion gases to and from the economizers, sweep air to the dryer, process off-gas from the dryer, dryer product temperature just before leaving the last dryer zone, hot air to and from the cyclone heater, and process off-gas from the cyclone.

7) Flow instrumentation is provided on the following: natural gas to the burners, primary and secondary combustion air to the burners, total combustion gas to the stack, process off-gas from the cyclone, air to the economizers, sweep air to the dryer, slurry feed to dryer, and feed rate to dryer.

8) Pressure instrumentation is provided on the following: natural gas to burners, primary and secondary combustion air to burners, and process off-gas from dryer.

9) Moisture content determination is performed using both on-line instrumentation and grab sample techniques for the dryer product, material from the 10-day storage pile, and the discharge from the twin auger mixer.

10) Alarms to be determined during detailed design.

11) The skip hoists, feeders, mixers, and other equipment are provided with standard instrumentation as specified by the vendors.

2.4 Drying and Off-Gas Treatment Sheet 2 of 2 - PFD SK-F-03912

2.4.1 Operations

On this flowsheet, the process off-gas leaving the heated cyclone is further cleaned, cooled, and condensed in an off-gas treatment system consisting of the following unit operations: (1) spray tower, (2) condenser, (3) scrubber, (4) heat exchanger, (5) reheater, (6) Medium-Efficiency Particulate Air (MEPA) filters, (7) carbon beds, (8) High-Efficiency Particulate Air (HEPA) filters, and (9) blower with

stack. In addition, the condensate and bleed streams from the various unit operations are also filtered and released to wastewater disposal or recycle.

In the off-gas treatment system, a spray tower removes solids from the off-gas to protect the condenser and other downstream equipment from solids buildup. In this tower, a small percentage of the steam in the off-gas is condensed and some of the acid gases are absorbed. Most of the off-gas then passes to the condenser which removes the majority of the steam from the off-gas. The acid gases remaining in the off-gas at this point are largely scrubbed from the off-gas in a packed tower scrubber. The off-gas is then dehumidified by a cooling and condensing step followed by reheating. MEPA filters are used to remove particulates to prevent loadup and fouling of the downstream carbon beds. The carbon beds are used to remove radon from the off-gas. However, any uncondensed organics present in the off-gas also build up on the carbon beds. Because of the radioactive contamination of the pit wastes, HEPA filters are installed to remove particulates from the off-gas prior to release to the atmosphere.

The wastewater filters remove particulates from the condensates and scrubber bleed prior to discharging them to the Biodenitrification Surge Lagoon. The filter press removes the high concentration of solids from the spray tower bleed prior to discharging it to the BSL. The filter cake is drummed and sent to the waste blending and loadout operations.

A more complete explanation of the operation is available in the Process Description.

2.4.2 Instrumentation and Controls

To support and control the operation depicted in PFD SK-F-03912, the following major controls and instrumentation are implemented:

1) The temperature of the off-gas leaving the condenser is controlled by varying the flow rate of the cooling water passed through the condenser.

2) The temperature of the off-gas leaving the heat exchanger is controlled by varying the flow rate of the chilled water passed through the heat exchanger.

3) The temperature of the off-gas leaving the reheater is controlled by varying the flow rate of the hot air passed through the reheater.

4) The total solids (suspended and dissolved) in the spray tower and scrubber sumps is manually controlled by setting the bleed to maintain the density below a set maximum value.

5) The caustic strength in the spray tower and scrubber sumps is controlled by monitoring the pH.

6) The filter press is provided with standard controls as specified by the vendor.

7) Temperature instrumentation is provided on the following: process off-gas streams to and from the spray tower, condenser, scrubber, heat exchanger, reheater, and carbon beds; cooling water to and from the condenser, chilled water to and from the heat exchanger, hot air to and from the reheater, spray tower sump liquid, and scrubber sump liquid.

8) Flow instrumentation is provided on the following: water and caustic makeup (totalizers) to the spray tower sump and the scrubber sump, cooling water, chilled water, backwash supply, hot air to reheater, scrubber and spray tower recycle, and bleed streams.

9) Level instrumentation is provided for the following: spray tower sump, scrubber sump, filter press feed tank, multimedia filter feed tank, and wastewater transfer tank.

10) Differential pressure instrumentation is provided on the following: MEPA filters, HEPA filters, carbon beds, and multimedia filters.

11) Density control is provided for the scrubber sump and spray tower sump liquid.

12) pH monitoring is provided for the scrubber sump and spray tower liquid.

13) An isokinetic sampler/monitor is provided for the process off-gas stack. Isokinetic sampling is continuous during normal operation with stack data input to the DCS.

14) Radon monitoring is provided before and after the carbon beds.

15) Alarms to be determined during detailed design.

16) The filter press is provided with standard instrumentation as specified by the vendor.

2.5 Dried Waste Blending and Loadout - PFD SK-F-03913

2.5.1 Operation

The Waste Blending and Loadout Facility consists of blending, railcar loading, lid handling, and railcar decontamination. Railcar loading incorporates an integral track scale to provide local indication of gross railcar weight to determine net load weight. During loading of the railcar, composite grab samples of the waste are taken to ensure compliance with the disposal site waste acceptance criteria and United States Department of Transportation requirements. If the waste sampling analysis shows that a particular railcar

does not meet all of the shipping and disposal requirements, then the railcar will be returned by the yard locomotive to the reject working pile located with the waste blending and loadout facility.

2.5.2 Instrumentation and Controls

1) A local weigh scale is used for the railcar filling operation.
2) A local flow indicator/totalizer is provided for the decontamination water.
3) Level control is provided for the decontamination water sump.
4) The skip hoist drive has motor torque control.
5) Hydraulic power units have flow and pressure indicators.
6) Alarms to be determined during detailed design.

2.6 Wastewater, Utilities, and Miscellaneous Systems (PFD to be developed during detailed design)

2.6.1 Operation

To be determined during detailed design.

2.6.2 Instrumentation and Controls

1) Spill Containment Sump Pumps: Pump control is entirely manual. Off-on control is incorporated in a local manual motor starter. Before running the pump, the operator manually operates a discharge valve to direct flow from the sump to a building sump tank or spare storage tank, depending on the contents of the sump.

2) Wash Water Sump Pump: The pump is controlled by a locally mounted HOA switch. The pump may be manually run in HAND position for maintenance purposes. In AUTO position, pump operation is controlled by level switches mounted in the sump tank. The liquid, on reaching a predetermined level in the sump tank, closes these level switches, which energizes the electrical contactor. An auxiliary contact closes during a decreasing level until the low-level switch opens, breaking the seal-in circuit and stopping the pump at low level.

3) Building sump pumps are controlled by locally mounted HOA switches. Each individual pump may be run manually in the hand position for maintenance purposes. In auto position, pump operation is controlled by low-, high-, and high-high-level switches mounted in the tank. The liquid, on reaching a predetermined level in the sump tank, closes the low-level contacts in both pump circuits. A continued rising sump level eventually closes the high-level contact in the pump circuit, initiating its start. An auxiliary contact closes the circuit during a decreasing level until

the low-level switch opens, breaking the seal-in circuit and stopping the pump at the low level. Should the inflow exceed the capacity of the pump, or should the pump be out of service, the level will continue to rise in the tank, closing the high-high contacts. This will sound the building sump pump high-high alarm, and initiate the start of the standby pump. Both pumps will continue to operate until the low level contacts open, breaking the seal-in circuits and stopping both pumps.

4) Emergency Horn Valve: Solenoid valve opens when power is lost at the valve.

5) Alarms:
   (1) Fire alarm system detects a fire or a pull station is activated.
   (2) Emergency shutdown is activated.
   (3) Plant compressed air pressure low.
   (4) Building sump tank reaches high-high level.

Mass and Energy Balance

MASS AND ENERGY BALANCES

Mass and energy balances have been prepared for the entire remediation process. Balances are shown in a tabulated form on each Process Flow Diagram (PFD) (attached). These PFDs represent each process operation area described in the Process Description, Subsection 1.2. They are performed based on the process design requirements specified in the Process Description, Subsection 1.3.

The balances describe Pit 6 operations. Based on the in situ moisture and optimum moisture content for the product, per Subsection 1.3, Table 1-1 of the Process Description, a judgement was made to select Pit 6 as representative in terms of determining material handling capacities to support the targeted output shipment of 960 tpd of the treated waste based on one dryer in operation. At the start of the remediation this will be the case.

Energy balances were also calculated for the drying and off-gas treatment operations. All the other operations are basically material handling operations carried out in ambient conditions not requiring an energy balance.

It shall be noted that balances are reflecting the preliminary stage of the design. During the course of further design, streams presently marked "TBD" will be included to make the mass and energy balances final. In addition, energy balances supplied by the dryer manufacturer will be incorporated as well as the updated information on in situ and optimum moisture content. At that time, mass and energy balances will be made on all the pits mainly to supply enough information to determine the optimum sequential order of pit remediation operations. Review of air dispersion modeling results is currently in progress. The results will also be incorporated in the final mass and energy balances.

Operational time varies by process area. While all the details for all involved streams are shown in the corresponding PFD, balance sheets for each PFD and an overall balance for the entire operation were developed and are included in Tables 1 through 6, attached.

Table 1 - Overall Balance

Stream No.	Stream Description	(tons/week)			
		Solids	Water	Gas	Total
	INPUT				
101	Dry Waste & Soil Excavation	72	18		90
102	Wet Waste Excavation	3837	1662		5499
104	Large Non-Processable Debris	59	15		74
105	Large Processable Debris	59	15		74
	TOTAL	4027	1710	0	5737
	OUTPUT				
317	Off-gas to Spray Tower	18	708		726
501	Wet Waste Excavation	169	42		211
509	Non-Processable Debris	3840	960		4800
	TOTAL	4027	1710	0	5737

Table 2 - PFD SK-F-03909 - Waste Retrieval and Transfer

Stream No.	Stream Description	(tons/week)			
		Solids	Water	Gas	Total
	INPUT				
101	Dry Waste and Soil Excavation	72	18		90
102	Wet Waste Excavation	3837	1662		5499
103	Large Debris Excavation	118	29		147
	TOTAL	4027	1710	0	5737
	OUTPUT				
101	Dry Waste & Soil to Preparation	72	18		90
102	Wet Waste to Preparation	3837	1662		5499
104	Large Non-Processable Debris to Debris Management	59	15		74
105	Large Processable Debris to Debris Management	59	15		74
	TOTAL	4027	1710	0	5737

Table 3 - PFD SK-F-03910 - Waste Preparation

Stream No.	Stream Description	(tons/week)			
		Solids	Water	Gas	Total
	INPUT				
101	Dry Waste & Soil to Preparation	72	18		90
102	Wet Waste to Preparation	3837	1662		5499
	TOTAL	3909	1681	0	5590
	OUTPUT				
206	Processable Waste to Debris Management	153	38		192
207	Non-processable Waste to Debris Management	38	10		48
212	Trommel Oversize to Blending	109	27		137
215	Wet Waste to Twin Auger Mixer	1512	679		2191
216	Wet Waste to Dryer	2024	908		2932
217	Dry Waste & Soil to Blending	72	18		90
	TOTAL	3909	1681	0	5590

Table 4 - PFD SK-F-03911 - Drying and Off-Gas Treatment Sheet 1 of 2

Stream No.	Stream Description	(tons/week)			
		Solids	Water	Gas	Total
	INPUT				
216	10-day storage to dryer	2024	908	0	2932
303	Sweep air	0	4	269	272
306	Combustion air (Total)	0	0	3109	3109
307	Natural Gas	0	0	82	82
		0	0	0	0
	Organics	0	0	0	0.34
	TOTAL	2024	912	3460	6396
	OUTPUT				
311	Furnace OG discharge	0	0	3191	3191
317	Process OG to spray tower	10	708	281	999
319a	Dryer product + cyclone solids	2006	200	0	2206
	TOTAL	2016	908	3472	6396

NOTES:

1) 8 tons/week of solids decompose to gases

2) 3.7 tons/week of water vapor in sweep air show up as gases in furnace OG

Table 5 - PFD SK-F-03912 - Drying and Off-Gas Treatment Sheet 2 of 2

Stream No.	Stream Description	(tons/week)			
		Solids	Water	Gas	Total
	INPUT				
317	OG to spray tower	10	708	281	999
423	Water make-up	0	329	0	329
424	Caustic add	0	5	0	5
432+437	Water/Caustic add	0	420	0	420
	TOTAL	10	1461	281	1752
	OUTPUT				
409	OG to atmosphere	0	2	272	274
417	Wastewater to hold tank	0	1020	0	1021
412	Spray tower bleed	10	448	0	458
	TOTAL	10	1471	272	1752

NOTES:

1) Quantities are preliminary - will be finalized during detailed design.

2) 9 (10)tons/week of gas are scrubbed or condensed into the water. By taking this into account, the total water and gas flows will balance.

Table 6 - PFD SK-F-03913 - Waste Blending and Loadout

Stream No.	Stream Description	(tons/week)			
		Solids	Water	Gas	Total
	INPUT				
104	Large Non-Processable Debris to Debris Management	59	15		74
105	Large Processable Debris to Debris Management	59	15		74
206	Processable Waste to Debris Management	153	38		192
207	Non-Processable Waste to Debris Management	38	10		48
212	Trommel Oversize to Blending	109	27		137
217	Dry Waste & Soil to Blending	72	18		90
320	Dried Product to Blending	3518	879		4397
	TOTAL	4009	1002	0	5011
	OUTPUT				
501	Non-Processable Waste to Disposal	169	42		211
509	Product to Off-Site Disposal	3840	960		4800
	TOTAL	4009	1002	0	5011

Process Flow Diagrams

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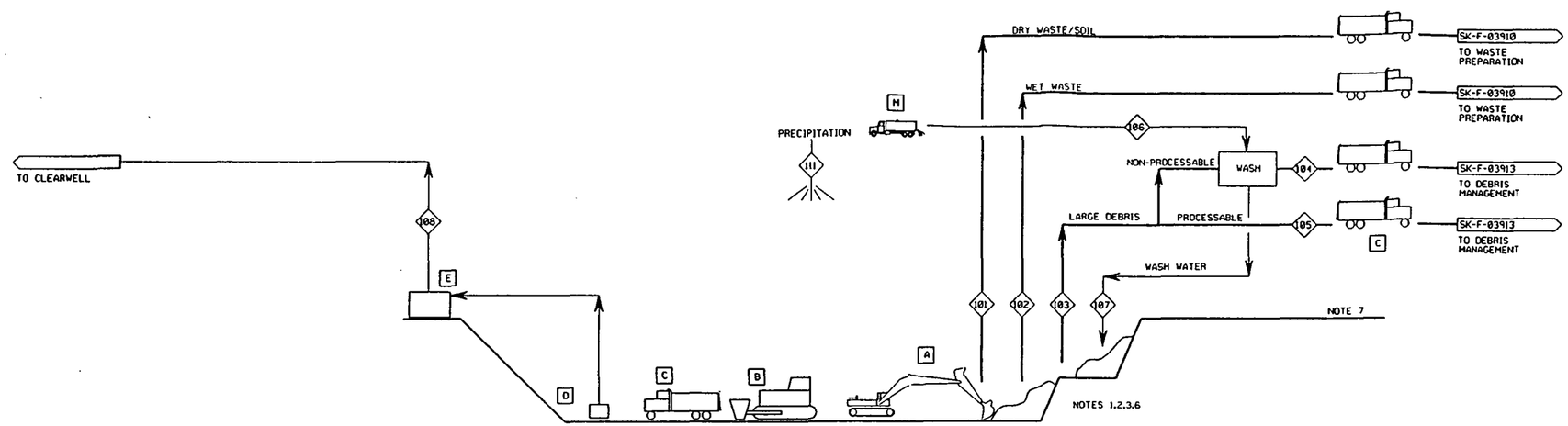
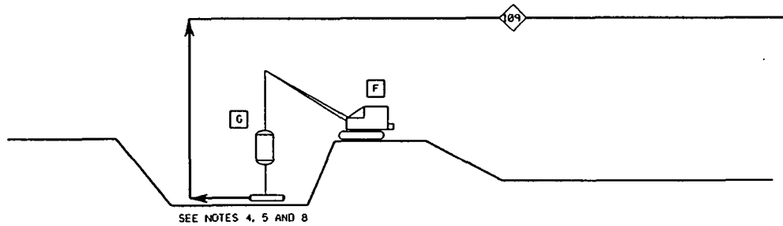
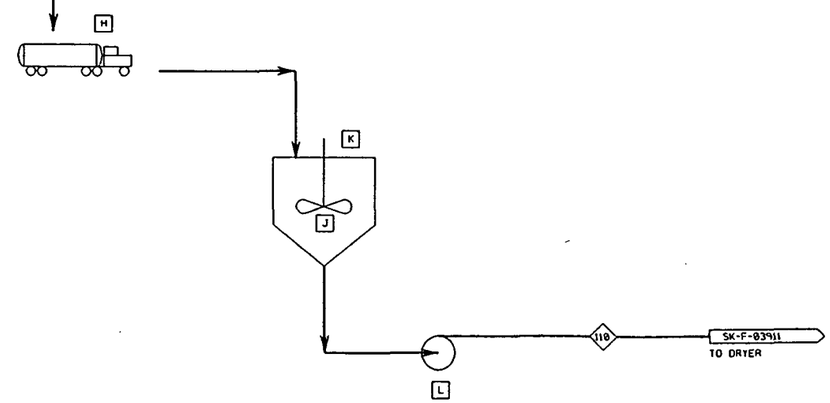


MECHANICAL EXCAVATION
(ALL PITS)



HYDRAULIC WASTE REMOVAL
(PITS 3,5,6, & CLEARWELL)



PIT 6 MASS BALANCE

STREAM NO.		101	102	103	104	105	106	107	108	109	110	111
COMPONENT		DR WASTE & SOIL REMOVAL	WET WASTE REMOVAL	LARGE DEBRIS REMOVAL	LG NON-PROC. DEBRIS	LARGE PROC. DEBRIS	WASH WATER SUPPLY	WASH WATER DRAINAGE	STORM WATER TO CLRWELL	SLURRY TO TANKER	SLURRY TO DRYER	PRECIP TO PITS
OPERATING TIME	(hrs/day)	8	8	8	8	8	TBD	TBD	TBD	CONTING	CONTING	TBD
OPERATING TIME	(days/wk)	5	5	5	5	5						
SOLIDS	(lbs/hr)	3612	191850	5897	2949	2949						
WATER/LIQUIDS	(lbs/hr)	903	83124	1474	737	737						
WATER VAPOR	(lbs/hr)											
AIR/GAS	(lbs/hr)											
MASS FLOW	(lbs/hr)	4515	274974	7372	3686	3686						
VOLUME FLOW	(scfm)											
TEMPERATURE	(F)											

NOTES

1. UNHANDLEABLE ITEMS SUCH AS LONG BEAMS MAY BE SIZE REDUCED AND WASHED AS REQUIRED AT THE PIT SITE FOR MORE EFFICIENT HANDLING AND TRANSFER.
2. IF WET, STICKY WASTE IS ENCOUNTERED DURING EXCAVATION, MIXING OF DRY SOILS OR CAP MATERIAL WITH THE WASTE WILL BE REQUIRED TO MAKE IT MORE HANDLEABLE.
3. EXCAVATION IS ILLUSTRATED IN GENERALIZED FORM AND AS A CONCEPT ONLY. IT SHALL BE ADJUSTED AS THE FINAL EXCAVATION PLAN IS DEVELOPED.
4. STORMWATER COLLECTION PUMP PRESENT FOR THIS OPERATION ALSO. PUMPING TO THE CLEARWELL.
5. PRECIPITATION RATE TO THIS OPERATION THE SAME AS SHOWN IN STREAM 111.
6. EXCAVATION ACTIVITIES DEPICTED AS STREAMS 101, 102 AND 103 TAKE PLACE SIMULTANEOUSLY.
7. EXCAVATION ACTIVITIES AND EQUIPMENT SHOWN AT BOTTOM OF PIT ALSO TYPICAL FOR TOP OF PITS.
8. SLURRY HYDRAULIC REMOVAL IS A CONTINGENCY ONLY, IN THE EVENT MECHANICAL EXCAVATION IS NOT POSSIBLE.

MAJOR EQUIPMENT LIST

MARK	QUANTITY	EQUIPMENT NAME
A	2	LONG REACH EXCAVATOR
B	2	TRACK-TYPE LOADER
C	4	DUMP TRUCK
D	1	STORMWATER COLLECTION PUMP
E	1	STORMWATER SUMP AND BOOSTER PUMP
F	1	BOOM CRANE
G	2	SLURRY PUMP
H	2	TANKER TRUCK
J	1	SLURRY SURGE TANK
K	1	SLURRY SURGE TANK AGITATOR
L	1	SLURRY SURGE TANK PUMP
M	1	WATER TRUCK

REF DWG NO.	DRAWING TITLE
SK-F-03910	WASTE PREPARATION
SK-F-03911	DRYING AND OFF-GAS TREATMENT SHEET 1 OF 2
SK-F-03913	DRIED WASTE BLENDING AND LOADOUT

PRELIMINARY
NOT FOR CONSTRUCTION

REV. NO.	ISSUE OR REVISION PURPOSE - DESCRIPTION	A-E	FERMCO	DATE
B	ISSUED FOR CONCEPTUAL DESIGN			
A	ISSUED FOR CONCEPTUAL DESIGN		N/A	

DETAILS AND 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
REMEDIATION SYSTEM DESIGN
CRU1/PO145

DRAWING TITLE
PROCESS
PROCESS FLOW DIAGRAM
WASTE RETRIEVAL

DRAWN BY	DATE	LEAD ENGINEER	DATE	CHECKED BY	DATE
P. A. WILSON	6/01/95	K. E. STRADFORD	8/1/95	S. C. VAALER	7/19/95

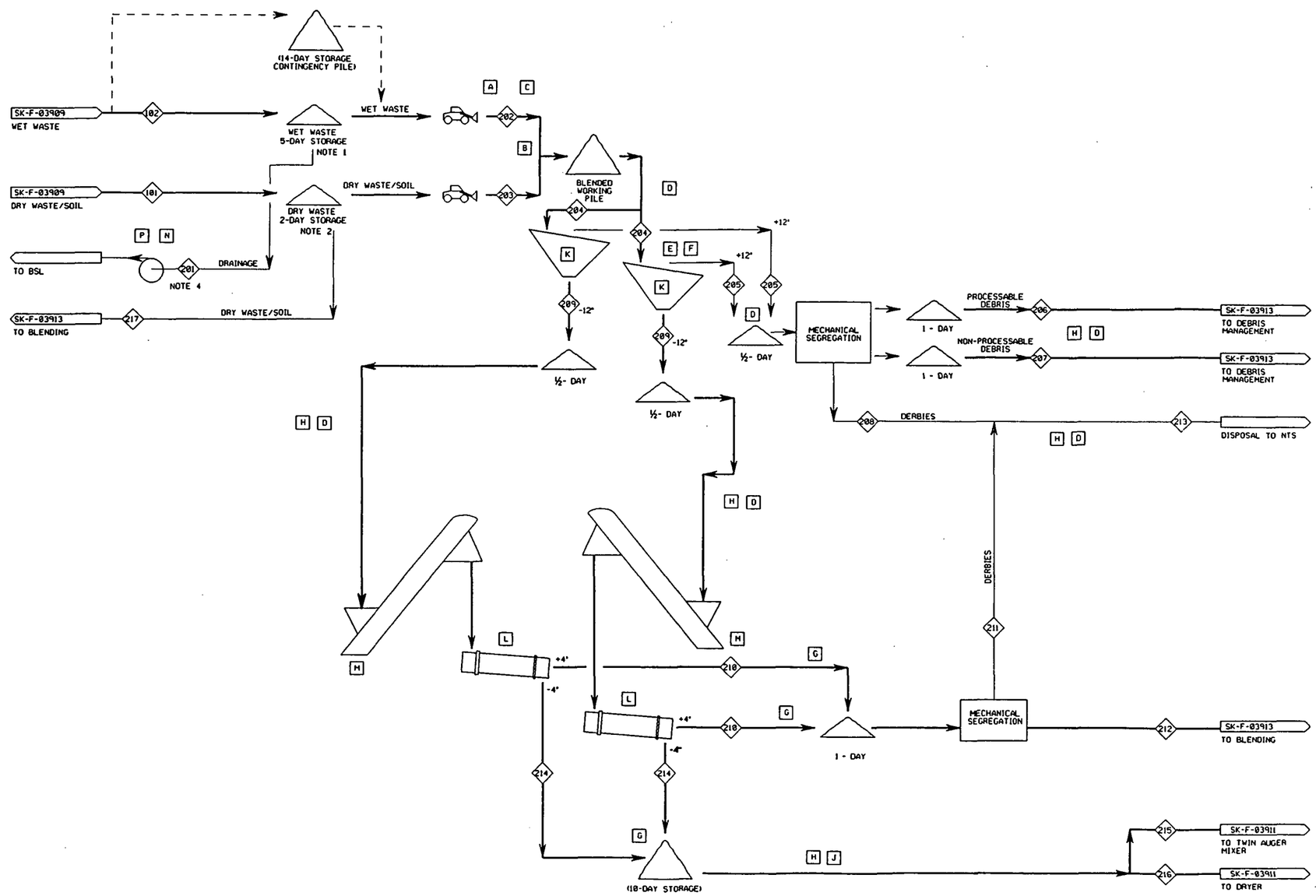
PLANT/BLDG NO.	FLOOR	SCALE	CLASS
		NONE	

SUBMITTED FOR APPROVAL	FERMCO CRU APPROVAL
N/A	N/A

A-E DUE PROJECT NO.	DATE	TEMP PROJECT NO.	DRAWING REF CODE NO.	DATE	SHEET NO.	REV. NO.
		WBS 1.1.1.1.1.3.1 00-90701	SK-F-03910		0001	B

PREPARED UNDER PARSONS PROJECT ORDER NUMBER
CRU1/PO145

skf03910.m(329.ws321) po145@ws321. Fri Oct 20 14:39:04 CDT 1995



NOTES

1. PIT 6 WASTE HAS A 31% (WET BASIS), IN-SITU MOISTURE CONTENT. THEREFORE IT IS ASSUMED THAT NO DRAINAGE WOULD OCCUR FROM THIS MATERIAL.
2. THE ASSUMPTION IS MADE THAT WET WASTE ABOVE 40% MOISTURE CONTENT, (WET BASIS), WILL REQUIRE MIXING WITH DRY MATERIAL FOR HANDLING. PIT 6 WASTE IS ALREADY BELOW 40% MOISTURE. THEREFORE NO MIXING IN OF DRY MATERIAL IS REQUIRED.
3. IN MANY CASES, ONE PIECE OF EQUIPMENT WILL BE USED IN MULTIPLE LOCATIONS.
4. THIS SUMP AND PUMP HANDLES DRAINAGE FOR THE CONTINGENCY, WET WASTE, AND DRY WASTE PILES.

MAJOR EQUIPMENT LIST

MARK	QUANTITY	EQUIPMENT NAME
A	1	FRONT END LOADER
B	1	DOZER
C	1	HYDRAULIC EXCAVATOR
D	1	FRONT END LOADER
E	-	BACK HOE, SEGREGATION
F	-	BACK HOE, SCRAPING
G	3	FRONT END LOADER
H	1	FRONT END LOADER
J	1	EXCAVATOR HYDRAULIC
K	2	12" GRIZZLY
L	2	4" TROMMEL SCREEN
M	2	SKIP HOIST
N	TBD	SUMP PUMP
P	TBD	SUMP

REF DWG NO.	DRAWING TITLE
SK-F-03909	WASTE RETRIEVAL
SK-F-03911	DRYING AND OFF-GAS TREATMENT SHEET 1 OF 2
SK-F-03913	DRIED WASTE BLENDING AND LOADOUT

PRELIMINARY
NOT FOR CONSTRUCTION

REV. NO.	ISSUE OR REVISION PURPOSE - DESCRIPTION	A-E	FERMCO	DATE
C	ISSUED FOR CONCEPTUAL DESIGN (CLIENT COMMENTS INCORPORATED)			
B	ISSUED FOR CONCEPTUAL DESIGN			
A	ISSUED FOR CONCEPTUAL DESIGN		N/A	

INITIALS AND 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
REMEDIATION SYSTEM DESIGN
CRU1/P0145

DRAWING TITLE
PROCESS
PROCESS FLOW DIAGRAM
WASTE PREPARATION

DRAWN BY	DATE	LEAD ENGINEER	DATE	CHECKED BY	DATE
P. A. WILSON	6/01/95	K. E. STRADFORD	8/1/95	S. C. VAALER	7/19/95

PLANT/BLDG NO. | FLOOR | SCALE NONE | CLASS

SUBMITTED FOR APPROVAL | FERMCO CRU APPROVAL N/A | N/A

A-E DOE PROJECT NO. | DATE | TEMP PROJECT NO. VBS 1.1.1.1.1.3.1 00-90701 | DRAWING INDEX CODE NO. SK-F-03910 | SHEET NO. 1 OF 2 | REV. NO. C

PREPARED UNDER PARSONS PROJECT ORDER NUMBER CRU1/P0145

PIT 6 MASS BALANCE

STREAM NO.	101	102		201	202	203	204	205	206	207	208	209	210	211	212	213	214	215	216	217
COMPONENT	DR WASTE & SOIL REMOVAL	WET WASTE REMOVAL		DRAINAGE TO CLEARVLL	WET WASTE MIXING	DRY WASTE MIXING	BLENDED WASTE TO GRIZZLY	>12" TO MECH. SEG.	PROC. WASTE TO DB MAN	NON PROC WASTE TO DB MAN	DERBIES TO DISPOSAL	<12" TO TROMMEL SCREEN	>4" TO MECH. SEG.	DERBIES TO DISPOSAL	>4" TO BLENDING AREA	TOTAL DERBIES TO DISP.	<4" TO 10-DAY STORAGE	10-DAY STG. TO T. AUGER	10-DAY STG. TO DRYER	DRY WASTE TO BLENDING
OPERATING TIME (hrs/day)	8	8			8		8	8	8	8	TBD	8	8	TBD	8	TBD	8	24	24	8
OPERATING TIME (days/wk)	5	5			5		5	5	5	5		5	5		5		5	7	7	5
SOLIDS (lbs/hr)	3612	191850			191850		95925	4796	7674	1919		91129	2734		5468		88395	17996	24096	3612
WATER/LIQUIDS (lbs/hr)	903	83124			83124		41562	1199	1919	480		40363	683		1367		39679	8885	10810	903
WATER VAPOR (lbs/hr)																				
AIR/GAS (lbs/hr)																				
MASS FLOW (lbs/hr)	4515	274974		0	274974	0	137487	5995	9593	2398		131492	3417		6835		128074	26082	34906	4515
VOLUME FLOW (scfm)																				
TEMPERATURE (F)																				
NOTES				1		2														

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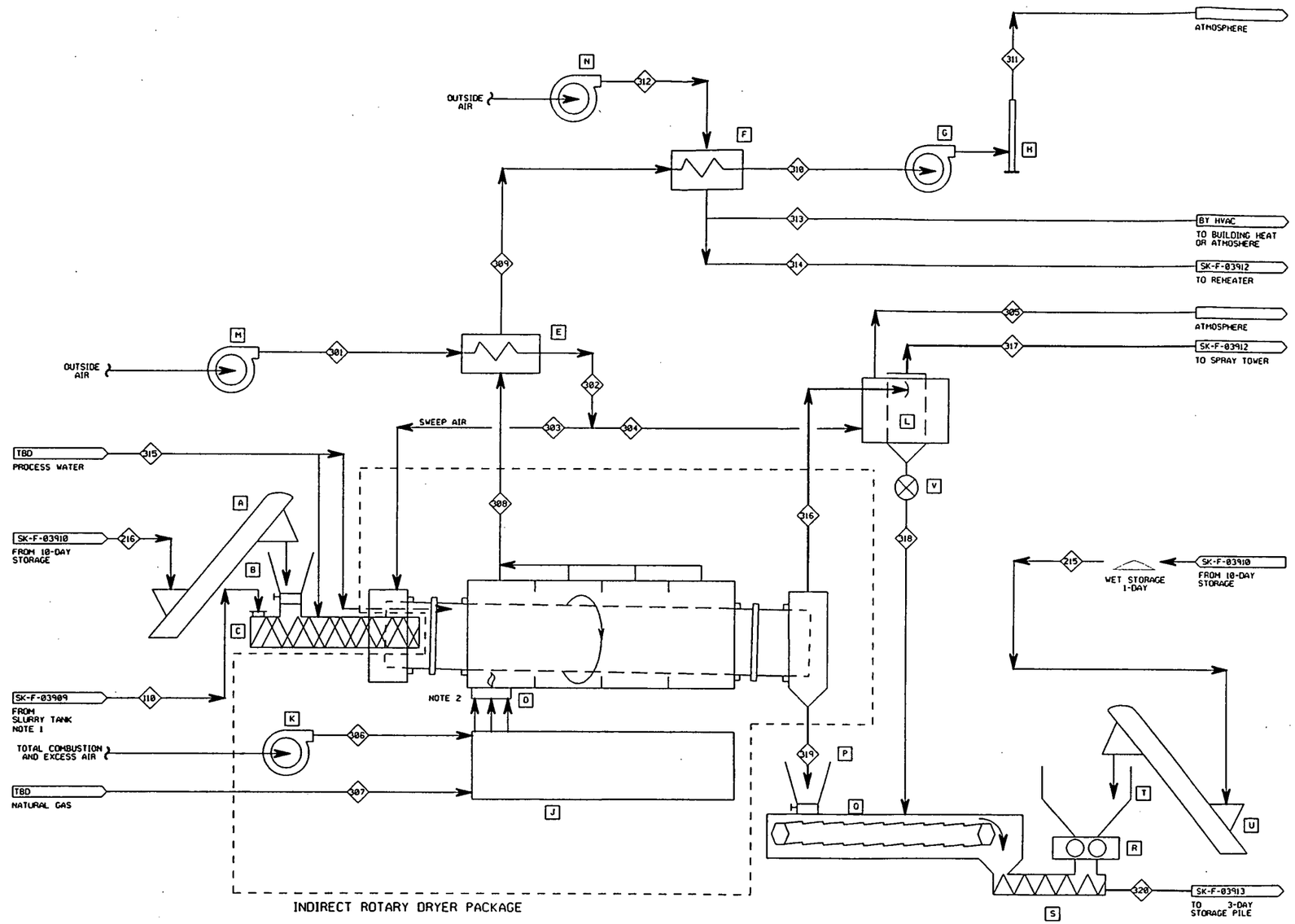

NOTES

1. AS A CONTINGENCY, SLURRY WILL BE FED TO THE DRYER ALONG WITH THE WASTE FROM THE DRYER FEED HOPPER.
2. THE BURNER SHOWN IS TYPICAL AS ONE OF THE MULTIPLE BURNERS PER FURNACE ZONE. TOTAL BURNERS PER ZONE AND TOTAL NUMBER OF ZONES IS TO BE DETERMINED BY THE VENDOR. BURNER ARRANGEMENT SHOWS INTAKES FOR NATURAL GAS, PRIMARY COMBUSTION AIR AND SECONDARY (COMBUSTION AND EXCESS) AIR. SECONDARY COMBUSTION AIR IS REQUIRED IF THE BURNERS ARE TO BE OPERATED AS STAGED COMBUSTION FOR LOWER NOx CONCENTRATIONS.

MAJOR EQUIPMENT LIST

MARK	QUANTITY	EQUIPMENT NAME
A	1	DRYER SKIP HOIST
B	1	DRYER FEED HOPPER W/GATE
C	1	DRYER FEEDER
D	1	INDIRECT ROTARY DRYER
E	1	HEAT ECONOMIZER #1
F	1	HEAT ECONOMIZER #2
G	1	COMBUSTION GAS EXHAUST FAN
H	1	COMBUSTION GAS STACK
J	1	BURNER PIPE & INSTRUMENTATION SKID
K	1	COMBUSTION AIR SUPPLY FAN
L	1	CYCLONE W/HEATING JACKET
M	1	AIR SUPPLY FAN #1
N	1	AIR SUPPLY FAN #2
P	1	DRYER DISCHARGE HOPPER
O	1	DRYER DISCHARGE CONVEYOR
R	1	WET MATERIAL FEED CONVEYOR
S	1	TWIN AUGER MIXER
T	1	WET MATERIAL FEED HOPPER
U	1	WET MATERIAL SKIP HOIST
V	1	ROTARY AIRLOCK

REF DWG NO.	DRAWING TITLE
SK-F-03909	WASTE RETRIEVAL
SK-F-03910	WASTE PREPARATION
SK-F-03912	DRYING AND OFF-GAS TREATMENT SHEET 2 OF 2
SK-F-03913	DRIED WASTE BLENDING AND LOADOUT

PRELIMINARY
NOT FOR CONSTRUCTION

REV. NO.	ISSUE OR REVISION PURPOSE - DESCRIPTION	A-E	FEMCO	DATE
B	ISSUED FOR CONCEPTUAL DESIGN			
A	ISSUED FOR CONCEPTUAL DESIGN		N/A	

INITIALS AND 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
REMEDIATION SYSTEM DESIGN
CRU1/PO145

DRAWING TITLE
PROCESS
PROCESS FLOW DIAGRAM
DRYING AND OFF-GAS TREATMENT SHEET 1 OF 2

DRAWN BY	DATE	LEAD ENGINEER	DATE	CHECKED BY	DATE
P. A. WILSON	6/01/95	K. E. STRADFORD	8/1/95	S. C. VANLER	7/19/95

PLANT/BLDG NO.	FLOOR	SCALE	CLASS
		NONE	

SUBMITTED FOR APPROVAL	FEMCO CRU APPROVAL
A-E DATE	N/A
N/A	

A-E DOE PROJECT NO.	FEMP PROJECT NO.	DRAWING SHEET CODE NO.	SHEET NO.	REV. NO.
	WBS 1.1.1.1.1.3.1 00-90701	SK-F-03911	001	B

PREPARED UNDER PARSONS PROJECT ORDER NUMBER
CRU1/PO145

PIT 6 MASS BALANCE

STREAM NO.	110	215	216	301	302	303	304	305	306	307	308	309
COMPONENT	SLURRY TO DRYER	10-DAY STG. TO T. AUGER	10-DAY STG. TO DRYER	AMBIENT AIR TO ECON'R 1	HOT AIR FROM ECON'R 1	SWEEP AIR	HOT AIR TO CYCLONE	HOT AIR FROM CYCLONE	TOTAL COMBUS'N AIR	TOT. NAT GAS TO BURNERS	FURNACE OG TO ECON'R 1	FURNACE OG TO ECONR'2
OPERATING TIME (hrs/day)	CONTING.	24	24	TBD	TBD	24	TBD	TBD	24	24	24	24
OPERATING TIME (days/wk)		7	7			7			7	7	7	7
SOLIDS (lbs/hr)		17996	24096									
WATER/LIQUIDS (lbs/hr)		8085	10810									
WATER VAPOR (lbs/hr)						44			504			
AIR/GAS (lbs/hr)						3198			36511	976	37991	37991
MASS FLOW (lbs/hr)		26082	34906			3242			37015	976	37991	37991
VOLUME FLOW (scfm)						717			8184	354	8556	8556
TEMPERATURE (F)		77	77			600			77	77	976	

STREAM NO.	310	311	312	313	314	315	316	317	318	319	320
COMPONENT	FURNACE OG TO EXH FAN	FURNACE OG D'CHARGE	AMBIENT AIR TO ECON'R 2	HOT AIR TO BUILDING	HOT AIR TO REHEATER	PROCESS WATER TO CLEAN	PROCESS OG TO CYCLONE	PROCESS OG TO SPRY TWR	CYCLONE SOLIDS	DRYER PRODUCT TO MIX	DRYER PRODUCT FROM MIX
OPERATING TIME (hrs/day)	24	24	TBD	TBD	TBD	TBD	24	24	24	24	24
OPERATING TIME (days/wk)	7	7					7	7	7	7	7
SOLIDS (lbs/hr)							1200	120	1080	22801	41877
WATER/LIQUIDS (lbs/hr)							120	12	108	2276	10469
WATER VAPOR (lbs/hr)							8414	8414			
AIR/GAS (lbs/hr)							3341	3341			
MASS FLOW (lbs/hr)							13075	11887	1188	25077	52347
VOLUME FLOW (scfm)							3692	3692			
TEMPERATURE (F)							240	266	266	205	180

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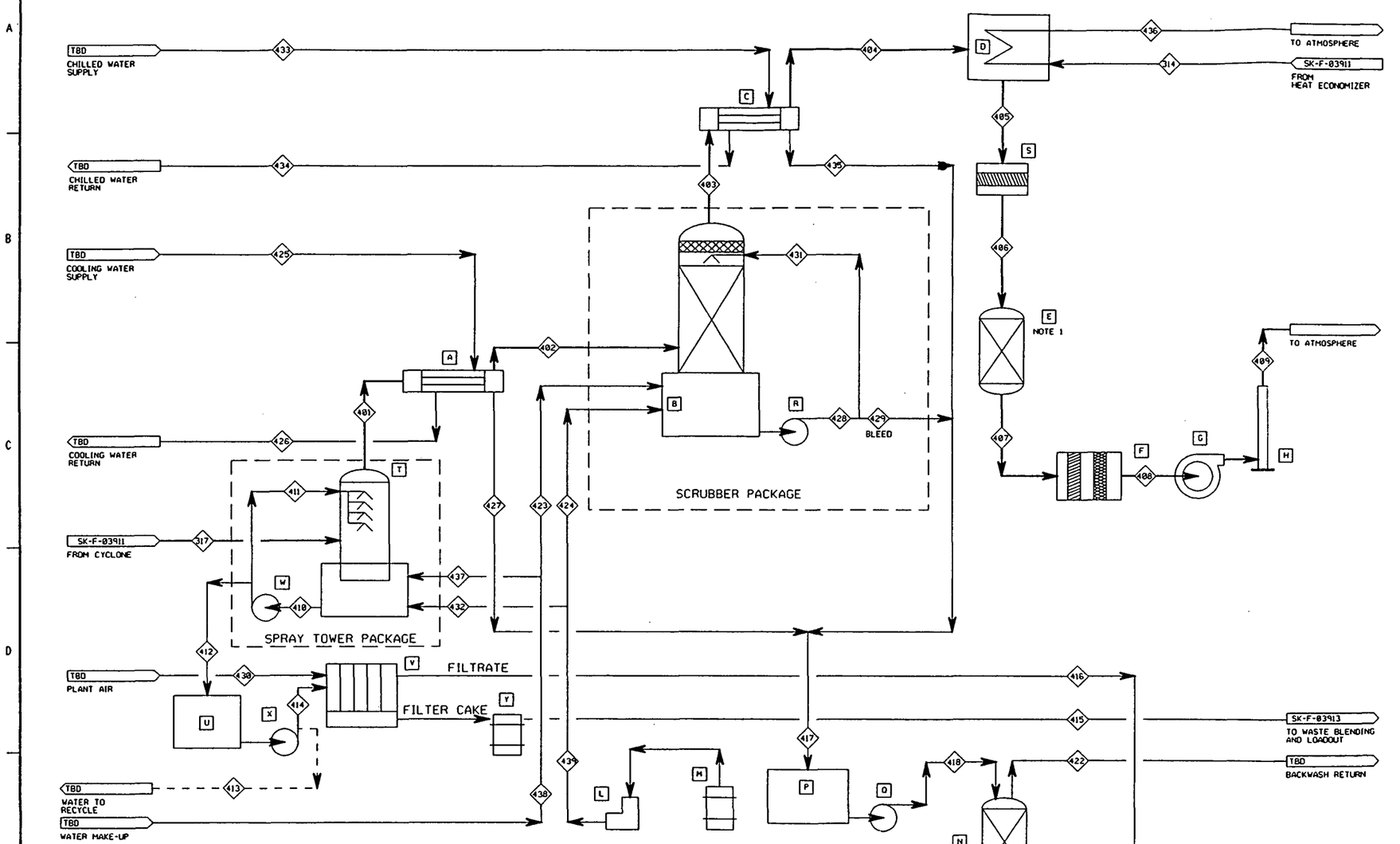


PIT 6 MASS BALANCE

STREAM NO.	424	425	426	427	428	429	430	431	432	433	434	435	436	437	438	439
COMPONENT	SCRUBBER CAUSTIC SUPPLY	COOLING WATER TO CONDEN'R	COOLING WATER FR CONDEN'R	CON'SATE #1 TO HOLD TNK	CAUSTIC SCRUBBER D'CHARGE	SCRUBBER BLEED TO HOLD TNK	PLANT AIR	RECYCLE TO TOWER	CAUSTIC TO SPRAY TOWER	CHILLED WATER TO HEAT EXC	CHILLED WATER FR HEAT EXC	CON'SATE #2 TO HOLD TNK	HOT AIR FROM REHEATER	SPRAY TOW WATER MAKE-UP	TOTAL WATER MAKE-UP	TOTAL CAUSTIC SUPPLY
OPERATING TIME (hrs/day)	24	24	24	24	24	24	TBD	24	TBD	24	24	24	TBD	TBD	TBD	TBD
OPERATING TIME (days/wk)	7	7	7	7	7	7		7		7	7	7				
SOLIDS (lbs/hr)				3.0	5.2	2.55		2.7				0.225				
WATER/LIQUIDS (lbs/hr)	54	571414	571414	7917	7545	4048		3497		25863	25863	179				
WATER VAPOR (lbs/hr)																
AIR/GAS (lbs/hr)																
MASS FLOW (lbs/hr)	54	571414	571414	7920	7550	4050		3500		25863	25863	179				
VOLUME FLOW (scfm)																
TEMPERATURE (F)	77	80	95	120	105	105		105		42	51	50				

STREAM NO.	314	317	401	402	403	404	405	406	407	408	409	410	411	412	413	414	415	416	417	418	419	420	421	422	423
COMPONENT	HOT AIR TO REHEATER	OFFGAS TO SPRAY TOWER	OFFGAS TO CONDEN'R	OFFGAS TO SCRUBBER	OFFGAS TO HEAT EXC	OFFGAS TO REHEATER	OFFGAS TO HEPA FILTER	OFFGAS TO CARB BED	OFFGAS TO HEPA FILTER	OFFGAS TO BLOWER	OFFGAS TO ATMOSPHE	SPRAY TOWER D'CHARGE	SPRAY TOWER RECYCLE	SPRAY TOWER BLEED	WATER FOR RECYCLE	BLEED WATER TO FILTER	FILTER CAKE TO LOADOUT	FILTRATE TO AWWT	WASTE WATER TO HOLD TNK	WASTE WATER TO FILTER	FILTERED WATER TO HOLD TNK	FILTERED WATER TO AWWT	BACKWASH WATER SUPPLY	BACKWASH WATER RETURN	SCRUBBER WATER MAKE-UP
OPERATING TIME (hrs/day)	TBD	24	24	24	24	24	24	24	24	24	24	24	24	TBD	TBD	TBD	TBD	TBD	24	24	TBD	TBD	TBD	TBD	24
OPERATING TIME (days/wk)		7	7	7	7	7	7	7	7	7	7	7	7						7	7					7
SOLIDS (lbs/hr)		120	6.0	3.0	0.45	0.225	0.225	0.0124	0.0113	.0000338	.0000338								5.8	5.8					
WATER/LIQUIDS (lbs/hr)		12										5000	5000						12144	12144					3918
WATER VAPOR (lbs/hr)		8414	8089	261	204	25	25	25	25	25	25														
AIR/GAS (lbs/hr)		3341	3341	3253	3234	3234	3234	3234	3234	3234	3234														
MASS FLOW (lbs/hr)		11887	11436	3516	3438	3259	3259	3259	3259	3259	3259	5000	5000						12150	12150					3918
VOLUME FLOW (scfm)		3692	3578	802	778	715	715	715	715	715	715														
TEMPERATURE (F)		266	201	120	112	50	95	95	95	95	95								114	114					77

PREPARED UNDER PARSONS PROJECT ORDER NUMBER CRU1/P0145

NOTES

1. REGENERATION OF THE CARBON BEDS IS NOT FOR REMOVAL OF RADON, BUT FOR OTHER CONTAMINANTS SUCH AS ORGANICS. TWO PARALLEL CARBON BED TRAINS ARE REQUIRED SO THAT ONE TRAIN CAN BE REGENERATED WHILE THE OTHER TRAIN IS IN SERVICE. ESTABLISHING THE NEED FOR RADON REMOVAL VIA CARBON BEDS AND DETERMINING THE OPERATIONAL SEQUENCE AND REQUIREMENTS FOR REGENERATION OF THE CARBON WILL BE PERFORMED DURING FINAL DESIGN.
2. THIS OFFGAS SYSTEM IS CONCEPTUAL. THE FINAL DESIGN WILL BE BASED ON THE RESULTS OF AIR DISPERSION MODELING.

MAJOR EQUIPMENT LIST

MARK	QUANTITY	EQUIPMENT NAME
A	2	OFFGAS CONDENSER (ONE STAND BY)
B	1	CAUSTIC SCRUBBER W/DEMISTER
C	1	OFFGAS HEAT EXCHANGER
D	1	OFFGAS REHEATER
E	2 SETS	CARBON BED (ONE STAND BY)
F	2	HEPA W/PREFILTERS (ONE STAND BY)
G	2	OFFGAS EXHAUST FAN (ONE STAND BY)
H	1	OFFGAS STACK
J	1	WASTEWATER TRANSFER TANK
K	2	WASTEWATER TRANSFER TANK PUMP
L	2	CAUSTIC SUPPLY PUMP
M	4	55 GALLON CAUSTIC DRUMS
N	2	MULTIMEDIA FILTER (ONE STAND BY)
P	1	MULTIMEDIA FILTER FEED TANK
O	2	MULTIMEDIA FILTER FEED TANK PUMP
R	2	CAUSTIC SCRUBBER PUMP
S	2	MEPA FILTER (ONE STAND BY)
T	1	SPRAY TOWER
U	1	FILTER PRESS FEED TANK
V	1	FILTER PRESS WITH FILTRATE PUMP
W	2	SPRAY TOWER PUMP
X	2	FILTER PRESS FEED TANK PUMP
Y	-	55 GALLON DRUMS

REF DWG NO.	DRAWING TITLE
SK-F-03911	DRYING AND OFF-GAS TREATMENT SHEET 1 OF 2
SK-F-03913	DRIED WASTE BLENDING AND LOADOUT

PRELIMINARY
NOT FOR CONSTRUCTION

REV. NO.	ISSUE OR REVISION PURPOSE - DESCRIPTION	A-E	FERNCO	DATE
B	ISSUED FOR CONCEPTUAL DESIGN			
A	ISSUED FOR CONCEPTUAL DESIGN		N/A	

INITIALS AND 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
REMEDIATION SYSTEM DESIGN
CRU1/P0145

DRAWING TITLE
PROCESS
PROCESS FLOW DIAGRAM
DRYING AND OFF-GAS TREATMENT SHEET 2 OF 2

DRAWN BY	DATE	LEAD ENGINEER	DATE	CHECKED BY	DATE
P. A. WILSON	6/21/95	K. E. STRADFORD	8/1/95	S. C. VAALER	7/19/95

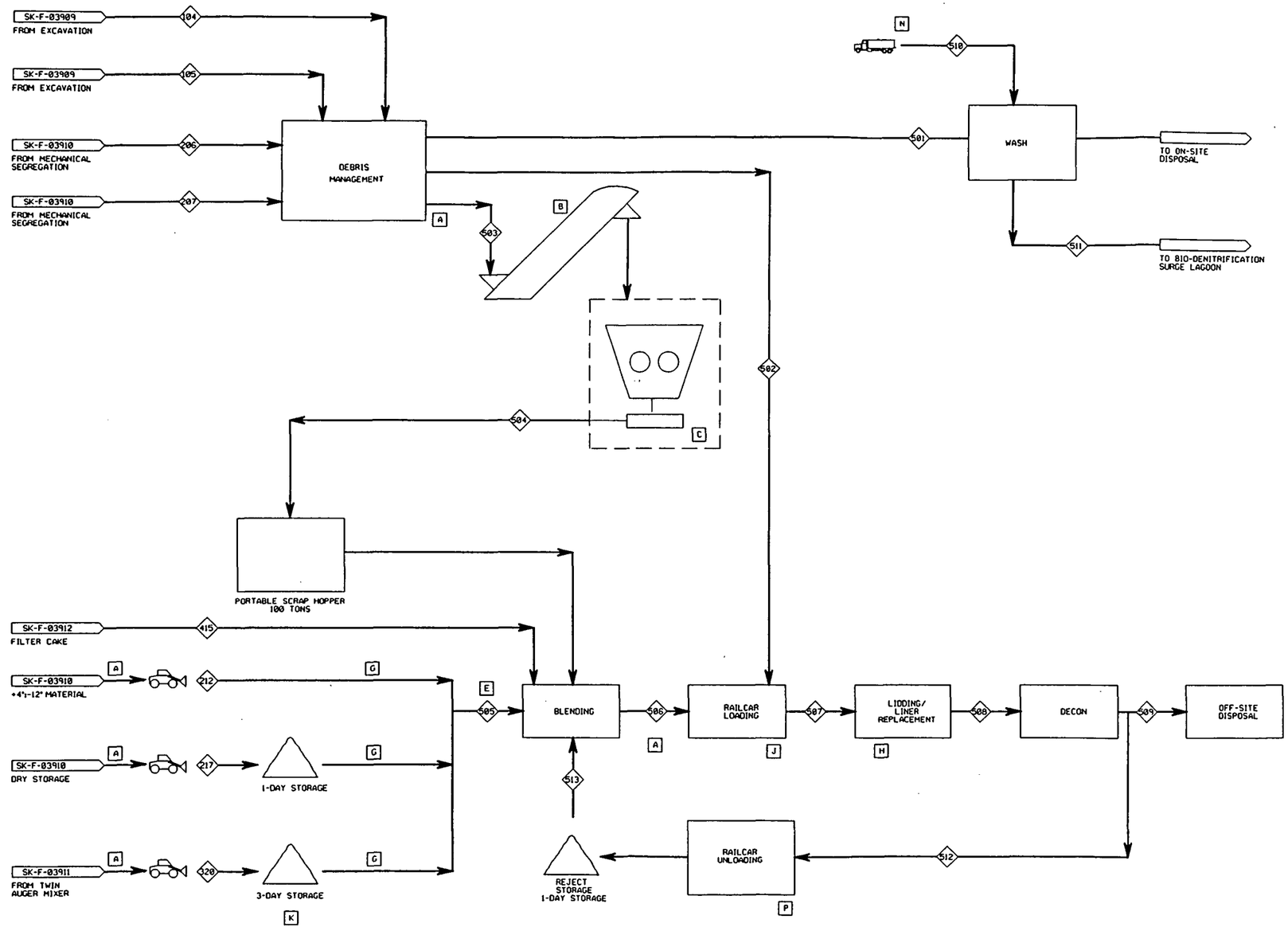
PLANT/BLDG NO.	FLOOR	SCALE	CLASS
		NONE	

SUBMITTED FOR APPROVAL	FERNCO CRU APPROVAL	
	N/A	N/A

A-E DATE | DATE

DOE PROJECT NO.	TEMP PROJECT NO.	DRAWING BOLT CODE NO.	SHEET NO.	REV. NO
	WBS 1.1.1.1.1.3.1 00-90701	SK-F-03912	00004	B

skf03913.m(276.ws414) po145@ws414. Thu Oct 19 14:23:31 CDT 1995



PIT 6 MASS BALANCE

STREAM NO.	104	105	206	207	212	217	320	415	501	502	503	504	505	506	507	508	509	510	511	512	513
COMPONENT	LG NON-PROC DEBRIS	LARGE PROC. DEBRIS	PROC. WASTE TO D B MAN.	NON-PROC WASTE TO D B MAN.	> 4" TO BLENDING AREA	DRY WASTE TO BLENDING	DRIED PROD. TO BLENDING	FILTER CAKE TO BLENDING	NON-PROC WASTE TO DISPOSAL	NON-PROC WASTE TO RAILROAD	DEBRIS TO CRUSHER	SHREDDED MAT'L TO BLENDING	MIXED MAT'L TO BLENDING	TOTAL TO LOADING	TOTAL TO LIDDING/ LINING	TOTAL TO DECON	TO OFF-SITE DISPOSAL	WASH WATER SUPPLY	WASH WATER RETURN	RAILCAR UNLOAD'G	REJECT TO BLENDING
OPERATING TIME (hrs/day)	8	8	8	8	8	8	24	TBD	8	8	8	8	8	8	8	8	8	TBD	TBD	TBD	TBD
OPERATING TIME (days/wk)	5	5	5	5	5	5	7		5	5	5	5	5	5	5	5	5				
SOLIDS (lbs/hr)	2949	2949	7674	1919	5468	3612	41877		8455	1084	5950	5950	184965	190915	192000	192000	192000				
WATER/LIQUIDS (lbs/hr)	737	737	1919	480	1367	903	10469		2114	271	1488	1488	46241	47729	48000	48000	48000				
WATER VAPOR (lbs/hr)																					
AIR/GAS (lbs/hr)																					
MASS FLOW (lbs/hr)	3686	3686	9593	2398	6835	4515	52347		10569	1355	7438	7438	231206	238644	240000	240000	240000				
VOLUME FLOW (scfm)																					
TEMPERATURE (F)																					

NOTES

MAJOR EQUIPMENT LIST

MARK	QUANTITY	EQUIPMENT NAME
A	1	FRONT END LOADER
B	1	SKIP HOIST
C	1	SHREDDER
D	1	FORK LIFT
E	1	DOZER D-6
F	1	FRONT-END LOADER
G	2	FRONT-END LOADER
H	1	BRIDGE CRANE
J	1 SET	TRACK SCALE
K	3	SUMP PUMP
L	1	CAR MOVER (NOT SHOWN)
M	2	PORTABLE SCRAP HOPPER
N	1	WATER TRUCK
P	1	BACKHOE

REF DWG NO.	DRAWING TITLE
SK-F-03910	WASTE PREPARATION
SK-F-03911	DRYING AND OFF-GAS TREATMENT SHEET 1 OF 2

PRELIMINARY
NOT FOR CONSTRUCTION

REV. NO.	ISSUE OR REVISION PURPOSE - DESCRIPTION	A-E	FERNCO	DATE
C	ISSUED FOR CONCEPTUAL DESIGN (CLIENT COMMENTS INCORPORATED)			
B	ISSUED FOR CONCEPTUAL DESIGN			
A	ISSUED FOR CONCEPTUAL DESIGN		N/A	

INITIALS AND 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
REMEDIATION SYSTEM DESIGN
CRU1/P0145

DRAWING TITLE
PROCESS
PROCESS FLOW DIAGRAM
DRIED WASTE BLENDING AND LOADOUT

DRAWN BY	DATE	LEAD ENGINEER	DATE	CHECKED BY	DATE
P.A. WILSON	6/01/95	K. E. STRADFORD	8/1/95	S. C. VANLER	7/19/95

PLANT/BLDG NO. | FLOOR | SCALE: NONE | CLASS

SUBMITTED FOR APPROVAL | FERNCO CRU APPROVAL: N/A | N/A

A-E DOC PROJECT NO. | DATE | FEMP PROJECT NO. WBS 1.1.1.1.1.3.1 00-90701 | DATE | DRAWING INDEX CODE NO. SK-F-03905 | SHEET NO. | REV. NO. C

PREPARED UNDER PARSONS PROJECT ORDER NUMBER CRU1/P0145

PARSONS
ERA PROJECT

MATERIAL AND EQUIPMENT LIST
(CONCEPTUAL DESIGN REPORT)

CRU-1 PO 145
Date: October 1995

Subject: WASTE RETRIEVAL
Project Title: Remediation System Design (Waste Retrieval)
Discipline: Mechanical/Civil

Rev. C
Checked by: DCO

Mark	Sketch No.	Qty.	Equipment Name	Description	Capacity	HP
A*	SK-F-03909	2	Long Reach Excavator	Caterpillar E650 with medium stick or equal	3 yd^3	-
B*	SK-F-03909	2	Track-Type Loader	Caterpillar 973 track-type loader or equal	4.2 yd^3	-
C*	SK-F-03909	4	Dump Truck	Caterpillar D25D or equal	13 yd^3	-
D*	SK-F-03909	1	Stormwater Collection Pump	Centrifugal	TBD**	TBD
E*	SK-F-03909	1	Stormwater Sump and Booster Pump	Centrifugal	TBD**	TBD
F*	SK-F-03909	1	Boom Crane	P&H Omega 18 or equal	16 ton	-
G	SK-F-03909	2	Slurry Pump	Submersible steel, 75 ft, TDH	200 gpm	15
H*	SK-F-03909	2	Tanker Truck	Double-walled tanker and truck combination	1,000 gal	-
J	SK-F-03909	1	Slurry Surge Tank	Fabricated steel tank	5,000 gal	-
K	SK-F-03909	1	Slurry Surge Tank Agitator	TBD**	TBD**	TBD
L	SK-F-03909	1	Slurry Surge Tank Pump	Air Diaphragm	TBD**	TBD
M	SK-F-03909	1	Water Truck	TBD**	-	-

* Supplied by Contractor
** TBD = to be determined

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PARSONS
ERA PROJECT

MATERIAL AND EQUIPMENT LIST
(CONCEPTUAL DESIGN REPORT)

CRU-1 PO 145
Date: 3 October 1995

Subject: WASTE RETRIEVAL
Project Title: Remediation System Design (Waste Preparation)
Discipline: Mechanical

Rev. C
Checked by: DCO

Mark	Sketch No.	Qty.	Equipment Name	Description	Capacity	HP
A	SK-F-03910	1	Front-End Loader	Caterpillar 966 wheeled loader or equal	4.5 yd^3	-
B	SK-F-03910	1	Dozer	Caterpillar D6 or equal	-	-
C	SK-F-03910	1	Hydraulic Excavator	Caterpillar E650 with medium stick or equal	3 yd^3	-
D	SK-F-03910	1	Front-End Loader	Caterpillar 966 wheeled loader or equal	4.5 yd^3	-
E	SK-F-03910	1	Back Hoe, Segregation	Minimum 25-foot reach	1 yd^3	-
F	SK-F-03910	2	Back Hoe, Scraping	Minimum 25-foot reach	1 yd^3	-
G	SK-F-03910	3	Front-End Loader	Caterpillar 936 wheeled loader or equal	2 - 3 yd^3	-
H	SK-F-03910	1	Front-End Loader	Caterpillar 936 wheeled loader or equal	2 yd^3-	-
J	SK-F-03910	1	Hydraulic Excavator	Caterpillar 214B with medium stick or equal	-	-
K	SK-F-03910	2	12-inch Vibrating Grizzly	Spring-mounted with eccentric drive	-	50
L	SK-F-03910	2	4-inch Trommel Screen	4-inch screen, 6 feet dia. drum, 20 feet long	-	25
M	SK-F-03910	2	Skip Hoist	Bucket type with automatic dumping	-	10
N	SK-F-03910	TBD**	Sump Pump	Centrifugal (Not shown on PFD)	TBD**	5
P	SK-F-03910	TBD**	Sump	Concrete	-	-

** TBD = to be determined

Equipment List

PARSONS
ERA PROJECT

MATERIAL AND EQUIPMENT LIST
(CONCEPTUAL DESIGN REPORT)

CRU-1 PO 145
Date: October 1995

Subject: WASTE RETRIEVAL
Project Title: Remediation System Design (Drying and Off-Gas Treatment)
Discipline: Mechanical Process

Rev. C
Checked by: DCO

Mark	Sketch No.	Qty.	Equipment Name	Description	Capacity	HP
A	SK-F-03911	1	Dryer Skip Hoist	Bucket type with automatic dumping	3 yd^3	10
B	SK-F-03911	1	Dryer Feed Hopper	Fabricated steel	TBD**	-
C	SK-F-03911	1	Dryer Feeder	Auger type	20 TPH	15
D	SK-F-03911	1	Indirect Rotary Dryer	22 tph wet field, 4.2 tph evaporation capacity	TBD**	125
E	SK-F-03911	1	Heat Economizer #1	TBD**	TBD**	-
F	SK-F-03911	1	Heat Economizer #2	TBD**	TBD**	-
G	SK-F-03911	1	Combustion Gas Exhaust Fan	Centrifugal	9840 SCFM	50
H	SK-F-03911	1	Combustion Gas Stack	Fabricated steel	9840 SCFM	-
J	SK-F-03911	1	Burner Pipe and Instrumentation Skid	Supplied with indirect rotary dryer	-	-
K	SK-F-03911	1	Combustion Air Supply Fan	Supplied with indirect rotary dryer	-	40
L	SK-F-03911	1	Cyclone with Heating Jacket	TBD**	4250 SCFM	-
M	SK-F-03911	1	Air Supply Fan #1	Centrifugal	TBD**	15
N	SK-F-03911	1	Air Supply Fan #2	Centrifugal	TBD**	15
P	SK-F-03911	1	Dryer Discharge Hopper	Fabricated steel	TBD**	-
Q	SK-F-03911	1	Dryer Discharge Conveyor	Inclined apron type	20 TPH	7 1/2
R	SK-F-03911	1	Wet Material Feed Conveyor	Auger type	TBD**	10
S	SK-F-03911	1	Twin Auger Mixer	Auger type	2.5 TPH	50
T	SK-F-03911	1	Wet Material Feed Hopper	Fabricated steel	TBD**	-
U	SK-F-03911	1	Wet Material Skip Hoist	Bucket type with automatic dumping	3 yd^3	5
V	SK-F-03911	1	Rotary Airlock	Vane type	TBD**	1 1/2

**TBD = to be determined

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PARSONS
ERA PROJECT

MATERIAL AND EQUIPMENT LIST
(CONCEPTUAL DESIGN REPORT)

CRU-1-PO 145
Date: October 1995

Subject: WASTE RETRIEVAL
Project Title: Remediation System Design (Drying and Off-Gas Treatment)
Discipline: Mechanical/Process

Rev. C
Checked by: DCO

Mark	Sketch No.	Qty.	Equipment Name	Description	Capacity	HP
A	SK-F-03912	2	Off-Gas Condenser	Shell and tube, one standby	3842 SCFM	-
B	SK-F-03912	1	Caustic Scrubber with Demister	Packed tower	1000 SCFM	-
C	SK-F-03912	1	Off-Gas Heat Exchanger	Shell and tube	1000 SCFM	-
D	SK-F-03912	1	Off-Gas Reheater	TBD**	1000 SCFM	-
E	SK-F-03912	2-set	Carbon Bed	TBD**, one standby	TBD**	-
F	SK-F-03912	2	HEPA with Prefilters	TBD**, one standby	TBD**	-
G	SK-F-03912	2	Off-Gas Exhaust Fan	Centrifugal, one standby	1000 SCFM	20
H	SK-F-03912	1	Off-Gas Stack	Fabricated steel	1000 SCFM	-
J	SK-F-03912	1	Wastewater Transfer Tank	Fabricated steel	TBD**	-
K	SK-F-03912	2	Wastewater Transfer Tank Pump	Centrifugal, Horizontal	TBD**	2
L	SK-F-03912	2	Caustic Supply Pump	Positive displacement metering	TBD**	2
M	SK-F-03912	4	55 Gallon Caustic Drums	-	-	-
N	SK-F-03912	2	Multimedia Filter	TBD**	28 gpm	-
P	SK-F-03912	1	Multimedia Filter Feed Tank	TBD**	5000 gal	-

** TBD = to be determined

PARSONS
ERA PROJECT

MATERIAL AND EQUIPMENT LIST
(CONCEPTUAL DESIGN REPORT)

CRU-1 PO 145
Date: October 1995

Subject: WASTE RETRIEVAL
Project Title: Remediation System Design (Drying and Off-Gas Treatment)
Discipline: Mechanical/Process

Rev. C
Checked by: DCO

Mark	Sketch No.	Qty.	Equipment Name	Description	Capacity	HP
Q	SK-F-03912	2	Multimedia Filter Feed Tank Pump	Centrifugal, horizontal	25 gpm	5
R	SK-F-03912	2	Caustic Scrubber Pump	Centrifugal	15 gpm	3
S	SK-F-03912	2	MEPA Filter	TBD**	TBD**	-
T	SK-F-03912	1	Spray Tower	TBD**	4255 SCFM 10 gpm	-
U	SK-F-03912	1	Filter Press Feed Tank	TBD**	TBD**	-
V	SK-F-03912	1	Filter Press with Filtrate Pump	TBD**	TBD**	TBD
W	SK-F-03912	2	Spray Tower Pump	Centrifugal	TBD**	1 1/2
X	SK-F-03912	2	Filter Press Feed Tank Pump	Centrifugal	TBD**	2
Y	SK-F-03912	4	55-Gallon Drums	-	-	-

** TBD = to be determined

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PARSONS
ERA PROJECT

MATERIAL AND EQUIPMENT LIST
(CONCEPTUAL DESIGN REPORT)

CRU-1 PO 145
Date: October 1995

Subject: WASTE RETRIEVAL
Project Title: Remediation System Design (Dried Waste Blending and Loadout)
Discipline: Mechanical

Rev. C
Checked by: DCO

Mark	Sketch No.	Qty.	Equipment Name	Description	Capacity	HP
A	SK-F-03913	1	Front-End Loader	Caterpillar 936 Wheeled Loader or equal	2 - 3 yd^3	-
B	SK-F-03913	1	Skip Hoist	Bucket type with automatic dumping	2 yd^3	5
C	SK-F-03913	1	Shredder	Shear type with hopper	20tph	200
D	SK-F-03913	1	Forklift	Propane type	5 ton	-
E	SK-F-03913	1	Dozer	Caterpillar Dozer D-6 or equal		-
F	SK-F-03913	1	Front-End Loader	Caterpillar 966 Wheeled Loader or equal	4.5 yd^3	-
G	SK-F-03913	2	Front-End Loader	Caterpillar 966 Wheeled Loader or equal	4.5 yd^3	-
H	SK-F-03913	1	Bridge Crane	Single girder with 2-1 ton hoist	2 ton	2;2; 1 1/2; 1 1/2
J	SK-F-03913	1 set	Track Scale	Platform type, electronic	125 ton	-
K	SK-F-03913	3	Sump Pump	Centrifugal	TBD**	5
L	SK-F-03913	1	Car Mover		TBD**	-
M	SK-F-03913	2	Portable Scrap Hopper	Custom design, fabricated steel	200 ft^3	-
N	SK-F-03913	1	Water truck	TBD**	TBD**	-
P	SK-F-03913	1	Backhoe	TBD**	TBD**	-

** TBD = to be determined

PARSONS
ERA PROJECT

MATERIAL AND EQUIPMENT LIST
(CONCEPTUAL DESIGN REPORT)

CRU-1 PO 145
Date: October 1995

Subject: DRYER FEED AND DISCHARGE BUILDINGS
Project Title: Remediation System Design
Discipline: Mechanical Utilities

Rev. C
Checked by: DCO

Mark	Sketch No.	Qty.	Equipment Name	Description	Capacity	HP
			DRYER DISCHARGE BUILDING			
	Not shown on PFD	1	Exhaust Fan	TBD**	6,000 scfm	15
	Not shown on PFD	6	Filter Unit	85 percent prefilter, HEPA filter	1,000 scfm	-
	Not shown on PFD	1	Supply Fan	TBD**	6,000 scfm	5
	Not shown on PFD	1	Gas Unit Heater	TBD**	500 mbh	-
			DRYER FEED BUILDING			
	Not shown on PFD	4	Filter Unit	85 percent prefilter, HEPA filter	1,000 scfm	-
	Not shown on PFD	1	Exhaust Fan	TBD**	3,000	7.5
	Not shown on PFD	1	Supply Fan	TBD**	-	2
	Not shown on PFD	1	Gas Unit Heater	TBD**	200 mbh	-
	Not shown on PFD	1	Air-Cooled Chiller	TBD**	20T	16.1 kw
	Not shown on PFD	1	Compressed Air System	Package unit with aftercooler, dryer and receiver	TBD**	125

** TBD = to be determined

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PARSONS
ERA PROJECT

MATERIAL AND EQUIPMENT LIST
(CONCEPTUAL DESIGN REPORT)

CRU-1 PO 145
Date: October 1995

Subject: WASTE RETRIEVAL
Project Title: Remediation System Design
Discipline: Electrical

Rev. C
Checked by: RJ

Mark	Sketch No.	Qty.	Equipment Name	Description	Capacity	HP
A	N/A	1	Substation, 13.2 kV/480 V	Switchable secondaries, rated 1500/2000 KVA		
B	N/A	3	Motor Control Center	480 V, Seven vertical sections, 600 amps buss		
C	N/A	1	Power Distribution Panel	480 V, 600 amp main, w/6 100 amp bkr(s)		
D	N/A	2	Distribution Transformers	480/240/120 V, Dry type, 3 phase, 50 KVA		
E	N/A	4	Distribution Panels	240/120 V, 42 CKT, 3 phase, w/100 amp main bkr		
F	N/A	2	Lighting Transformers	480/208/120 V, dry type, 3 phase, 50 KVA		
G	N/A	3	Lighting Panels	208/120 V, 42 CKT, 3 phase, w/100 amp main bkr		
H	N/A	1	Diesel Generator	Back-up, 300 KW, P.F. = .85 or greater, 480 V, 3 phase		
I	N/A	1	UPS	Uninterruptible power supply, 20 KW, 480 V, 3 phase		

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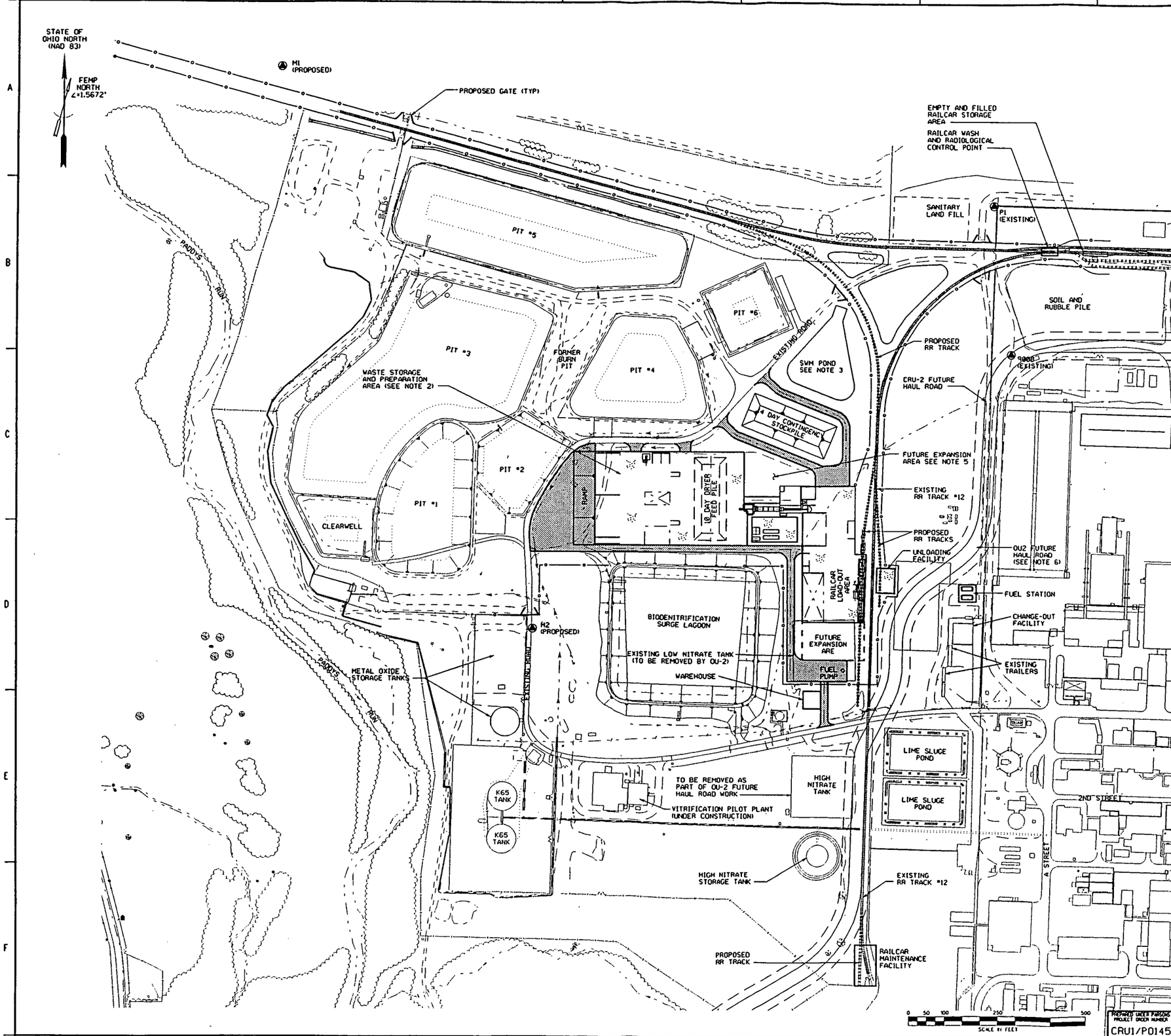


NOTES

1. EXISTING CONDITIONS SHOWN ON THIS DRAWING WERE PREPARED FROM FEMP SITE PROVIDED DATA FROM THE DOCUMENTS LISTED BELOW.

   EXISTING SITE DATA SOURCE (IN PLANT FILES)
   FEMP 1992 FLYOVER SURVEY
   FEMP CONTRACTOR PROJECT DESIGN DOCUMENTS

2. FOR DETAILED EQUIPMENT LAYOUT, SEE MATERIAL HANDLING SKETCHES SK-M-03917, SK-M-03919 AND SK-M-03921.
3. STORMWATER MANAGEMENT (SWM) POND SIZED TO MANAGE THE 25-YEAR, 24 HOUR STORM, WITH A 100-YEAR STORM EMERGENCY OVERFLOW TO PADDYS RUN. SEE CONCEPTUAL UTILITY PLAN, SK-G-03666.
4. 14 DAY CONTINGENCY STOCKPILE TO BE OPEN SIDED ROOF COVERED.
5. IF ADDITIONAL FUTURE EXPANSION AREA IS REQUIRED, 14 DAY CONTINGENCY STOCKPILE AND THE ACCESS ROAD JUST SOUTH OF THE STOCKPILE WILL BE REMOVED.
6. COORDINATION OF OU2 HAUL ROAD CONSTRUCTION AND UNLOADING RAILROAD SPUR IS REQUIRED.

LEGEND

EXISTING		PROPOSED
	ROAD/PAVEMENT	
	RAILROAD	
	STRUCTURE	
	FENCE	
	SURVEY MONUMENT	
	CONCRETE PAD	

REF DWG NO.	DRAWING TITLE
SK-M-03917	FEED PREPARATION AREA
SK-M-03919	DRYING FACILITY
SK-M-03921	BLENDING AND RAIL LOADOUT FACILITY
SK-G-03666	CONCEPTUAL UTILITY PLAN

PRELIMINARY
NOT FOR CONSTRUCTION

REV. NO.	ISSUE OR REVISION PURPOSE - DESCRIPTION	A-E	FERNCO	DATE
B	ISSUED FOR CONCEPTUAL DESIGN (CLIENT COMMENTS INCORPORATED)			
A	ISSUED FOR CONCEPTUAL DESIGN			

INITIALS AND 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
OU1 REMEDIATION SYSTEM DESIGN

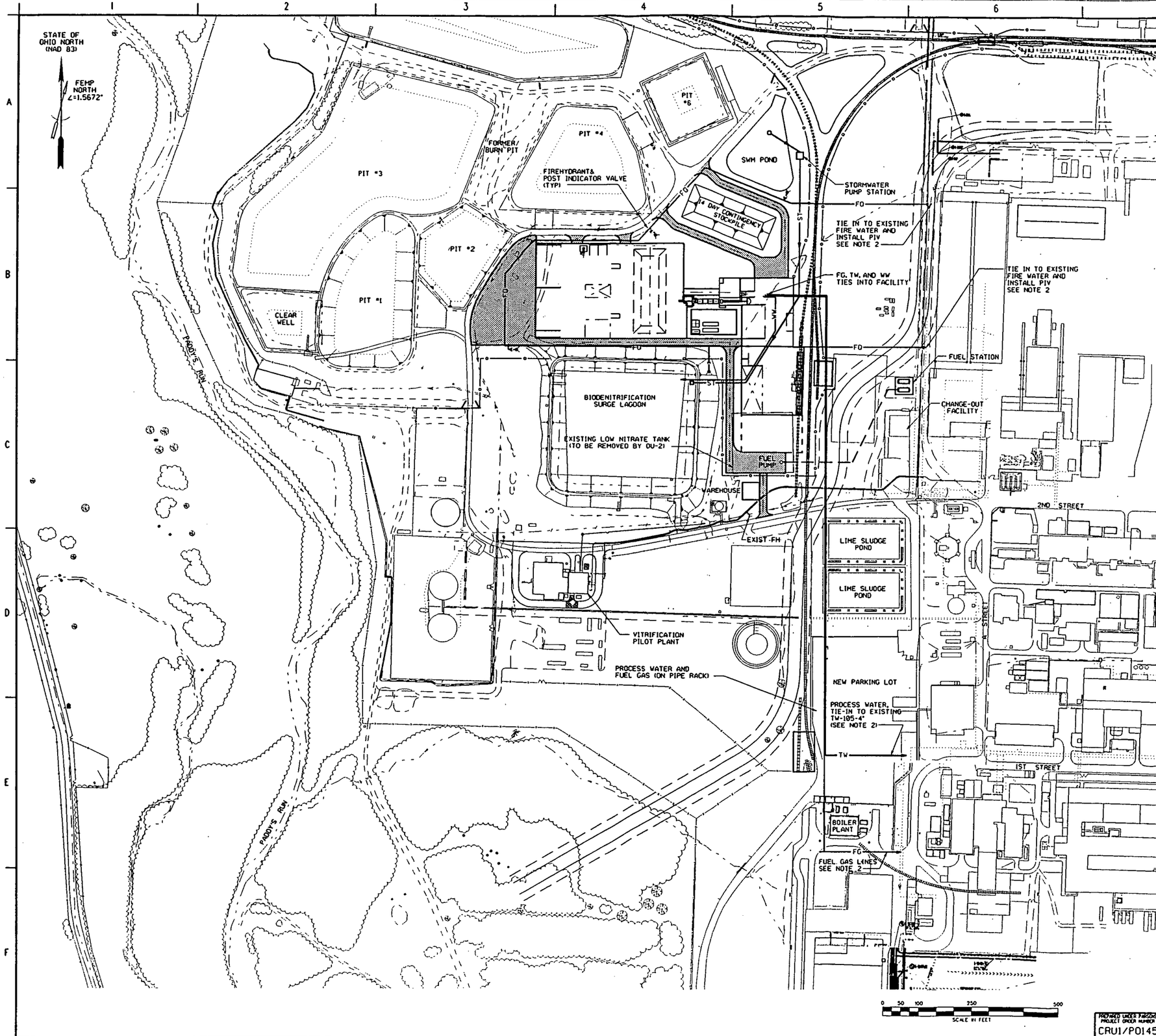
DRAWING TITLE
CIVIL
CONCEPTUAL SITE PLAN

DRAWN BY	DATE	LEAD ENGINEER	DATE	CHECKED BY	DATE
Y. AFSHAR	9-22-95			K. GERARD	9-25-95
PLANT/BLDG. NO.		FLOOR		SCALE 1"=100'	CLASS
SUBMITTED FOR APPROVAL		FERNCO CRU APPROVAL			
A-E	DATE		DATE		

DOE PROJECT NO.	FEMP PROJECT NO.	DRAWING NO.	SHEET NO.	REV. NO.
	WBS 1.1.1.1.1.3.1 00-90701	SK-G-03936	0001	B

PREPARED UNDER PARSONS PROJECT ORDER NUMBER CRU1/P0145

skg03666.m(1065.ws412) po145@ws412. Fri Oct 20 08:15:54 CDT 1995



NOTES

1. EXISTING CONDITIONS SHOWN ON THIS DRAWING WERE PREPARED FROM FEMP SITE PROVIDED DATA FROM THE DOCUMENTS LISTED BELOW.

   EXISTING SITE DATA SOURCE (IN PLANT FILES)
   FEMP 1992 FLYOVER SURVEY
   FEMP CONTRACTOR PROJECT DESIGN DOCUMENTS

2. INTERFACE POINTS WITH EXISTING UTILITY LINES MAY CHANGE DURING TITLE DESIGN.

LEGEND

EXISTING		PROPOSED
	ROAD/PAVEMENT	
	RAILROAD	
	STRUCTURE	
	FENCE	
	FIREWATER LINE	—FO—
	STORMWATER LINE	—ST—
	WASTEWATER	—WW—

REF DWG NO.	DRAWING TITLE
SK-G-03936	CONCEPTUAL SITE PLAN

PRELIMINARY
NOT FOR CONSTRUCTION

REV. NO.	ISSUE OR REVISION PURPOSE - DESCRIPTION	A-E	FERNCO	DATE
B	ISSUED FOR CONCEPTUAL DESIGN (CLIENT COMMENTS INCORPORATED)			
A	ISSUED FOR CONCEPTUAL DESIGN			

INITIALS AND 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
OU1 REMEDIATION SYSTEM DESIGN

DRAWING TITLE
CIVIL
CONCEPTUAL UTILITY PLAN

DRAWN BY	DATE	LEAD ENGINEER	DATE	CHECKED BY	DATE
Y. AFSHAR	7-7-95			K. GERARD	9-25-95

PLANT/BLDG. NO.	FLOOR	SCALE	CLASS
		1"=100'	

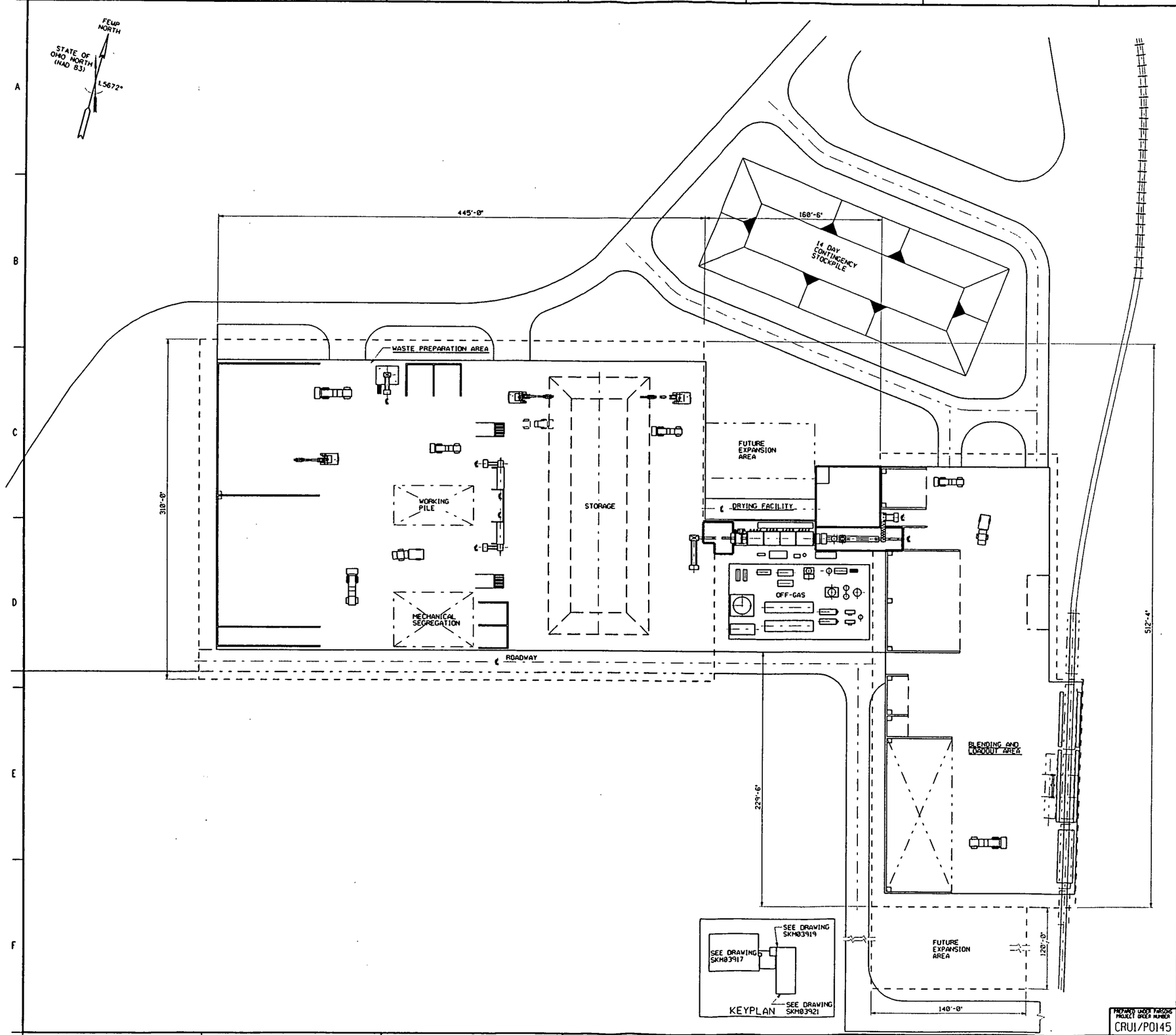
SUBMITTED FOR APPROVAL | FERNCO CRU APPROVAL

000205

A-E DOC. PROJECT NO.	DATE	FEMP PROJECT NO. WBS 1.1.1.1.1.3.1	DATE	DRAWING INDEX CODE NO.	SHEET NO.	REV. NO.
		00-90701		SK-G-03666	0002	B

PREPARED UNDER PARSONS PROJECT ORDER NUMBER
CRU1/P0145

skm03916.m(1705.ws316) po145@ws316. Fri Oct 20 14:24:46 CDT 1995



NOTES

REF DWG NO.	DRAWING TITLE
SK-M-03917	PLAN - WASTE PREPARATION AREA
SK-M-03919	PLAN - DRYING AREA
SK-M-03921	PLAN - BLENDING/RAIL LOADOUT AREA
SK-G-03942	CIVIL SITE - PLAN

PRELIMINARY
NOT FOR CONSTRUCTION

REV. NO.	ISSUE OR REVISION PURPOSE - DESCRIPTION	A-E	FEMCO	DATE
B	ISSUED FOR CONCEPTUAL DESIGN (CLIENT COMMENTS INCORPORATED)			
A	ISSUED FOR CONCEPTUAL DESIGN			

INITIALS AND DATE

UNITED STATES DEPARTMENT OF ENERGY
FERNALD ENVIRONMENTAL MANAGEMENT PROJECT

THIS DRAWING PREPARED BY
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CINCINNATI, OHIO

PROJECT NAME
OU1 REMEDIATION SYSTEM DESIGN
CRU1 / P0145

DRAWING TITLE
MATERIALS HANDLING
GENERAL ARRANGEMENT PLAN
PIT WASTE REMEDIATION FACILITY

DRAWN BY	DATE	LEAD ENGINEER	DATE	CHECKED BY	DATE
NH TERRY	18-3-95			K. TULI	18-3-95

PLANT/BLDG NO. | FLOOR | SCALE 1/20" = 1'-0" | CLASS

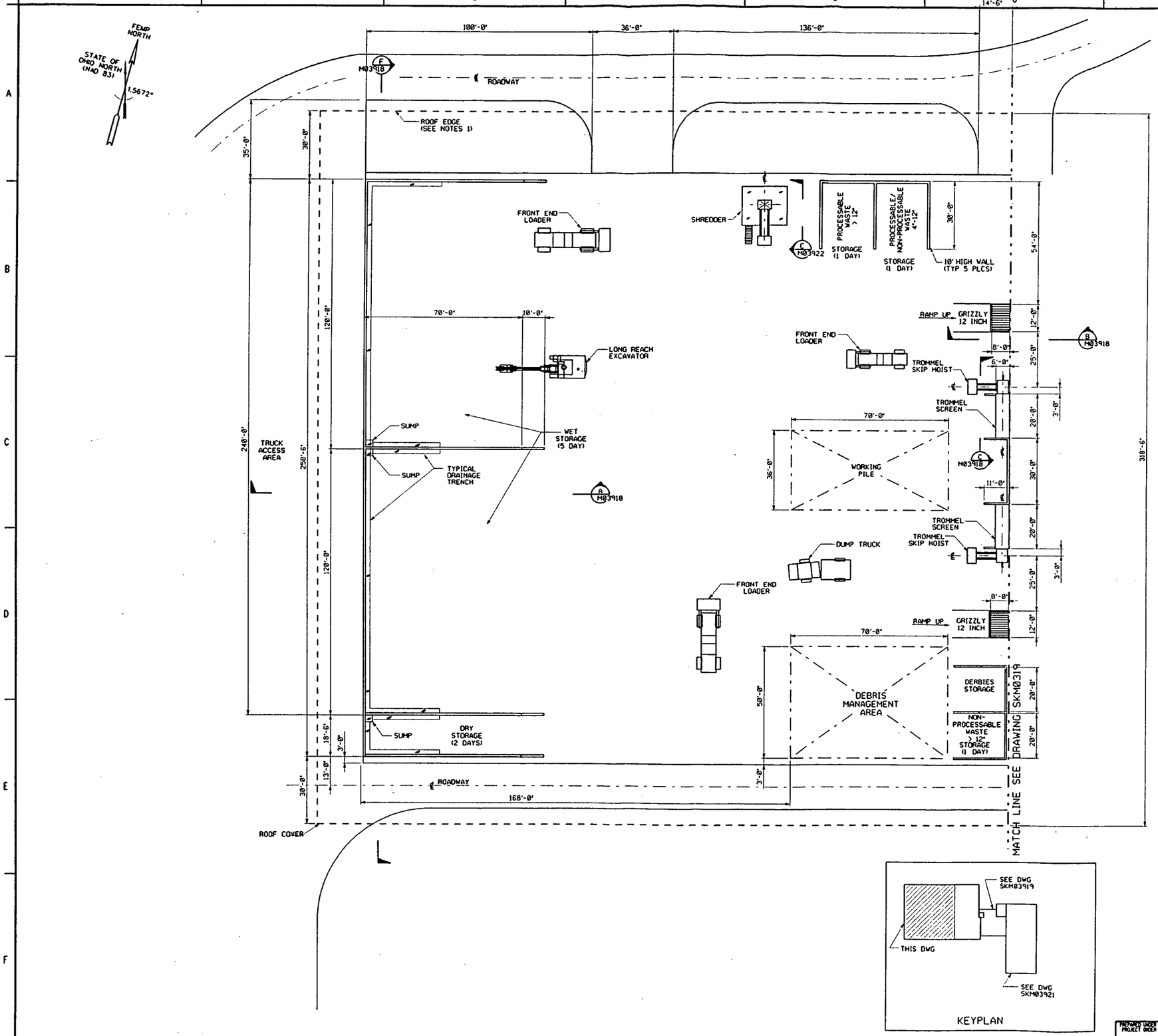
SUBMITTED FOR APPROVAL | FEMCO CRU APPROVAL 000206

A-E DATE | DATE

PREPARED UNDER PARSONS PROJECT ORDER NUMBER: CRU1/P0145

DOE PROJECT NO.	FEMP PROJECT NO.	DRAWING PROJ CODE NO.	SHEET NO.	REV. NO
	VBS 00-90701	SK-M-03916	M0011	B

skm03917.m(1711.ws316) po145@ws316. Fri Oct 20 14:44:56 CDT 1995



NOTES

1. DURING HANDLING OF SEMI-DRY AND DRY WASTE, MOBILE WATER SPRAY EQUIPMENT WILL BE USED TO CONTROL FUGITIVE EMISSIONS IN THE AREA.

REF DWG NO.	DRAWING TITLE
SK-M-03918	MATERIAL HANDLING SECTIONS WASTE PREPARATION AREA
SK-M-03919	MATERIAL HANDLING PLAN DRYING FACILITY

PRELIMINARY
NOT FOR CONSTRUCTION

REV. NO.	ISSUE OR REVISION PURPOSE - DESCRIPTION	A-E	FERMCO	DATE
B	ISSUED FOR CONCEPTUAL DESIGN (CLIENT COMMENTS INCORPORATED)			
A	ISSUED FOR CONCEPTUAL DESIGN			

INITIALS AND DATE

UNITED STATES DEPARTMENT OF ENERGY
FERNALD ENVIRONMENTAL MANAGEMENT PROJECT

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CINCINNATI, OHIO

PROJECT NAME
OU1 REMEDIATION SYSTEM DESIGN
CRU1 / P0145

DRAWING TITLE
MATERIAL HANDLING PLAN
WASTE PREPARATION AREA

DRAWN BY	DATE	LEAD ENGINEER	DATE	CHECKED BY	DATE
M.TERRY	09-13-95			K. TULI	10-4-95

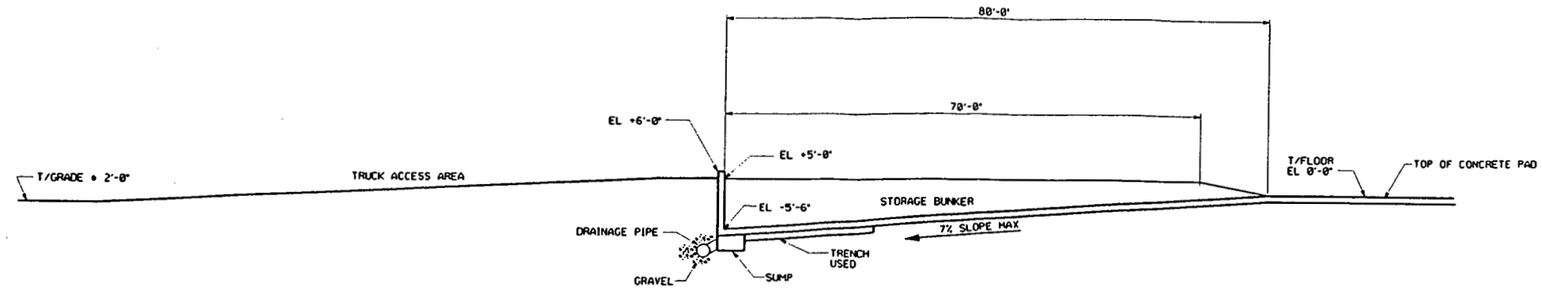
PLANT/BLDG NO.	FLOOR	SCALE	CLASS
		1/16" = 1'	

SUBMITTED FOR APPROVAL | FERMCO CRU APPROVAL | 000207

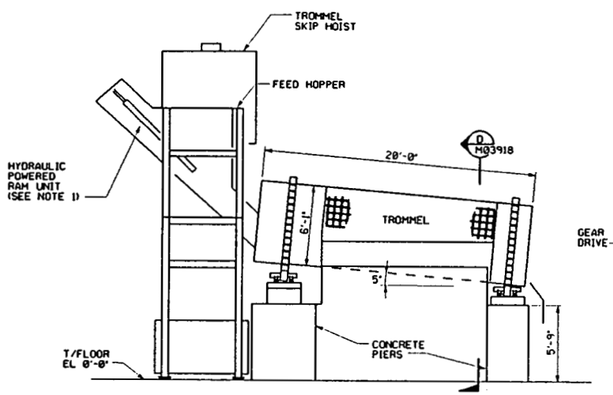
A-E DOE PROJECT NO.	TEMP PROJECT NO.	DRAWING SHEET CODE NO.	SHEET NO.	REV. NO.
	WBS 1.1.1.1.1 00-90701	SK-M-03917	M0012	B

PREPARED UNDER PARSONS PROJECT ORDER NUMBER CRU1/P0145

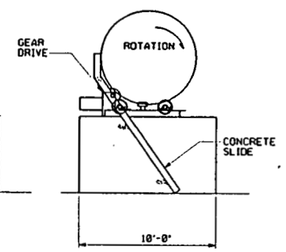
skm03918.m(1703.ws316) po145@ws316. Fri Oct 20 14:12:33 CDT 1995



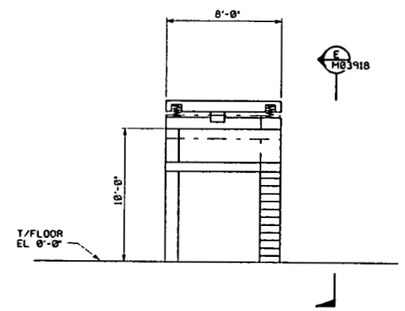
SECTION A REF
1/8"=1'-0" M03918 M03917



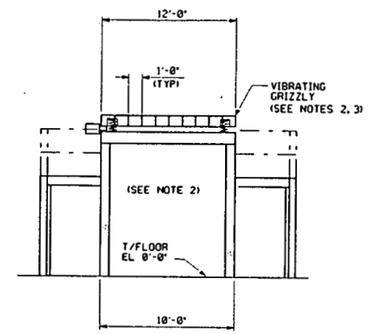
SECTION C REF
1/4"=1'-0" M03918 M03917



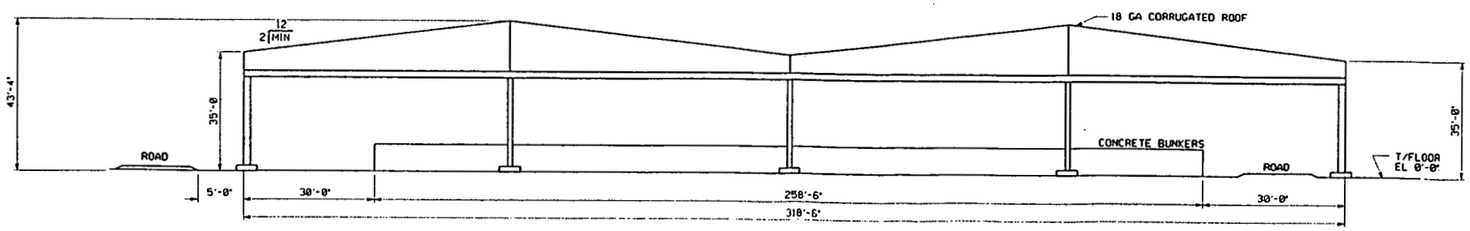
SECTION D REF
1/4"=1'-0" M03918



SECTION B REF
1/4"=1'-0" M03918 M03917



VIEW E REF
1/4"=1'-0" M03918



SECTION F REF
NTS M03918 M03917

NOTES

1. RAM UNIT WILL BE PERIODICALLY USED TO DISLODGE ANY BRIDGING OF MATERIAL INSIDE THE FEED HOPPER.
2. UNDERSIZE MATERIAL WILL BE RETRIEVED BY MOBILE EQUIPMENT.
3. BACKHOE BUCKET MAY BE USED PERIODICALLY TO SCRAPE THE OVERSIZE FROM THE GRIZZLY AND TO WORK THE MATERIAL THROUGH IT.

REF DWG NO.	DRAWING TITLE
SK-M-03917	PLAN - WASTE PREPARATION AREA

PRELIMINARY
NOT FOR CONSTRUCTION

REV. NO.	ISSUE OR REVISION PURPOSE - DESCRIPTION	A-E INITIALS	FERNCO INITIALS	DATE
B	ISSUED FOR CONCEPTUAL DESIGN (CLIENT COMMENTS INCORPORATED)			
A	ISSUED FOR CONCEPTUAL DESIGN			

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
OU1 REMEDIATION SYSTEM DESIGN
CRU1 / PO145

DRAWING TITLE
MATERIAL HANDLING
SECTIONS
WASTE PREPARATION AREA

DRAWN BY	DATE	LEAD TRADER	DATE	CHECKED BY	DATE
D.TERRY	09-13-95			J.ROBINSON	9/28/95
PLANT/BLDG NO.		FLOOR		SCALE	CLASS
				AS NOTED	
SUBMITTED FOR APPROVAL		FERNCO CRU APPROVAL			

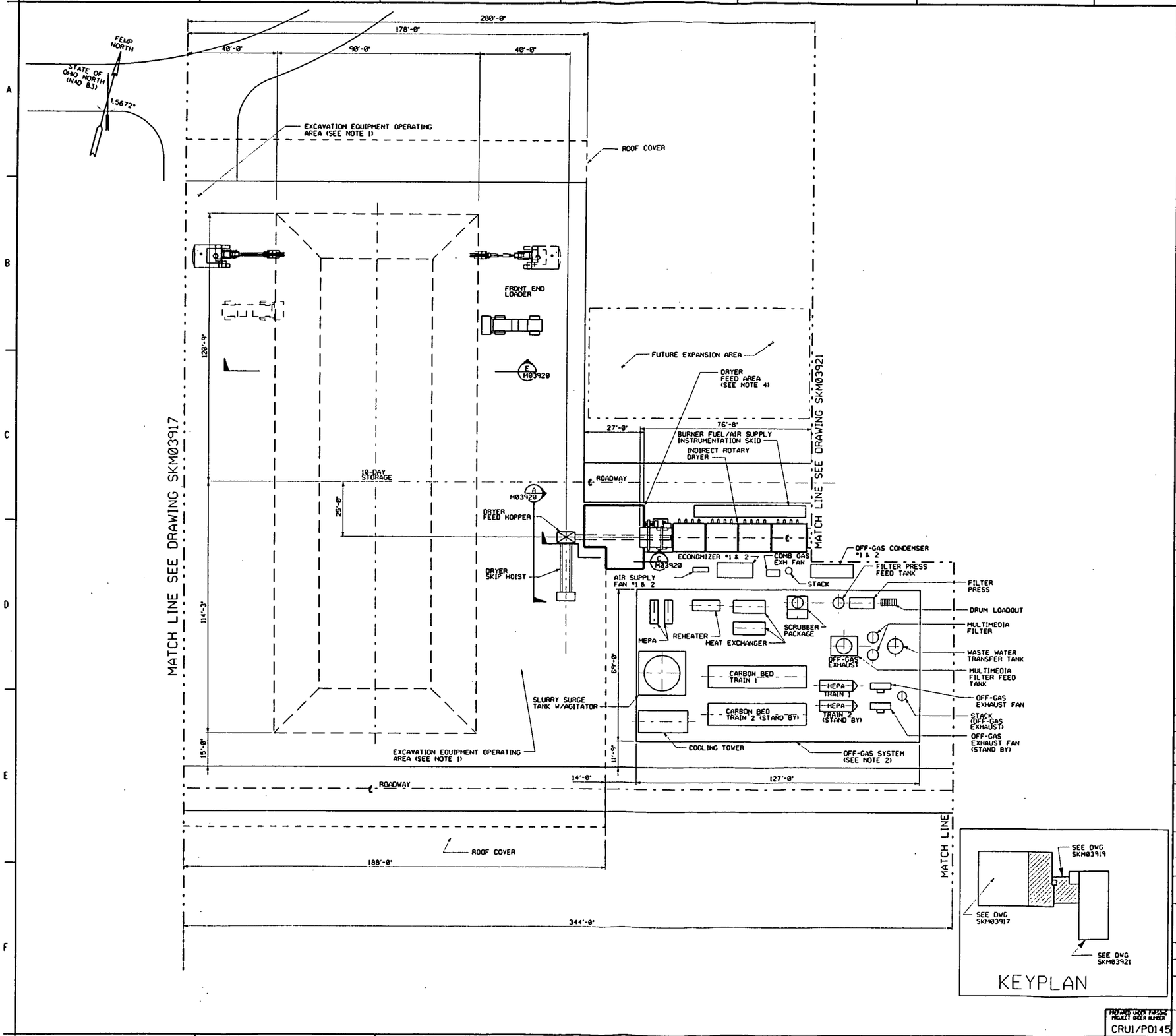
000208

A-E DOE PROJECT NO.	DATE	TEMP PROJECT NO.	DATE	DRAWING SHEET CODE NO.	SHEET NO.	REV. NO.
		WBS.1.1.1.1 00-90701		SK-M-03918	M0013	B

PREPARED UNDER PARSONS PROJECT ORDER NUMBER
CRU1/PO145

0163

skm03919.m(1707.ws316) po145@ws316. Fri Oct 20 14:30:44 CDT 1995



NOTES -

1. EXCAVATION EQUIPMENT OPERATING AREA WILL ALSO BE USE FOR ACCESS ACROSS THE FACILITY IN THE NORTH-SOUTH DIRECTION.
2. ONLY MAJOR EQUIPMENT IS SHOWN IN THIS AREA.
3. MOBILE EQUIPMENT WILL BE SUPPLIED WITH ENGINEERED CONTROLS TO MAINTAIN WORKER EXPOSURE ALARA.
4. HEPA, FAN & STACK TO SUPPORT THIS AREA.

REF DWG NO.	DRAWING TITLE
SK-M-03917	PLAN - WASTE PREPARATION AREA
SK-M-03920	SECTIONS - DRYING FACILITY
SK-M-03921	PLAN - BLENDING AND RAIL LOADOUT FACILITY

PRELIMINARY
NOT FOR CONSTRUCTION

REV. NO.	ISSUE OR REVISION PURPOSE - DESCRIPTION	A-E	FERNCO	DATE
B	ISSUED FOR CONCEPTUAL DESIGN (CLIENT COMMENTS INCORPORATED)			
A	ISSUED FOR CONCEPTUAL DESIGN			

INITIALS AND DATE

UNITED STATES
DEPARTMENT OF ENERGY
FERNALD ENVIRONMENTAL MANAGEMENT PROJECT

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CINCINNATI, OHIO

PROJECT NAME
OU1 REMEDIATION SYSTEM DESIGN
CRU1 / P0145

DRAWING TITLE
MATERIAL HANDLING
PLAN
DRYING FACILITY

DRAWN BY	DATE	LEAD CHECKER	DATE	CHECKED BY	DATE
N.TERRY	09-13-95			J. ROBINSON	9/28/95

PLANT/BLDG NO. | FLOOR | SCALE 1/16" = 1'-0" | CLASS

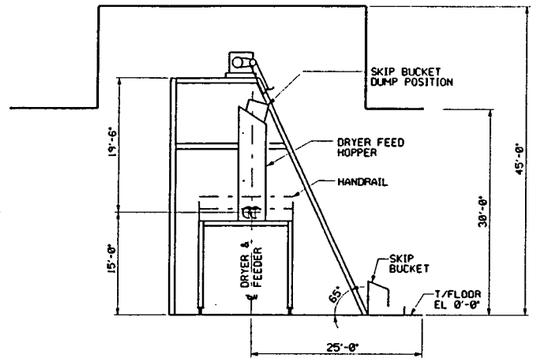
SUBMITTED FOR APPROVAL | FERNCO CRU APPROVAL

000209

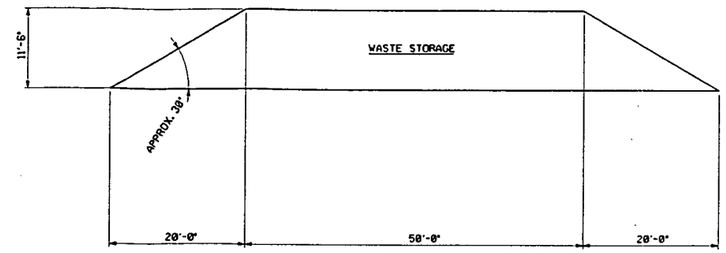
A-E DATE | DOE PROJECT NO. | FEMP PROJECT NO. WBS 1.1.1.1.1 00-90701 | DRAWING REF. CODE NO. SK-M-03919 | SHEET NO. M0014 | REV. NO. B

PREPARED UNDER PARSONS PROJECT ORDER NUMBER CRU1/P0145

skm03920.m(457.ws319) po145@ws319. Fri Oct 20 14:19:22 CDT 1995



SECTION A REF M03920 M03919



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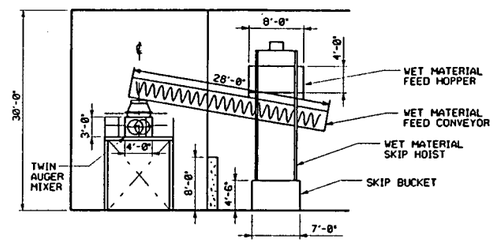
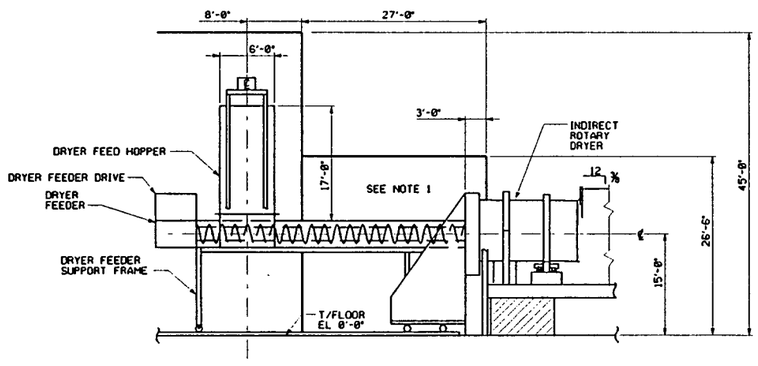


SECTION B REF M03920 M03921
1/8"=1'-0"



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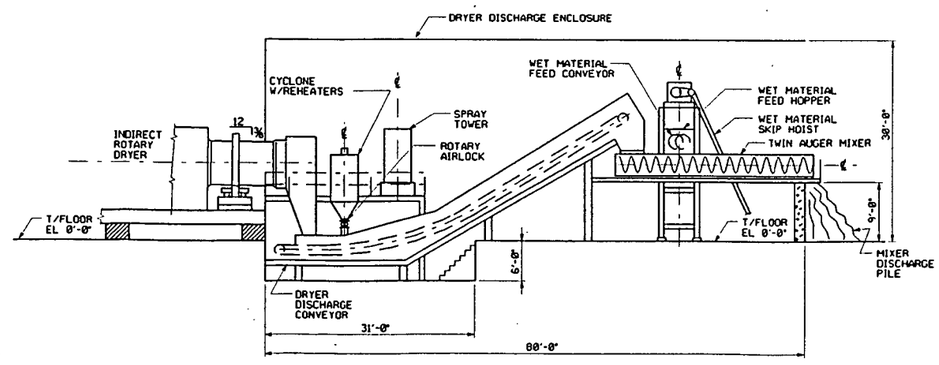


SECTION D REF M03920 M03921

NOTES

1. THIS AREA IS USED FOR MAINTENANCE OF DRYER FEED END EQUIPMENT. AREA IS VENTILATED THROUGH HEPA FILTERS TO CONTROL RADIOACTIVE EMISSIONS TO THE ATMOSPHERE.

REF DWG NO.	DRAWING TITLE
SK-M-03919	MATERIAL HANDLING PLAN DRYING FACILITY
SK-M-03921	MATERIAL HANDLING PLAN BLENDING AND RAIL LOADOUT FACILITY

PRELIMINARY
NOT FOR CONSTRUCTION

REV. NO.	ISSUE OR REVISION PURPOSE - DESCRIPTION	A-E INITIALS AND DATE	FERNCO INITIALS AND DATE	DATE
B	INCORPORATE CLIENT COMMENTS (CLIENT COMMENTS INCORPORATED)			
A	ISSUED FOR CONCEPTUAL DESIGN			

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
OU1 REMEDIATION SYSTEM DESIGN
CRU1 / PO145

DRAWING TITLE
MATERIAL HANDLING
SECTIONS
DRYING FACILITY

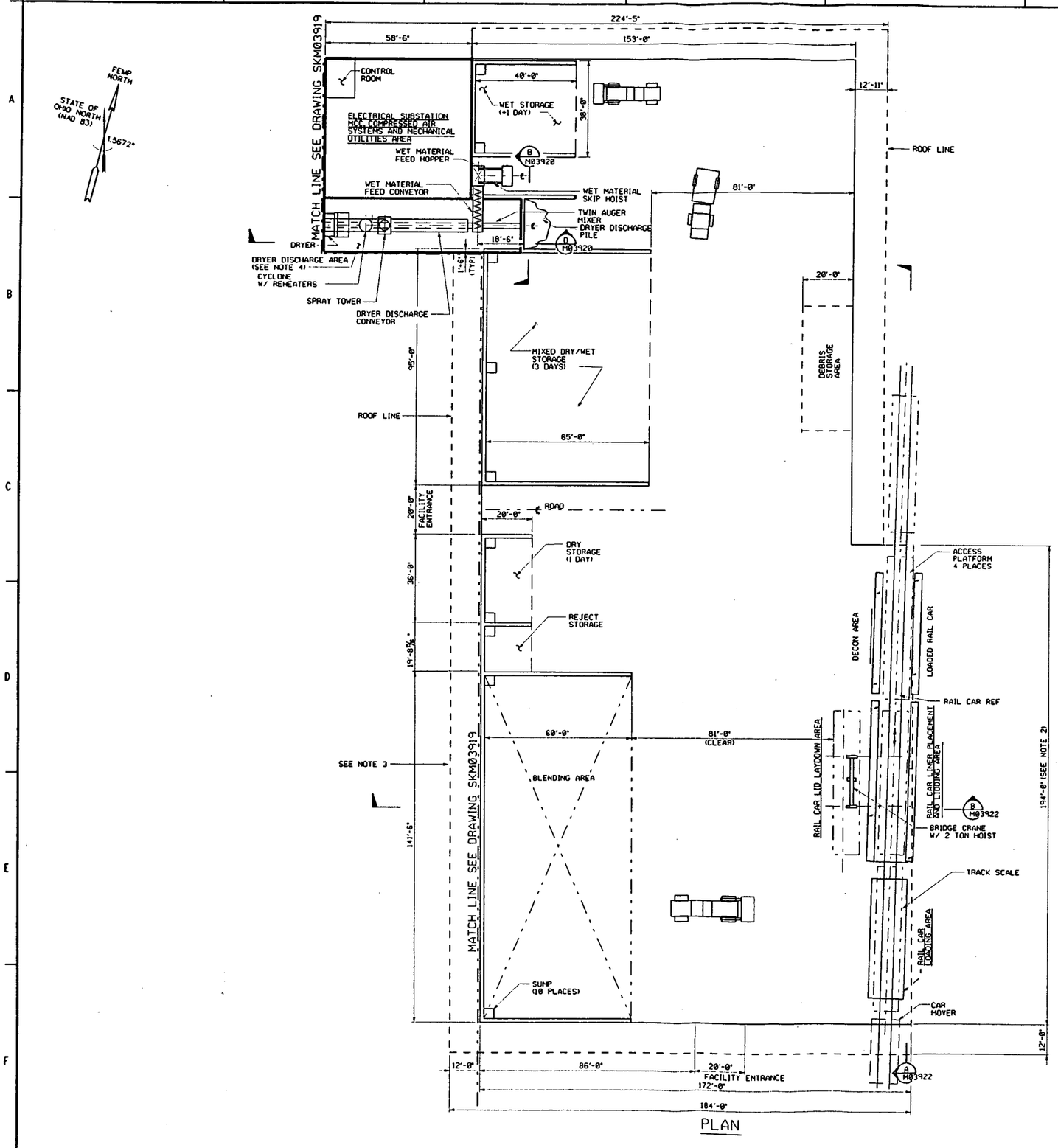
DRAWN BY	DATE	LEAD ENGINEER	DATE	CHECKED BY	DATE
N.TERRY	09-13-95			J. ROBINSON	9-28-95
PLANT/BLDG NO.		FLOOR		SCALE 1/8 "=1'	CLASS

SUBMITTED FOR APPROVAL | FERNCO CRU APPROVAL | A-E DATE | DATE

000210

PREPARED UNDER PARSONS PROJECT ORDER NUMBER	DOE PROJECT NO.	TEMP PROJECT NO.	DRAWING INDEX CODE NO.	SHEET NO.	REV. NO.
CRU1/PO145		WBS 1.1.1.1.1 00-90701	SK-M-03920	M0015	B

skm03921.m(459.ws319) po145@ws319. Fri Oct 20 14:29:27 CDT 1995



NOTES

1. DURING HANDLING OF SEMI-DRY AND DRY WASTE, MOBILE WATER TRUCKS WITH WATER SPRAYS WILL BE USED TO CONTROL FUGITIVE EMISSIONS IN THE AREA.
2. THE EAST SIDE OF THIS AREA IS COVERED TO THE GROUND LEVEL TO PREVENT RAIN WATER INFILTRATION.
3. ROOF COVER IS EXTENDED BEYOND THE STORAGE AREA TO AFFORD PROTECTION FROM RAIN WATER INFILTRATION.
4. HEPA FAN AND STACK TO SUPPORT THIS AREA.

REF DWG NO.	DRAWING TITLE
SK-M-03919	MATERIAL HANDLING PLAN DRYING FACILITY
SK-M-03920	MATERIAL HANDLING SECTIONS RAIL LOADOUT
SK-M-03922	MATERIAL HANDLING SECTIONS BLENDING AND RAIL LOADOUT FACILITY

PRELIMINARY
NOT FOR CONSTRUCTION

REV. NO.	ISSUE OR REVISION PURPOSE - DESCRIPTION	A-E	FERNCO	BWE
B	ISSUED FOR CONCEPTUAL DESIGN (CLIENT COMMENTS INCORPORATED)			
A	ISSUED FOR CONCEPTUAL DESIGN			

INITIALS AND DATE

UNITED STATES DEPARTMENT OF ENERGY
FERNALD ENVIRONMENTAL MANAGEMENT PROJECT

THIS DRAWING PREPARED BY
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CINCINNATI, OHIO

PROJECT NAME
OU1 REMEDIATION SYSTEM DESIGN
CRU1 / P0145

DRAWING TITLE
MATERIALS HANDLING PLAN
BLENDING AND RAIL LOADOUT FACILITY

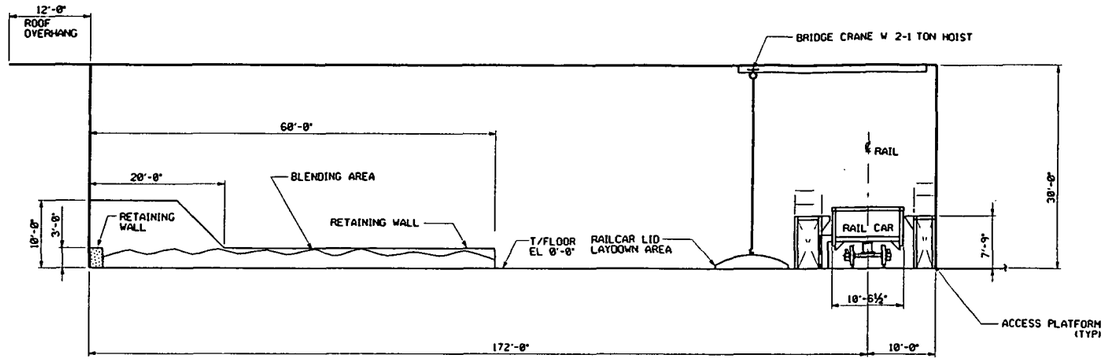
DRAWN BY	DATE	LEAD ENGINEER	DATE	CHECKED BY	DATE
NH TERRY	09-13-95			K. MADDEN	9-28-95
PLANT/BLDG. NO.		FLOOR		SCALE 1 /16" =1'-0"	CLASS
SUBMITTED FOR APPROVAL		FERNCO CRU APPROVAL			

A-E DATE

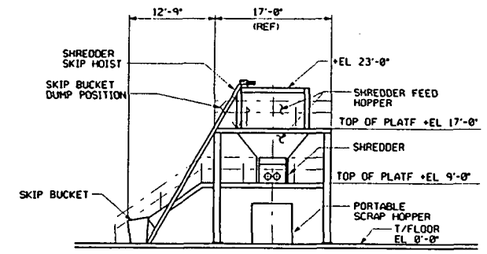
000211

PREPARED UNDER PARSONS PROJECT ORDER NUMBER	DOE PROJECT NO.	FEMP PROJECT NO.	DRAWING INDEX CODE NO.	SHEET NO.	REV. NO.
CRU1/P0145		WBS 00-90701	SK-M-03921	M0016	B

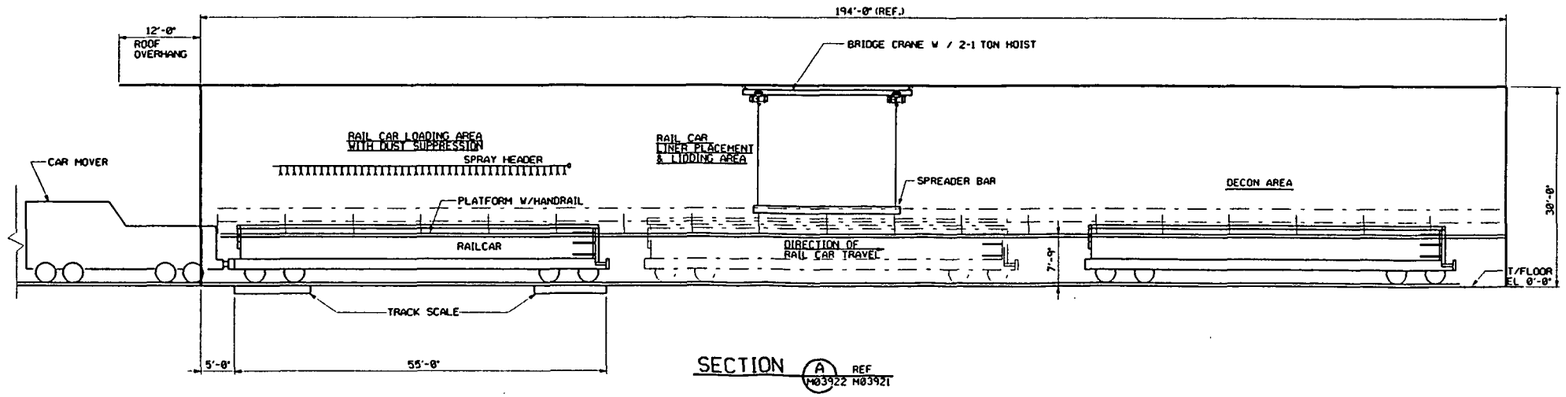
skm03922.m(462.ws319) po145@ws319. Fri Oct 20 14:38:19 CDT 1995



SECTION (B) REF M03922 M03921



SECTION (C) REF M03922 M03917



SECTION (A) REF M03922 M03921

NOTES

REF DWG NO.	DRAWING TITLE
SK-M-03917	PLAN - WASTE PREPARATION AREA
SK-M-03921	PLAN - BLENDING AND RAIL LOADOUT FACILITY

PRELIMINARY
NOT FOR CONSTRUCTION

REV. NO.	ISSUE OR REVISION PURPOSE - DESCRIPTION	A-E	FERNCO	DATE
B	ISSUED FOR CONCEPTUAL DESIGN (CLIENT COMMENTS INCORPORATED)			
A	ISSUED FOR CONCEPTUAL DESIGN			

INITIALS AND 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
OU1 REMEDIATION SYSTEM DESIGN
CRU1 / P0145

DRAWING TITLE
MATERIAL HANDLING
SECTIONS
BLENDING AND RAIL LOADOUT FACILITY

DRAWN BY	DATE	LEAD ENGINEER	DATE	CHECKED BY	DATE
N. TERRY	09-13-95			K. MADDEN	9-28-95
PLANT/BLDG. NO.		FLOOR		SCALE 1/8 "=1'	CLASS

SUBMITTED FOR APPROVAL — A-E — DATE
FERNCO CRU APPROVAL — DATE

000212

PREPARED UNDER PARSONS PROJECT ORDER NUMBER	DOE PROJECT NO.	TEMP PROJECT NO.	DRAWING INDEX CODE NO.	SHEET NO.	REV. NO.
CRU1/P0145		WBS 1.1.1.1 00-90701	SK-M-03922	M0017	B

Equipment Specifications

Operable Unit 1
Project Order 145

October 1995
Revision A

Environmental Remedial Action Project
Fernald Environmental Management Project
Fernald, Ohio
FERMCO Subcontract No. 2-21487

PARSONS

Fairfield Executive Center
6120 South Gilmore Road
Fairfield, Ohio 45014

Equipment Specifications

This section contains the performance specifications for the major items of mechanical equipment: the shredder, the indirect dryer, the waste loadout system, and the off-gas control system. These specifications will be used for competitive procurement of items requiring long-lead fabrication times. Civil specifications are found in the Site Improvement Plan.

The specifications include applicable codes and standards, qualitative and quantitative specifications and performance measures for finished equipment, materials of construction, fabrication methods, and inspection and testing. The specifications also include instructions to bidders on bid evaluation, submittals, quality assurance, and delivery, storage, and handling of materials and equipment.

The specifications included in this section are at varying stages of completion at this time. The shredder specification and the dryer specification are nearly complete, the off-gas control system specification is in early draft stages, and the waste loadout system specification contains only a description of the system.

Shredder

Shredder Performance Specification

Operable Unit 1
Project Order 145
October 1995
Revision A

Environmental Remedial Action Project
Fernald Environmental Management Project
Fernald, Ohio
FERMCO Subcontract No. 2-21487

PARSONS

Fairfield Executive Center
6120 South Gilmore Road
Fairfield, Ohio 45014

U.S. DEPARTMENT OF ENERGY
FERNALD ENVIRONMENTAL MANAGEMENT PROJECT
FERMCO SUBCONTRACT NO. 2-21487

PROJECT ORDER 145

SPECIFICATIONS

SECTION 00003

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13652	SHREDDER	A	09/05/95
DIVISION 15 - MECHANICAL			
15172	MOTORS FOR SHREDDER	A	09/05/95
DIVISION 16 - ELECTRICAL			
16052	BASIC ELECTRICAL MATERIALS AND METHODS FOR SHREDDER	A	09/05/95

END OF SECTION

U.S. DEPARTMENT OF ENERGY

FERNALD ENVIRONMENTAL MANAGEMENT PROJECT

FERMCO SUBCONTRACT NO. 2-21487

SECTION 13652

SHREDDER

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SECTION 13652
SHREDDER

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Requirements for the design, engineering support, fabrication, delivery, and installation assistance for one shredder.

1.2 RELATED SECTIONS

A. Section 15172 - Motors for Shredder.

B. Section 16052 - Basic Electrical Materials and Methods for Shredder.

1.3 REFERENCES

A. Acts:
1. Fastener Quality Act of 1990.

B. American Bearing Manufacturers Association, Inc. (ABMA):
1. ABMA 9-90 Load Rating Standard for Ball Bearings.
2. ABMA 11-90 Load Rating Standard for Roller Bearings.

C. American Gear Manufacturers Association (AGMA):
1. AGMA 2001B-88 Fundamental Rating Factors and Calculation Methods for Involute Spur and Helical Gear Teeth.

D. American Society for Testing and Materials (ASTM):
1. ASTM A36-94 Standard Specification for Carbon Structural Steel.

2. ASTM A325-94 — Standard Specification for Structural Bolts, Steel, Heat Treated 120/105 ksi Minimum Tensile Strength.

3. ASTM A500-93 — Standard Specification for Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes.

4. ASTM A563-94 — Standard Specification for Carbon and Alloy Steel Nuts.

5. ASTM F436-93 — Standard Specification for Hardened Steel Washers.

E. American Welding Society, Inc. (AWS):

1. AWS D1.1-94 — Structural Welding Code - Steel, Thirteenth Edition.

F. Code of Federal Regulations (CFR):

1. 29 CFR 1910.
2. 40 CFR 261, Subparts C and D.

G. National Fire Protection Association (NFPA):

1. NFPA 68-94 — Guide for Venting of Deflagrations.
2. NFPA 69-92 — Standard on Explosion Prevention Systems.
3. NFPA 70-93 — National Electrical Code.

H. Steel Structures Painting Council (SPC):

1. SP6-91 — Surface Preparation, Specification No. 6 - Commercial Blast Cleaning.

I. Codes

1. Uniform Building Code - UBC 1994.
2. Ohio Basic Building Code OBBC 1995.

J. American Society of Civil Engineers (ASCE):

1. ASCE 7-93 — Minimum Design Loads for Building and Other Structures.

K. American Iron and Steel Institute (AISI).

1.4 SYSTEM DESCRIPTION

A. The shredder is one component in a waste drying facility. The shredder provides size conditioning of waste materials to meet waste acceptance criteria for final disposal.

B. Waste materials will be excavated from process pits located on the site. Gross materials separation will be performed at the pits. This waste will be transported in batch fashion to the waste preparation facility and will be temporarily stored in feed pits. Waste material is then moved in batches from the feed pits and passed through a series of screens. The screens size the material for the drying process. The material that passes through the screen is sent to the dryer surge pile. The tramp materials that are collected on the screens are removed to a separation area. Materials that can be size reduced through the shredder are included in final off-site disposition along with dried waste from the dryer. Some of the large debris encountered during excavation of pits is also sent to the shredder for size reduction. As a result of these separations, the following materials are expected to be fed to the shredder:

1. Agglomerated clay, magnesium fluoride slag, and lime - greater than 4-inch diameter.
2. Dust collector bags.
3. Graphite crucibles and molds.
4. Rocks, bricks, and ceramics (12 inch by 12 inch by 2 inch).
5. 55- to 85-gallon steel drums.
6. Reinforced concrete blocks (2 feet by 2 feet by 12 inches).
7. Wood and pallets 4 feet wide by 4 feet long, made of 4-inch by 4-inch, pressure-treated wood.
8. Light gage structural steel such as 2-foot by 2-foot by 1/4-inch angles, 2-inch by 6-inch by 1/4-inch channels, etc. I-beams are not to be processed through the shredder.
9. Polyethylene and plastic materials.

C. Materials will be fed into the shredder through a top-mounted hopper. A skip hoist (furnished by FERMCO) will load the waste material into the shredder system in 2 cubic yard bulk batches. Access to the top of the hopper must remain clear for this purpose. The shredder system will be required to size reduce the materials to no more than 4 inches in any two dimensions, and the third dimension cannot exceed 4 feet. The shredder will discharge out the bottom.

D. The Seller shall provide, per the requirements contained in this specification, the shredder (mounted on a base frame) and the feed hopper, sized to support the operating system. The base frame will be mounted to a support frame (supplied by others) which will position it relative to the other facility equipment. The Seller shall also supply the hydraulic power unit (if applicable) on a separate skid with all interconnecting hoses, a local control, and an electric service box. In addition, the system shall be supplied with a dry chemical or CO_2 fire suppression system. An option shall be provided for the inclusion of a dust suppression system.

E. The shredder system shall comply with all pertinent sections of OSHA (29 CFR 1910) and the other national standards as enumerated in Part 2.

1.5 BID EVALUATION

A. Proposals shall be evaluated by a Technical Evaluation Board (TEB). The TEB will be organized by and make its recommendation to FERMCO based on the criteria as outlined in Appendix B.

1.6 SUBMITTALS

A. At Proposal: 10 copies and one reproducible (Mylar), if applicable, shall be submitted for the following:

1. Description of shredding process, focusing on how the Seller's equipment meets or exceeds the requirements of this specification.

2. Description of the dry chemical or CO_2 fire suppression system, including a description of fire detection methodology.
3. Preliminary dimensioned outline drawings for the equipment and systems, including estimated weights and anchor bolt locations, and locations for all Seller-supplied equipment.
4. Preliminary Instrument and Control Diagrams depicting instruments, logic, control, and interlocks for motor starters and control panel.
5. Preliminary magnitude and location of all dynamic loads from all major equipment.
6. Preliminary foundation loads.
7. List of optional equipment which, in the Seller's opinion, increases the efficiency or reliability, or simplifies the maintenance of the system. All suggested optional equipment shall include a rational explanation of why the accessory is desirable.
8. Any exception to this specification shall be clearly identified in the Seller's proposal. If there are no exceptions, the Seller shall state "No Exceptions." The proposal may be considered nonresponsive without this information.
9. Quality assurance/quality control procedures.
10. The Seller shall complete and return Data Sheets located in Appendix A.
11. The Seller shall provide written notification of any flammable hydraulic fluids and any hazardous substance as defined under 40 CFR 261, Subparts C and D, integral to the equipment and required for shipping, installation, operations, or maintenance of the equipment supplied under this specification.
12. The Seller shall provide spare parts requirements with prices and deliveries for 3 years' operation, with mandatory start-up spares identified. The Seller shall also include consumable requirements for normal operation. This includes part numbers, cost, stock point, and delivery time. Consumables are items which must be replenished due to deterioration, wear, failure, or maintenance within a 6-month period or normal operation.

B. After Award of Contract: Within 6 weeks after award of purchase order, the Seller shall submit 10 copies and one reproducible (Mylar), if applicable, of the following information for approval prior to start of fabrication:

1. Certified shop drawings for the equipment arrangement, including estimated weights and skid anchor bolt locations (size and structural loadings). Drawings shall indicate the extent of assembly of equipment or fabrication size which Seller will ship to the site. In addition, the drawing shall bear the seal of a Professional Engineer registered in the State of Ohio.
2. Anchor bolt load (including sizes) calculations bearing the seal of a Professional Engineer registered in the State of Ohio. Anchor bolt load and size calculations shall include the effects of wind and seismic loads, as follows:
   a. Seismic Load: Use provisions of the Uniform Building Code (1994), using Z = 0.13, C = 2.75, I = 1.25 and Rw = Remediation Factors from Table 16-P. Total seismic load shall include all normal operating components and attachments.
   b. Wind load: Basic wind speed of 80 mph (per OBBC 1995). I (importance factor) = 1.07, exposure C. Determine the wind loads using factors and coefficients as stipulated in ASCE 7-93.
3. Electric system control diagrams.
4. Electric system single line diagrams.
5. Hydraulic system schematic diagrams, if applicable.
6. Materials of construction of the shredder.
7. A weekly schedule (bar chart) of Seller activities from date of award to delivery of the shredder to the site. The schedule shall include specific hold points that will be placed in the Seller's production process to allow FERMCO to witness fabrication, inspections, and tests.
8. Power requirements and connection points.
9. The Seller shall furnish the paint system specification, including colors, name of

manufacturer, Material Safety Data Sheets (MSDSs), and other pertinent information to FERMCO for approval.

C. During Fabrication: 10 copies of the following shall be submitted:

1. Report for inspection during fabrication: The Seller shall furnish reports describing resolution of disagreements and non conformance discovered during prefinish inspection(s).

D. At Shipment: 10 bound copies and one reproducible (Mylar), if applicable, shall be submitted for the following:

1. The Seller shall provide approved Operations and Maintenance (O&M) Manuals. As a minimum, the O&M Manuals shall contain the following information:
   a. Operating procedures.
   b. Instructions for maintenance.
   c. Installation instructions.
   d. Troubleshooting guide.
   e. Maintenance schedule and service guide.
   f. Parts list and diagrams of major components to be maintained.
2. The Seller shall provide certified test results from all shop testing of equipment provided under this specification.
3. The Seller shall provide the terms and conditions of their warranty for workmanship and materials.
4. The Seller shall supply MSDSs for all chemical compounds supplied or required for operations and maintenance of equipment supplied under this specification, including preservatives, hydraulic fluids, oils, lubricants and greases.
5. The Seller shall provide certification of conformance for all equipment supplied under this specification.
6. The Seller shall provide a lubrication chart for all equipment supplied under this specification.
7. The Seller shall provide start-up instructions.
8. The Seller shall provide a procedure for cleaning, handling, inspecting, repackaging, and storing all equipment supplied under this specification.

9. The Seller shall provide a list of all equipment required for installing the equipment provided under this specification.
10. The Seller shall submit a shipping plan for approval.

1.7 QUALITY ASSURANCE

A. Quality Assurance Program Requirements

1. The Quality Assurance Program shall include the following items:
   a. Design Control: Provide a program to identify control measures used to ensure that design requirements, including quality standards, are defined and verified as applicable, and are accurately represented in drawings, specifications, and procedures.
   b. Instructions, procedures, and drawings: The Seller's activity affecting quality shall be prescribed by and performed in accordance with documented instructions, procedures, or drawings. These documents include criteria for acceptance.
   c. Document control: Control the preparation, issue, and change of documents that specify quality requirements or prescribe activities affecting quality to ensure that correct documents are employed.
   d. Inspection: Plan and execute inspections to verify conformance to purchase order quality and technical requirements. These inspections shall be documented and approved by FERMCO. Notification of the site is required at least 2 weeks prior to the performance of the inspection. Witness hold points will be specified later.
   e. Test control: Plan and execute tests verifying conformance of an item or process according to written procedures which contain the test requirements and acceptance limits. Notification of the site is required at least 2 weeks prior to the performance of the test.

f. Control of test and measuring equipment: Control and calibrate all tools, gauges, instruments, and other devices used for activities affecting quality.

g. Inspection, test, and operating status: Provide for the identification of acceptance status of items procured by the tagging, marking, or documents traceable to the items required by the specifications.

h. Control of nonconforming items: Provide for items or processes that do not conform to procurement document requirements. Nonconformances shall be controlled to prevent inadvertent installation or use, and shall be documented.

i. Quality assurance records: Generate, compile, and maintain all program records that furnish documentary evidence of quality, and provide records as specified by the procurement document.

B. Source Inspections/Test: Equipment will be tested at the shop to ensure that all shredder operations function safely and according to operating parameters.

1. Successful completion of shop testing shall be confirmed by issuing certified copies of the test reports to FERMCO.
2. Shop testing and inspection shall take place at the Seller's shop, with both FERMCO and Seller present. The Seller shall be responsible for necessary modifications or adjustments to the shredder.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Packing and Shipping: The Seller shall prepare and package the shredder system for delivery to ensure that it is not damaged and that components are not lost or diverted during shipment to the site. Shipment shall be made in accordance with the Seller's approved shipping plan. The Seller will pay all shipping and insurance costs required to safely deliver the shredder to the site.

1. Shipping Plan: A shipping plan shall be prepared in accordance with the subcontract instructions and submitted to FERMCO for approval a minimum of 6 weeks prior to shipment. The plan shall define routing, precautions, shipping weights of major components, loading and handling requirements, carrier, shipping documents, and any other data to ensure safe and timely delivery of the requisitioned item. Shipments which may present potential personnel safety hazards at the receiving site due to conditions such as pressurized containers, non-life-supporting atmospheres, hazardous materials, etc. shall be conspicuously marked or labeled with precautionary warnings.
2. Preparation for Delivery and Shipping: Upon completion of assembly, testing, and inspection, the Seller shall prepare all items for shipment and deliver them to the site. All equipment shall be thoroughly clean and dry. All liquid lubricants shall be drained from equipment prior to shipment.
3. Labeling: Each item or unit package shipped shall be clearly labeled with the name of the equipment contained, part and serial number, subcontract number, and destination. Labeled items shall be identifiable on the bill of material and referenced on the General Arrangement Drawings and Details to facilitate field assembly and installation.
4. Tags and nameplates: Each component of the shredder must be identified by a permanent tag and nameplate, with lettering a minimum of 1/4 inch in height.

B. Acceptance at Site:

1. Acceptance testing and inspection shall take place at the site, with both FERMCO and Seller present. The Seller shall be responsible for necessary modifications or adjustments to the shredder to meet the stated performance.
2. Acceptance of the shredder by FERMCO will be determined by successful completion of the test

program. The test shall demonstrate the equipment's ability to consistently process the surrogate materials described in Table 1 of Article 2.4.

C. Storage and Protection:

1. Materials, parts, subcomponents, and finished products shall be protected from the natural elements, industrial atmosphere, and hazardous conditions that could cause deterioration, corrosion, or damage. This requirement applies to both interim storage or handling during manufacturing and final shipment to the site.
2. All equipment shall be thoroughly cleaned of loose, spattered, or excess weld metal; metal chips; grease; oil; layout markings; and other foreign material. All components shall be dry prior to packing. All process connections shall be capped or plugged. Padding, bracing, blocking, and lock-wire shall be installed as needed to prevent damage by mechanical shock during handling and transportation. Instruments too heavy or too delicate to be shipped while mounted on the equipment shall be installed, wired up, tested, and then disconnected, removed, packed, and shipped for permanent mounting at the site.
3. Preservatives: Unless otherwise specified or approved by FERMCO, preservatives shall not be applied. Where preservatives have been approved for use, the preservative identity and the method of removal shall be stated in shipping documents and on a notice attached to the item or unit package. The Seller shall furnish MSDSs for preservatives used.

1.9 PROJECT CONDITIONS

A. Location

1. The purchased equipment shall be required to operate at the FEMP site in Fernald, Ohio, outside, under roof.

B. Elevation

1. The site elevation is approximately 590 feet above sea level.

C. Duty

1. The system shall be designed for continuous operation, 8 hours per day, 365 days per year.

D. Life

1. The system shall be designed to have an effective operating life of 20 years.

E. Building Temperature

1. The ambient temperature in which the system will operate will range between -10 degrees F and 110 degrees F.

F. Available Utilities

1. Utility services furnished are listed below:

Electrical Power	480 volts preferred, three phase, 60 Hz.
Process Water	40 to 50 psig.
Compressed Air	90 psig.

PART 2 PRODUCTS

2.1 EQUIPMENT

The following performance requirements are nominal requirements. The Seller may submit alternatives for these requirements that meet program objectives. Alternates will be evaluated by FERMCO to determine acceptability.

A. Dust Suppression System

1. The system shall be bid as an option. Equipment and costs for this option shall be separate from the other system components provided under this specification.
2. The shredder dust suppression system shall be self-contained, requiring only building utilities for operations.

3. The dust suppression system shall be locally controlled so that an operator can activate it when it is needed.
4. The dust suppression system shall minimize release of dust to the building when in operation.

B. Feed System

1. The shredder will be fed by a skip hoist with 2 yd^3 capacity (7 feet long, 3½ feet wide, 4 feet deep - dimensions verified later by others). The minimum shredder hopper feed opening size shall be 80 by 90 inches. The waste material will free fall 7 feet from the skip hoist car to the shredder shaft centerline.
2. The hopper cover shall be actuated to open when hopper is being charged, and shall be actuated to close when hopper contents are being shredded.
3. The hopper walls shall have a minimum side slope of 45 degrees.
4. The hopper shall have an available volume of at least 6 cubic yards to accommodate waste (water level full).
5. The hopper shall be equipped with side access ports for clearing bridged materials.
6. A hydraulic feed ram system shall be provided and installed in the hopper to prevent rolling of drums and other items that roll inside the shredder. Ram will be extended to hold drums in place so that cutters can grab and shear rolling objects.

C. Shredder System

1. The shredder shall be sized to process the following inventory in an 8-hour shift.
   a. 30 units - 55-gallon drums full of wet soil (20 percent sand, 50 percent silt, 30 percent clay at 35 percent moisture dry basis [db]).
   b. 40 units - 24-inch by 24-inch by 12-inch steel reinforced concrete blocks (4,000 psi concrete with 3 - 22 inch, No. 4 rebar)

c. 200 units - 12-inch diameter agglomerated balls (33 percent clay, 33 percent magnesium fluoride, 33 percent lime, 25 percent moisture content db), 150 lbs/ft^3 bulk density.

d. 240 units - 12-inch by 12-inch by 12-inch carbon graphite molds.

e. 160 units - Wood pallets (48 inches by 48 inches, 1,000-lb load rating).

2. The shredding mechanism shall be designed such that 98 percent of the material exiting the shredder system shall not be larger than 4 inches in any two dimensions and 4 feet in the third dimension.

3. The shredder system shall meet performance and acceptance testing requirements set forth in Table 1 in Article 2.4, and Article 3.4.

4. The shredder system shall be equipped with variable speed drives. The drives may be hydraulic.

5. The shredder system shall have automatic reversal capabilities to clear jams, should they occur. Seller shall quote the capabilities to eject nonprocessable items through a rock box to a container at ground level as an option.

6. All working parts, equipment, and systems shall be arranged for convenient operation, obstruction-free access and passage, inspection, lubrication, maintenance, and ease of replacement, and shall comply with OSHA 29 CFR 1910.

D. Structural System

1. Structural Interfaces: The shredder, including its drive, shall be mounted on a structural base frame. Hydraulic power units (if applicable) will be mounted on a separate structural frame including valve panel, reservoir, electric motor, pumps, etc.

2. Materials of construction shall meet the following requirements:

a. Carbon and Structural Steel: ASTM A36.

b. Structural Tubing: ASTM A500, Grade B.

c. Bolts, Nuts, and Washers: ASTM A325.
d. Anchor Bolts: ASTM A36; Washers: ASTM F436; Nuts: ASTM A563.
e. Welding Materials: AWS D1.1.

E. Electrical System
1. Seller shall provide all motors, motor starters, and all electrical equipment and wiring.
2. The electrical system shall comply with the requirements specified in Section 16052 and Section 15172.
3. The equipment shall be prewired to the maximum extent possible before shipment. Field wiring shall be kept to a minimum.
4. Seller shall provide equipment and skid grounding lugs, prewired to a single location for tie-in to facility ground system in accordance with NFPA 70.
5. Seller shall provide a motor unloading device so that the shredder drive motor is always started unloaded.

F. Control System: The shredder control system shall, as a minimum, perform the following control functions.
1. Local Functions:
a. Shredder start/stop switch.
b. Shredder kill switch with alarm.
c. Dust suppression system on/off switch (option).
d. Local indicators for motor volt/amperage usage.
e. Local indications of hydraulic fluid temperature and pressure, if applicable.
f. Local indication of activated fire suppression system.
g. Local alarm to indicate high torque condition for the shredder.
2. Remote Functions:
a. The shredder control system shall be provided with DCS input/outputs such that alarms and equipment can be stopped from a remote location on a DCS terminal supplied by FERMCO.

b. A 10-inch by 10-inch by ¼-inch-thick camera mounting plate shall be supplied and attached to the hopper system. The plate shall be positioned so that a mounted camera can "see" into the hopper when the top is open. The positioning of the camera mounting plate shall not interfere with shredder operations, including skip loading operations.

G. Fire Protection System

1. A dry chemical or CO_2 fire suppression system shall be supplied with the shredder. The primary hazard is the potential for uranium metal fires from tramp uranium missed in the separation process.
2. Explosion vents complying with NFPA 68 and 69 requirements, as they are applicable to the system design, shall be supplied with the system.
3. The system shall provide tie-ins to the facility enunciator.

H. Safety Systems

1. The equipment shall be designed to protect the operator from contact with moving parts and loose debris.
2. Maximum noise level from operation of the shredder system shall not exceed 85 dBA at 1 meter distance from the machine at normal hearing height. If 85 dBA can not be achieved, then the Seller shall submit at the time of bid the noise level that can be achieved. Measures that reduce this noise level without losing system functionality will be evaluated favorably by FERMCO.

I. Cleaning System

1. It is FERMCO's intent to clean the shredder with water; the Seller shall provide cleaning recommendations at time of bid.
2. The Seller shall include in cleaning recommendations an opinion on the effectiveness of steam cleaning of equipment proposed under this specification.

2.2 MATERIALS

A. Shredder Shafts and Cutters

1. Cutter shafts shall be minimum AISI, No. 4140 alloy steel or equal.
2. Cutters shall be heat treated to Rc 55 or equal.

B. Hydraulic Fluid

1. Nonflammable hydraulic fluid shall be used wherever practicable. The Seller shall notify FERMCO at the time of bid if flammable hydraulic fluids are required.

C. Bearings

1. Bearing materials shall be selected to provide a minimum life (L-10) of 50,000 hrs per ABMA 9-90 and 11-90, with the exception of bearings used in motors and gear reducers. Gear reducer bearing materials shall be selected to provide a minimum life (L-10) of 5,000 hrs. See Section 15172 for motor bearing requirements.

D. Fasteners

1. The Seller is hereby given notice that The Fastener Quality Act of 1990 applies to the provision of fasteners. The Seller certifies that suspect or counterfeit fasteners are not being provided or incorporated as part of an end item for delivery under this purchase order. The Seller shall provide certification of specification conformance to FERMCO upon request and agrees to comply with all record keeping requirements by law.

E. Gear Reducers

1. Gear reducers shall be designed in accordance with AGMA 2001B-88, with a minimum service factor of 1.5 on motor nameplate ratings.

F. Absolutely no hazardous materials such as lead, mercury, asbestos, PCBs, etc., shall be used in the manufacture of the shredder.

2.3 ACCESSORIES

A. Each module of the shredder shall be supplied with lifting lugs situated around the center of gravity so that straight lifts will be achieved using Seller-recommended rigging.

2.4 FABRICATION

A. Welding

1. Welding shall be performed by qualified welders using qualified weld procedures. Welders and weld procedures shall be qualified in accordance with AWS D1.1.

B. Finish

1. Prefinish Inspection: Prior to the painting of the components but after completion of fabrication, FERMCO shall have an opportunity to inspect the unit at the manufacturer's location. The Seller shall notify FERMCO 7 working days prior to the inspection.
2. Shop Preparation: Steel surfaces that are to be shop painted shall be subjected to "Commercial Blast Cleaning," SP No. 6. All weld spatter shall be removed before blast cleaning.
3. Application:
   a. All coatings shall be applied in accordance with the manufacturer's published application instructions.
   b. Coatings shall not be applied when the relative humidity exceeds 85 percent.
   c. Newly coated surfaces shall be protected from rain, condensation, and contamination until thoroughly dry.
4. Paint System and Schedule:
   a. All surfaces to be painted shall receive two coats.
   b. Prime coat shall be a minimum 2-mil thickness, inorganic zinc-rich primer.
   c. Finish coat shall be at least 4 mils thick.
   d. Prime and finish coat colors shall be different.

e. Requirements stated are a minimum. The Seller shall verify that the paint system will be suitable for the intended application.

f. The Seller shall provide 1 gallon of touch-up paint for the shredder and 1 quart each for the control panel and transformer(s).

g. Paint shall be formulated of ingredients which, when physically stripped from the equipment, shall not cause the discarded paint to be considered a hazardous waste by either RCRA characteristics (ignitability, toxicity, corrosivity, or reactivity) or by virtue of listing (D, K, P, or U lists) as per 40 CFR, Part 261, Subparts C and D.

C. Lubrication

1. Prior to testing, all components that require lubrication shall be lubricated in accordance with the manufacturer's recommendations. The Seller shall fill the machine with all required lubricant after delivery and installation at the FEMP site.

D. Shop Assembly and Performance Testing

1. The Seller shall completely assemble the system in the Seller's shop and perform tests with a FERMCO representative present as outlined in Table 1.

Table 1 - Shredder Performance Requirement

MATERIAL	PROCESSING RATE	REQUIREMENTS
Two 55-gallon steel drums full of wet soil (20 percent sand, 50 percent silt, 30 percent clay at 35 percent moisture dry weight basis (db)) and five pieces of 4"x 8"x 6' oak	All material shredded in 5 minutes	All material roughly blended and shredded.

MATERIAL	PROCESSING RATE	REQUIREMENTS
2 cubic yards of silty clay sized sludge containing five 3-foot-square, 60 mil plastic membrane pieces, and five 3-mil-thick, 5-gallon garbage bags full of sawdust, clay slurry at 50 percent moisture db	Waste material passing through crusher/shredder in 4 minutes	Sludge material lumps destroyed and plastic and wood shredded.
Steel reinforced concrete block 24" x 24" x 12" (4000 psi 3 - 22" pieces of #4 rebar	Block crushed in 5 minutes	Unshredded steel segregated from shredded material
Unshreddable 36" steel channel 6" x 4" x 5/16) in a drum full of wet soil (40 percent moisture db)	Drum and shreddable contents size reduced in 2 minutes.	Steel channel may not damage crusher/shredder and must be easily removed or automatically segregated from the shredded material
80 ft^3 of 12" diameter clay balls.	Size reduced in 2 minutes.	Clay balls completely disintegrated without plugging the shredder.
Two wood pallets, 4' x 4' x 4"	Pallets crushed in 2 minutes	Pallets size reduced.

E. Seller shall make all necessary modifications to equipment to meet the stated performance requirements.

PART 3 EXECUTION

3.1 EXAMINATION

A. Seller's Instructions:

1. Packages may be stored temporarily indoors or outdoors at -30 degrees F to 120 degrees F and at any degree of relative humidity.
2. The Seller shall provide a representative to witness FERMCO's receiving inspection. The Seller's representative shall oversee unpacking operations and provide FERMCO written verification that unpacking was performed in accordance with Seller's instructions.

B. Receiving Inspection:

1. FERMCO will receive and inspect packages containing the shredder system components to verify the contents and to check for possible damage during shipment.

C. Handling and Storage:

1. FERMCO will safely handle and store the shredder components (assemblies) in accordance with the Seller's instructions.
2. FERMCO will repackage, as necessary, the shredder components, under supervision of the Seller's representative and in accordance with the Seller's repackaging instructions.
3. Multiple items and miscellaneous hardware shall be stored together in a group lot.

3.2 PREPARATION

A. The Seller shall prepare and supply to FERMCO a complete list of equipment required for installation.

3.3 INSTALLATION

A. The shredder system shall be installed by FERMCO in the plant area designated for the shredder system. The overall site plan will be prepared to meet the Seller's design requirements. All the foundations and building

footing for the facility will be in place at the time of the shredder installation.

B. The Seller shall provide an on-site technical representative(s) to assist with the assembly and installation of the shredder. The technical representative(s) shall certify that the assembly and installation is in accordance with the Seller's drawings and instruction. The Seller's representative's services shall be quoted on a per diem basis.

C. Before installation commences, FERMCO will have equipment that connects to or interlocks with the shredder, as well as all necessary installation equipment as specified by the Seller, available on site.

D. FERMCO will install equipment in accordance with Seller's approved installation instructions.
   1. Set and adjust units level and plumb.
   2. Install all equipment that connects to or interlocks with the shredder.
   3. Connect to utilities, add lubricant and oils, and make shredder system operational.

3.4 FIELD QUALITY ASSURANCE

A. Configuration Controls
   1. After installation, the Seller shall certify that all connections with site utilities, all connections prescribed by the Seller's installation instructions, and all interconnects with FERMCO-supplied equipment have been made correctly.
   2. The Seller shall:
      a. Verify that settings and continuity of circuits are correct per Seller's start-up procedures.
      b. Verify that all lubrication points have been lubricated as required by the Seller's start-up procedures.

B. Acceptance Test

1. FERMCO will perform acceptance testing while Seller's representative is present, in accordance with Article 2.4, Paragraph D.

3.5 ADJUSTING

A. FERMCO, acting on Seller's representative's instructions and at Seller's cost, shall make any necessary adjustment to correct deficiencies identified in the acceptance testing.

3.6 CLEANING

A. FERMCO shall clean equipment after installation, removing all oil and lubricants, debris, and construction materials.

B. FERMCO shall paint any nicks and scrapes generated during the installation process per Seller's requirements, using Seller-supplied paint.

END OF SECTION

APPENDIX A

DATA SHEETS

SYSTEM DATA SHEETS

Project Title: _____

Company Name: _____

Preparer: _____ Date: _____

Equipment Name: _____

1. Motor List (see Section 15172)

2. Total Weight of Shredder (excluding hydraulic power unit) _____ lbs

3. Drive System Hydraulic or Electromechanical

4. Hopper

   A. Volume (water level full) _____ ft^3

   B. Hopper Feed Opening _____

   C. Materials of Construction _____

5. Shredder Cutters

   A. Configuration _____

   B. Diameter/Width _____ inches

   C. Materials of Construction _____

   D. Hardness _____

   E. Cutting Speed _____ rpm

   F. Number of Hooks/Cutter _____

6. Cutter Shafts (if applicable)

   A. Diameter _____ inches

B. Materials of Construction _____

C. Tensile/Yield Strength of Material _____

7. Gear Reducers

List for each gear reducer the following information

A. AGMA Service Factor (based on connected motor HP)

1. Mech. hp Rating (normal running conditions, durability) _____

2. Stall Torque Strength Rating _____

3. Thermal Horsepower Rating _____

B. Minimum L-10 Bearing Life _____ hrs

8. Bearings

Cutter Shaft Bearings

A. Minimum L-10 Life _____ hrs

9. Couplings

List for each coupling the following information

A. Type Geared/Flexible

B. Horsepower Rating _____ hp

10. Provide motor data as listed in Section 15172, Attachment 1.

11. Maximum Expected Noise Level for Operating Shredder _____ dBA @ 1 meter

12. Shredder Drive System Data:

_____

_____

_____

13. Describe equipment furnished to prevent drums from rolling inside the shredder.

_____

_____

_____

_____

14. Dust Suppression System Data: _____

_____

_____

_____

_____

15. Fire Suppression System Data: _____

_____

_____

_____

_____

16. Cleaning Recommendations (per Article 2.1, Paragraph I, Subparagraph 2): _____

_____

_____

_____

17. Compressed Air Consumption _____ scfm

18. Process Water Consumption _____ gpm

19. References (for existing similar installations):

	Name	Address	Phone
A.			
B.			
C.			
D.			
E.			

APPENDIX B

BID EVALUATION CRITERIA

BID EVALUATION CRITERIA

This appendix contains bid evaluation criteria for the Shredder. The primary topics, marked by capital letters "A" through "D," form the "backbone" for the bid evaluation. Each primary topic is assigned a weighting factor in the form of a percent of the total value used in the evaluation. This number appears to the right of each primary topic. When summed with the other primary topic, the two equal 100 percent of the evaluation.

A primary topic may have subtopics. Each subtopic is assigned a weighting factor indicating its relative importance within the topic. When subtopics are summed, they equal 100 percent of a single primary topic.

A. Technical Factors (Weight of 40%)

A technical assessment of the proposals will be made based on the following considerations:

No.	Requirement	Percent of Category "A"
1.	Equipment Specification 1) How does one bidder's equipment compare with other bidder's equipment based on data furnished in the data sheets? 2) Does the proposal meet the requirements of the specification?	45%
2.	Operation and Controls 1) How involved is the operator in running the equipment? 2) How hard is it to check system status, including hydraulic system pressure and temperature, motor amperage, dust suppression system status, and fire suppression system status? 3) How hard is it to bring the system on-line after a shutdown?	10%

No.	Requirement	Percent of Category "A"
3.	Equipment Configuration and Maintenance 1) Are all of the components of the system clearly identified? 2) How many mechanical/wear points are in the system? 3) Can maintenance be performed easily at each wear location? 4) Which parts are most likely to require replacement during facility life? 5) Does this system have advantages over other systems being evaluated (i.e., fewer components and ease of maintaining components)?	10%
4.	Ease of Clearing Jams and Removing Nonshreddable Materials 1) What types of materials will cause jamming of equipment? 2) What sorts of feed practices will cause jamming of the equipment? 3) Does the equipment provide any mechanisms to prevent or clear jams? 4) Where are jams most likely to occur in the system? 5) Are access hatches provided to service equipment at probable jam locations?	20%

No.	Requirement	Percent of Category "A"
5.	Adherence to Codes and Standards 1) Was the system fabricated to meet specified materials standards? 2) Does the system provide shield on moving parts, labeling, etc., as required by OSHA? 3) Does the manufacturer identify which codes and standards its system complies with?	10%
6.	Responsiveness in Submitting Deliverables 1) Have all requested submittals been included with the proposal? 2) If not, how many have been submitted? 3) Can a proper bid evaluation be performed based on the submitted materials?	5% (if not complete, may result in rejection)

B. Experience in Similar Installations (Weight of 20%)

An assessment of the Bidder's experience will be made based on the following considerations:

No.	Requirement	Percent of Category "B"
1.	Number of years experience in fabricating this type of shredder system.	30%
2.	List of references with favorable responses when called.	40%

3.	Installed equipment that can be visited that processes similar types of materials.	30%

C. Equipment Safety (Weight of 10%)

A safety assessment of the proposals will be made based on the following considerations:

No.	Requirement	Percent of Category "C"
1.	Effectiveness of fire suppression/containment capabilities	40%
2.	Provisions for operator safety in accordance with OSHA 1910	25%
3.	Adequacy of controls to facilitate an interlock system	25%
4.	Is there a means of locking down and tagging out power to the system to prevent system actuation during maintenance and jam clearing?	10%

D. Price (Weight of 30%)

Price represents 30% of the evaluation. Total price will be evaluated and scored in determining the lowest responsive, responsible offers.

U.S. DEPARTMENT OF ENERGY

FERNALD ENVIRONMENTAL MANAGEMENT PROJECT

FERMCO SUBCONTRACT NO. 2-21487

Division 15 - Mechanical

SHREDDER PERFORMANCE SPECIFICATION

PARSONS

SECTION 15172
MOTORS FOR SHREDDER

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Low voltage, three phase induction motors.

B. Low voltage, single phase induction motors.

1.2 RELATED SECTIONS

A. Section 13652 - Shredder.

B. Section 16052 - Basic Electrical Materials and Methods for Shredder.

1.3 REFERENCES

A. American Bearing Manufacturers Association (ABMA):
1. ABMA 9-90 — Load Ratings and Fatigue Life for Ball Bearings.
2. ABMA 11-90 — Load Ratings and Fatigue Life for Roller Bearings.

B. Institute of Electrical and Electronics Engineers (IEEE):
1. IEEE 112-91 — Standard Test Procedure for Polyphase Induction Motors and Generators.

C. National Electrical Manufacturers Association (NEMA):
1. NEMA MG 1-93 — Motors and Generators.
2. NEMA MG 13-84 — Frame Assignments for AC Integral-Horsepower Induction Motors.

D. National Fire Protection Association (NFPA):
1. NFPA 70-96 — National Electrical Code.

1.4 SYSTEM DESCRIPTION

A. Provide electric motors as required for the Shredder. Each motor shall be selected especially for its respective driven equipment. Each motor shall be adequate for the full range of the driven equipment's performance.

1.5 SUBMITTALS

A. Product Data: Provide data for motors, including full load amps, NEMA frame size, and additional standard nameplate data. Provide efficiency and power factor for each of 1/2, 3/4, and full load. Include catalog sheets and drawings showing voltage, ratings, impedances, normal and short circuit current ratings, dimensions, and enclosure details.

B. Operation and Maintenance Data: Include assembly drawings and bearing data, including replacement sizes and lubrication instructions.

C. Certificate of Conformance: Provide statement certifying that the materials supplied meet or exceed contract requirements.

D. Testing Procedures: Submit written procedures for all required testing. Test procedures shall include criteria for acceptable performance.

E. Manufacturer's Installation Instructions: Indicate application conditions and limitations of use stipulated by product testing agency. Include instructions for storage, handling, protection, examination, preparation, installation, and commissioning of products.

F. Recommended Spare Parts Lists: Provide, where applicable.

G. Material Safety Data Sheet (MSDS): Submit MSDSs for all cutting oils, caulks, sealants, and all similar components.

H. Test Reports: Indicate satisfactory completion of required tests and inspections. Submit results verifying performance in accordance with IEEE 112.

I. Motor Data Sheets: Provide completed motor data sheet (Attachment 1) for each motor provided.

1.6 QUALITY ASSURANCE

A. Conform to NFPA 70 and NEMA MG 1.

PART 2 PRODUCTS

The listing of equipment suppliers below in no way precludes the offerer from proposing alternate suppliers of any of the equipment to be furnished within the scope of this specification. This list of suppliers is intended to identify the type of equipment and general quality of that equipment that will be included in the offerer's proposal. It is the offerer's responsibility to propose equipment that is best suited for this project in combined terms of quality and price.

2.1 MANUFACTURERS

A. Reliance Electric.

B. U. S. Motors.

C. General Electric.

2.2 EQUIPMENT

A. General Construction and Requirements

1. Electrical Service: Refer to related sections of the specifications and the drawings for required characteristics.
2. Motors: Design for continuous operation at a temperature of 40 degrees C ambient, and for temperature rise in accordance with NEMA MG 1 limits for insulation class, service factor, and motor enclosure type. Motors to be controlled by

variable frequency drives shall be of a design suitable for this type of operation.

3. Visible Nameplate: Nameplate to indicate motor horsepower, voltage, phase, frequency, rpm, full load amps, locked rotor amps, frame size, manufacturer's name and model number, service factor, power factor, serial number, and bearing numbers. Nameplate shall be stainless steel, permanently attached to the motor frame.
4. Electrical Connection: Conduit connection boxes, threaded for conduit and designed to allow for 90 degree step rotation of the conduit entrance. Oversize conduit boxes shall be provided.
5. Motor Service Factor: Furnish motors with service factors required by the table in Paragraph D. Motor size in hp shall be selected to serve the driven equipment over its full performance range as though the service factor is 1.0.
6. Motor voltage shall be 115 V, single-phase for motors 1 hp or less. Other motors shall be 460 V, three-phase.
7. Motors drawing less than 250 W that are intended for intermittent service may be germane to equipment manufacturer and need not conform to these specifications.

B. Three Phase - Squirrel Cage Induction Motors

1. Motors shall be 460 V, three phase, 60 Hz.
2. The motor connection diagram shall be stainless steel, permanently stamped and attached to the motor either inside the conduit box or on the same side as the conduit box.
3. Starting Torque: To be matched to the driven equipment.
4. Starting Current: Not to exceed six times full-load current.
5. Power Output, Locked Rotor Torque, Breakdown or Pullout Torque: NEMA Design B characteristics or as required by the driven equipment.
6. Design, Construction, Testing, and Performance: Conform to NEMA MG 1 for Design B motors.
7. Insulation System: Non-hygroscopic NEMA Class F or better.

8. Testing Procedure: In accordance with IEEE 112, Test Method B. Load test motors to determine freedom from electrical or mechanical defects and for compliance with performance data.
9. Motor Frames: NEMA MG 13 standard T-frames of steel, aluminum, or cast iron with end brackets of cast iron or aluminum with steel inserts.
10. Bearings: Grease lubricated, anti-friction ball bearings with housings equipped with plugged provision for prelubrication, rated for minimum ABMA 9 and 11, L-10 life of 20,000 hours.
11. Sound Power Levels: To NEMA MG 1.
12. Motors shall be high efficiency type.
13. Motors shall be totally enclosed fan cooled (TEFC).
14. Nominal Efficiency: Meet or exceed values in schedules as given herein at full load and rated voltage when tested in accordance with IEEE 112.
15. Nominal Power Factor: Meet or exceed values in schedules as given herein at full load and rated voltage when tested in accordance with IEEE 112.

C. Performance Schedule: Three Phase - Energy efficient, TEFC.

HP Factor	RPM (Syn)	NEMA Frame	Minimum Percent Efficiency	Minimum Percent Power Factor
1	1200	145T	81	72
1-1/2	1200	182T	83	65
2	1200	184T	85	68
3	1200	213T	85	63
5	1200	215T	86	66
7-1/2	1200	254T	89	68
10	1200	256T	89	75
15	1200	284T	90	72
20	1200	286T	90	76
25	1200	324T	90	71
30	1200	326T	91	79
40	1200	364T	92	78
50	1200	365T	92	81
60	1200	404T	92	83
75	1200	405T	92	80
100	1200	444T	93	83
125	1200	445T	93	85
1	1800	143T	82	84
1-1/2	1800	145T	84	85
2	1800	145T	84	85
3	1800	182T	87	83
5	1800	184T	88	83
7-1/2	1800	213T	89	85
10	1800	215T	90	84
15	1800	254T	91	86
20	1800	256T	91	85
25	1800	284T	92	84
30	1800	286T	93	86
40	1800	324T	93	83
50	1800	326T	93	85
60	1800	364T	93	87

HP Factor	RPM (Syn)	NEMA Frame	Minimum Percent Efficiency	Minimum Percent Power Factor
75	1800	365T	93	87
100	1800	405T	94	86
125	1800	444T	94	87
150	1800	445T	94	88
200	1800	447T	95	87
1-1/2	3600	143T	82	85
2	3600	145T	82	87
3	3600	182T	82	87
5	3600	184T	85	88
7-1/2	3600	213T	86	86
10	3600	215T	86	86
15	3600	254T	88	91
20	3600	256T	89	89
25	3600	284T	90	92
30	3600	286T	91	92
40	3600	324T	91	91
50	3600	326T	90	92
60	3600	364T	91	93
75	3600	365T	91	91
100	3600	405T	92	92

For motors not in schedule, furnish manufacturer's standard high-efficiency motor.

D. Service Factor Schedule

HP	3600 rpm	1800 rpm	1200 rpm	900 rpm
1/6 - 1/3	1.35	1.35	1.35	1.35
1/2	1.25	1.25	1.25	1.15
3/4	1.25	1.25	1.15	1.15
1	1.25	1.15	1.15	1.15
>1 - 150	1.15	1.15	1.15	1.15

E. Single phase motors shall conform to the following respective requirements. The driven equipment supplier shall furnish motor starter, motor type, and motor enclosure type suitable for the application.

1. Single Phase Power - Split Phase Motors
   a. Starting Torque: Less than 150 percent of full load torque.
   b. Starting Current: Up to seven times full load current.
   c. Breakdown Torque: Approximately 200 percent of full load torque.
   d. Drip-Proof Enclosure: Class A (50 degrees C temperature rise) insulation, NEMA Service Factor, prelubricated sleeve or ball bearings.
   e. Enclosed Motors: Class A (50 degrees C temperature rise) insulation, 1.0 Service Factor, prelubricated ball bearings.
2. Single Phase Power - Permanent-Split Capacitor Motors
   a. Starting Torque: Exceeding 1/4 of full load torque.
   b. Starting Current: Up to six times full load current.
   c. Multiple Speed: Through tapped windings.
   d. Open Drip-Proof or Enclosed Air Over Enclosure: Class A (50 degrees C temperature rise) insulation, minimum 1.0 Service Factor, prelubricated sleeve or ball bearings, automatic reset overload protector.
3. Single Phase Power - Capacitor Start Motors
   a. Starting Torque: Three times full load torque.
   b. Starting Current: Less than five times full load current.
   c. Pull-Up Torque: Up to 350 percent of full load torque.
   d. Breakdown Torque: Approximately 250 percent of full load torque.
   e. Motors: Capacitor in series with starting winding; provide capacitor-start/capacitor-run motors with two capacitors in parallel with run capacitor remaining in circuit at operating speeds.
   f. Drip-Proof Enclosure: Class A (50 degrees C temperature rise) insulation, NEMA Service Factor, prelubricated bearings.

g. Enclosed Motors: Class A (50 degrees C temperature rise).

PART 3 EXECUTION

Not used.

END OF SECTION

ATTACHMENT 1

MOTOR DATA SHEET

MOTOR DATA SHEET

Submit for each motor. Mark N/A if not applicable.

1. Driven Equipment Number _____
2. Driven Equipment Name _____
3. Motor Manufacturer _____
4. Quantity _____
5. Horsepower (hp) _____
6. RPM _____
7. Voltage _____
8. Enclosure Type _____
9. Frame _____
10. Phase/Frequency _____
11. 40 degree C ambient insulation _____
12. Service Factor _____
13. NEMA Design _____
14. Space Heaters _____
15. Full Load Amperes (FLA) _____
16. Locked Rotor Amperes (LRA) _____
17. Efficiency:
    - 1/2 Load _____
    - 3/4 Load _____
    - Full Load _____
18. Power Factor:
    - 1/2 Load _____
    - 3/4 Load _____
    - Full Load _____

U.S. DEPARTMENT OF ENERGY

FERNALD ENVIRONMENTAL MANAGEMENT PROJECT

FERMCO SUBCONTRACT NO. 2-21487

Division 16 - Electrical

SHREDDER PERFORMANCE SPECIFICATION

PARSONS

SECTION 16052
BASIC ELECTRICAL MATERIALS AND METHODS FOR SHREDDER

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Electrical equipment, material, and services required for shredder.
   1. Disconnect switches.
   2. Motor starters.
   3. Selector switches.
   4. Enclosures for electrical equipment.
   5. Molded case circuit breakers.
   6. Variable frequency drives.
   7. Conduit.
   8. Wire and cable.
   9. Instrument cable.
   10. Nameplates.
   11. Wire markers and cable tags.
   12. Splicing and termination components.

1.2 RELATED SECTIONS

A. Section 13652 - Shredder.

B. Section 15172 - Motors for Shredder.

1.3 REFERENCES

A. National Fire Protection Association (NFPA):
   1. NFPA 70-96 — National Electrical Code.

B. American National Standards Institute (ANSI):
   1. ANSI C80.1-90 — Rigid Steel Conduit-Zinc Coated.

C. Underwriters Laboratories, Inc. (UL):
   1. UL 360-86 — Liquid-Tight Flexible Steel Conduit.
   2. UL 486A-91 — Wire Connectors and Soldering Lugs for Use with Copper Conductors.

3.	UL 510-94	Polyvinyl Chloride, Polyethylene, and Rubber Insulating Tape.

D. National Electrical Manufacturers Association (NEMA):

1.	NEMA AB 1-93	Molded Case Circuit Breakers and Molded Case Switches.
2.	NEMA ICS 1-93	Industrial Controls and Systems General Requirements.
3.	NEMA ICS 2-93	Industrial Controls and Systems, Controllers, Contactors and Overload Relays Rated Not More Than 2000 Volts AC or 750 Volts DC.
4.	NEMA ICS 3.1-90	Safety Standards for Construction and Guide for Selection, Installation and Operation of Adjustable Speed Drive Systems.
5.	NEMA ICS 6-93	Industrial Controls and Systems Enclosures.
6.	NEMA KS 1-90	Enclosed and Miscellaneous Distribution Equipment Switches (600 Volts Maximum).
7.	NEMA 250-91	Enclosures for Electrical Equipment (1000 Volts Maximum).

1.4 SYSTEM DESCRIPTION

A. Design Conditions: As noted in Section 13651. Ambient shall be 40 degrees C.

B. Design Criteria: As noted in Section 13651.

C. Electrical starters, controls, wiring, and conduit required to operate the shredder specified and as indicated on drawings. Where these electrical items are mounted on the same shipping section, they shall be electrically connected using wire or cable and conduit as specified herein. For items not mounted on the same shipping section, electrical interconnection diagrams shall be furnished, conveying clearly how these items are to be wired. Disregard requirements herein for material or equipment not required for the shredder.

1.5 SUBMITTALS

A. Product Data: Provide data for all equipment and materials specified. Include catalog sheets and drawings showing voltage, ratings, impedances, normal and short circuit current ratings, dimensions, and enclosure details.

B. Manufacturer's Installation Instructions: Indicate application conditions and limitations of use stipulated by product testing agency. Include instructions for storage, handling, protection, examination, preparation, installation, and commissioning of products. Provide interconnection wiring diagrams indicating actual point-to-point termination of wiring between electrical switches, controls, starters, and other equipment. Wire terminations and individual wires must be labeled with numbers.

C. Testing Procedures: Submit written procedures for all required testing. Testing procedures shall include criteria for acceptable performance.

D. Certificate of Conformance: Provide statement certifying that the equipment and materials supplied meet or exceed contract requirements.

E. Material Safety Data Sheet (MSDS): Submit MSDSs for cutting oils, caulks, sealants, and all other similar components.

F. Test Reports: Indicate satisfactory completion of required tests and inspections.

1.6 QUALITY ASSURANCE

A. Regulatory Requirements: All products and services performed shall conform to the requirements of NFPA 70.

B. Certifications: All items shall be tested and listed for the purpose intended by Underwriters Laboratories or Factory Mutual, Inc., with label attached.

PART 2 PRODUCTS

2.1 EQUIPMENT

A. Disconnect Switches

1. Nonfusible Switch Assemblies: NEMA KS-1, type HD quick-make, quick-break, visible blade, load interrupter knife switch in type 4 enclosures, conforming to NEMA 250, with externally operable handle interlocked to prevent opening front cover with switch in ON position. Handle lockable in OFF position.
2. Fusible Switch Assemblies: NEMA KS-1, type HD quick-make, quick-break, visible blade, load interrupter knife switch in type 4 enclosures, conforming to NEMA 250, with externally operable handle interlocked to prevent opening front cover with switch in ON position. Handle lockable in OFF position. Fuse Clips: FS W-F-870. Designed to accommodate Class R fuses.

B. Motor Starters

1. Magnetic Motor Controllers: NEMA ICS 1 and ICS 2, AC general purpose, circuit breaker, combination, Class A magnetic controller for induction motor. Each controller shall have a control power transformer with two primary fuses, one secondary fuse with other secondary lead grounded.
2. Coil Operating Voltage: 120 volts, 60 hertz.
3. Overload Relay: NEMA ICS 2 bimetal, ambient compensated.
4. Enclosure: NEMA ICS 6, type 4.
5. Selector Switch: Cover mounted, rotary type, on-off.
6. Minimum Size Contactor: Size 1.
7. Circuit Breaker: Instantaneous trip only, minimum 22 kA symmetrical interruption.
8. Pilot Lights: Two push-to-test, industrial type with nameplates.

C. Selector Switches

1. Stainless steel enclosure, NEMA ICS 6, type 4.
2. Two-position, maintained contact (start/stop).
3. Three-position, maintained contact (hand/off/auto).

D. Enclosures for Electrical Equipment

1. All enclosures for electrical equipment shall be type 4, conforming to NEMA ICS 6 or NEMA 250, as appropriate.

E. Molded Case Circuit Breakers

1. NEMA AB 1 with integral thermal and instantaneous magnetic trip in each pole. Provide common trip handle for all poles with capability of physical lockout. Terminals, minimum 75 degrees C rated.
2. Breaker enclosures shall be type 3R, conforming to NEMA 250.

F. Variable Speed Drives

1. Manufacturers:
   a. Cutler Hammer.
   b. Allen Bradley.
   c. Westinghouse.
   d. Substitutions: Submit to the FERMCO Construction Manager for engineering approval. The listing of equipment suppliers in no way precludes the offerer from proposing alternate suppliers of any of the equipment to be furnished within the scope of this specification. This list of suppliers is intended to identify the type of equipment and general quality of that equipment that will be included in the offerer's proposal. It is the offerer's responsibility to propose equipment that is best suited for this project in combined terms of quality and price.
2. Provide enclosed variable frequency drive suitable for load intended, conforming to the requirements of NEMA ICS 3.1.
3. Ratings
   a. Rated Input Voltage: 480 volts, three phase, 60 Hertz.
   b. Motor Nameplate Voltage: 460 volts, three phase, 60 Hertz.
   c. Displacement Power Factor: Between 1.0 and 0.95, lagging, over entire range of operating speed and load.
   d. Operating Ambient: -10 degrees C to 40 degrees C.
   e. Humidity: 20-90 percent noncondensing.

4. Design
   a. Employ microprocessor-based inverter logic isolated from power circuits.
   b. Employ pulse width modulated inverter system.
   c. Employ switching power supply operating off DC link.
   d. Design for ability to operate drive with motor disconnected from output.
   e. Design to attempt five automatic restarts following fault condition before locking out and requiring manual restart.
5. Product Options and Features
   a. Display: Provide integral digital display to indicate output voltage, output frequency, and output current.
   b. Status Indicators: Separate indicators for overcurrent, overvoltage, ground fault, overtemperature, and input power ON.
   c. Volts per Hertz Adjustment: Manufacturer's standard.
   d. Current Limit: 150 percent of rated for 1 minute.
   e. Acceleration Rate Adjustment: 0.5-30 seconds.
   f. Deceleration Rate Adjustment: 1-30 seconds.
   g. Provide hand-off-automatic selector switch and manual speed control.
   h. Input Signal: 4-20 mA DC, 250 ohms loop impedance (maximum).
   i. Safety Interlocks: Provide terminals for remote contact to inhibit starting under both manual and automatic mode.
   j. Control Interlocks: Provide terminals for remote contact to allow starting in automatic mode.
   k. Manual Bypass: Provide contactor, motor running overload protection, and short circuit protection for full voltage, nonreversing operation of the motor. Include isolation switch to allow maintenance of inverter during bypass operation.
   l. Disconnecting Means: Include integral circuit breaker on the line side of each drive.

2.2 MATERIALS

A. Conduit

1. Rigid steel, heavy wall, galvanized conduit conforming to ANSI C80.1. Conduit shall be 3/4 inch minimum in diameter. Attachment straps, hangers, and struts shall be galvanized.
2. Liquid-tight flexible metal conduit conforming to UL 360. Conduit shall be 3/4 inch minimum in diameter.

B. Wire and Cable

1. Single conductor, 600-volt insulated copper conductor. Conductors for power and lighting branch circuits shall not be smaller than No. 12 AWG. Conductors No. 12 AWG and No. 10 AWG shall be solid. Conductors No. 8 AWG and larger shall be stranded. Conductors for control shall not be smaller than No. 14 AWG stranded. Conductors for Class 1 remote-control and signal circuits shall be enclosed in cable and shall comply with NFPA 70. Conductors for solenoid valves and/or limit switches shall be multiconductor No. 16 AWG, as required. Power and lighting conductor insulation shall be Type THW, XHHW, or THWN. Conductors required to be rated 90 degrees C in accordance with NFPA 70 shall be type XHHW-2 or THW-2.
2. Any special conductors shall be as required and UL listed for the purpose intended.

C. Instrument Cable

1. Instrumentation cable shall be No. 16 AWG stranded tinned copper conductors. Conductors shall be polyethylene insulated and rated 600 volts, 60 degrees C. Conductors shall be twisted with aluminum-polymer shield; No. 18 AWG stranded, tinned copper drain wire. Cable shall have overall-chrome gray FR-PVC jacket.

D. Nameplates

1. Nameplates shall be engraved, three-layer laminated plastic, 5/16-inch bold style, black letters on white background.

E. Wire Markers and Cable Tags

1. Wire markers shall be single-conductor, slip-on, heat-shrinkable sleeve with typed or printed black letters on a white background. Wire markers shall be similar to W. H. Brady Co. computer-printable "Bradysleeve" or approved equal.
2. Cable tags shall be rectangular, flat, non-heat-shrinkable tags with 1/8-inch-high letters. Cable markers shall be similar to Raychem-type TMS or approved equal.

F. Splicing and Termination Components

1. Wire connectors, UL 486A, as applicable.
2. Insulation tape, UL 510.
3. Provide solderless terminal lugs on stranded conductors.
4. Twist-on splicing connectors (wire nuts) are <u>not</u> acceptable for 480-volt splices.

2.3 FABRICATION

A. Conduit

1. Route conduit parallel or at right angles to equipment lines. Provide conduit supports at approximately 8-foot intervals.
2. Cut conduit square using saw or pipecutter. All cut ends of conduit shall be reamed.
3. Install no more than the equivalent of three 90- degree bends between boxes. Use hydraulic one-shot conduit bender or factory elbows for conduit diameter larger than 1-1/2 inch.
4. Use form 8 conduit bodies to make sharp changes in direction. Avoid moisture traps; provide junction box with weep hole.
5. Provide cast metal boxes such as FS or FD.
6. Provide 1/8-inch nylon pull cord in empty conduits.
7. Final conduit connections to motors or other vibrating equipment shall be made with approximately 3-foot liquid-tight flexible metal conduit.

B. Wire and Cable

1. All wire and cable shall be completely enclosed in conduit or in junction boxes, metal raceway, or panels.

2. Swab conduit before installing cable. Remove burrs, dirt, or other debris.
3. When pulling cable into conduit, use wire pulling compound.
4. Splices shall be made only in outlet or junction boxes.
5. Provide equipment grounding conductor along with phase conductors in all conduits.
6. Multiconductor cables shall contain an integral ground conductor.
7. Grounding conductors shall be connected to equipment with compression lugs. Grounding connections shall be made to clean, dry surfaces. Scale, rust, grease, and dirt shall be removed from surfaces to which grounding connections are to be made.
8. Conductors shall be color coded. Conductors No. 6 AWG and larger shall be identified using colored tape at terminals and splice points. Conductors No. 8 AWG and smaller shall be identified using colored insulation or jacket. Color coding shall be as follows:

480Y/277V	Phase A	Brown
	Phase B	Orange
	Phase C	Yellow
	Neutral (grounded)	Gray
	Ground	Green or bare
208Y/120V	Phase A	Black
	Phase B	Red
	Phase C	Blue
	Neutral (grounded)	White
	Ground	Green or bare
240/120V	Phase	Black
	Phase	Red
	Neutral (grounded)	White
	Ground	Green

C. Nameplates
1. Degrease and clean surfaces to receive nameplates.
2. Install nameplates parallel to equipment lines. Secure nameplates to equipment fronts using self-tapping screws.

D. Wire and Cable Markers

1. Provide wire markers on each conductor in pull boxes and junction boxes, and at each load connection. Provide cable tags in pull boxes for multiconductor cables.
2. Wire and cable tags shall identify panel and circuit number or control wire number, as required.

E. Motor Starters

1. Install motor controllers with selector switches approximately 54 inches above finished floor.
2. Install overload heater elements in motor controllers to match motor characteristics.
3. Provide engraved nameplate identifying motor served.

F. Selector Switches

1. Mount selector switches at a mounting height of 54 inches above the floor, adjacent to the equipment controlled. Provide unistrut mounting supports.

G. Variable Speed Drives

1. Fabrication
   a. Wiring Terminations: Match conductor materials and sizes indicated.
   b. Enclosure: NEMA 250, Type 4.
   c. Finish: Manufacturer's standard enamel.
2. Do not install drive until building environment can be maintained within the service conditions required by the manufacturer.
3. Select and install overload heater elements in motor drives to match installed motor characteristics.
4. Provide engraved plastic nameplates.
5. Provide neatly typed label inside each motor drive door identifying motor served, nameplate horsepower, full load amperes, code letter, service factor, and voltage/phase rating.

H. Grounding

1. Provide ground conductor termination lugs (minimum two) adequate for 4/0 wire on each shipping section.
2. Bond all electrical enclosures to any conducting structures on which they are mounted and to the ground termination lugs in accordance with NFPA 70.

2.4 SOURCE QUALITY CONTROL

A. Testing

1. Power and Control Wire: All wires shall be tested for continuity. Wire insulation shall be megger tested between each conductor and ground. A 1000-volt megger shall be used for insulation rated 600 volts. Minimum resistance shall be 100 megohms.
2. Utilization Equipment:
   a. Make electrical connections to utilization equipment in accordance with manufacturer's instructions.
   b. Installation shall conform to the requirements of NFPA 70.
   c. Motor windings shall be checked for continuity.
   d. Motor windings rated 460 volts nominal shall be megger tested with a 1000-volt megger prior to connection of power leads. Minimum acceptable resistance shall be 50 megohms.
   e. Motor and phase rotation shall be checked with a phase rotation tester similar to G. Biddle Company (Catalog No. 56060) or equal on equipment which could be damaged by reverse rotation.
      1) Motor and phase rotation shall be verified before energizing motors.
      2) All motors shall be "bumped" to check for proper direction of rotation prior to performing operational tests on the equipment.

B. Verification of Performance: Record for submittal, the results for testing, Article 2.4, Paragraph A above.

PART 3 EXECUTION

Not used.

END OF SECTION

Dryer

Indirect Dryer Performance Specification

Operable Unit 1
Project Order 145
September 1995
Revision A

Environmental Remedial Action Project
Fernald Environmental Management Project
Fernald, Ohio
FERMCO Subcontract No. 2-21487

PARSONS

Fairfield Executive Center
6120 South Gilmore Road
Fairfield, Ohio 45014

U.S. DEPARTMENT OF ENERGY
FERNALD ENVIRONMENTAL MANAGEMENT PROJECT
FERMCO SUBCONTRACT NO. 2-21487

PROJECT ORDER 145
SPECIFICATIONS

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15090	PIPING SUPPORTS AND ANCHORS	A	10/10/95
15171	MOTORS FOR INDIRECT DRYER	A	10/10/95
15250	INSULATION	A	10/10/95
DIVISION 16 -			
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SECTION 11182
INDIRECT DRYER PERFORMANCE SPECIFICATION

PART 1 GENERAL

1.1 SCOPE OF WORK

Clean-up efforts are currently underway at the Fernald Environmental Management Project (FEMP). The FEMP, formerly known as the Feed Materials Production Center, is a United States Department of Energy (DOE) facility near Fernald, Ohio (northwest of Cincinnati), which was operated from 1952 to 1989 to provide high purity uranium metal products to support United States defense programs.

Production at the facility was suspended in 1989, and focus was shifted to environmental restoration and waste management activities. The entire FEMP site has been divided into five operable units. (Operable unit is a term employed to provide physical groupings of environmental areas of concern at a site.) The contents of eight separate waste pits (Pits 1 through 6, the Burn Pit, and the Clearwell) and the associated caps, clay liners, and surrounding soils, have been designated as Operable Unit 1 (OU-1). The pit contents, caps, liners, and soils are the materials of interest for this specification.

A Remedial Investigation/Feasibility Study, several Treatability Studies, and other supporting tests have been performed on the OU-1 materials. Based on the information developed during these studies, a preferred alternative for remediation of the waste pits was determined. This alternative involves retrieving the materials from the pits, drying them to appropriate moisture levels, then packaging the dried materials for shipment and disposal at a low-level radioactive waste disposal facility. The indirect rotary dryer described in this specification will be used to dry the pit waste materials.

This specification defines the overall engineering, design, fabrication/manufacturing, shop testing, packaging, delivery, and field testing of the indirect dryer system, complete with all necessary equipment, controls, and instrumentation.

Article 1.1 (Continued)

It also defines the requirements for providing technical assistance for installation and acceptance testing.

This specification is prepared to be used as a support document with the Request for Proposal (RFP) Package.

1.2 DESIGN

A. General:

Equipment and materials of construction shall conform to the requirements of this specification and to the SELLER's standard or recommended design for the intended service. Equipment shall conform to this specification, and to acceptable industry standards of engineering, design, and workmanship.

The intent of this specification is to define all the requirements for the entire indirect dryer system for bidding purposes. It is not the intent of this specification to restrict the design of the indirect rotary dryer system and its components. The specification requirements for equipment/components and material are intended to establish a minimum level of offering and should not be construed as limiting the SELLER in offering higher grade equipment/components and material which will provide comparable service.

The SELLER may propose different components than those specified as additional alternatives, providing they meet the technical requirements specified in Article 2.2. These alternates shall be included in the bid package. Also, the SELLER shall take exception to the specification when conflicts exist. Both SELLER's alternates and exceptions shall be stated according to the requirements of Article 1.5. The SELLER will be selected and the equipment package will be purchased based on the requirements of the final purchase specification.

Article 1.2 (Continued)

B. Reference Specifications (Sections) and Documents: Specifications and documents listed below are part of this specification.

1. Piping Specifications, Sections 15060, 15090, and 15250, and Electric Motor Specification, Section 15171 (Division 15).
2. Painting Specification, Section 09900 (Division 9).
3. Electrical Specifications, Section 16051 and 16856 (Division 16).
4. Requirements/instructions for FEMP suppliers:
   a. "Standard Requirements for FEMP Suppliers," Form FS-F-2672, Pages 1 through 4 (Appendix 1).
   b. "Explanation of Standard Requirements for FEMP Suppliers," Form FS-F-2672-1, Pages 1 through 3 (Appendix 1).
5. Submittal requirements:
   a. "SELLER Drawing and Data Commitment," Form E-212 (Appendix 2).
   b. "SELLER Drawing and Data Submittal Requirements," Pages 1 through 4, Specification No. E-212-A (Appendix 2).
6. Data sheets:
   a. Centrifugal fan data sheet (Appendix 3).
   b. Dryer data sheet (Appendix 3).
   c. Burner data sheet (Appendix 3).
7. Drawings and sketches:
   a. Indirect rotary dryer system diagram (Appendix 4).
   b. General arrangement (Appendix 4).
   c. Instrumentation and control interfaces (Appendix 4).
8. Supporting information:
   a. Pit Waste Characterization Data (Appendix 5).
   b. Surrogate Feed Drying Test Data (Appendix 5).

C. Codes and Standards:
SELLER shall comply with the codes and standards referenced in this paragraph. The SELLER shall state

exceptions to these standards in accordance with the requirements of Article 1.5.

1. Air Movement and Control Association (AMCA):
   a. AMCA 99 Standards Handbook.
   b. AMCA 210 Test Code for Air Moving Devices.
2. American Bearing Manufacturers Association (ABMA):
   a. All applicable standards.
3. American Gear Manufacturers Association (AGMA):
   a. AGMA 390.03A-80
      Gear Handbook
   b. AGMA 2000-A-88
      Gear Classification and Inspection Handbook
   c. AGMA 2004-B-89
      Gear Materials and Heat Treatment Manual
4. American Institute of Steel Construction (AISC):
   a. AISC M016-89
      Manual of Steel Construction - Allowable Stress Design (ASD) (Ninth Edition)
   b. AISC S302-86
      Code of Standard Practice for Steel Buildings and Bridges
   c. AISC S329-85
      Specification for Structural Joints using ASTM A325 or A490 Bolts - Allowable Stress Design
   d. AISC S335-89
      Specification for Structural Steel Buildings, Allowable Stress Design and Plastic Design (ASD)
5. American National Standards Institute (ANSI):
   a. ANSI A10.13-89
      Construction and Demolition Operations - Steel Erection - Safety Requirements
   b. ANSI A14.3-93
      Safety Requirements for Fixed Ladders
   c. ANSI C2-93
      National Electrical Safety Code
   d. ANSI Y14.5M-82
      Dimensioning and Tolerancing

Article 1.2 (Continued)

6. American Society of Civil Engineers (ASCE):
   a. ASCE 7-93
      Minimum Design Loads for Buildings and Other Structures
7. American Society of Mechanical Engineers (ASME):
   a. ASME
      Boiler and Pressure Vessel Codes, 1992
   b. ASME (USAS) B4.1-67
      Preferred Limit and Fits for Cylindrical Parts
8. American Society for Testing and Materials (ASTM):
   a. ASTM A29/A29M, Rev. A-93
      Steel Bars, Carbon and Alloy, Hot Wrought and Cold Finished
   b. ASTM A36/A36M, Rev. A-93
      Structural Steel
   c. ASTM A148/A148M, Rev. B-93
      Steel Castings, High Strength for Structural Purposes
   d. ASTM A307-94
      Carbon Steel Bolts and Studs, 60,000 Tensile Strength
   e. ASTM A325-93
      Structural Bolts, Steel, Heat Treated
   f. ASTM A500-93
      Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes
   g. ASTM A563-93
      Carbon and Alloy Steel Nuts
   h. ASTM A564/A564M, Rev. A-92
      Hot-Rolled and Cold-Finished Age-Hardening Stainless and Heat-Resisting Steel Bars and Shapes
   i. ASTM B3-90
      Soft or Annealed Copper Wire
   j. ASTM C109-93
      Standard Test Method for Compressive Strength of Hydraulic Cement Mortars

Article 1.2 (Continued)

k. ASTM C827-87
Standard Test Method for Change in Height at Early Ages of Cylindrical Specimens from Cementitious Mixtures

l. ASTM F436-93
Hardened Steel Washers

9. American Welding Society, Inc. (AWS):

a. AWS A2.4-93
Standard Symbols for Welding, Brazing, and Nondestructive Examination

b. AWS D1.1-94
Structural Welding Code-Steel

c. AWS QC1-88
Standard for AWS Certification of Welding Inspectors, Fourteenth Edition

10. International Conference of Building Officials (ICBO):

a. Uniform Building Code - 1994

11. International Society for Measurement and Control (ISA):

a. ISA S-5.1-84
Symbols and Identification

12. National Electrical Manufacturers Association (NEMA):

a. NEMA 250-91
Enclosures for Electrical Equipment

13. National Fire Prevention Association (NFPA):

a. NFPA 54-92
National Fuel Gas Code

b. NFPA 68-94
Guide for Venting of Deflagrations

c. NFPA 70-93
National Electrical Code

d. NFPA 80-92
Standard for Fire Doors and Fire Windows

e. NFPA 82-94
Standards on Incinerators and Waste and Linen Handling Systems and Equipment

f. NFPA 85C-91

Article 1.2 (Continued)

Standards for the Prevention of Furnace Explosions/Implosions in Multiple Burner Boiler-Furnaces

g. NFPA 86-90
Standard for Ovens and Furnaces

h. NFPA 101-94
Code for Safety to Life and from Fire in Buildings and Structures

14. Occupational Safety and Health Administration (OSHA):
    a. 29 CFR 1910
    Occupational Safety and Health Standards
    b. 29 CFR 1926
    Safety and Health Regulations for Construction
15. Ohio Basic Building Code (OBBC), 1995
16. Steel Structures Painting Council (SSPC):
    a. SSPC SP 3-89
    Surface Preparation Specification No. 3 - Power Tool Cleaning
    b. SSPC SP 6-91
    Surface Preparation Specification No. 6 - Commercial Blast Cleaning
17. United States Department of Energy:
    a. DOE Order 6430.1A-89
    General Design Criteria for Low-Level Nonreactor Nuclear Facility
    b. DOE Order 6430.1A, Section 1525-4
    Safe Surface Temperatures
    c. DOE Order 6430.1A, Section 1555-2.6.8
    Plant Insulation

1.3 SUBMITTALS

A. Requirements:
SELLER's records, data, drawings, and documentation submittal shall be performed as requested and scheduled in accordance with the requirements specified by FERMCO "SELLER Drawing and Data Submittal Requirements," Specification No. E-212-A, and "SELLER Drawing and Data Commitment Form, E-212," attached in Appendix 2.

Article 1.3 (Continued)

The SELLER shall maintain documents attesting to this procurement as records. The records shall be retrievable and protected against damage or loss.

All records generated as a result of this order, but not required to be submitted, must be stored and maintained in accordance with the SELLER's QA Program. FERMCO reserves the right to have access to the files for the retention time specified by the SELLER in the SELLER's QA Program.

The SELLER shall prepare a documentation inventory transmittal sheet (listing all documents and number of pages) and attach this sheet to each set of documentation. Each set of documentation shall list FERMCO's purchase order number, project number, and equipment piece number, and be consecutively numbered.

The SELLER shall comply with all the requirements as specified by FERMCO in documents including "Explanation of Standard Requirements for FEMP Suppliers" and form FS-F-2672, "Standard Requirements for FEMP Suppliers," attached in Appendix 1.

B. Submittals Required with Bid Package:

1. Dimensioned outline drawings for the equipment and systems (general arrangement with elevations), including weights, space requirements (for all SELLER-provided equipment), anchor bolt locations (informative), and preliminary structural loadings. Drawings shall indicate the system and equipment interfaces as defined in Article 2.2, Paragraph H, and the fabrication sizes which FERMCO will receive on site.
2. Materials of construction and associated design criteria and features of the major components (see Article 2.1, Paragraph B) of the indirect dryer system.
3. A weekly schedule (bar chart) of SELLER activities from date of award to delivery of the indirect dryer system. Activities shall include design

Article 1.3 (Continued)

review/approval processes, inspection of fabrication, shop testing, and delivery. The schedule shall indicate specific hold points which will be placed in the SELLER's production process, design, and fabrication to allow FERMCO to review, approve design, and witness fabrication, inspections, and tests. FERMCO shall be given 1 week to review and respond to SELLER's design deliverables.

In preparation of the above schedule, the following shall be incorporated: FERMCO shall be notified a minimum of 1 week in advance of the designated hold point dates for the above activities (see Requirements, Appendix 1). The inspections of fabrication will include examination of the structure, dimensions, and workmanship; operation of moveable components; and review of shipping instructions.

4. The construction/installation schedule for the indirect dryer package, indicating SELLER's involvement and services.
5. A system description of drying process and operation.
6. Major equipment list with process duty outline specification and equipment sizes.
7. Electric motor list and wiring schematic for all electrical systems furnished.
8. Magnitude and location of all dynamic loads from all major equipment.
9. Conceptual Process Flow Diagram, including heat and material balances.
10. Utility requirements:
    a. Power (kw)
    b. Natural Gas (scfm, psig), note availability in Article 2.2, Paragraph C, Subparagraph 1.
    c. Water (gpm)
    d. Plant air (scfm, psig)
11. All pertinent major design data (outline data sheets) or information required to assemble and operate the system. Data sheets provided in Section 15171 and Appendix 3 are to be filled out

to the extent indicated and submitted by the SELLER with the bid package.

12. QA Program:
The SELLER shall submit the QA Program as specified in Article 1.4.

13. Submittal schedule:
The SELLER shall provide a submittal schedule in accordance with the requirements as specified in the documents attached in Appendix 2.

14. Project Team:
The SELLER shall submit a breakdown of the management and organizational structure within the SELLER's company, and provide a list of resumes for key technical personnel.

15. List of References:
The SELLER shall provide a list of references. The references shall be clients for whom the SELLER has supplied currently operating indirect dryer systems comparable to the system specified herein. References shall include identification of the application, client name, address, and phone number.

16. The SELLER shall provide the terms and conditions of the SELLER's warranty for workmanship and materials.

17. Cost proposal (F.O.B. on FEMP site) with breakdown to include the following:
    a. Engineering and design.
    b. Rotary dryer (excluding furnace).
    c. Furnace (excluding burners and controls).
    d. Burners, controls, and the burner piping and instrumentation skid.
    e. Combustion-air supply fan.
    f. Electric motors, instrumentation, and controls.
    g. All structural supports and service platforms.
    h. All ductwork.
    i. Technical services for installation.
    j. Technical services for start-up support.
    k. Technical services for acceptance testing.

Article 1.3 (Continued)

l. Daily rate for operator training.

m. Spare parts list with unit prices good for 1 year.

18. Description of Microstation or DXF format to be used for submitting drawings.

19. List of instruments provided by SELLER.

C. Deliverables Required After Award, During Execution, and at Project Closeout:

1. Shop/Engineering drawings:

The SELLER shall prepare engineering drawings that illustrate the salient features of the indirect dryer. The drawings shall comply with ANSI Y14.5M. The drawings shall include the information and specifications, relating to the assembly and secondary assemblies, necessary to inspect, assemble, and install the indirect dryer unit. The drawings shall specify the dimensions, tolerances, fits, anchor bolt settings, and operating weights. These drawings shall have a list of components with a reference to shop drawings and bill of materials needed for installation of that assembly. They shall delineate weld and inspection requirements, material specifications, and surface and heat treatments. Drawings may be supplemented by specifications and/or data sheets which are cross-referenced.

Shop drawings shall be provided for the assembly base frames and for the main frame. These drawings shall:

a. Indicate sizes, spacing, and locations of components and structural members, bolted connections, and welded connections.

b. Indicate welded connections with AWS A2.4 welding symbols. Indicate net weld lengths.

c. State the vertical loads and lateral forces (wind and seismic) used in the design.

In addition, the drawings shall be in sufficient detail so that the indirect dryer system may be interfaced with required utilities and mating

assemblies and equipment. These drawings shall be submitted to FERMCO for approval.

After approval by FERMCO, the SELLER shall submit two sets of reproducible drawings identified as "Certified for Construction." These drawings shall be submitted on dry erasable Mylar, 30-inch by 42-inch maximum size. In addition, they shall be submitted in Microstation or DXF format on either floppy disk or 9-track tape. SELLER shall describe the format to be used in the bid package.

2. Spare parts list:
The SELLER shall provide a final parts list and a recommended spare parts list. The spare parts list shall be identified on the drawings' bill of material section. This spare parts list shall be confirmed and updated by the SELLER at the time of project close-out to reflect any additions or changes in spare parts. The spare parts shall identify the supplier, the supplier's part number, and the sales office responsible for the Cincinnati, Ohio, area.

3. Installation, Operations, and Maintenance (IOM) Manuals:
The SELLER shall prepare bound IOM manuals which, as a minimum, contain:
   a. Installation instruction for all assemblies and subassemblies as specified by corresponding drawings.
   b. Operating procedures, including start-up and emergency shutdown (see operating modes under Article 2.2, Paragraph C, Subparagraph 2).
   c. Instructions for maintenance.
   d. Troubleshooting guide.
   e. Maintenance schedule and service guide.
   f. Instrument maintenance and calibration procedures.

The manuals shall be submitted to FERMCO for review and approval a minimum of 6 weeks prior to

Article 1.3 (Continued)

the shipment of each assembly of the entire package. The SELLER shall furnish 10 bound copies and one reproducible copy of the approved manuals to FERMCO to be included with the shipment.

4. Material Safety Data Sheets (MSDSs) on all finishing products.

5. Manufacturer's Mill Certificate:
Factory mill certification that ASTM A325 bolts and other listed products meet specified requirements.

6. Mill Test Reports:
Submit reports indicating structural strength, destructive, and non-destructive test analysis for each batch of steel from each supplier.

7. Acceptance Test Plan and Procedures:
The SELLER shall prepare Acceptance Test Procedures and an Acceptance Test Plan that will cover the requirements for acceptance testing specified in Article 3.6. The plan and procedures must be approved by FERMCO prior to application.

8. Engineering Calculations:
The SELLER shall submit complete calculations for structural design. The calculations and related drawings shall be stamped by a professional engineer licensed in the State of Ohio.

D. Bid Evaluation Method:
This section defines the method of evaluation and ranking of results to be performed by FERMCO.

1. All bids received will be subjected for review based on the following common categories:
   a. Price.
   b. Technical merit.
   c. Experience in the design and fabrication of hazardous waste dryers.

Article 1.3 (Continued)

d. Management approach to the project, and qualification of key personnel.
e. Ability to meet schedule in terms of both material delivery and vendor print submittals.
f. Fabrication capabilities and union contract status.
g. Quality control and quality assurance program.
h. Location of design and fabrication shop(s).

Bases for point allotment:

Above cat.	Weight %
a.	30
b.	25
c.	25
d.	10
e.	3
f.	3
g.	3
h.	1

For category a above, the following scale is used: The low bidder is given the full 30 points. All other bidders are given or deducted points according to the following formula:

30 - [10.0 x (bid - low bid)/$500,000]

For category b above, the following scale of points is used for each item of technical compliance from the list of items subsequently specified in this document:

10 - bidder states compliance or offers acceptable alternate
7 - bidder implies compliance
5 - item not properly addressed
3 - bidder statements confusing or misleading
1 - does not meet specification

Article 1.3 (Continued)

For example, there are 40 items of technical compliance, so the maximum number of points possible is 40 x 10 = 400. If a bidder receives 300 points, the overall rating would be:
300/400 x 25% = 18.75

Spec Ref.	Description	Points
1.2.B	SELLER compliance to references	_____
1.2.C	SELLER compliance to codes and standards	_____
1.3.A	Submittal requirements	_____
1.3.B	Submittals required from SELLER	_____
1.3.C	SELLER's deliverables after award	_____
1.5.A	SELLER's stated alternates	_____
2.1.A	Responsibilities by SELLER	_____
2.1.B	Materials and equipment by SELLER	_____
2.1.C	Services by SELLER	_____
2.2.B	Technical description	_____
2.2.C.1	Process design criteria	_____
2.2.C.2	General operating conditions	_____
2.2.D	Mechanical requirements:	
2.2.D.1.a	Rotary dryer shell	_____
2.2.D.1.b	Support stations assemblies	_____
2.2.D.1.c	Drive assembly	_____
2.2.D.1.d	Dryer feed head	_____
2.2.D.1.e	Dryer discharge head	_____
2.2.D.1.f	Dryer seals	_____
2.2.D.1.g	Main support frame	_____
2.2.D.2.a	Furnace requirements	_____
2.2.D.2.b	Furnace refractories	_____
2.2.D.2.c	Furnace burners	_____
2.2.D.3	Burner piping and instrumentation skid	_____
2.2.D.4	Combustion-air supply fan	_____
2.2.D.5	Dryer caked-on feed removal	_____
2.2.D.6	Arrangement requirements	_____

2.2.E	Control and instrumentation requirements:	
2.2.E.1	Specific requirements	_____
2.2.E.2	General requirements	_____
2.2.E.3	Installation requirements	_____
2.2.E.4	Operator controls	_____
2.2.G	Structural requirements	_____
2.2.H	Design interfaces	_____
2.3	Materials of construction	_____
2.4	Fabrication requirements	_____
3.1	Testing and inspection	_____
3.2	Equipment identification	_____
3.3	Finish and painting	_____
3.4	Product delivery and acceptance	_____
3.5	Erection and installation	_____
3.6	Final acceptance methods	_____

Total Items = 40

1.4 QUALITY ASSURANCE

A. Quality Assurance Program Requirements:

1. The SELLER shall maintain a Quality Assurance Program that, as a minimum, addresses the elements checked in Q-1 of the "Standard Requirements for FEMP Suppliers," Form FS-F-2672 (see Appendix 1).
2. The Quality Assurance Program shall include the following items:
   a. Design Control:
      Provide a program to identify control measures used to ensure that design requirements, including quality standards, are defined and verified as applicable and are accurately represented in drawings, specifications, and procedures.
   b. Instructions, Procedures, and Drawings:
      The SELLER's activities affecting quality shall be prescribed by and performed in accordance with documented instructions,

Article 1.4 (Continued)

procedures, or drawings. These documents include criteria for acceptance.

c. Document Control:
Control the preparation, issue, and exchange of documents that specify quality requirements or prescribe activities affecting quality to ensure that correct documents are employed.

d. Inspection:
Plan and execute inspections to verify conformance to purchase order quality and technical requirements. These inspections shall be documented and provided as required by Form FS-F-2672 (Appendix 1). Notification of FERMCO is required at least 1 week prior to the performance of the inspection.

e. Test Control:
Plan and execute tests verifying conformance of an item or process according to written procedures which contain the test requirements and acceptance limits. These tests shall be documented and provided as required by the attached Form FS-F-2672. Notification of FERMCO is required at least 1 week prior to the performance of the test.

f. Control of Test and Measuring Equipment:
Control and calibrate all tools, gauges, instruments, and other devices used for activities affecting quality.

g. Inspection, Test, and Operating Status:
Provide for the identification of acceptance status of items procured by tagging or marking, or documents traceable to the items required by the specifications.

h. Control of Nonconforming Items:
Provide for control of items or processes that do not conform to procurement document requirements. Nonconformances shall be controlled to prevent inadvertent installation or use, and shall be documented.

Article 1.4 (Continued)

i. Quality Assurance Records:
Generate, compile, and maintain all program records that furnish documentary evidence of quality and shall provide records as specified by the procurement document or Form FS-F-2672.

j. Handling, Storage, and Shipping:
Provide procedures to control requirements specified in Article 3.4.

k. Corrective Action:
Provide procedures to implement corrective actions.

B. Standard Requirements List:

1. The SELLER shall provide the elements checked in Section Q-2 of the "Standard Requirements for FEMP Suppliers," Form FS-F-2672 (see Appendix 1).

C. Source Inspections/Test:
Control equipment shall be tested to ensure all indirect dryer component assemblies and sub-assemblies are functioning safely and according to operating parameters.

1. All shop testing requirements shall be handled according to Article 1.3, Paragraph B.
2. Successful completion of testing (both attended and unattended by FERMCO) shall be confirmed by issuing certified copies of the test results to FERMCO.
3. Acceptance testing at site:
Final inspection and acceptance at the FEMP will be in accordance with this specification and the following:
   a. Acceptance testing and inspection shall take place at the FEMP site with FERMCO and the SELLER present in accordance with the requirements specified in Article 3.6.
   b. The successful completion of the inspections and acceptance tests and surveillances will be FERMCO's method of final acceptance of the

Article 1.4 (Continued)

purchased system, as specified in Article 3.6.

1.5 SELLER'S STATED DEVIATIONS AND SUBSTITUTIONS

A. SELLER's Responsibility:
The SELLER is to submit in writing to FERMCO exceptions or proposed changes to this specification as alternates in the bid package. Each exception or proposed change shall:

1. Identify the item (component) as specified in this specification.
2. Identify the criteria that cannot be met or proposed for change.
3. Present the proposal for resolution and/or for alternate.

B. FERMCO's Responsibility:
All deviations from this specification or substitutions offered by the SELLER will be evaluated during bid technical evaluation by FERMCO. However, these deviations and substitutions will not be evaluated if they are not properly presented in the bid package as required by this article. In addition, approved exceptions will ultimately result in revision to the specification to incorporate the exception.

PART 2 PRODUCTS

2.1 MATERIALS AND EQUIPMENT

A. Responsibilities for Materials and Equipment:

1. All deliverable materials and equipment as identified in Article 2.1, Paragraph B, shall be the responsibility of the SELLER. The SELLER is also responsible for the quality and compliance of the work of the SELLER's suppliers.
2. The SELLER shall be responsible for all engineering, design, fabrication, inspection, testing, checkout technical assistance, and

Article 2.1 (Continued)

delivery of all deliverable materials and equipment.

B. Materials and Equipment to be Provided by SELLER:

Equipment Number (EN)	Description	Quantity
1.	Indirect rotary dryer system with furnace	1
2.	Burner piping and instrumentation skid complete with supply pipeline headers (air and gas), manifolds with instrumentation, and controls per set of burners per zone, fittings, structural frame, and supports	1
3.	Instrumentation, controls, alarms, control panels, electrical wiring, and connections for safe and efficient operation of all equipment and controls	1 lot
4.	Combustion-air supply fan	1
5.	Electric motors:	
	a. Rotary dryer drive motor	1
	b. Rotary dryer auxiliary drive motor	1
	c. Combustion-air supply fan drive motor	1
	d. Other motors as specified by SELLER	TBD
6.	Maintenance platforms, walkways, structures	TBD

C. Services to be Provided by SELLER:

1. Technical assistance and monitoring for compliance with site installation requirements for all items specified in Article 2.1, Paragraph B.
2. Technical assistance for start-up and a readily available question-answering service.
3. Technical assistance and monitoring for compliance with requirements for acceptance testing, as specified in Article 3.1 and Article 3.6.
4. Instrument inspection, testing, calibration, and tuning:
   a. SELLER shop checkout.
   b. Software checkout.
   c. Installation supervision.
   d. Field system checkout and start-up.

Article 2.1 (Continued)

D. Items to be Provided by FERMCO:

1. All utilities and piping to the indirect rotary dryer burner piping and instrumentation skid (air, natural gas, water, drain).
2. Dryer feeder.
3. Product discharge chute from the indirect rotary dryer product discharge flange.
4. Combustion gas ductwork and support between the combustion gas exhaust manifold and the stack.
5. Process off-gas ductwork and support from the indirect rotary dryer discharge head to the process off-gas treatment area.
6. Electrical power supplies and field wiring.
7. Unloading and storage of assemblies and sub-assemblies, installation of indirect dryer system.
8. Concrete foundations and support pillars for the following items:
   a. Indirect rotary dryer system (EN-1).
   b. Burner piping and instrumentation skid (EN-2).
   c. Combustion-air supply fan (EN-4).
   d. Maintenance platforms, walkways, and structures (EN-6).
9. Control Room, located within 100 feet of the dryer.
10. Enclosed rooms at feed and discharge ends of drying system.
11. Air exhaust system and connection to seal shrouds at feed and discharge ends.

E. Fasteners:

1. The SELLER is hereby given notice that the Fastener Quality Act of 1990 applies to the provision of fasteners. The SELLER certifies that suspect or counterfeit fasteners are not being provided or incorporated as part of an end item for delivery under this purchase order. The SELLER shall provide certification of specification conformance to FERMCO upon request and agree to comply with all recordkeeping requirements by law.

2.2 TECHNICAL REQUIREMENTS

A. General:

The SELLER shall furnish all deliverable items identified in Article 2.1, Paragraphs B and C, to conform with the design requirements specified in this section.

The SELLER shall propose a proven design, including modifications, as required, to provide all concepts defined in the specification. All piping and flanges and fittings supplied with this equipment shall conform to requirements stipulated in the piping specification sections provided in Division 15. All structural components shall be provided in accordance with the structural requirements specified in Article 2.2, Paragraph G. All components, platforms, walkways, stairs, and guards (for rotating equipment) supplied by the SELLER shall conform to the applicable OSHA standards.

B. System Description:

The pit wastes will be dried in an indirect rotary dryer system. This system will consist of (1) an externally heated rotating cylinder (rotary dryer) to receive and dry wastes while advancing material from the feed head toward the discharge, (2) a multiple-zone furnace surrounding the rotary cylinder to generate heating gases by combusting natural gas, (3) a fuel and air supply system to the burners, and (4) burner management and dryer process control. The combustion gases produced in each zone of the furnace by a set of burners will be controlled to set the rotary dryer shell at a temperature to be specified by the SELLER to meet thermal performance requirements. The SELLER shall justify selected material of construction for the rotary shell, taking into account such factors as required thickness of material, length and diameter of the dryer, corrosion and oxidation, and feed rate. The SELLER shall use A36 as a baseline, and give a cost comparison against at least two other alloys.

Article 2.2, B (Continued)

The indirect dryer system shall be designed to receive and process wet waste material of various moisture contents depending on the type of feed waste. Feed waste material will be received from the following sources: (1) screened waste, and (2) intermittent waste slurry. Screened material and intermittent waste slurry will be fed into the rotary dryer via an auger type feeder. This feeder will be purchased by FERMCO and specified to meet dryer requirements. The dryer SELLER will be provided with the feeder specification and given the opportunity to bid on it.

The rotary dryer system shall consist of a cylindrical shell rotated with a variable speed drive. The rotating cylinder shall be heated externally by a furnace, enclosing the rotary cylinder, with adequate length to satisfy heat transfer requirements. Heat energy for the indirect drying shall be produced in the multiple furnace zones by a set of burners located in each zone, using natural gas as fuel for combustion. Burners shall be operated with adjustable primary air/fuel ratio, and secondary air to control the flame temperature so the rotating cylinder does not exceed its allowable shell temperature as specified by the SELLER. Exit gases from each furnace zone shall be collected into a header, from where they will be transferred to a combustion gas discharge system provided by FERMCO.

Heat energy from each furnace zone shall be indirectly transferred into the material advancing inside the rotating shell. This heat transfer from the furnace will take place through convection, conduction, and radiation. To ensure better mixing of the material inside, the shell shall be equipped with shallow type agitating flow disturbers, to be placed inside the shell along the entire heated length. Evaporated water shall be swept from the dryer with a controlled flow of preheated air in a cocurrent (parallel) fashion, and it shall be discharged at the discharge end of the dryer.

Waste material continuously fed into the dryer will advance through the heated section, where it will be heated up to 200-250 degrees F. The SELLER shall specify how this is measured. Due to the heat transferred into the material, water will be evaporated, and some small amounts of organics contained in the waste will be vaporized. Preheated sweep air flowing cocurrently with the advancing waste will carry off the vapors. The SELLER shall determine gas composition at the discharge point. A total heat and material balance shall be supplied by the SELLER.

Dried material with the 10 percent final moisture content will leave the heated section. Dried material will fall by gravity through the discharge head chute for further handling by FERMCO.

C. Operating Conditions and Requirements:
SELLER shall design equipment to meet the following minimum criteria:

1. Process Design Criteria:
   a. Particle size distribution: 100 percent <4 inches; 80 percent <200 mesh (see Appendix 5, Section 5.3).
   b. Feed moisture content: 30 to 200 percent (all moisture contents expressed on a dry basis [lbs water/lbs dry solids] x 100 percent).
   c. Bulk density: 79 lbs/ft^3 at 200 percent moisture content, 126 lbs/ft^3 at 30 percent moisture content.
   d. Specific gravity of dried solids: 2.5 to 3.25.
   e. Feed composition: For details of pit waste composition, see Appendix 5, Section 5.2.
   f. Plasticity data: see Appendix 5, Section 5.6.
   g. Feed rate: SELLER shall determine processing rates for feed at 30, 45, 100, and 200 percent dry basis moisture content, with a product moisture content of 10 percent. In each operating mode, the dryer shall be able

Article 2.2, C (Continued)

to evaporate moisture at a rate of 4.2 tph. Maximum processing rate in any case shall be 22 tph feed.

h. Feed temperature: ambient (see Article 2.2, Paragraph C, Subparagraph 2).

i. Dryer product temperature: 200-250 degrees F.

j. Heat transfer: Indirect.

k. Dried product moisture content: 10 percent, as a minimum design criteria. Maximum moisture content should equal no free liquid as prescribed by the paint filter liquids test (EPA SW-846, Method 9095).

l. Process off-gas: Temperature, maximum = 350 degrees F; entrained solids lbs/hr = TBD by SELLER.

m. Sweep air: Volume, maximum = ratio of evaporated water present in the dryer, to sweep air volume TBD by SELLER; temperature to be determined by SELLER.

n. Rotary dryer shell temperature, maximum: TBD by SELLER.

o. Temperature of outer furnace shell, maximum: 125 degrees F.

p. Combustion gas outlet temperature: SELLER shall determine and include in the required heat and material balance.

q. Combustion air temperature, inlet to burner manifold: ambient (see Article 2.2, Paragraph C, Subparagraph 2).

r. Natural gas characteristics: heating value = 1,027 Btu/ft^3; pressure = 60 psig; availability = 168,000 acfh in 6-inch pipeline; composition = CH_4 - 96 percent, C_2H_6 - 1.9 percent, N_2 - 0.036 percent, C_nH_n - 2.064 percent.

2. General:

The indirect dryer system shall be operated at the FEMP site at Fernald, Ohio. The indirect dryer will be located under a roofed structure with partial siding and subject to weather-related

temperature variations, wind, wind-driven rain, and earthquake loading criteria. The feed head of the rotary dryer and the discharge head shall be enclosed in a room with maintained temperatures. The feed head and the discharge head may need to be insulated for personnel protection. The SELLER shall ensure that all conductive surfaces be designed to stay at or below 125 degrees F, and that nonconductive surfaces such as insulation or plastic stay at or below 150 degrees F, or that a protective guard shall be supplied to keep personnel from contacting such surfaces.

The SELLER shall specify any special environmental conditions, including temperature and moisture protection, that must be provided for any equipment, instrumentation (hardware and software), or material. The following are the environmental and operating conditions:

a. Ambient conditions outside (summer, winter):
   Summer:
   Dry bulb temperature: 92 degrees F
   Wet bulb temperature: 73 degrees F
   Winter:
   Dry bulb temperature: -1 degree F
b. Ambient conditions for enclosed process areas:
   Dry bulb temperature: 55 - 104 degrees F
c. Ambient conditions for control room:
   Dry bulb temperature: 72 ± 5 degrees F
   Relative Humidity: 35 - 50 percent
d. Plant elevation: 578 feet above sea level
e. The system shall be designed for operation in seismic zone 2A as designated in the Uniform Building Code.
f. Operating schedule:
   Operating days/week - 7
   Operating shifts/day - 3
   Operating hours/shift - 8

Article 2.2, C (Continued)

g. Operating modes:

1) Normal
The facility is operated at the normal flow rate as specified in Article 2.2, Paragraph C, Subparagraph 1.g.

2) Hot idle
The facility is idled below operating temperatures, and not drying feed. All burners either shut off or set to low fire mode.

3) Heat-up
The facility is started by heating up the system, from cold status to the thermal conditions of normal operations.

4) Cool down
The facility is cooled down from any of the above operating modes to ambient conditions.

5) Normal shutdown

6) Emergency shutdown

7) Restart after normal shutdown

8) Restart after emergency shutdown

h. Fire protection:
The indirect dryer system shall comply with the applicable NFPA codes and standards listed in Article 1.2, Paragraph C. In addition, the SELLER shall identify any special fire protection requirements needed by any purchased item (equipment, instruments, hardware, software, material).

D. Mechanical Requirements:

1. Indirect rotary dryer:

The indirect rotary dryer assembly shall include the following sub-assemblies and components.

a. Rotary Dryer Shell:

Rotary dryer cylindrical shell material of construction shall be selected by SELLER. It shall be a heat- and corrosion-resistant steel alloy to withstand operating conditions, and be of rolled steel plate, welded construction. Thickness of the shell shall be determined by the SELLER based on the mechanical/structural requirements to ensure a design life of 15 years for the rotary shell operated at the design conditions. The rotary shell shall be reinforced at the riding rings support and at the drive girth gear. Proper safety factors shall be applied calculating the working combined stresses to ensure that: (1) under operating conditions, tension and shear stresses will never exceed the material strength (yield stress, with the applied safety factors); (2) proper allowance is provided (0.3 mils per 1,000 hours) for oxidizing, carburizing, and sulfidizing environments; (3) deflection shall not exceed 0.0002 mils at the point of maximum moment between the supports. The SELLER shall provide calculations supporting thickness selection.

The rotary dryer shell shall accommodate two support riding rings, one at the feed end and one at the discharge end. It shall also accommodate one driving spur gear at the feed end, and seal assemblies at both ends. SELLER shall describe the complete design of the shell, riding rings, and driving spur gear. All applicable AGMA standards shall be adhered to.

Article 2.2, D (Continued)

The rotary shell shall have cylindricity tolerances on radius per ASME B4.1. The shell shall be built of steel plate, rolled into a circle, and welded in sections with circumferential joints as required. The shell sections shall have one longitudinal joint per circle. The SELLER shall specify number of sections required for optimum design, fabrication, shipping, installation, and operation. The SELLER shall state the maximum section length, and shall note if the entire length of the shell can be manufactured and delivered in one piece.

Rotary shell shall be supplied with the following internals:

1) Inside feed spirals to carry feed waste from the feed end into the furnace covered "Hot Zone" of the dryer. It shall be noted that the dryer feeder will be specified by FERMCO to be capable of feeding the waste directly into the "Hot Zone" or as close as the mechanical design allows. Feeder spirals shall provide an additional feature for flexibility in operation. SELLER shall determine the need for a retainer ring on the feed end to prevent backspill into the feed head.
2) Shallow type inside flow disturbers to be supplied through the entire heated length of the rotary dryer. SELLER shall design the disturbers to maximize heat transfer into the waste, and minimize caking of waste onto the rotary shell.

The rotary shell welding shall comply with ASME code Sections VIII and IX, with the

exception that no code stamp is required (see requirements in Article 2.4, Paragraph B).

Materials of construction:

1) Shell plate - heat- and corrosion-resistant alloy TBD by SELLER.
2) Riding rings - ASTM A148, Grade 80-40, hardness to be specified by SELLER.
3) Roller - cast steel, ASTM A148, Grade 90-60, hardness to be specified by SELLER.
4) All joints shall be double-butt welded.
5) Roller shafts - forged steel, to be specified by SELLER.
6) Spur gear - steel alloy and hardness to be specified by SELLER.
7) Feed head - ASTM A36.
8) Discharge head - ASTM A36.

b. Support stations assemblies:
Rotating cylinder shall be supported at two locations through the riding rings, riding on the carrying rollers assembly. Carrying rollers shall be of either forged or cast alloy steel with hot pressed and shrunk on forged alloy steel roller shafts. The entire carrying assembly, consisting of four bearings and two rollers, shall be mounted on a rigid structural steel frame with base plates and adjusting screws for proper alignment. Bearings shall be antifriction in pillow blocks with high temperature lubrication, and shall conform to applicable ABMA standards.

The support station next to the drive assembly shall be provided with thrust rollers to limit the longitudinal movement of the rotating cylinder and to maintain alignment of the gear and pinion, as well as the riding rings with the carrying rollers.

Article 2.2, D (Continued)

Thrust rollers, welded into hot-rolled steel shafts, shall be machined to match the thrust riding gear, which shall be tapered to take the full downhill thrust.

Thrust rollers shall be mounted in heavy journal housings which shall be clamped together with two heavy steel rods. Housings shall be fitted with bronze journal bearings.

The two thrust rollers shall be mounted on the common steel frame with the riding rollers.

c. Drive assembly:
Rotary shell shall be driven through a drive mechanism by a variable speed motor. The variable speed drive and motor shall be suitable for starting a fully-loaded rotary shell. Maximum rpm of the cylinder shall be designed not to exceed a resultant tangential velocity of 100 ft/min, with a 10:1 turndown.

Drive mechanism may consist of the pinion gear and shaft running in pillow blocks supplied with roller bearings. All bearings shall conform to applicable ABMA standards. The main pinion shall be made of forged steel and shall be integrated with the pinion shaft. The teeth are to be through hardened (302-352 Bhn). All gearing parameters shall be determined and supplied by the SELLER. The shaft shall be coupled to a gear reducer (Falk or approved alternate) with a service factor of 1.5. All gear box service factors must be based on motor nameplate horsepower, not operating horsepower. Applicable AGMA standards shall be adhered to. The variable speed motor shall be coupled to the gear reducer through the drive shaft. The gear reducer shall have a second high-speed drive

extension to accommodate a second electric motor, backed up with a diesel generator provided by FERMCO. The auxiliary drive is to be used in case of power outage to rotate the dryer at the minimum rpm. In addition, a hand-operated inching mechanism shall be supplied and mounted on the gear reducer low rpm output shaft.

The drive components, the pinion bearing blocks, gear reducer, pinion and spur gear housing support, etc., shall be mounted on a common steel frame. The base frame shall be equipped with adjusting screws for proper alignment of the respective components. The SELLER shall specify the spur/pinion gear lubrication and type of enclosure guard.

The drive assembly to rotate the cylindrical shell shall be located at the feed end. The SELLER has the option of locating the drive behind the support station toward the discharge end, providing the mechanical design allows for this arrangement. Such an arrangement would shorten the length of the feeder at the feed end. The SELLER also may offer a different drive option such as a hydraulic drive, provided its application is justified (operability, maintenance, life expectancy, etc.).

d. Rotary dryer feed head:
The feed end head shall be of carbon steel plate welded construction. The feed end head shall be aligned with the rotating cylinder. It also shall support the stationary flange for the rotary dryer seal system.

The feed head shall be designed to support and accommodate the dryer feeder provided by FERMCO (through a sealed/flanged connection),

Article 2.2, D (Continued)

the sweep air connections, the visual inspection window, and the high pressure wash spray inlet connections. Feed end housing shall be designed to be removable on rail tracks and equipped with locking blocks.

The feed head shall accommodate the sweep air intake nozzles. The sweep air shall be introduced at three inlet points located in the feed head. The SELLER shall furnish piping connecting the three sweep air inlet nozzles to an overhead header. Each connecting pipe shall be equipped with a manually adjustable butterfly valve.

e. Rotary dryer discharge head:
The discharge head shall be of carbon steel welded construction. The discharge housing shall mate with the rotating cylinder through a circular opening. This opening shall be designed to support the stationary part of the rotary dryer seal system.

Moisture content and temperature of both the product bed and the process off-gas shall be measured inside the rotary shell at the exit point of the final heating zone. The SELLER shall determine the type of instrumentation required, along with the size and location of flanges required on the discharge head. The SELLER shall also specify the expected amount of entrained solids in the process off-gas for the various types of surrogate feed shown in Table A of Article 3.6 The dried product discharge outlet located at the bottom of the discharge housing shall be designed so that the product from the dryer drops through it vertically by gravity.

The discharge bottom shall be supplied with a flange to ensure an airtight bolted

connection. All flanged connections shall be sized and located by the SELLER.

The dryer discharge head shall have the following openings for flanged connections:

Description	Quantity
Process Off-Gas	1
On-Line Humidity Probes	TBD
Product outlet	1
Manhole	1
TV camera	1
Sight port	1
Thermocouples	TBD
Grab sampler	1

f. Rotary dryer seals:
The rotating dryer seals are to be provided at both the feed and the discharge ends to avoid gas leakage into or out of the dryer. The seals shall be a sliding contact/ labyrinth combination. The contact section of the seal assembly shall consist of a fixed part connected to the feed end head and the discharge head of the dryer, respectively, and a rotating part connected to the dryer barrel.

A seal ring with spring loading may be considered to compensate for normal seal wear, heat up, and cool down. The seal must have easy access for adjustment and replacement.

A rotating flange shall be supplied with the machined surface. The seal ring shall mate with this surface. Segmented guides and spring-loaded adjustable bolts may be provided. Labyrinth section shall be designed with a minimum of one or more pieces.

Article 2.2, D (Continued)

The SELLER shall furnish dryer seals of a type that has been proven in the field by at least 3 years of satisfactory service. It is expected that the seal shall include the above features. The seal assembly shall be designed for a normal pressure differential across the seal of 2 inches W.C. and shall accommodate the longitudinal and radial expansion based on operating conditions. The seal shall be designed to ensure a "puff-proof" tight sealing.

Each seal shall be enclosed in a shroud that extends completely around the periphery of the seal. The shroud shall be attached to and supported from the fixed head of the rotary dryer and shall be airtight except for necessary clearance of approximately 1/2 inch at the dryer barrel. The clearance between the shroud and the rotating barrel shall be the minimum required to prevent contact during operation. An exhaust system connecting to the shroud will be supplied by FERMCO to maintain a negative pressure so that air flow is always from the ambient to the shroud through the clearance space at a minimum face velocity of 200 fpm. The shroud shall be removable for seal maintenance and shall have an access port for seal inspection. Seals shall also be provided at both ends of the furnace between the fixed furnace and the rotating shell. These seals should not require shrouds.

g. Main support frame:
The entire indirect dryer assembly consisting of the two support stations and the drive assemblies, as well as the entire furnace, shall be located and anchored on an integrated structural base frame, designed and supplied by the SELLER. This structure

will be located and anchored on the concrete pillar to be provided by FERMCO. The foundation requirements for anchoring the main support frame shall be provided by the SELLER.

2. Furnace:

a. The rotary dryer shall be supplied with a furnace surrounding the rotary shell. The function of this furnace is to generate high temperature flue gases by combustion of natural gas as fuel.

The furnace shell housing the rotating cylinder shall be designed and constructed to accommodate and support refractory lining. The furnace shall be designed and built in sections (zones) along the length of the dryer. Each zone shall be equipped with its own designated set of burners to supply the source of heat required for drying. The SELLER shall specify the thermal duty required for each zone, and shall consider placing baffles between furnace zones for better thermal control. Drying shall be accomplished through indirect heat transfer between the hot gases and the feed, which is fed into the rotating cylinder and advances from the feed end toward the discharge end.

The furnace shell shall be carbon steel plate welded construction and shall be designed in sections with joining flanges. Each furnace section shall be supplied in halves, the upper and lower parts to be fitted together with joints and secured with bolts and nuts.

The furnace sections shall be flanged together. The furnace shall be designed with all necessary stiffening and structurally clamped together, as required. Each section

Article 2.2, D (Continued)

(zone) of the furnace shall be supplied with, but not limited to, the following openings:

Opening	Quantity/Zone
Burner(s)	TBD
Exit gas nozzle	1
Sight port(s)	TBD
Instrumentation	
— thermocouples	TBD
— pressure gauge	1
— outer furnace shell surface temperature measuring device	1

The SELLER shall determine furnace outline dimensions, refractory lining (thickness and type), annular spacing between the refractory hot surface and the outside surface of the rotating shell, number of burners and sight ports per zone, and the quantity and location of thermocouples placed inside each zone. These thermocouples shall measure flame, rotary shell, and annular headspace temperatures at various locations. As a minimum, the furnace annular headspace temperature shall be measured in each zone at the first and last burner. A combined furnace off-gas temperature measurement in the off-gas header shall be included. At least one rotary shell temperature measurement per burner shall be required, with the location to be determined by the SELLER.

Physical dimensions and thermal capacity of the furnace shall be determined by the SELLER to meet technical requirements as specified in Article 2.2, Paragraph C, Subparagraphs 1 and 2.

b. Refractories:
The furnace shall be refractory lined to withstand heat. Use of refractory bricks and/or ceramic fiber may be proposed with proper backing insulation to ensure that the temperature will not exceed 125 degrees F on the furnace external metallic surfaces. The SELLER may propose the option of using pre-installed "soft" refractories.

c. Burners:
The burners shall be a high velocity type of gas burner. The burners shall be designed (1) to burn natural gas and produce a short flame with high exit velocity; (2) to ensure a low NO_x production; (3) to achieve furnace temperature required to maintain dryer shell temperature below its maximum; and (4) to be capable of operating with a turndown ratio of 10:1. In addition, the burner shall be operable in low and high fire with ambient air and with electronic direct spark ignition. In burner selection, to achieve a low NOx concentration in the combustion gases, two-stage combustion may be considered. This burner shall have the capacity to be operated over 1,400 degrees F with primary and secondary combustion air supply. The burner shall be supplied to accommodate UV flame detectors for flame supervision and be operable with a cross-connected ratio control.

The number of burners per zone and the spacing between burners shall be specified by the SELLER. The SELLER shall select the burners and their thermal duty per zone based on the thermal design requirements specified in Article 2.2 of this specification. The SELLER shall specify the following

Article 2.2, D (Continued)

operational parameters of the selected burner and include data in the bid.

1) Air capacity (scfm) at 70 degrees F, not firing.
2) Air capacity (scfm) at 70 degrees F, stoichiometric.
3) Pressure differential (in. of water), air orifice.
4) Burner tile pressure drop.
5) Maximum percent excess air.
6) Maximum percent excess fuel.
7) Flame length, stoichiometric.
8) Flame diameter, stoichiometric.
9) Ignition (scfm at psig) natural gas, maximum.
10) Ignition (scfm at psig) natural gas, minimum.
11) Air/Fuel ratio at ignition, maximum.

3. Burner piping and instrumentation skid:
The SELLER shall provide all necessary equipment and instrumentation for each set of burners provided independently for each zone of the furnace (fuel and air headers, interconnecting pipes, fittings, valves, control and safety valves fitting and support) on an integrated skid. For general piping requirements, see piping specifications, Sections 15060, 15090, and 15250.

Components to be installed on the skid shall include, but are not limited to, the following:

a. Gas supply header with independent manifold for each set of burners per zone. The manifold shall include the high and low gas pressure switches, pressure gauge, manual reset shutoff valve, automatic shutoff valve, automatic gas blocking valve, shutoff valves (inlet and outlet), two leak test cocks and interconnecting piping, automatic vent valve, and proof-of-closure switch.

b. The main air supply header shall be supplied with flow control valves to each zone of the burners.

c. The piping and valving for each individual burner shall include the interconnecting piping (burner gas supply) with manual shutoff valve, gas metering orifice, gas ratio regulator, gas limiting orifice valve, flexible pipe connection to the burner, interconnecting piping (gas lighting) with solenoid valve, gas regulator, and limiting gas valve.

Installed instruments, valves, etc., shall be located on the skid to allow easy access for maintenance and replacement. Interconnecting piping within the skid and between the skid and the burners as well as the air supply piping to the air header, located on the skid, shall be supplied by the SELLER. The fuel supply (natural gas) to the main gas header located on the skid will be provided by FERMCO.

The skid shall be designed to have a structural frame for support and routing of valves, pipes, manifolds, etc., and base plate to anchor skid. Any support structure for the skid needed by arrangement shall be supplied by the SELLER. The concrete slab (foundation) will be provided by FERMCO.

4. Combustion-air supply fan:
The duty of the combustion air supply fan is to provide combustion air directly to all sets of burners installed in parallel, for each zone of the dryer furnace. Intake air to the fan will be from ambient. The combustion air fan shall be sized by the SELLER to:

Article 2.2, D (Continued)

a. Have adequate pressure in the air header located on the burner piping and instrumentation skid to provide the required air pressure (identical) for each burner per zone.

b. Supply all of the combustion air (including required excess air) at burner rated capacity and over the range of 10:1 operational turn-down ratio.

c. The fan static pressure rating shall be determined by the SELLER. Total static head shall be calculated based on pressure drop requirements including the line, fitting and valve losses, pressure drop across equipment, and burner air inlet pressure requirements.

d. The fan shall be designed to deliver 15 percent excess volume against a 30 percent static pressure overload.

e. The fan shall be supplied with a variable speed motor with controls to accommodate operation as defined by turndown ratio above. The proper means of adjoining the fan and system characteristics must be provided.

f. The fan shall be a single-inlet, single width, AMCA Class III non-overloading centrifugal type. The bearings shall be grease lubricated, ball or roller type, and shall take all radial and end thrust. The fan shall be furnished as a complete unit, including motor, guard, and mounting base. The fan shall conform to AMCA 99 and AMCA 210. The foundation will be supplied by FERMCO per SELLER's requirements.

5. Dryer caked-on feed removal:

a. Means shall be provided to remove caked-on feed from the inside of the rotary section for a distance from the start of the heated section to be specified by the SELLER. Cake removal shall be accomplished by the application of high pressure water, or by a

different method proposed by the SELLER. If a high-pressure water or steam system is chosen, the inlet end of each pipe must terminate outside the dryer with a globe valve and a quick-connect coupling. All components of this system, whether water, steam, or mechanical scraping, must be stainless steel.

6. Arrangement requirements:
The location of the dryer and all equipment supplied by the SELLER (Article 2.1, Paragraph B) shall be clearly indicated on a general arrangement drawing. All walkways, platforms, stairs, and support structures associated with the equipment shall be included. The major dimensions for major items and equipment assemblies shall be provided to give locations in both plan view and elevation. Preliminary arrangement drawings shall be part of the bid package described in Article 1.3, Paragraph B. The location of the dryer shall be subject to the following requirements:
   a. Both the feed and discharge housings shall be located in enclosed rooms (enclosed room to be provided by FERMCO; see Article 2.2, Paragraph H).
   b. The length of the rotating cylinder not covered by the furnace shall be determined by the SELLER according to the following requirements:
      1) At the feed end, accommodate one support station and the drive mechanism.
      2) At the discharge end, accommodate one support station.
   c. At the discharge end, the elevation shall be set to provide a minimum 5-foot clearance between the floor and the discharge point of the discharge head. The elevation at the feed end shall be determined by the required slope.

Article 2.2, D (Continued)

d. The entire assembly shall be supported on concrete pillars (provided by FERMCO) as required and specified by the SELLER.

E. Control and Instrumentation Requirements:

1. Specific requirements:

a. The instrumentation and control philosophy of the operation of the indirect dryer system shall be determined and supplied by the SELLER. The SELLER shall also specify and furnish the instrumentation, sensors, and controls for the equipment. The indirect dryer will be monitored and controlled remotely from a control room provided by FERMCO.

Each furnace zone shall be set up to have its own temperature control, independent of the other zones. Each set of burners per zone shall be automatically or remotely controllable as a set for rough control. In addition, each burner shall then be manually adjustable by the operator for fine-tune control as required. Temperature control for each set of burners shall be measured and averaged out to determine shell temperature at each burner. This average will be signalled to the controller and compared to a predetermined, set temperature band. In case any shell temperature measurement of the calculated average is out of this range, an alarm will sound for operator action.

The dryer system shall be furnished with a separate control console (panel) for local monitoring and operation. The panel will be wired to the dryer monitoring and control instruments via an interconnection cabinet/enclosure. The interconnection cabinet/enclosure shall be positioned on the dryer for ease of installation of conductors

from the panel. Wiring connection points shall be clearly identified for point-to-point wiring at the job site.

Interconnection wiring will be supplied and installed by FERMCO. It shall be the responsibility of the SELLER to provide interconnection diagrams to connect the dryer to the panel.

In addition, certain operating parameters will be of interest as inputs to a data acquisition system provided by FERMCO. The SELLER shall make these parameters of interest available for input to the data acquisition system. A listing of parameters of interest will be provided by the SELLER as part of the package submittal after award.

The indirect dryer control system shall perform, but not be limited to, the following functions:

1) Supervise burner ignition: Prior to warm-up, initiation of control logic shall verify that the following limits are satisfied:
   a) Furnace temperatures are within operating limits.
   b) Furnace pressure is within operating limits.
   c) Combustion air supply fan is operating.
   d) Combustion gas exhaust fan is operating.
   e) Process off-gas fan is operating.
   f) Natural gas pressure is adequate.
   g) Dryer is rotating.
2) Once operating, the following limits will shut down the burners:
   a) Furnace temperature is out of limits.

Article 2.2, E (Continued)

b) Furnace pressure is out of limits.
c) Combustion air flow is inadequate.
d) Natural gas flow is inadequate.
e) Dryer is not rotating.
f) Rotary shell temperature exceeds high limit.

A flame safeguard programming control system (Honeywell Model R4140L or approved equal) shall be provided to control each burner lightoff sequence. The supervised burner ignition system shall follow the start-up sequence as outlined by the SELLER in accordance with NFPA standards.

3) Control burners: Burners/zone shall be controlled (capable of 10:1 turndown ratio) to maintain selected shell temperature. Shell temperature shall be set by the operator.

4) Measure, control, and display inside furnace temperatures and the temperature of the outer surface of the rotating cylinder in each zone.

5) Measure, control, and display furnace exit gas temperature for each zone.

6) Measure, control, and display temperature and flow of combustion air.

7) For fuel/air ratio control of all sets of burners/zone and each individual burner within each zone, a pressure-balanced regulator control system is acceptable. The SELLER may quote, as an alternative, a fully metered electronic fuel/air ratio control for each set of burners per zone integrated with a programmable microprocessor.

Article 2.2, E (Continued)

2. General Requirements:
   a. Locally mounted transmitters shall be two-wire, loop powered configuration, with 4 to 20 mAdc output signal. Accuracy ±1.5 percent of full scale.
   b. Remote instruments used to provide operator information shall be equipped with digital readouts, 3-1/2 digits minimum.
   c. Direct reading instruments (i.e., pressure gauges, thermometers, etc.) shall be analog display, 4-1/2-inch dial, black letters on white background, phenolic case and polycarbonate lens. Accuracy ±5 percent of full scale.
   d. Temperature sensors shall be thermocouples selected based on the estimated operating/process temperature to be measured. All thermocouples shall be installed with protecting wells, unless the intended use is the monitoring of surface temperatures.
   e. Materials of construction shall be chosen to provide the optimum resistance to corrosion and wear, while maintaining economic value for the duration of the project.

3. Installation Requirements:
   a. Process sensing instrumentation shall be directly installed on the dryer or the dryer's utility piping whenever conditions permit. Remote installation of field instruments is acceptable to avoid environmental limitations as specified by the instrument manufacturer.
   b. Differential pressure transmitters and switches may, at the option of the installer, be installed remotely from the dryer utilizing instrument stands and racks, as well as stainless steel impulse lines between the process and the transducer/transmitter.
   c. Horizontal runs of instrument impulse lines shall be sloped at 1/4 inch per foot.

Article 2.2, E (Continued)

Installations sensing liquids and condensing gases and vapors shall have impulse lines sloping down to the instrument. All other installations shall have lines sloping up to the instrument.

d. Instruments directly connected to the process by impulse lines shall be installed with process isolation valves to facilitate maintenance and calibration of the instruments without shutdown of the dryer or its support utilities.

e. All instruments and sensors will have affixed a permanent stainless steel tag with the vendor's identification number (loop number) engraved in 1/8-inch-high letters (minimum). The tag may be affixed to the instrument by adhesive, screws or stainless steel wire.

f. Sight ports shall be installed on the sidewall of the indirect dryer system to observe burner operation. The SELLER shall design and recommend the sight port dimensions, type of mounting, heat resistant glass suitable for the operating temperature, type of stainless steel shutter, and type of purging.

4. Operator Controls:

a. Information and data for the operation of the dryer will be displayed on a local control panel, along with manual controls to start and stop the dryer. Controls and displays may be supplied as part of the control software or as discrete components wired to more conventional control/indicating devices.

b. The operator control station will be NEMA 4 rating. This will allow the control station to be located outside in a potentially damp area.

c. All instruments and controls will be positioned such that viewing, operation, calibration, and maintenance functions may be

performed without physically dismantling the instruments and controls.

5. Codes and Standards:
SELLER shall comply with the applicable codes and standards listed in Article 1.2, Paragraph C including, but not limited to, ISA S-5.1.

F. Electrical Requirements:
1. See electrical sections in Divisions 15 and 16.

G. Structural Requirements:
1. The rotary dryer support stations will be supported and anchored on concrete foundations (provided by FERMCO) which are capable of resisting all vertical and unbalanced horizontal loads and forces emanating from the dryer. The SELLER shall be responsible for providing information concerning the location, magnitude, and direction of all equipment forces with verifiable calculations stamped by a professional engineer licensed in the State of Ohio. This information shall be furnished with the general arrangement design drawing submittals.
2. Information shall be provided indicating the expected amount (in inches) and direction of thermal expansion for all specified equipment, including proposed location of expansion joints, expansion devices, support lugs, lateral guides, or spring mounts where needed.
3. Equipment/structural design shall provide for loads as specified below:
   a. Roof, live load: 20 psf.
   b. Platforms and walkways, live load: 60 psf.
   c. Wind load: Velocity pressure shall be calculated using equation 3 of ASCE 7-93, using V = 80 mph basic wind speed and I = 1.07. Design wind pressures and forces shall be in accordance with ASCE 7-93, Table 4.
   d. Seismic load: Use provisions of the Uniform Building Code, using Z = 0.13, c = 2.75, I =

Article 2.2, G (Continued)

1.25, and Rw = reduction factors from Table 16-P. W (total seismic load) shall include all normal operating contents, piping, and attachments.

e. Shop drawings shall state the vertical loads and lateral forces used (wind and seismic) in the design.

4. Materials of construction shall meet the following requirements:
   a. Carbon and Structural Steel: ASTM A36.
   b. Structural Tubing: ASTM A500, Grade B.
   c. Bolts, Nuts, and Washers: ASTM A325.
   d. Anchor Bolts: ASTM A36; Washers: F436; Nuts: A563.
   e. Welding Materials: AWS D1.1; E70XX.
5. Welding requirements are specified in Article 2.4.
6. Finish and painting requirements are specified in Article 3.3.
7. Additional Codes and Standards:
   SELLER shall also comply with the applicable AISC and ANSI codes and standards listed in Article 1.3, Paragraph C.

H. Design Interfaces:

This section identifies the interface, interaction, or interconnection points expected for the indirect rotary dryer system. Additional interfaces required by the SELLER's design must be clearly identified within the SELLER's proposal.

1. Mechanical interfaces:
   Mechanical interfaces required within the indirect dryer system shall be provided in accordance with the requirements of this specification.
   a. Combustion-air supply fan, inlet flange.
   b. Gas supply line header on the burner pipe skid, inlet flange.
   c. Combustion gas exhaust header, discharge flange.
   d. Feed end head, dryer feeder, inlet flange.
   e. Discharge head, product discharge flange.

Article 2.2, H (Continued)

f. Discharge head, process off-gas discharge flange.

g. Feed end head, high-pressure water inlets, quick-connect couplings.

h. Feed end head, sweep air, inlet flange.

2. Structural Interfaces:

The indirect dryer assembly and its supporting base frame shall be supplied by the SELLER. To support this assembly, reinforced concrete foundations and pillars will be supplied by FERMCO. Structural support for platforms, equipment, piping, etc., included in the system shall also be supplied by the SELLER. The SELLER shall supply drawings indicating the dimensions and location of mounting requirements as well as structural loads, vibrational loads, and deflections that will be used by FERMCO to design and specify the support foundation.

a. Indirect rotary dryer system, main support frame with anchor bolts.

b. Burner piping and instrumentation skid, support structure with anchor bolts.

c. Combustion-air supply fan, base frame with anchor bolts.

d. Maintenance platforms, walkways and structures; with anchor bolts.

e. Feed and discharge ends, support structures with anchor bolts.

3. Ventilation:

Feed end head and discharge head of the indirect dryer will be located in enclosed rooms (building) to be provided by FERMCO per space requirements provided by the SELLER. Each end of the rotating cylinder will penetrate into a room. The SELLER shall specify the required dimensions for the openings. The seals for these building openings at both ends will be provided by FERMCO. The shrouds surrounding the mechanical seals of the indirect rotary dryer in the rooms at both ends

Article 2.2, H (Continued)

shall be designed and supplied by the SELLER as specified in Article 2.2, Paragraph D, Subparagraph 1.f. Shrouds will be vented to the plant HVAC system by FERMCO to ensure a minimum vacuum of -0.3 inches W.C. relative to atmosphere.

The indirect rotary dryer shall operate at a minimum vacuum of -0.5 inches W.C. relative to atmosphere at the feed end. The draft will be supplied by the process off-gas system to be supplied by FERMCO. The SELLER shall specify pressure drop across the dryer system.

4. Electrical Interfaces:
Interfaces between FERMCO and SELLER responsibilities are delineated in the electrical sections 15171, 16051, and 16856.

5. Instrumentation and Controls:
All instrumentation sensors mounted on the indirect dryer system are the responsibility of the SELLER.

2.3 MATERIALS OF CONSTRUCTION

All materials shall be new and, unless otherwise specified in this specification, shall be in accordance with the following:

A. Carbon and Structural Steel: ASTM A36.

B. Carbon and Alloy Steel Bars: ASTM A29.

C. Copper Wire: ASTM B3.

D. Precipitation Hardened Steel: ASTM A564, UNS S17400, Type 630.

E. Threaded Fasteners: ASTM A307, Carbon Steel.

F. Controls and Instrumentation: Per Article 2.2, Paragraph E.

Article 2.3 (Continued)

G. Electrical: Per Divisions 15 and 16.

H. Structural: Per Article 2.2, Paragraph G.

I. Piping: Per Sections 15060, 15090, and 15250 in Division 15.

J. Other materials: As recommended and specified by SELLER.

2.4 FABRICATION REQUIREMENTS

A. General:
The indirect dryer system shall be fabricated with materials, welding processes, and refractory fabrication techniques listed herein, and machined and assembled in conformance with approved SELLER drawings.

B. Welding:
Prior to fabrication, welding procedures and welder qualifications shall be submitted to FERMCO for approval. Welding procedures for the dryer rotating cylinder (shell) shall be qualified to conform with the requirements of ASME, Section VIII, Subsection B, Parts UW-26, UW-27 and UW-28.

1. Welder Qualification:
Within the previous 12 months, welders and welding operators shall be qualified to the actual procedures used in fabrication. For carbon steel, welders shall be qualified per AWS D1.1.

2. Fabrication:
The edges and surfaces of the parts to be welded may be cut to shape and size by mechanical means such as machining, shearing, or grinding, or by oxygen or arc cutting. After oxygen or arc cutting, all slag and molten material shall be removed by mechanically grinding the edge back a minimum of 1/16 inch of parent material before welding. All groove welds shall have complete

Article 2.4 (Continued)

penetration and all welds shall have complete fusion with the base metal.

3. Equipment and Tools:
All tools and equipment used on carbon steel shall be free of contamination and foreign matter that would be detrimental to fabrication. Wire brush material shall be compatible with the base metal. Grinding wheels shall be resin bonded.

4. Filler Metal:
Filler metals for structural steel shall conform to AWS D1.1, Table 4.1.1, E70 Series. Filler metals for alloy steel shall be specified in accordance with the steel alloy manufacturer's instructions.

Controlled storage and handling of electrodes, fluxes, and other welding materials shall be maintained. Coated electrodes that have been open or unheated in excess of 8 hours shall be used only if they are oven heated in accordance with electrode manufacturer's recommendations. The heat and time shall be maintained and recorded by a recording instrument.

C. Refractories:
The refractories shall be installed at the site. The SELLER may utilize a subcontractor for refractory installation, but must retain responsibility. The SELLER shall provide a refractory design and installation plan for FERMCO review and approval. The SELLER may propose the option of using pre-installed, "soft" refractories.

PART 3 EXECUTION

3.1 TESTING AND INSPECTION

A. General:
The SELLER's quality control department shall be responsible for ensuring that the equipment components and accessories are shop inspected during fabrication and sub-assemblies functionally tested prior to shipment to prove compliance with the requirements of this specification. Inspection and test reports shall be submitted to FERMCO.

B. Integrated Plan:
The SELLER shall submit and maintain a detailed plan with schedule for manufacturing, inspection, and testing. The plan shall be submitted to FERMCO for approval prior to fabrication. FERMCO reserves the right to designate "source inspection hold points" which shall be incorporated into the plan at no cost. The hold points shall define the specific operations in the fabrication or inspection sequence that are to be witnessed by FERMCO or their authorized representative.

C. Witnessing and Notification:
FERMCO reserves the right to witness the shop inspection and tests and, therefore, shall have access to the SELLER's facilities during fabrication, inspection, and testing of equipment or components. The SELLER shall notify FERMCO at least 7 calendar days prior to dates on which inspection or tests at the SELLER's plant, or at the site during installation, are to be performed to maintain the SELLER's manufacturing or shipping schedule.

D. Proposed Procedures:
The SELLER shall submit proposed inspection and acceptance test procedures to FERMCO for approval.

E. Weld Inspection:
Weld inspection procedures and Non-destructive Examination (NDE) welding inspector qualifications shall be submitted to FERMCO for approval.

Article 3.1 (Continued)

1. Steel and Alloys:
All NDE shall be per AWS D1.1 with acceptance criteria per either Section 8 or Section 10, if applied to tubular products. All welds shall be 100 percent visual and either magnetic particle or liquid penetrant tested. Ten percent of each welder's welds shall be radiographed for the full length. All shell weld intersections shall be radiographed to clearly show at least 2 inches each side of the intersection. Inspection reports shall be traceable to each weld joint.

2. Dryer rotating cylinder (shell):
The SELLER shall ensure that the methods of inspection meet the steel suppliers' special instructions given for welding on components that will be subjected to cyclic temperature conditions. All NDE shall be performed in accordance with the requirements of ASME Section VIII, Subsection B, Part UW, "Inspection and Tests," and referred part of Subsections A and C. All welds shall be 100 percent visual and either magnetic particle (MP) or liquid penetrant (PT) tested according to the requirements of ASME Section VIII, Appendix 6, for MP and Appendix D for PT. Applied procedure must be performed in accordance with the requirements of T-150 of Section V.

3. NDE Welding Inspector Qualifications:
The NDE inspectors shall be qualified to actual NDE procedures used in accordance with AWS QC1.

F. Weld Repair Procedures:
All weld defects shall be repaired in accordance with repair procedures submitted by SELLER and approved by FERMCO prior to use. The welds shall then be rewelded and the repaired welds shall be completely retested in conformance with the approved testing method.

G. Tolerances:
Cylindrical tolerances and metal fits shall be in accordance with ASME B4.1. The mating parts described

with a class of fit shall be machined to the limits specified therein.

3.2 EQUIPMENT IDENTIFICATION

Equipment shall be identified with a 16-gage stainless steel tag measuring not less than 2 inches by 4 inches, stamped with the equipment tag number. Letters and numbers shall be a minimum of 1/4-inch high for readability. The tag shall be prominently displayed and shall be welded to the equipment. The equipment numbers shall be indicated on the equipment list to be developed by the SELLER.

3.3 FINISH AND PAINTING

A. SELLER shall furnish with the bid all information, procedures, and requirements with regard to painting and special coatings of the equipment included in this specification. Work shall include surface preparation, primer, and special coat applied in the shop, and field touch-up of shop-applied primer. The SELLER shall specify a minimum dry film thickness per coat according to applicable standards. The SELLER shall also specify different colors for each top coat.

B. Before commencing work, SELLER shall select the proper coating for the anticipated surface temperatures and shall submit to FERMCO for approval a complete list of special coating materials to be used. SELLER shall also submit printed manufacturer's data and recommendations of the special coatings relating to the requirements for surface preparation, thinning, mixing, handling application, and storage of material.

C. Unless otherwise specified by the SELLER, the following surfaces shall be excluded from receiving special coatings:
   1. Stainless steel.
   2. Glass.

Article 3.3 (Continued)

3. Exposed carbon steel and alloys subject to wear, flexure, or close fits (e.g., wheel treads, wheel track, cams, bearings, bearing shafts and housings, retaining rings and grooves, cylinder rods, chains, sprockets, pins, gears, pulley grooves, screw threads, springs, etc.)

3.4 PRODUCT DELIVERY AND ACCEPTANCE

A. Packaging:

1. Preparation for Packaging:
All materials shall be cleaned to remove all chips, slag, weld spatter, and all visible oil and grease prior to shipment. After completion of equipment preparation and inspection at the SELLER's site, the SELLER shall ensure secure packaging to prevent shifting and damage during transport.

2. Packaging:
Boxes, crates, and packages containing the equipment shall be clearly labeled with the name of the equipment, tag number, weight, pick-up points, and any other information required to properly identify and safely handle the items during shipping and storage. The components shall be packaged and protected to prevent corrosion, entrance of foreign matter, damage, and loss during shipment. All openings (including the rotary shell) shall be covered, capped, or plugged to prevent ingress of foreign material during shipment and storage. Exposed screw threads shall be protected with plastic caps or plugs. Vapor phase inhibitors (VPI paper) shall be used in boxes or crates. The vapor phase inhibitors shall not be used internal to the equipment. All shipments shall be accompanied with an itemized packing list attached to each shipping container.

B. SELLER's Instructions:
The SELLER shall submit to FERMCO for approval procedures for cleaning, handling, inspecting,

repackaging, and storing the components at FERMCO's site before installation. Packages may be stored temporarily indoors or outdoors at -30 degrees F to 120 degrees F and at any degree of relative humidity.

C. Receiving Inspection:
FERMCO will receive and inspect packages containing the indirect dryer system components to verify the contents and to check for possible damage during shipment.

D. Handling and Storage:
FERMCO will be responsible for safe handling and storage of the indirect dryer components (assemblies) in accordance with the supplier's instructions. Multiples shall be stored together in a group lot.

3.5 ERECTION AND INSTALLATION

The indirect dryer system, with the exception of the refractories, shall be installed by FERMCO in the plant area designated for the dryer system (see the General Arrangement Drawing in Appendix 4). The overall site plan will be prepared to meet the SELLER's design requirements. All the foundations and building footings for the facility will be in place at the time of the indirect dryer installation.

A. The indirect dryer system installation shall be in accordance with the following paragraphs:

1. All components of the indirect dryer system shall be assembled under the responsibility of the SELLER at the site in accordance with the schedule and the performance plan included with the terms and conditions.
2. FERMCO shall be responsible for all transport, cranes, and equipment for installation and erection of the dryer system.
3. FERMCO is responsible for coordinating the erection and installation to correspond with other facility construction and to notify the SELLER 30

Article 3.5 (Continued)

days in advance of scheduled indirect dryer installation.

4. FERMCO is responsible for structural concrete supports and coordination with the SELLER for the interfaces before and during erection.
5. The SELLER shall be responsible for the installation of all refractories and proper refractory curing.

3.6 FINAL ACCEPTANCE METHODS

A. Preconditions:

Final acceptance of the installed drying equipment shall be determined by subjecting it to an acceptance test. The acceptance test is to take place after the following preconditions are satisfied:

1. All inspections and mechanical/functional tests shall have been completed per specified requirements (Article 3.1).
2. A system operational readiness check shall have been performed, and it has been determined that the system is ready for start-up. All safety features shall be functional.
3. The dryer surrogate feeds shall be prepared by FERMCO using the formulas in Appendix 5, Table G. Feed for the acceptance test shall be made up of the following weight parameters of the surrogate:

Feed	wt%
Surrogate 1	30
Surrogate 2	30
Surrogate 3	20
Surrogate 4	20

Moisture content in feed and the product as well as the required evaporation rate shall be in accordance with the requirements specified in Table A.

4. Adequate utility supplies (electric, air, fuel) are available.

5. The off-gas handling system shall be ready to maintain the proper pressure (vacuum) in the dryer.
6. The Acceptance Test Plan and Acceptance Test Procedures have been prepared and agreed to by the SELLER and approved by FERMCO.

Table A - Feed and Product Moisture Contents and Evaporation Rates for Acceptance Testing

Test Runs	Feed		Product	Off-Gas	
	Moisture Content (dry basis)	Rate (tons/hr)	Moisture Content	Entrained Solids (lbs/hr)	Evaporated Water (tons/hr)
1	30%	per SELLER	10%	per SELLER	4.2
2	150%	per SELLER	10%	per SELLER	4.2

B. Methods of Acceptance:

Acceptance of the equipment shall be based on its ability to successfully perform the acceptance tests at the specified conditions within the specified ranges and limits. The methods shall include the following:

1. Demonstrate that the equipment is capable of drying the feed from the specified feed moisture content to the specified product moisture content at the specified evaporation rate (see Table A). Demonstrate maximum push-through capacity of wet feed (tons/hr).
2. Demonstrate the capability to adjust the feed rate, residence time, and heat transfer conditions as required for each test run.
3. Demonstrate continuous 3 hours of steady-state operation for each test run. If the steady-state condition is interrupted due to a mechanical or other problem, the test shall be restarted and run at steady-state for a continuous 3 hours after correction of the problem. (Note: Steady-state is achieved when the rate of solids fed to the dryer

Article 3.6 (Continued)

equals the rate of solids leaving the dryer, and targeted product moisture content is achieved.)

4. Demonstrate control of (1) furnace temperatures (each zone if applicable), (2) residence time, (3) feed rate; and demonstrate that the seals meet specification requirements.

5. Demonstrate the mechanical performance of each component of the drying equipment to prove that the components and materials of construction will withstand the conditions at the specified design parameters (e.g., temperatures, pressures, thermal loads, mechanical loads, processing rates). As part of this demonstration, the parameters listed in Table B will be measured. The acceptable limits for those parameters, if applicable, are also listed in Table B.

Table B - Acceptance Limits for Dryer Parameters

Parameter	Limits
Furnace Skin Temperature	<125 °F
Moisture Content of Feed	Table A value ±2.5%
Moisture Content of Product	Table A value ±2.5%
Feed Rate	Table A value ±2.5%
Entrained Solids in Process Off-Gas	Table A value ±2.5%

END OF SECTION

APPENDIX 1

REQUIREMENTS/INSTRUCTIONS FOR FEMP SUPPLIERS

Fernald Environmental Restoration Management Corporation

STANDARD REQUIREMENTS FOR FEMP SUPPLIERS

SECTION I

Project/Item Name: OU-1 INDIRECT DRYER SPECIFICATION

P.O. Subcontract No.

Requisition No. _____ CWA _____

Drawing(s) No. _____

Specification(s) _____

Remarks _____ Originated By _____

Standard Requirement Number Q-1

SUPPLIER'S QUALITY PROGRAM REQUIREMENTS

- ☐ 1) Organization
- ☐ 2) Q Program
- ☒ 3) Design Control
- ☐ 4) Procurement Document Control
- ☒ 5) Instructions, Procedure & Drawings
- ☒ 6) Documentation Control
- ☐ 7) Control of Purchase Items
- ☒ 8) Identification & Control
- ☐ 9) Control of Processes
- ☒ 10) Inspection
- ☒ 11) Test Control
- ☒ 12) Control of Test Equipment
- ☒ 13) Handling, Storage & Shipping
- ☒ 14) Inspection, Test & Operating Status
- ☒ 15) Control of Nonconforming Items
- ☒ 16) Corrective Action
- ☒ 17) Q Records
- ☐ 18) Audits

Supplier's Quality Program must be approved before contract can be awarded and shall as a minimum address the elements checked above.

SECTION II

Q-2	STANDARD REQUIREMENTS LIST	CHECK (-) IF REQ'D.	WHEN REQ'D. (1)	NO. OF COPIES REQ'D. (2)	DRAWINGS SPECIFICATIONS REFERENCE	REQUIRED FOR (3)
	Special Processing Procedures & Personnel Certifications					
A	Cleaning Procedure	x	BU	2		A-QE
B	Heat Treat Procedure	x	BU	2		A-QE
C	Helium/Halogen Leak Procedure		BU			A-QE
D	Hydrostatic Test Procedure	x	BU	2		A-QE
E	Pneumatic Test Procedure		BU			A-QE
F	Liquid Penetrant Test Procedure	x	BFR	2		A-QE
G	Liquid Penetrant Personnel Certification	x	BFR	2		A-QE
H	Magnetic Particle Test Procedure	x	BFR	2		A-QE
I	Magnetic Particle Personnel Certification	x	BFR	2		A-QE
J	Radiographic Procedure	x	BFR	2		A-QE
K	Radiographic Personnel Certification	x	BFR	2		A-QE
L	Ultrasonic Test Procedure	x	BFR	2		A-QE
M	Ultrasonic Test Personnel Certification	x	BFR	2		A-QE
N	Visual Examination Procedure	x	BFR	2		A-QE
O	Weld Procedure & Procedure Qualification	x	BU	2		A-QE
P	Welder Performance Personnel Certification	x	BU	2		A-QE
Q	Insulation Resistance Test Procedure	x	BU	2		A-QE
R	Continuity/Resistance Test Procedure	x	BU	2		A-QE
S	Free Iron Test Procedure		BU			A-QE

LEGEND

(1) BC = Before Contract Can Be Awarded; BFR = Before Fabrication Release; BU = Before Use; PS = Prior To Shipment; WS = With Shipment

(2) One Copy Must Be Suitable For Reproduction By Electrostatic Means (e.g. Xerox)

(3) A-QE = Approval By Quality Engineering; A-I = Acceptance By Inspection; INF = For Information & Comment; A-PE = Approval By Project Engineer

STANDARD REQUIREMENTS FOR FEMP SUPPLIERS (Cont'd)

Standard Requirement Number	STANDARD REQUIREMENTS LIST	CHECK (✓) IF REQ'D	WHEN REQ'D. (1)	NO. OF COPIES REQ'D. (2)	DRAWINGS SPECIFICATIONS REFERENCE	REQUIRED FOR (3)
Q-3	Integrated Manufacturing Inspection/Test Plan	x	BFR	2		A-QE
Q-4	Traceability Procedure		BC			A-QE
Q-5	Special Pkg./Ship./Rig. Requirements		BU			A-QE
Q-6	Source Inspection/Test (By FERMCO)	x	PS	N/A		
Q-7	Supplier's Disposition Request (SDR)	x	PS	2		A-QE
Q-8	Assembly & Parts List Traceability		PS			AI/INF
Q-9	Design Controlled Products (Catalog Data)		WS			INF
Q-10	Inspection/Test Data	x	WS	2		A-QE
Q-11	Radiography Quality Requirements	x		2		A-I
Q-12	Chemical/Physical Test Reports					
A	Raw Material - Mill Chemical Reports	x	BU			A-I, A-QE
B	Raw Material - Mill Physical Reports	x	BU			A-I, A-QE
Q-13	Weld Joint Test Specimens		WS			A-QE
Q-14	Identification of Shelf-Life Materials		PS			INF
Q-15	Identification of Shelf-Life Materials Installed in an Assembly		PS			INF
Q-16	Serialization		PS			INF
Q-17	Supplier Quality Assurance Release	x	WS	2		A-I
Q-18	Special Processing Certifications	x	PS	2		A-I
Q-19	FERMCO-ICPP Supplied Items - Certification		PS			A-I
Q-20	Detailed Inspection/Test Procedure	x	BU	2		A-QE
Q-21	Certification of Materials to ASME Code		PS			INF
Q-22	Calibration Procedures		PS			A-QE
Q-23	Supplier Certification	x	PS	2		A-QE
Q-24	Other					

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QUALITY ENGINEER

DATE

FS-F-2872 (REV 4/1/93)

STANDARD REQUIREMENTS FOR FEMP SUPPLIERS (Cont'd)

Standard Requirement Number	STANDARD REQUIREMENTS LIST	CHECK (✓) IF REQ'D.	WHEN REQ'D. (1)	NO. OF COPIES REQ'D. (2)	DRAWINGS SPECIFICATIONS REFERENCE	REQUIRED FOR (3)
E-1	Engineering Drawings					
A	Schematics		BC	1		
B	Block Diagram Conceptual PFDs		BC	1		
C	Piping Plan		BFR	4		
D	Piping Elevation		BFR	4		
E	Foundation Plan		BFR	4		
F	Elevation Drawing		BFR	4		
G	General Arrangement Drawing/Conceptual		BFR/BC	4		
H	Structural Detail Drawings		BFR	4		
I	Assembly Drawing		BFR	4		
J	Interface Drawings		BFR	4		
K	Flow Diagrams (P & I.D.)		BFR	4		
L	Panel Cutout Drawings		BFR	4		
M	Weld Map		BFR	4		
N	Original As Built Tracings (Sepia)		WS	2		
O	Weight of Unit		BC	1		
P	Descriptive Data		BC	1		
Q	Connection Drawing		BFR	4		
E-2	Curves & Calculations					
A	Characteristic Curves		PS	4		A-PE
B	Performance Curves		PS	4		A-PE
C	Test Result Curves		PS	4		A-PE
D	Calibration Curves		PS	4		A-PE
E	Operating Curves		PS	4		A-PE
F	Correction Curves		PS	4		A-PE
G	Design Analysis					
H	Single Failure Analysis					
I	Failure Mode Analysis		BFR	4		A-PE
J	Fault Tree Analysis					

STANDARD REQUIREMENTS FOR FEMP SUPPLIERS (Cont'd)

Standard Requirements Number	STANDARD REQUIREMENTS LIST	CHECK (-) IF REQ'D	WHEN REQ'D. (1)	NO. OF COPIES REQ'D. (2)	DRAWINGS SPECIFICATIONS REFERENCE	REQUIRED FOR (3)
E-3	Parts Lists & Manuals					
A	Special Tool List	x	PS			INF
B	Spare Parts List	x	QS			INF
C	Installation Manual	x	PS			A-PE
D	Maintenance Manual	x	PS			A-PE
E	Operating Manual	x	PS			A-PE
E-4	Other					
	Specifications (Confirming)	x	BFR	4	-	A-PE

ENGINEERING APPROVAL

DATE

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FS-6-2872 REV 4-1 931

Fernald Environmental Restoration Corporation

EXPLANATION OF STANDARD REQUIREMENTS FOR FEMP SUPPLIERS

STANDARD FERMCO QUALITY REQUIREMENTS

The item numbers herein correspond to the numbers on Form FS-F-2672. The narrative under each number provides amplification of the standard quality requirements set forth in this form.

Requirement No. — Quality Requirements

Q-1 SUPPLIER'S QUALITY PROGRAM

The supplier must document and maintain a quality program which addresses the elements identified. The supplier's program will be reviewed against ANSI/ASME NQA-1-1983 "Quality Assurance Program Requirements for Nuclear Facilities." When required, the supplier's quality system procedures, operating instructions and subsequent changes thereto must be made available to the buyer.

Q-2 SPECIAL PROCESSING PROCEDURES AND PERSONNEL CERTIFICATIONS

Special processing procedures and personnel certifications, as required by Form FS-F-2672 must be submitted to the buyer for approval. Special processing procedures and personnel certifications of supplier suppliers must also receive prior approval by the buyer.

NOTE: Special processes are defined as follows:

a. Those such as welding, heat treating, plating, etc., which are controlled by a quality standard, or other governing specification, and for which the results cannot be readily determined without either disfiguration of the product, or utilization of nondestructive examination or special inspection/tests or,

b. Those nondestructive examinations or special inspections/tests which are conducted in accordance with requirements of applicable quality standards or other governing specifications, and which are used to detect product discrepancies without destroying the usefulness of the product. This shall include all nonoperating electrical tests, when applicable.

Q-3 INTEGRATED MANUFACTURING/INSPECTION/TEST PLAN

The supplier must prepare, maintain, and use an integrated plan which itemizes the manufacturing, inspection and/or test steps associated with initial material preparation through and including end item delivery. The plan must be sumitted to FERMCO. As applicable, FERMCO may designate "source inspection hold points" which will be incorporated in the inspection/test plan at no additional cost to FERMCO.

Q-4 TRACEABILITY PROCEDURE

All items purchased under this procurement package (except as specifically otherwise noted in the contract must be traceable to the raw material heat/melt/lot from which they were fabricated. A description of the method by which the supplier will achieve and maintain traceability must be submitted to FERMCO. This description must include the identification of all documents/forms used for traceability and a description of how they relate to one another. The submittal of an example would be helpful.

Q-5 SPECIAL PACKAGING, SHIPPING, AND RIGGING REQUIREMENTS

The supplier must prepare and submit a packaging, shipping, and rigging procedure. As a minimum, this procedure must contain the following:

a. Measures taken to prevent damage in transit;

b. A detailed description of the design of the container;

c. Overall dimensions of container and approximate weight;

d. Recommended method for off-loading (e.g., fork lift);

e. Special off-loading devices (e.g., special slings);

f. Special instructions to assure proper packaging for storage at buyer's facility.

g. Special instructions for marking, if applicable.

Q-6 SOURCE INSPECTION/TEST (FERMCO)

Items covered by this procurement must be source inspected/tested FERMCO. The characteristics to be inspected/tested may be shown in documentation of Number Q-3 above. Evidence of source inspection/ shall be shown on the supplier's processing records. The supplier notify FERMCO at least five working days in advance of the time product will be ready for source inspection/test. Source inspection/ does not constitute FERMCO acceptance of the end item. "Source" to the supplier's plant, or any supplier supplier's plant, or wherever inspection is necessary.

Q-7 SUPPLIER'S DISPOSITION REQUEST (SDR)

Request for consideration by FERMCO of any departures from drawin specifications, or other procurement package requirements must recorded on FERMCO's Supplier Disposition Request (SDR) From FS 2642. Do not ship until disposition is made by FERMCO.

Q-8 ASSEMBLY AND PARTS LISTS — TRACEABILITY

The supplier must furnish for each assembly or other end item reproducible copy of the assembly parts list identifying each major component and subassembly by part number, drawing change letter/num and serial or lot control number as applicable. When specif traceability (no. Q-4) and shelf life date (No. Q-14 and/or No. Q-15) s also be tabulated.

Q-9 SUPPLIER DESIGN CONTROLLED PRODUCTS (CATALOG DATA)

Reproducible copies of applicable specifications, drawings, and descriptive catalog sheets must be submitted to FERMCO with the in shipment under this procurement package. The supplier must not cha his design in any way without changing his part number, un authorized by FERMCO Buyer or Subcontract Administrator.

Q-10 INSPECTION/TEST DATA

All actual inspection/tests are to be submitted by the supplier to FERM on any suitable form. The inspection/test required may be dimensio inspection data, functional test data, and/or nondestructive test data each case, the data must be correlatable to the material/items be supplied. The data must include the following information, as applica

a. Part number;

b. Drawing number/specification number;

c. Serial numbers;

d. Lot identification number;

e. Heat/melt number;

f. Subcontract/purchase order number;

g. Each characteristic inspected/tested and the inspection/test seque

h. Each characteristic requirement, including drawing or specifica paragraph reference;

i. Inspection/test results (attributes or variables data, as specifie Form FS-F-

j. Inspection/test equipment used;

k. Inspection/test set-up employed;

l. Inspection/test environment;

m. Inspector's/tester's/interpreter's name/number;

n. Supervisor's signature.

Q-11 RADIOGRAPHY QUALITY REQUIREMENTS

Required radiographic examinations must be performed using the "double film" technique. Both films must be of the same speed and exposed in the same film holder. Each film must meet the quality requirements of the applicable specification, code, or standard. A system of identification must provide traceability of each radiograph to the specific item and to a positive location on the item to which the radiograph pertains. Radiographs of weld repairs must be sequentially identifiable for each repair. Indications revealed by radiography which exceed 50% of the allowable must be recorded on a radiographic interpretation report. Radiographic film including repair exposures and interpretation reports must be submitted to **FERMCO** and will become the property of **FERMCO**.

Q-12 CHEMICAL/PHYSICAL TEST REPORTS

The supplier must furnish:

a. Copies of chemical reports for each heat of the raw material obtained from the original mill source of the material (Ladle analysis).

b. Copies of physical reports for each heat of the raw material obtained from the original mill source of the raw material.

c. Copies of chemical reports applicable to the end item and prepared from chemical analyses conducted by direct supplier or by an independent laboratory after the end item has been appropriately processed.

d. Copies of physical test reports applicable to the end item and prepared from tests conducted by **FERMCO**'s direct supplier or by an independent test agency after the end item has been appropriately processed.

Reports must be clearly identified with, and traceable to, the raw material and/or end item(s) submitted. They must also contain the purchase order number, the applicable specification, and the heat or lot number they represent.

Q-13 WELD JOINT TEST SPECIMENS

For each weld configuration, the supplier must prepare and furnish two typical weld joint specimens in addition to the weld qualification specimens suitable for metallurgical and physical testing, using the same material and procedures as will be used for the finished item.

Q-14 IDENTIFICATION OF SHELF-LIFE MATERIALS

The supplier must identify each item, package, or container of limited shelf-life material with its cure or manufacture date, shelf-life expiration data, storage temperature and humidity, and special handling conditions, in addition to the usual identification requirements of name, part or code number, specification number, type, size, quantity, etc. This identification, including special handling conditions, must be recorded on certifications and shipment documents for the material.

Q-15 IDENTIFICATION OF SHELF-LIFE MATERIALS INSTALLED IN AN ASSEMBLY

a. The supplier must furnish cure date, assembly date, part name and number, compound number and manufacturer identification (if different from part number) for parts (synthetic or natural) installed in assemblies delivered under this procurement package. This information must be identifiable with the assembly, and when applicable, with parts within the assembly to which it applies.

Q-16 SERIALIZATION

The supplier must serialize parts, components, subassemblies, and assemblies, as required by drawings, specifications, and/or procurement package. The serial numbers must be as given elsewhere in the contract. When two or more serialized parts are joined in an assembly, a list of each assembly serial number with part numbers, change letters, and component serial numbers must be submitted.

Q-17 SUPPLIER QUALITY RELEASE - FERMCO

The supplier must withhold shipment of items covered by this contract until the "Supplier Quality Release" (Form FS-F-2643) is approved by the cognizant **FERMCO** Quality Representative or his designee. A copy of the Release must be submitted to **FERMCO**.

NOTE: This release is to confirm completion of so[illegible] inspection/test and does not indicate final acceptanc[illegible] authority to ship material.

Q-18 SPECIAL PROCESSING CERTIFICATIONS

For each item check-marked in Requirement No. Q-2 of Form FS-F-2672 the supplier must submit a written certification stating: the specification title and number used to perform the process; the applicable specification revision letters or numbers, the name of the agency which performed the processing; the date; and the signature of a responsible representative of the supplier. When parts are serialized, serial numbers must also appear on the certification.

Q-19 FERMCO SUPPLIED ITEMS — CERTIFICATION

The supplier must submit a certification stating that the items furnished were produced using materials/items furnished by **FERMCO**.

Q-20 DETAILED INSPECTION/TEST PROCEDURE

The supplier must prepare, maintain, and use an inspection/test procedure. The procedure must include the following information, as applicable:

a. Part number;

b. Drawing and/or specification number;

c. Subcontract or purchase order number;

d. Each characteristic to be inspected/tested and the inspection/test sequence;

e. The corresponding requirement for each characteristic, including drawing and/or specification paragraph references;

f. The data to be recorded for each characteristic and the form of this data — i.e., attributes or variables;

g. Inspection/test equipment to be used;

h. Inspection/test setup to be sued;

i. Inspection/test environment;

j. Special qualifications certifications required of inspection/test personnel.

Q-21 CERTIFICATION OF MATERIALS TO ASME CODE

The supplier must submit a certification stating that materials are in accordance with ASME Boiler and Pressure Vessel Code Section II "Materials Specifications". The certification must identify each item fabricated and reference the materials used to the ASME Section material designations. Each certification must contain the signature of a responsible representative of the supplier.

Q-22 CALIBRATION PROCEDURE

The supplier shall submit his calibration procedure, that demonstrates traceability to National Bureau on Standards. It shall be applicable to all inspection, test, and measuring equipment used by the supplier in conjunction with work performed under this contract.

Q-23 SUPPLIER CERTIFICATION

Supplier shall submit written certification of his compliance with specifications and contractual requirements. The certification must reference the following (a. through f):

a. The certificate shall identify the purchased material or equipment, purchase order or subcontract number.

b. The certificate shall identify the purchased material or equipment specification, specification changes, waivers or deviations applicable to the subject material or equipment.

c. The certificate shall identify any procurement requirements that have not been met, together with an explanation and the means for resolving the nonconformance.

d. The certificate shall be attested to by a person who is responsible for the quality assurance function.

e. The certificate system, including the procedure to be followed in filling out a Supplier Certificate shall be described in the supplier's quality assurance program.

f. The supplier's quality assurance program shall provide means to verify the validity of the Supplier Certificate, such as performance of audits of the supplier or independent inspection or test of the item.

Q-24 OTHER

STANDARD ENGINEERING REQUIREMENTS

Requirement No.	Engineering Requirements

E-1 ENGINEERING DRAWINGS

Engineering drawings, diagrams, plans and specifications as required by applicable subcontract/purchase order on Form FS-F-2672, "Standard Requirements for FEMP Suppliers" must be submitted to the purchaser in accordance with schedule and for purpose indicated in applicable form. Documents required must be identified in a manner that provides positive correlation with materials, items or services specified in this purchase contract.

E-2 CURVES AND CALCULATIONS

The supplier must provide to the purchaser:

a. Graphs indicating characteristic curves, performance/test curves, operating curves or corrective curves, in accordance with schedule and for the purpose shown on applicable Form FS-F-2672, "Standard Requirements for FEMP Suppliers".

b. Engineering calculations and analyses (i.e., design analysis, stress analysis, single failure analysis and failure mode analysis) in accordance with schedule and for the purpose shown on the applicable Form.

Documents described in a. and b. above, must be identified to provide positive correlation with applicable materials, items or services specified in this contract.

E-3 PARTS LISTS AND MANUALS

The supplier must provide to the purchaser:

a. Special tool list or recommended spare parts list as indicated on applicable Form FS-F-2672, "Standard Requirements for FEMP Suppliers".

b. Manuals related to installation, maintenance or operation of items/systems specified in this purchase contract.

E-4 OTHER

APPENDIX 2

SUBMITTAL REQUIREMENTS

FERNALD ENVIRONMENTAL MANAGEMENT PROJECT

FERNALD, OHIO

Specification No. E-212-A

SELLER DRAWING AND DATA SUBMITTAL REQUIREMENTS

Prepared by:

FERMCO

Prepared By Steve A. Hall Date 6/10/93

Project Engineer _____ Date _____

Engineering Manager _____ Date _____

Project Director _____ Date _____

Rev. No.	By	Revisions	Date	Checked	Approved
A	SAH	Issued for Review	6/8/93		
B	SAH	Issued for Approval	6/11/93	[illegible]	W. Hoppe for R. Emerton

CRU4:ENGR:11JUNE93

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SELLER DRAWING AND DATA SUBMITTAL REQUIREMENTS

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1.0	SUBMITTAL INSTRUCTIONS	2
2.0	DOCUMENT QUALITY REQUIREMENTS	4

FERMCO

SELLER DRAWING AND DATA SUBMITTAL REQUIREMENTS

1.0 SUBMITTAL INSTRUCTIONS

1.1 Drawings, documentation and instruction manuals shall be submitted in accordance with the requirements of this specification, the equipment specification, Seller Drawing and Data Commitment Form, and Purchase Order/Contract requirements.

1.2 Drawing and documentation submittals shall be accompanied by a transmittal letter. The transmittal letter shall show the following:

1.2.1 Project Name

1.2.2 Project Number

1.2.3 Purchase Order or Requisition Number (whichever is applicable).

1.2.4 Equipment Tag Number.

1.2.5 Document identification number, title, revision number, and date.

1.2.6 Seller's description and quantities of items sent.

1.2.7 Seller's "Master List" (see 1.5 below).

1.3 Drawings, technical documentation and instruction manuals shall be directed to:

Mailing Address	Shipping Address
FERMCO	FERMCO
P.O. Box 398704	7400 Willey Road
Cincinnati, Ohio 45239-8704	Fernald, Ohio 45030
Att: CRU1 Document Control	Att: CRU1 Document Control

1.4 The quantity of instruction manuals to be provided shall be as listed in FERMCO's specification and "Seller Drawing and Data Commitment Form" (Form E-212). The manuals shall be in durable covers with project identification on the front cover and spine.

1.5 FERMCO's requirements as shown on the "Seller Drawing and Data Commitment Form" shall be cross referenced by the Seller on a "Master List." This "Master List" shall identify all drawings and

FERMCO

data that the Seller is providing and the FERMCO requirement that it satisfies. All drawings to be submitted shall be listed by drawing number, title, revision identification and date.

1.6 The Seller shall submit to FERMCO all drawings and data on or before the date specified and as mutually agreed upon on the "Seller Drawing and Data Commitment Form." If Seller is unable to meet the required submittal date, Seller must notify FERMCO at least 15 working days (3 weeks) in advance and commit to a new submittal date to the satisfaction of FERMCO.

1.7 Large drawings/data shall be rolled and sent in mailing tubes. Drawing size of 30" x 42" are preferred. The minimum acceptable drawing size is 24" x 36". A copy of the transmittal letter shall be included inside the tube.

Certified for Construction (CFC) and As-Built drawings shall be supplied as dry erasable Mylars (30" x 42") unless otherwise stated in the specification or approved by FERMCO. Drawing reproducibles shall not be folded. In addition, CFC and As-Built drawings shall be on floppy disc in Intergraph CAD format.

1.8 Documents submitted to FERMCO will be reviewed for completeness and compliance with requirements of Section 1.1 above. Drawings, data sheets, manuals and other documents supplied will be returned for corrections if information thereon is incomplete, incorrect or of unacceptable quality.

All documents submitted to FERMCO will be returned to the Seller marked as follows:

Instruction	Definition
A	Proceed
B	Proceed with fabrication. Change drawings/data as noted and resubmit.
C	Do not proceed. Change drawings/data as noted and resubmit.
IO	Information Only

For all documents that receive an "A" or "IO" authorization, a copy of the transmittal will be mailed or FAXed to show the authorization. Copies of the documents will not be attached. Seller shall then stamp the documents "Certified for Construction" and re-send them to FERMCO (see 1.7 above).

All documents returned with "B" or "C" instruction shall be

FERMCO

resubmitted by the Seller with corrections as requested on the document. In the event of disagreement, the Seller shall contact FERMCO immediately to resolve differences. Acceptance of changes shall not relieve Seller of any contractual obligations to FERMCO. Once the documents are resubmitted by the Seller and approved by FERMCO, the Seller shall stamp the documents "Certified For Construction" and re-send them to FERMCO (see 1.7 above).

To accelerate flow of information, major comments on drawings and data submitted may be confirmed by telex in addition to returning marked-up copies to the Seller.

1.9 Unless otherwise specified in writing by FERMCO, all documents returned to Seller with comments must be resubmitted to FERMCO within ten (10) working days after receipt by Seller.

1.10 Seller as-built drawings shall be stamped "Final As-Built Drawing" and submitted to FERMCO (see 1.7 above).

2.0 DOCUMENT QUALITY REQUIREMENTS

All submittals of documentation shall meet the following quality requirements and be suitable for microfilm reproduction.

2.1 Legibility and contrast of the documents shall be such that every line, number, letter and character shall be clearly legible.

2.2 Reproductive quality shall be of such clarity that a third generation copy will meet the legibility requirements of Item 2.1.

2.3 Documentation shall be typed and arranged in a neat progressional manner.

2.4 Documents, when applicable, shall contain a table of contents, list of figures, and tables of applicable, reference or complementary documents.

END OF SPECIFICATION

FERMCO

DATE:

SPECIFICATION NO._____ DATE:_____ REQ NO._____ DATE:_____

EQUIPMENT TAG NUMBER(S)_____ SERVICE_____

SELLER_____ SELLER'S JOB NO._____

INSTRUCTIONS:

1. All drawings/data submitted shall be marked with PURCHASE ORDER (PO) NUMBER or REQUISITION NUMBER (whichever is applicable) and EQUIPMENT TAG NUMBER(S).

2. Identical items may be represented on common drawing with all EQUIPMENT TAG NUMBERS clearly shown.

3. All drawings/data submitted shall be of good quality that will allow production of legible copies and microfilming.

4. FERMCO will specify in Column I the QUANTITY.

5. The SELLER enters in Column IV the PROMISED SUBMITTAL time (in weeks) After Receipt of Order (ARO). SELLER shall state if required items are being included with proposal submittal. FERMCO will assign priorities in Column III to drawings/data (HIGHEST PRIORITY = LOWEST number). SELLER shall return this form to FERMCO with its proposal. The SELLER'S signature is required.

6. The DUE DATE (Column V) will be entered by FERMCO at the time the PO is issued. The DUE DATE shall be based upon the promised submittal time furnished by the SELLER (Column IV). Upon receipt of the PO, the SELLER shall provide FERMCO the drawings and data as specified.

DRAWINGS/DATA REQUIRED BY FERMCO

I	II	III	IV	V
QTY	DESCRIPTION	PRIORITY	SELLER PROMISED SUBMITTAL (WEEKS)	DATE DUE TO FERMCO
2	Visual Examination Procedure	2		
2	Weld Procedure & Procedure Qualification	3		
2	Welder Performance Personnel Certification	3		
2	Integrated Manufacturing Inspection/Test Plan	2		
2	Inspection/Test Data	5		
2	Supplier Quality Assurance Release	5		
2	Detailed Inspection/Test Procedure	3		
2	Supplier Certification	4		
1	Schematics	1		
1	Block Diagram (Outline Arrangement Drawing)	1		
4	Piping Plan	2		
4	Piping Elevation	2		
4	Foundation Plan	2		

CERTIFIED BY:_____ COMPANY:_____ DATE:_____

FERMCO

DATE: REV. 0

SPECIFICATION NO. _____ DATE: _____ REQ NO. _____ DATE: _____

EQUIPMENT TAG NUMBER(S) _____ SERVICE _____

SELLER _____ SELLER'S JOB NO. _____

DRAWINGS/DATA REQUIRED BY FERMCO

I	II	III	IV	V
QTY	DESCRIPTION	PRIORITY	SELLER PROMISED SUBMITTAL (WEEKS)	DATE DUE TO FERMCO
4	Elevation Drawing /outline drawing	2/1		
4	General Arrangement Drawing/outline drawing	2/1		
4	Structural Detail Drawing	2		
4	Assembly Drawing	2		
4	Interface Drawings	2		
4	Flow Diagrams (P&ID)	2		
4	Panel Cutout Drawings	2		
4	Weld Map	2		
2	CFC and As-Built Drawings (Mylar)	5		
1	Weight of Unit	1		
1	Descriptive Data	1		
4	Connection Drawing	2		
4	Characteristic Curves	4		
4	Performance Curves	4		
4	Test Result Curves	4		
4	Calibration Curves	4		
4	Operating Curves	4		
4	Failure Mode Analysis	2		
4	Special Tool List	4		
4	Spare Parts List - Priced	5		
8	Installation Manual	4		
8	Maintenance Manual	4		
8	Operating Manual	4		
4	Specifications (Conforming)	2		

CERTIFIED BY: _____ COMPANY: _____ DATE: _____

APPENDIX 3

DATA SHEETS

REVS	NO.	DATE	BY	CK	APP	DESCRIPTION	REVS	NO.	DATE	BY	CK	APP	DESCRIPTION

DESIGN OPERATING CONDITIONS

Elevation ASL _____ Installation ☐ Indoors ☐ Outdoors Ambient Temp Min _____°F _____ Max _____°F

Application _____

Gas Temp Design ____°F Min _____°F Max _____°F Vol _____cfm Static Pressure _____in. WG(1)

Fan Inlet Density _____ lb/cu ft. Design Outlet Vel _____ fpm (± 10%) Allow Noise Level _____ db(2)

Service ☐ Continuous ☐ Intermittent Environment ☐ Rel Clean ☐ Dusty ☐ Corrosive ☐ Other _____

FAN PHYSICAL DATA

Rotation ☐ CW ☐ CCW Inlet ☐ Single ☐ Double Discharge ☐ Single Width ☐ Double Width

Arrangement _____

Drive ☐ Direct ☐ V-Belt (3)(4)(5) ☐ Other _____ Motor (6) Position _____

CONSTRUCTION AND ACCESSORIES

Fan Housing – ☐ Standard ☐ Other _____

Connection – ☐ Inlet ☐ Flanged ☐ Slip-on
☐ Disch ☐ Flanged ☐ Slip-on
☐ Drain ☐ Flanged ☐ Thd Pipe Cplg

Access Door ☐ Bolted Plate ☐ Quick Release

Wheel(7) Type ☐ Backward Incl ☐ Forward Curved
☐ Other _____

Const ☐ Standard ☐ Other _____

Spark Resistant Reqd ☐ Yes ☐ No
Type ☐ A ☐ B ☐ C

Shaft ☐ Standard ☐ Other _____
Seal Required ☐ Yes ☐ No
Heat Slinger Required ☐ Yes ☐ No

Insulation Clips Required ☐ Yes ☐ No

Screen Reqd – Inlet ☐ Yes ☐ No Outlet ☐ Yes ☐ No

Bearings(8) ☐ Pillow Block Roller ☐ Sleeve ☐ Ball
☐ Split Housings ☐ Solid Housings
☐ Grease Lube ☐ Oil Lube ☐ Other _____

Discharge Damper – Opposed Blade Req ☐ Yes ☐ No
Parallel Blade Req ☐ Yes ☐ No

Vaned Inlet Damper Required ☐ Yes ☐ No

Drive ☐ Direct ☐ Rigid Coupling ☐ Direct Coupling
☐ V-Belt ☐ Fixed ☐ Adjustable(4)

Guard(5) Required ☐ Yes ☐ No

Vibration – Isolators Required ☐ Yes ☐ No
Isolation Base Required ☐ Yes ☐ No

Painting – Mfr Standard ☐ Yes ☐ No
Other _____

Motor and Drive Weather Cover Required ☐ Yes ☐ No

(1) At Design Temperature and Elevation.
(2) Performance ratings shall be based on tests made in accordance with the latest AMCA codes.
(3) V-belt drive shall have a minimum of two belts and shall be rated 2.5 times rated motor horsepower.
(4) Adjustable V-belt drive shall be adjustable 10% above and 10% below design fan rpm.
(5) V-Belt Drive guard shall have a 3-inch diameter tachometer test hole at drive and driven shafts.
(6) Refer to Standard Motor Specifications for motor characteristics.
(7) Wheel and shaft shall be statically and dynamically balanced as a unit.
(8) Bearings shall be self-aligning. Grease fittings shall be of the extended hydraulic type.

✱ TO BE COMPLETED BY VENDOR ✱

Fan Mfr _____ Model _____ Size _____ Class _____

Fan rpm @ Design Conditions _____ Mfr Max _____ Sound ☐ (re: 10^{-12} W) ☐ Pressure (db re: 0.0002 Microbar)

Brake hp @ Design Conditions _____ Min Temp _____ Band 1 ___ 2 ___ 3 ___ 4 ___ 5 ___ 6 ___ 7 ___ 8 ___

@10% Above Design rpm _____ Weights Fan Wheel _____ lb Shaft _____ lb

Motor hp _____ No. Drive Belts _____ hp/Belt ____ Fan Excluding Motor and Drive _____ lb

Design Outlet Velocity _____ fpm Tip Speed _____ fpm Fan Including Motor and Drive _____ lb

WR^2 _____ lb ft² Blade Frequency _____ Hz Housing Material _____ Thickness _____ in

Does the proposed equipment meet all requirements as specified on this Data Sheet? ☐ Yes ☐ No

If not, have all deviations been identified and alternates proposed? ☐ Yes ☐ No

Notes: _____

Tag No.

DATA SHEET PARSONS	CENTRIFUGAL FAN	Sheet of	Job Number
		Document Number	Rev

10/93 ENG125

DATA SHEET
INDIRECT ROTARY DRYER

SELLER to fill in information marked with a "*."

A. Dryer Section Duty Requirements

1. Feed Rates
   a. #1 Feed (Crushed/Shredded Waste, lbs/hr) 34,900
   b. #2 Feed (Filtered Cake, lbs/hr) 18,650
   c. #3 Feed (Slurried Waste, lbs/hr) 15,000

2. Feed/Product Moisture Content (%DB)
   a. #1 Feed 45/10
   b. #2 Feed 100/10
   c. #3 Feed 150/10

3. Water to be Evaporated
   a. #1 Feed (lbs/hr) 8,400
   b. #2 Feed (lbs/hr) 8,400
   c. #3 Feed (lbs/hr) 8,400

4. Feed Composition See Appendix 5, Section 5.2

5. Feed Screen Analysis See Appendix 5, Section 5.3

6. Feed General Nature (Yes/No)
   a. Sticky Yes x No ____
   b. Plastic Yes x No ____
   c. Abrasive Yes x No ____
   d. Corrosive Yes x No ____

7. Feed Temperature Ambient

8. Dried Product Temperature Max. °F 200 - 250

9. Dryer Process Off-Gas
   a. Flow (SCFM) *_____
   b. Temperature (°F) *_____
   c. Gas composition (as estimated by SELLER based on given feed composition in Appendix 5, Sections 5.2 and 5.3)
      1) Inorganic solids (entrained, lbs/hr) *_____
      2) Inorganic gas (% by volume)*
         (a) H_2O _____
         (b) SO_x _____

000362

(c) NO_x _____
(d) HF _____
(e) CO_2 _____
(f) Others _____

3) Organics (volatilized)*

Component	PPM
_____	_____
_____	_____
_____	_____
_____	_____
_____	_____

4) Sweep/air (cocurrent) Yes x No _____
a) Inlet Flow SCFM *_____
Temp °F *_____
b) Outlet Flow SCFM *_____
Temp °F *_____

10. Thermal Conditions
a. Dryer
1) Rated Thermal Capacity (Btu/Hr) *_____
2) Heat Transfer coefficient
Btu/ft^2(heated shell)/hr/°F *_____
3) Water evaporation (max.)
Lbs/ft^2(heated shell)/hr *_____
b. Furnace
1) Furnace rated capacity *_____
2) Heat load, btu/ft^3(furnace)/hr _____
c. System Overall Heat Efficiency % _____

B. Design Data
1. Dryer
a. Shell
1) Length-Inside diameter (ft-in) *_____
2) Length-Heated section (ft-in) *_____
3) Length-Cooled section (ft-in) *_____
4) Number of support stations
5) Length-Cantilevered section
(a) @ feed end (ft-in) *_____
(b) @ discharge end (ft-in) *_____
6) Length-Overall (ft-in) *_____
b. Shell wall thickness:

	(ft-in)	Material of Construction
1) Under girth gear	*_____	*_____
2) Under riding ring	*_____	*_____
3) Height feed spirals	_____	_____

4) Height flow disturbers _____ _____

5) Weight (lbs)

(a) Steel shell only *_____

(b) Complete w/gear, rings *_____

c. Riding rings

1) Straight face riding ring: Material

(a) Ring O.D. (ft-in) _____Tolerance ± (in)*

(b) Ring I.D. (ft-in) _____Tolerance ± (in)*

(c) Face Width (ft-in)_____*

(d) Weight (lbs) _____

2) Beveled face riding ring: Material

(a) Ring O.D. (ft-in) _____Tolerance ± (in)*

(b) Ring I.D. (ft-in) _____Tolerance ± (in)*

(c) Face Width (ft-in)_____*

(d) Weight (lbs) *_____

d. Material of construction

1) Shell *_____

2) Riding Rings *_____

(a) Straight face *_____

(b) Beveled face *_____

e. Drive assembly[1]

1) Gear ratio *_____

2) Mechanical efficiency (%) _____

3) Manufacturer _____

4) HP rating *_____

5) AGMA service factor *_____

6) Center distance (ft-in) *_____

7) Shell (installed) centerline tolerance (in.) _____

	GIRTH GEAR	PINION GEAR
8) Pitch diam. (ft-in)	*_____	*_____
9) Face width (in.)	*_____	*_____
10) Working depth of tooth (in.)	_____	_____
11) Whole depth of tooth (in.)	_____	_____
12) Number of teeth	_____	_____
13) Material of construction	_____	_____
14) Weight (lbs)	*_____	*_____
15) Mounting	_____	_____

[1] Attach description and component data sheet if any other type of drive assembly is proposed by the SELLER.

16) Lubrication: Type* _____
Reservoir capacity (gal.) _____
17) Enclosure: Type* _____ Size (ft-in) _____
Wall thk. (in.) _____ Material* _____
18) Seal: Type* _____ Material* _____
19) Pinion Shaft: Indicate whether **separate** or **integral**
(a) O.D. at pinion gear (in.)* _____
(b) O.D. at bearings (in.) _____
(c) Pillow Blocks: _____
Type/Make _____
Manufacturer _____
Bearings type _____
Lubrication type* _____
Seal type* _____

	Material of Construction	Weight (lbs)
20) Shaft *	_____	_____
21) Pillow blocks*	_____	_____
22) Pinion drive enclosure*	_____	_____

	High Speed Side	Low Speed Side
23) Couplings*	_____	_____

f. Gear reducer:
1) Overall reduction ratio *_____
2) Mechanical efficiency (%) _____
3) Manufacturer _____
4) HP rating *_____
5) AGMA Service Factor *_____

	High Speed Shaft	Low Speed Shaft
6) Diameter (in)	_____	_____
7) RPM	_____	_____
8) No. of shaft connections	_____	_____
9) Lubrication	_____	_____
(a) Gears (oil/grease)	_____	_____
(b) Bearings (oil/grease)	_____	_____
10) Oil reservoir capacity	_____	_____
11) Grease fittings	_____	_____
12) Bearing types	_____	_____
13) Bearing designed life expectancy	_____	_____
14) Housing type and arrangement	_____	_____
15) Materials of construction		
(a) Gears	_____	_____
(b) Shafts	_____	_____
(c) Bushings	_____	_____
(d) Housing	_____	_____

g. Drive Motor: Ref. electric motor data sheet in Attachment 1 of Section 15171*.

h. Pinion drive assembly base frame:

1) Type of construction*_____

2) Size (ft-in) _____

3) Number of anchor bolts (lbs) _____

4) Load per anchor bolt (lbs) _____

5) Weight (lbs) *_____

2. Dryer support stations:

Number _____ Type _____

a. Support stations with carrying rollers only

1) Carrying roller:

(a) Number per sta.*_____

(b) O.D. (in) *_____

(c) Face width (in)*_____

(d) Mounting on the shaft _____

(e) Material of construction*_____

(f) Weight (lbs) *_____

2) Pillow Blocks:

(a) Type and make *_____

(b) Bearings, type & size (ft-in) _____

(c) Lubrication _____

(d) Seal _____

(e) Material of Construction *_____

(f) Weight (lbs) *_____

b. Support Station w/carrying and beveled roller:

1) Carrying roller:

(a) Number of rollers/station*_____

(b) O.D. (in.) *_____

(c) Face width (in.) *_____

(d) Mounting on the shaft _____

(e) Material of Construction *_____

(f) Weight (lbs) *_____

2) Pillow Blocks:

(a) Type and make *_____

(b) Bearings, type & size (ft-in) _____

(c) Lubrication _____

(d) Seal _____

(e) Material of Construction *_____

(f) Weight (lbs) *_____

3) Thrust roller:

(a) Number of rollers/station*_____

(b) O.D. (in) *_____

(c) Bevel face width (in.)*_____
(d) Mounting on the shaft _____
(e) Material *_____
(f) Weight (lbs) *_____

4) Thrust bearings:
(a) Type & Size (ft-in)*_____
Material *_____
(b) Housing: Type _____ Material _____
(c) Tie Rods: Size (in)_____Material _____
(d) Weight of housing & bearing assem.(lbs) *_____

c. Base frames: Station a. Station b.
1) Type of construction *_____ *_____
2) Size (ft-in x ft-in) *_____ *_____
3) Number of anchor bolts_____ _____
4) Load per anchor bolt (lbs)_____ _____
5) Weight (lbs) *_____*_____

d. Main frame:
1) Designed to Support Yes_____ No_____
(a) Support station a. *_____ No_____
(b) Drive assembly *_____ No_____
(c) Furnace *_____ No_____
(d) Support station b. *_____ No_____
2) Pattern of foundations, every (ft-in) _____
3) Overall length (ft-in)*_____
4) Width (ft-in) *_____
5) Static forces _____
6) Dynamic forces _____

3. Dryer feed head:
a. Type of Construction:

*O.D. (Ft-in)	Thick (in.)	*Material	Weight (lbs)

1) Width/Length (ft-in) Cylinder*_____
2) No. traveling wheels*_____
3) Center line wheels (ft-in)*_____

b. Connections Outline Dimensions (ft-in)
1) Feeder (sq. flange) _____
2) Water lines _____
3) Sight port _____
4) Camera port _____
5) Pressure tap _____
6) Sweep air inlets_____

4. Dryer discharge head:
   a. Connections — Outline Dimension (ft-in)
      1) Connection to shell _____
      2) Process off-gas _____
      3) Product outlet _____
      4) Manway _____
      5) Camera port _____
      6) Sight port _____
      7) Thermocouples _____
      8) Grab Sampler _____

5. Dryer seal:
   a. Manufacturer * _____
   b. Type * _____
   c. General Description * _____
   _____
   _____
   d. Material:
      1) Seal * _____
      2) Body * _____
      3) Rub Ring* _____
      4) Springs* _____
   e. No. of Springs_____ Load Per Spring. lbs _____
   f. Start-up Torque Due To Seal Drag, lb-ft _____
   g. Running Torque Due To Seal Drag, lb-ft _____
   h. Seal Design Pressure Differential, in. WC _____
   i. Approx. Air inleakage per seal:
      @ 0.5 in. WC pres. diff., cfm _____
      @ 2.0 in. WC pres. diff., cfm _____
   j. Operating Speed Range, rpm _____
   k. Expected Working Life of Seal Material, mos. _____
   l. Approx. Time req'd to Remove & Replace Seal, man hrs. _____
   m. NOTES: _____
   _____
   _____

C. Furnace
   1. Number of zones * _____
   2. Number of burners/zone * _____
      (see burner data sheet)
   3. Shell material of construction* _____
   4. Dimensions:
      a. Inside diameter (hot face) * _____
      b. Refractory inside diameter * _____
      c. Shell thickness * _____

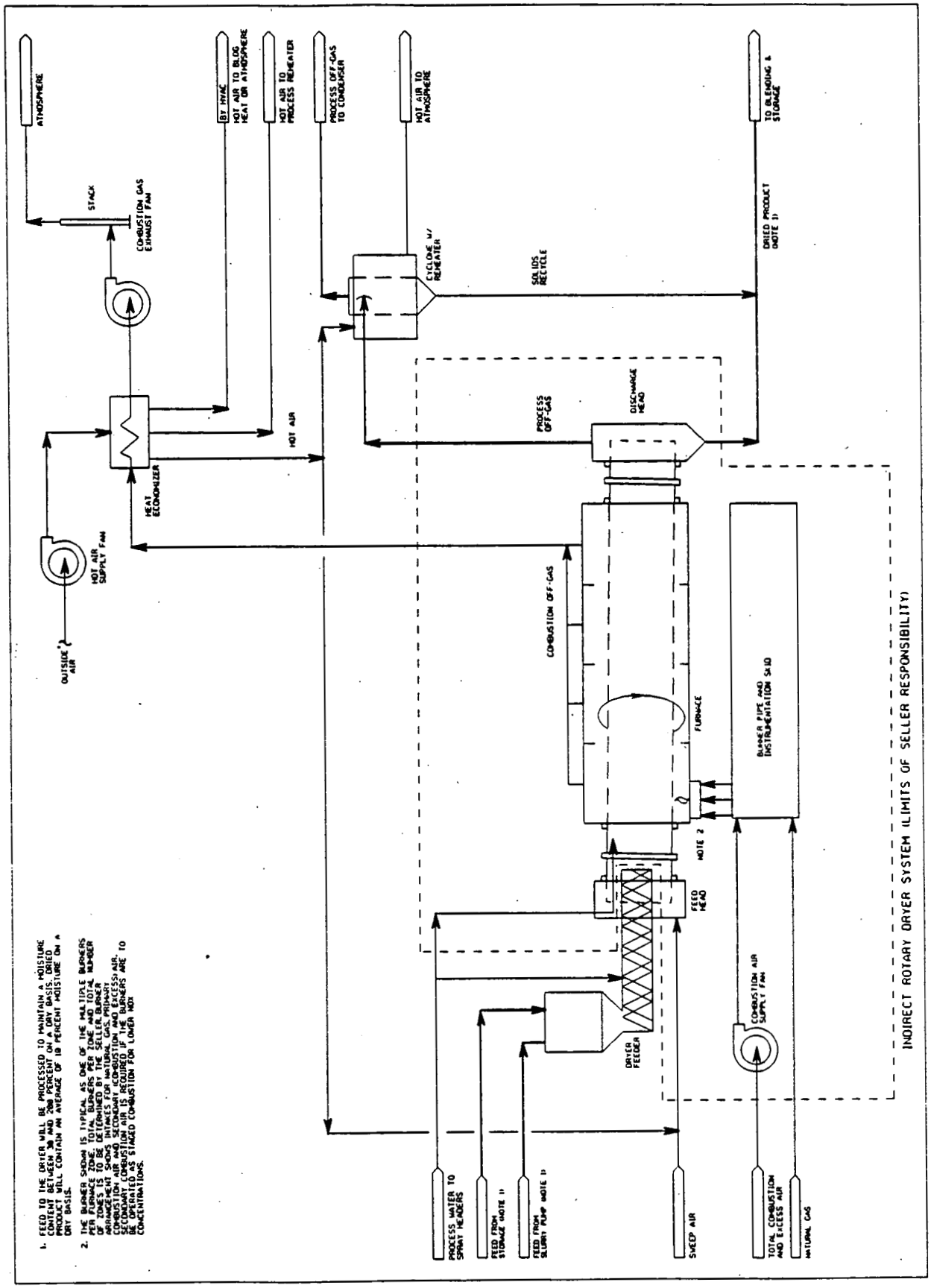
5. Design
   a. Shell split vertically* Yes ____ No ____
   b. Shell split horizontally* Yes ____ No ____
   c. Shell section horizontal length (ft-in) _____
   d. Number of sections *_____
   e. Overall furnace inside length (ft-in) *_____
   f. Overall furnace outside length (ft-in) *_____
   g. Total height (ft-in) _____
   h. Sections are flanged* Yes _____ No ____
   i. Refractories:
      1) Refractory brick
         Type *_____
         Thick (in.) _____
      2) Ceramic fiber
         Type *_____
         Thick (in.) _____
      3) Insulation
         (a) Fiberboard *_____
         (b) Type *_____
         (c) Thick (in.)*_____
   j. Brick/ceramic fiber properties
      1) Chemical composition _____
      2) Bulk density _____
      3) Cold crushing strength _____
      4) Modulus of rupture _____
      5) Thermal expansion _____
      6) Porosity _____
      7) Thermal conductivity _____
      8) Thermal shock membranes _____
      9) Specific heat _____

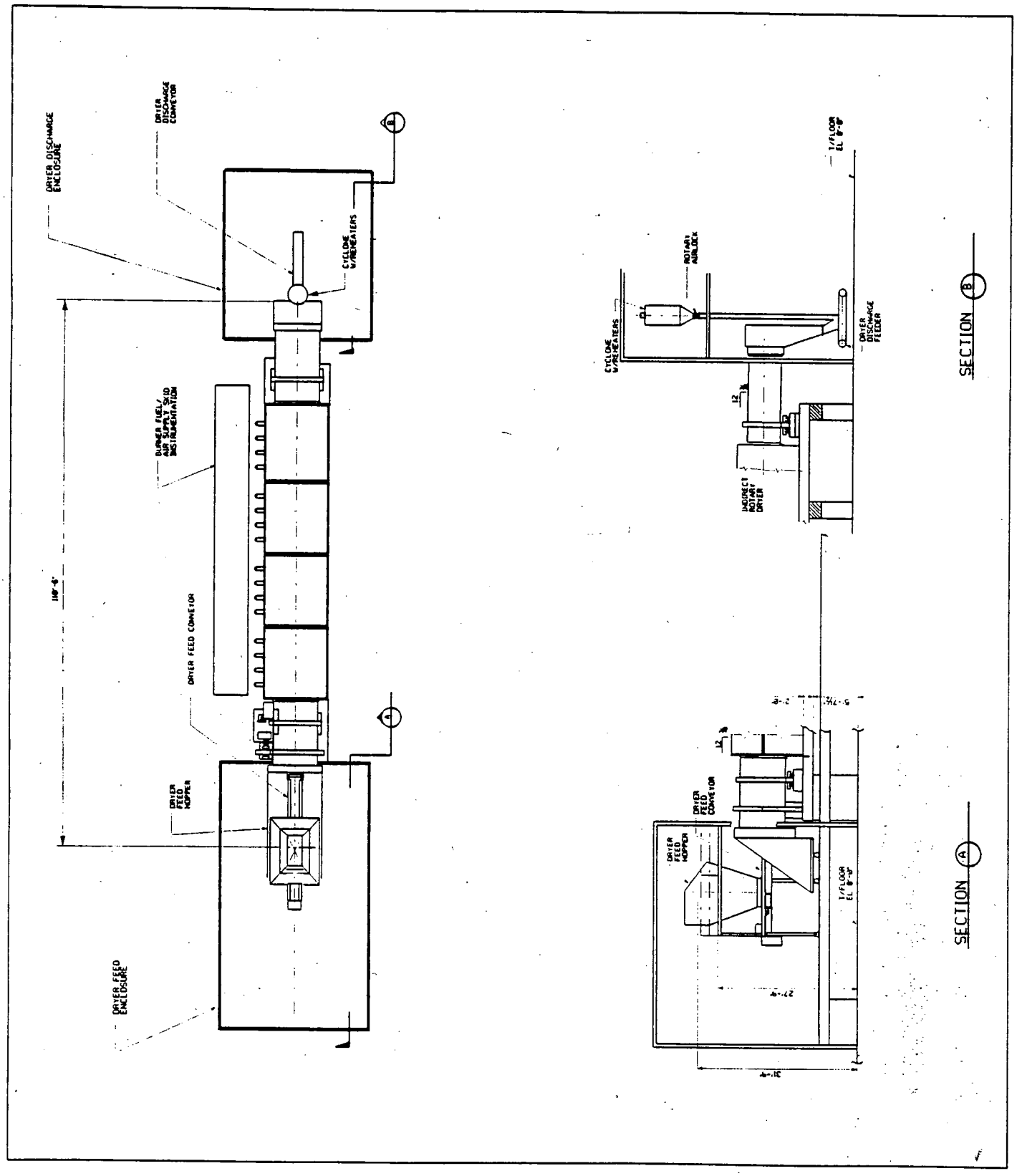
DATA SHEET
BURNERS

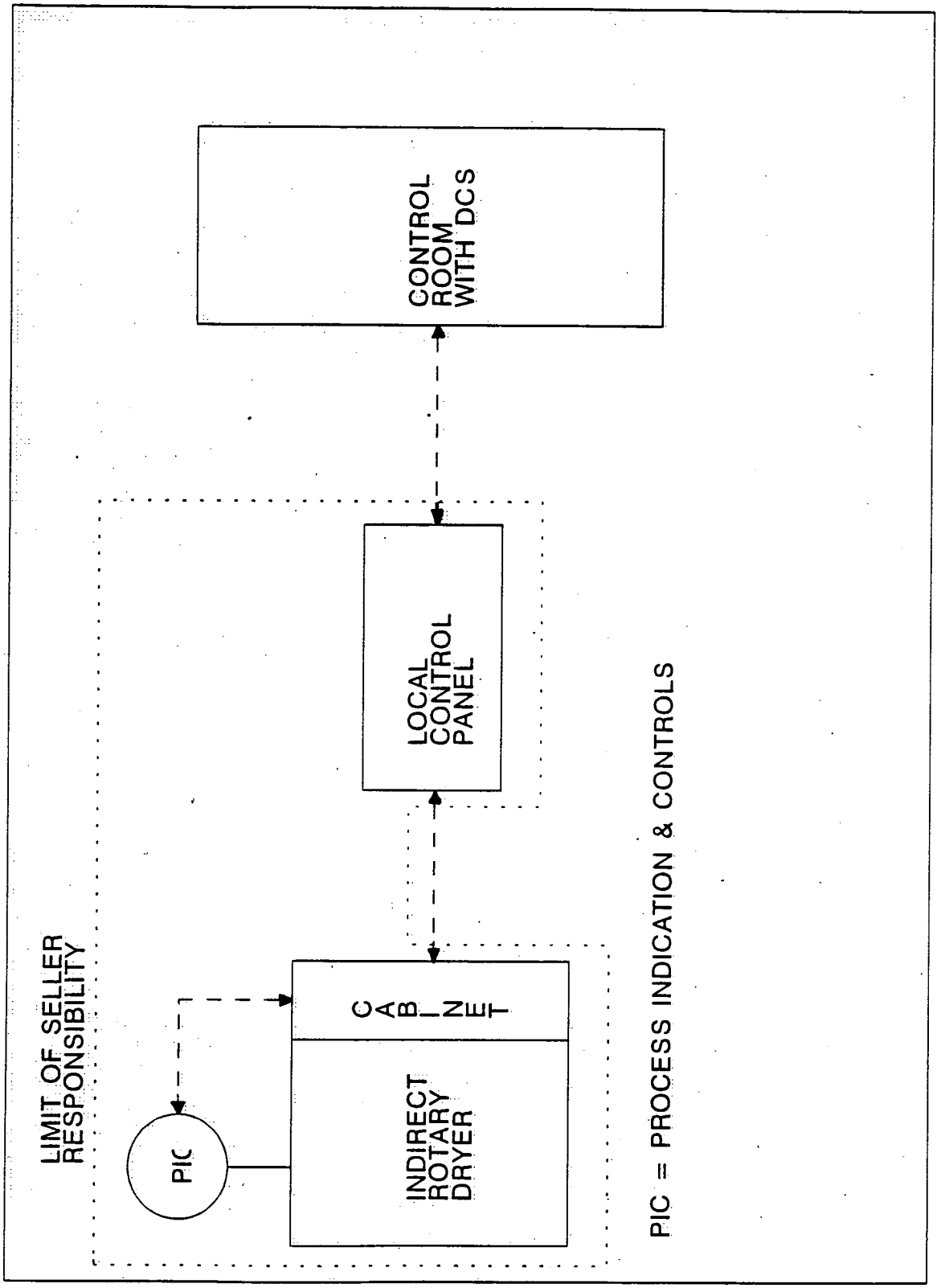
Item No.		*
Quantity		*
Manufacturer		*
Manufacturer's Model No.		*
Type Fuel (see Article 2.2, Paragraph C, Subparagraph 1.r)		Natural Gas
Max. Rated Output, btu/hr		*
Turndown Ratio		*
Size: (Attach Catalog Cut)		
Fuel Inlet, in.		*
Comb. Air (primary) Inlet, in.		
Pilot Air Inlet, in.		
Pilot Gas Inlet, in.		
Comb. Air (secondary) Inlet, in.		
Fuel Nozzle Orifice, in.		
Supply pressures: psi		
Fuel	maximum*	minimum*
Comb. Air (primary)	maximum*	minimum*
Comb. Air (secondary)	maximum	minimum
Atomizing Fluid	maximum	minimum
Pilot Gas		*
Fluid flow Rates: lbs/hr		
Fuel	maximum*	minimum*
Comb. Air (primary)	maximum*	minimum*
Comb. Air (secondary)	maximum*	minimum*
Pilot Gas		*
Length of Flame, in.	maximum*	minimum*
Scanner: No. per burner		*
Type		
Materials:		
Body		*
Nozzle		*
Tiles		*

APPENDIX 4

DRAWINGS AND SKETCHES


ATMOSPHERE
STACK
COMBUSTION GAS EXHAUST FAN
BY HVAC
HOT AIR TO BLDG HEAT OR ATMOSPHERE
HOT AIR TO PROCESS REHEATER
PROCESS OFF-GAS TO CONDENSER
HOT AIR TO ATMOSPHERE
TO BLENDING & STORAGE
DRIED PRODUCT (NOTE 1)
CYCLONE W/ REHEATER
SOLIDS RECYCLE
HOT AIR
HEAT ECONOMIZER
PROCESS OFF-GAS
DISCHARGE HEAD
HOT AIR SUPPLY FAN
OUTSIDE AIR
COMBUSTION OFF-GAS
FURNACE
BURNER PIPE AND INSTRUMENTATION SKID
NOTE 2
FEED HEAD
DRYER FEEDER
COMBUSTION AIR SUPPLY FAN
INDIRECT ROTARY DRYER SYSTEM (LIMITS OF SELLER RESPONSIBILITY)
PROCESS WATER TO SPRAY HEADERS
FEED FROM STORAGE (NOTE 1)
FEED FROM SLURRY PUMP (NOTE 1)
SWEEP AIR
TOTAL COMBUSTION AND EXCESS AIR
NATURAL GAS
1. FEED TO THE DRYER WILL BE PROCESSED TO MAINTAIN A MOISTURE CONTENT BETWEEN 30 AND 200 PERCENT ON A DRY BASIS. DRIED PRODUCT WILL CONTAIN AN AVERAGE OF 10 PERCENT MOISTURE ON A DRY BASIS.
2. THE BURNER SHOWN IS TYPICAL AS ONE OF THE MULTIPLE BURNERS PER FURNACE ZONE. TOTAL BURNERS PER ZONE AND TOTAL NUMBER OF ZONES IS TO BE DETERMINED BY THE SELLER. BURNER ARRANGEMENT SHOWS INTAKES FOR NATURAL GAS, PRIMARY COMBUSTION AIR AND SECONDARY COMBUSTION AIR AND EXCESS AIR. SECONDARY COMBUSTION AIR IS REQUIRED IF THE BURNERS ARE TO BE OPERATED AS STAGED COMBUSTION FOR LOWER NOX CONCENTRATIONS.


DRYER DISCHARGE ENCLOSURE
DRYER DISCHARGE CONVEYOR
CYCLONE W/REHEATERS
BURNER FUEL/ AIR SUPPLY SKID INSTRUMENTATION
110'-6"
DRYER FEED CONVEYOR
DRYER FEED HOPPER
DRYER FEED ENCLOSURE
T/FLOOR EL 8'-0"
ROTARY AIRLOCK
DRYER DISCHARGE FEEDER
INDIRECT ROTARY DRYER
SECTION B
DRYER FEED CONVEYOR
DRYER FEED HOPPER
SECTION A


CONTROL ROOM WITH DCS
LOCAL CONTROL PANEL
LIMIT OF SELLER RESPONSIBILITY
PIC
CABINET
INDIRECT ROTARY DRYER
PIC = PROCESS INDICATION & CONTROLS

APPENDIX 5

SUPPORTING INFORMATION

5.1 Background

The feed to the dryer will consist of the contents from eight separate waste pits (Pits 1 through 6, the Burn Pit, and Clearwell). These pits contain secondary processing wastes resulting from a uranium processing facility. Consequently, the feed will cover a broad range of characteristics. The majority of feed material is composed of general sump sludge, neutralized raffinate, and magnesium fluoride.

The general sump sludge consists of 1) filtrates from various processing plants, 2) wastewater from the laboratory, and 3) general decontamination and cleanup water that was neutralized with lime. Raffinate from the solvent extraction operation was neutralized and sent to the pits. The magnesium fluoride in the pits was produced by the reduction of uranium tetrafluoride to uranium metal using magnesium metal. Some of the resulting magnesium fluoride slag was reprocessed to recover uranium. The insoluble materials left over after the acid digestion recovery process were filtered out, reslurried, mixed with lime, and pumped to the pits.

Other wastes known to have been deposited in the pits include:

1) Contaminated asbestos materials
2) Contaminated rags, paper, and polyethylene
3) Dust collector bags
4) Scrap salts
5) Uranium and thorium tetrafluoride
6) Contaminated soil, rocks, sand, brick, and ceramics
7) Dust collector residues
8) UO_3 and U_3O_8
9) Miscellaneous sludges
10) Uranium chips and turnings
11) Water softening and treatment sludges
12) Graphite crucibles and molds
13) Ash from burning or incineration (pallets, paper, graphite, oils)
14) Flyash from coal-fired boiler
15) Steel drums

(Note that all dryer feed will be processed to size reduce items so they do not exceed 4 inches in any dimension.)

Samples of the pit wastes have been characterized by several organizations. The data is summarized in this appendix. One important characterization effort was performed by the University of Cincinnati (UC). They classified the wastes based on the Unified Soil Classification System (USCS). Subsequent test work has focused on four major classifications: nonplastic (NP-Type 1), low-plasticity silt (ML-Type 2), high-plasticity silt (MH-Type 3), and low-plasticity clay (CL-Type 4).

Bench- and pilot-scale drying tests were performed by PARSONS using surrogate materials. The surrogates were developed to cover the range of physical characteristics exhibited by the actual wastes. Four surrogates were formulated to first meet the Atterburg limit criteria that would place them in the appropriate USCS group, and also to have particle size distributions similar to those of the actual pit wastes (see Tables F and G). The pilot-scale drying tests were performed in batch and continuous, indirect and direct rotary dryers.

5.2 Pit Waste Composition

The composition of the pit wastes was developed from several data sources. To be conservative, for data reported in more than one source, the highest data point was used. Some inorganic data reported cations only. The cations were assumed to combine with oxygen or other anions to form chemical components. The selection of chemical components was based on historical knowledge of the process and in-house experience at PARSONS. The results are shown in Table C. For all the pits, the total weight of each element/substance was preserved. With the chemical components determined, appropriate adjustments to the mg/kg values of the cations were made to account for the added elements, and a total weight of all the components was determined. Finally, the weight of each component was divided by the total weight to normalize the data and provide a weight fraction value for each component. Note that the organic content is very small. Pit 2 has the highest organic content with less than 0.4 percent. Consequently, the organic content does not affect the drying characteristics of the pit wastes. Also note that, due to the radium content of some of the pit wastes, radon gas will be released to the process off-gas.

5.3 Size Distribution

The particle size distribution is reported in Table B. The data are presented as weight fractions in four size classifications: 1) gravel, 2) sand, 3) fines, and 4) clay-sized (<2μ). The gravel fraction is material greater than 4 mesh, the sand fraction ranges from 200 mesh to 4 mesh, and the "fines" fraction is less than 200 mesh (note that this fraction includes the clay-sized material).

In general, the bulk of the feed is very fine (less than 200 mesh). Note that all feed must be less than 4 inches in any dimension so any debris from the pits will be size reduced prior to being fed to the dryer.

5.4 Moisture Content

The moisture contents of the actual pit wastes as reported in Table B varies from 10 percent to over 600 percent (all moisture contents expressed on a dry basis = [lb water/lb dry solids] x 100 percent). However, the pit materials will be processed to provide feed with a specified moisture content ranging from 30 to 200%.

5.5 Bulk Density

The solid specific gravities of the feed (given in Table B) range from 2.50 to 3.25. Bulk (slurry) densities calculated at the minimum and maximum moisture contents of the feed assuming an average solid specific gravity of 2.9, range from 79 to 126 lb/ft^3.

5.6 Plasticity Data (Atterberg Limits - ASTM D4318)

The dryer feed will consist of materials ranging from non-plastic to high-plasticity silt based on the Atterburg limit data reported in Table B.

The values for the four surrogate feeds used in the pilot-scale tests are summarized in Table A.

Table A - Average Atterburg Limits - Four Types of Feed

Feed Type	Description	Plastic Limit	Plasticity Index
1	Non-plastic	N/A	N/A
2	Low-plasticity Silt	30	15
3	High-plasticity Silt	55	40
4	Low-plasticity Clay	20	20

5.7 Thermogravimetric Analyses:

Thermogravimetric analyses were performed by UC on composite samples of the actual wastes. Table D relates the USCS classification to a "group designation" and pit number. This group designation then becomes part of the Sample ID in Table E which summarizes the TGA tests. The results are given in Figures A-5.1 through A-5.9.

5.8 Drying Curves

Drying tests on surrogate feeds were conducted by PARSONS. One phase of the test work was performed in a batch indirect rotary dryer equipped with sampling capabilities. Consequently, samples of the surrogates could be obtain during the drying process. The moisture content of these samples was determined and the results were plotted. These drying curves present the moisture content as a function of drying time. They are presented in Figures A-5.10 through A-5.13.

5.9 Waste/Soil Characteristics for Excavation and Handling

This section provides a general description of the waste materials found in the OU-1 waste pits, primarily in terms of soil material classifications. The data were obtained from the OU-1 Remedial Investigation/Feasibility Study (RI/FS) and University of Cincinnati Accelerated Life Testing and Environmental Research (ALTER) testing of materials obtained from small diameter samplers (split-spoon and Shelby Tube) and bulk archived sample material from auger boring and grab sampling. The pits, especially the

covered pits, contain debris of various sizes. Various debris were encountered during DEEP wet trenching with a track hoe at various locations at Pits 1, 2, and 3. Debris encountered included large pieces of concrete rubble, coarse gravel, planks of lumber, sheet metal, metal bands, and metal wire.

Waste Pit 1

Based on ALTER and OU-1 RI/FS data, in general, Pit 1 waste materials behave like nonplastic silts (ML) (with nonplastic fines) with little cohesion and low dry strength. The moisture contents ranged from about 16 to 40 percent (dry weight basis).

Waste Pit 2

Based on ALTER data and OU-1 RI/FS data, in general, Pit 2 waste materials range in behavior from nonplastic silts and sands (silt with sand, sandy silt, silty sand) to highly plastic silts (sandy elastic silt). Some lean clays are also present. Moisture contents range from about 17 percent (lean clay with sand) to 320 percent (nonplastic silt with sand). Moisture content of the sandy elastic silt material ranges from about 70 to 230 percent.

Waste Pit 3

Based on ALTER data and OU-1 RI/FS data, in general, Pit 3 waste materials range in behavior from low plasticity silts and sands (sandy silt and silty sand) to highly plastic silts (sandy elastic silt, elastic silt with sand). Some lean clays are also present. Moisture contents range from about 35 percent (sandy silt) to 153 percent (elastic silt with sand). Moisture content of the sandy elastic silt material ranges from about 42 to 153 percent.

In-place strength of Pit 3 waste from the DEEP Cone Penetrometer Test (CPT) probes and Standard Penetration Test (SPT) tests indicates very low strengths over much of the pit area (below the cap materials). Low strengths are expected to result in waste collapse at quite low natural slopes, which may present safety concerns and excavation inefficiencies due to flat slopes. Based on the relative values from CPT data and previous data, angles of repose are estimated to range from 10 to 12 degrees prior to dewatering. Laboratory test results to confirm the shear strengths estimated from the CPT probes are not yet available. In addition,

existing data also indicate that the moisture content for much of the waste (in situ conditions) is above the liquid limit, indicating the material could behave like a fluid. Dewatering may be necessary in Pit 3 to maintain an open, relatively flat, safe slope.

Waste Pit 4

Based on ALTER data and RI/FS data, in general, Pit 4 waste materials range in behavior from nonplastic silts (silt, silt with sand, and sandy silt) to lean and silty clays (lean clay with sand, sandy lean clay, sandy silty clay). Moisture contents range from about 10 percent (sandy lean clay) to 62 percent (sandy silty clay).

Waste Pit 5

Based on ALTER data, in general, Pit 5 waste material behaves as a high-plasticity elastic silt. The pit also contains some nonplastic silt. In general, the moisture content of the waste material in Pit 5 is the highest of the OU-1 waste material tested. Moisture content of the elastic silt material ranges from about 161 to 620 percent. The moisture content of the nonplastic silt material was about 109 to 115 percent.

Based on preliminary DEEP data, waste materials appear to be low density with extremely high moisture contents that do not tend to be free-draining.

Waste Pit 6

Based on ALTER data, in general, Pit 6 waste material behaves as a nonplastic to low plasticity silt (silt, sandy silt, silt with sand, and silty sand). The pit also contains some high plasticity elastic silt. Water content of Pit 6 materials range from about 27 percent (silt with sand) to 425 percent (nonplastic silt). Based on preliminary DEEP data, waste materials appear to be free draining.

Burn Pit

Based on RI/FS and ALTER data, in general, Burn Pit waste material ranges in behavior from a low plasticity silt (sandy silt) to a

silty sand. Some lean clay with sand is also present. Water content of Burn Pit waste materials range from about 25 percent (lean clay with sand) to 43 percent (silty sand).

Clearwell

Based on ALTER data, in general, the waste in the Clearwell contains materials behaving as high-plasticity silts (sandy elastic silt, elastic silt with sand), silty sand, and sandy lean clay. The water contents of these materials range from about 35 percent (sandy lean clay) to 72 percent (sandy elastic silt).

TABLE B

FROM

COOPERATIVE REMEDY SCREENING PROGRAM

UNIVERSITY OF CINCINNATI

FINAL REPORT, CRSP-AO-008

JULY 1994

Table B - Basic Geotechnical Characterization Testing Results for the OU1 Waste Pit Samples

Samp #	Pit	Moisture Content %	% Gravel	% Sand	% Fines	% <2μ	Solids Specific Gravity (G_s)	Liquid Limit %	Plastic Limit %	PI %	pH of Solids in H_2O	Liquidity Index	Activity Index	USCS
1A	1	20.3	0.0	14.2	85.8			-	-	-		-		NP
2A	1	24.7	0.0	13.2	86.8			-	-	-		-		NP
3A	1	39.1	2.9	26.8	70.3			-	-	-		-		NP
4A	1	18.0	0.0	9.0	91.0			-	-	-		-		NP
5A	1	20.7	0.4	10.8	88.8	0.0	3.02	-	-	-	7.27	-	-	NP
6A	1	21.1	0.0	9.0	91.0			-	-	-		-		NP
7A	1	20.7	1.1	9.8	89.1			-	-	-		-		NP
8A	1	22.7	3.9	37.6	58.5			-	-	-		-		NP
9A	2	35.4	1.0	55.1	43.9			33.1	23.2	9.9		1.23		SM
10A	2	38.3	7.6	26.1	66.3	22.2	2.72	42.3	23.1	19.2	7.67	0.79	0.86	CL
11A	2	70.5	5.5	27.8	66.7	11.7	2.67	66.8	42.2	24.6	7.53	1.15	2.10	MH
12A	2	16.7	4.2	22.3	73.5			44.1	16.2	27.9		0.01		CL
13A	3	145.4	3.2	33.7	63.1			89.7	55.8	33.9		2.64		MH
14A	3	152.7	3.5	23.8	72.7			81.8	58.9	22.9		4.10		MH
15A	3	42.2	6.5	25.8	67.7	3.1	2.69	46.9	31.7	15.2	7.74	0.70	4.87	ML
16A	3	96.8	3.3	27.0	69.7	15.7	2.72	77.8	44.3	33.5	7.76	1.57	2.13	MH
17A	3	142.0	1.0	15.3	83.7			69.9	53.9	16.0		5.51		MH
18A	3	41.9	2.5	40.9	56.6			37.9	30.5	7.4		1.54		ML
19A	3	36.1	6.0	19.9	74.1			44.1	25.2	18.9		0.58		CL

000385

Table B - Basic Geotechnical Characterization Testing Results for the OU1 Waste Pit Samples (Continued)

Samp #	Pit	Moisture Content %	% Gravel	% Sand	% Fines	% <2μ	Solids Specific Gravity (G_s)	Liquid Limit %	Plastic Limit %	PI %	pH of Solids in H_2O	Liquidity Index	Activity Index	USCS
21A	4	18.0	6.4	29.5	64.1	6.6	3.25	28.4	18.5	9.9	7.79	-0.05	1.50	CL
22A	4	23.3	0.0	12.0	88.0			-	-	-		-		NP
23A	4	22.2	0.8	15.2	84.0	8.4	3.02	-	-	-	7.73	-	-	NP
24A	4	10.1	13.4	24.7	61.9			33.9	16.7	17.2		-0.38		CL
25A	4	25.4	1.2	34.7	64.1			34.1	21.8	12.3		0.29		CL
26A	4	29.3	1.2	18.0	80.8			-	-	-		-		NP
30A	5	173.0	0.0	5.0	95.0			70.7	57.7	13.0		8.87		MH
31A	5	497.5	0.0	5.2	94.8			94.2	50.6	43.6		10.25		MH
32A	5	483.0	0.0	3.4	96.6			102.2	80.5	21.7		18.55		MH
33A	5	507.3	0.0	1.3	98.7			108.4	71.8	36.6		11.90		MH
34A	5	451.7	0.0	1.9	98.1			102.2	64.6	37.6		10.30		MH
35A	5	161.1	0.0	11.9	88.1	14.5	2.70	90.9	60.2	30.7	8.53	3.29	2.12	MH
36A	5	342.4	0.0	8.1	91.9			103.8	75.6	28.2		9.46		MH
37A	5	620.0	0.0	0.2	99.8			93.0	58.0	35.0		16.06		MH
38A	5	495.7	0.0	2.7	97.3		2.74	112.3	68.1	44.2	8.72	9.67	-	MH
39A	5	448.5	0.0	5.9	94.1			112.0	69.6	42.4		8.94		MH
40A	5	114.5	0.0	5.5	94.5			-	-	-		-		NP
41A	5	109.3	0.0	6.0	94.0	8.9	2.71	-	-	-	8.34	-	-	NP
57A	5	242.3	0.0	14.6	85.4			87.7	60.9	26.8		6.77		MH
58A	5	295.7	0.0	10.4	89.6	10.2	2.70	77.1	52.7	24.4	8.22	9.96	2.37	MH

Table B - Basic Geotechnical Characterization Testing Results for the OU1 Waste Pit Samples (Continued)

Samp #	Pit	Moisture Content %	% Gravel	% Sand	% Fines	% <2μ	Solids Specific Gravity (G_s)	Liquid Limit %	Plastic Limit %	PI %	pH of Solids in H_2O	Liquidity Index	Activity Index	USCS
43A	6	425.1	0.0	3.7	96.3			-	-	-		-		NP
45A	6	26.8	0.0	27.6	72.4	9.6	3.21	-	-	-	9.19	-	-	NP
45C	6	117.6	0.0	51.3	48.7			-	-	-		-		SM
46A	6	107.4	0.0	13.8	86.2	27.9	2.98	47.0	28.4	18.6	9.43	4.25	0.67	ML
47A	6	111.4	0.0	9.8	90.2	35.2	2.85	64.9	33.1	31.8	9.40	2.46	1.45	MH
49A	CW	53.4	3.3	31.1	65.6			43.9	25.6	18.3		1.52		CL
50A	CW	65.1	10.9	36.4	52.7			50.6	32.5	18.1		1.80		MH
51A	CW	61.9	0.0	51.5	48.5			45.0	28.0	17.0		1.99		SM
52A	CW	40.2	8.5	47.0	44.5			39.3	24.9	14.4		1.06		SM
53A	CW	35.4	0.0	39.4	60.6	22.3	2.69	35.1	18.0	17.1	8.35	1.02	0.77	CL
54A	CW	73.9	0.5	22.5	77.0			54.7	39.2	15.5		2.24		MH
55A	CW	71.7	1.8	23.7	74.5	23.8	2.78	52.4	38.0	14.4	8.24	2.34	0.61	MH
56A	CW	68.5	3.3	31.3	65.4			53.3	40.2	13.1		2.16		MH
27A	BP	25.5	2.6	26.2	71.2			41.3	24.7	16.6		0.05		CL
28A	BP	25.6	4.4	37.0	58.6			35.1	31.0	4.1		-1.32		ML
29A	BP	30.0	8.5	38.2	53.3	15.0	2.50	37.8	26.7	11.1	7.74	0.30	0.74	ML

TABLE C

FROM

METSIM[R] PROCESS SIMULATION MODEL

PIT WASTE INDIRECT THERMAL DRYING

OU1, PO-19, TASK 291

PARSONS, MARCH 1995, REVISION 0

Date: 10/10/95
Rev.: A RE: CT

WBS No.: 1.1.1.1.1.3.1
ERA/CRU No.: 1/PO-145

Table C - Pit Waste Composition

Component	Normalized Weight Fraction (of Total Organics)							
	Pit 1	Pit 2	Pit 3	Pit 4	Pit 5	Pit 6	Burn Pit	Clearwell
Organics								
1,4-Dioxane	7.49E-02	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
2,4-Dichlorophenol	0.00E+00	0.00E+00	0.00E+00	1.16E-02	0.00E+00	0.00E+00	0.00E+00	0.00E+00
2,4-Dinitrophenol	0.00E+00	0.00E+00	0.00E+00	5.55E-02	0.00E+00	0.00E+00	0.00E+00	0.00E+00
2,6-Dinitrotoluene	0.00E+00	0.00E+00	2.41E-02	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
2-Butanone	4.56E-02	0.00E+00	8.67E-02	0.00E+00	0.00E+00	5.53E-02	0.00E+00	0.00E+00
4,4-DDT	1.92E-02	6.69E-04	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
4-Chloro-3-Methylphenol	0.00E+00	0.00E+00	0.00E+00	1.16E-02	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Acenaphthene	0.00E+00	2.05E-02	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Acenaphthylene	0.00E+00	0.00E+00	2.41E-02	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Acetone	0.00E+00	0.00E+00	2.89E-02	0.00E+00	2.82E-01	0.00E+00	0.00E+00	5.72E-02
Anthracene	0.00E+00	5.73E-02	2.41E-02	1.67E-02	0.00E+00	0.00E+00	2.66E-02	4.00E-02
AROCLOR 1221	7.20E-02	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
AROCLOR 1248	1.20E-01	0.00E+00	1.16E-01	3.79E-02	1.39E-01	0.00E+00	0.00E+00	9.44E-03
AROCLOR 1254	1.56E-01	0.00E+00	8.19E-02	3.43E-02	2.78E-01	1.86E-02	6.60E-02	2.11E-02
AROCLOR 1260	9.36E-02	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Benzo(a)Anthracene	0.00E+00	6.21E-02	2.41E-02	2.37E-02	0.00E+00	0.00E+00	5.40E-02	4.00E-02
Benzo(a)Pyrene	0.00E+00	5.73E-02	2.41E-02	2.42E-02	0.00E+00	0.00E+00	3.34E-02	4.00E-02
Benzo(b)Fluoranthene	0.00E+00	6.21E-02	2.41E-02	2.93E-02	0.00E+00	0.00E+00	8.22E-02	4.00E-02
Benzo(g,h,i)Perylene	0.00E+00	2.01E-02	2.41E-02	1.16E-02	0.00E+00	0.00E+00	2.48E-02	4.00E-02
Benzo(k)Fluoranthene	0.00E+00	3.58E-02	0.00E+00	1.87E-02	0.00E+00	0.00E+00	4.28E-02	4.00E-02
Benzoic Acid	5.28E-02	0.00E+00	1.18E-01	2.22E-02	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Bis(2-Ethylhexyl)Phthalate	2.16E-02	0.00E+00	2.65E-02	1.36E-02	1.03E-01	2.65E-02	8.31E-02	1.92E-02
Chlorobenzene	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	6.85E-05	0.00E+00
Chloroform	7.80E-03	0.00E+00	0.00E+00	6.56E-03	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Chrysene	0.00E+00	4.78E-02	2.41E-02	2.27E-02	0.00E+00	0.00E+00	6.00E-02	4.00E-02
Di-n-Butylphthalate	0.00E+00	0.00E+00	2.41E-02	1.16E-02	8.51E-02	0.00E+00	0.00E+00	4.86E-02
Dibenzofuran	0.00E+00	1.72E-02	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Diethylphthalate	0.00E+00	0.00E+00	1.04E-01	1.16E-02	0.00E+00	0.00E+00	4.28E-02	4.00E-02
Fluoranthene	0.00E+00	2.34E-01	2.41E-02	9.08E-02	0.00E+00	0.00E+00	1.37E-01	8.87E-02
Fluorene	0.00E+00	2.96E-02	0.00E+00	1.72E-02	0.00E+00	0.00E+00	1.46E-02	4.00E-02
Indeno(1,2,3-cd)Pyrene	0.00E+00	2.20E-02	2.41E-02	1.16E-02	0.00E+00	0.00E+00	1.88E-02	4.00E-02
Isophorone	0.00E+00	0.00E+00	2.27E-02	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Methylene Chloride	0.00E+00	0.00E+00	1.01E-02	1.11E-02	2.82E-02	2.85E-02	0.00E+00	2.86E-02
N-Nitroso-di-n-Propylamine	0.00E+00	0.00E+00	2.27E-02	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Naphthalene	0.00E+00	1.10E-02	0.00E+00	1.36E-02	0.00E+00	0.00E+00	4.28E-02	0.00E+00
Pentachlorophenol	0.00E+00	6.69E-03	6.99E-02	0.00E+00	0.00E+00	0.00E+00	2.23E-02	0.00E+00
Phenanthrene	2.88E-02	1.77E-01	2.41E-02	8.07E-02	0.00E+00	0.00E+00	1.29E-01	6.01E-02
Pyrene	0.00E+00	1.19E-01	2.41E-02	4.54E-02	0.00E+00	0.00E+00	1.20E-01	4.00E-02
Tetrachloroethene	7.80E-03	2.15E-05	0.00E+00	2.67E-03	0.00E+00	8.44E-01	0.00E+00	0.00E+00
Tributyl Phosphate	3.00E-01	1.86E-02	0.00E+00	3.63E-01	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Vinyl Chloride	0.00E+00	9.08E-04	0.00E+00	8.07E-05	0.00E+00	0.00E+00	1.29E-04	0.00E+00
Phenol	0.00E+00	0.00E+00	0.00E+00	0.00E+00	8.51E-02	0.00E+00	0.00E+00	0.00E+00
Methyl Butyrate	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.75E-04	0.00E+00	0.00E+00
Trichloroethene	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.71E-02	0.00E+00	0.00E+00
Toluene	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
AROCLOR 1242	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	9.44E-03
2,4,5-Trichlorophenol	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.17E-01
Total Organics (mg/kg)	83.34	2,093.35	41.5	198.15	22.33	34.37	116.72	34.97

Table C - Pit Waste Composition (Continued)

Component	Normalized Weight Fraction (of Total Inorganics)							
	Pit 1	Pit 2	Pit 3	Pit 4	Pit 5	Pit 6	Burn Pit	Clearwell
Inorganics								
NH4HCO3	0.00E+00	0.00E+00	0.00E+00	2.35E-03	0.00E+00	0.00E+00	0.00E+00	0.00E+00
NH4NO3	2.42E-04	1.99E-05	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Al2O3	4.09E-02	7.68E-02	1.18E-01	4.35E-02	3.88E-02	4.17E-02	4.52E-02	7.76E-02
SbO2	1.65E-04	2.71E-04	1.51E-04	3.32E-04	1.08E-04	0.00E+00	3.09E-04	6.97E-05
As2O3	2.12E-05	9.83E-04	4.80E-02	1.85E-05	4.92E-03	4.68E-05	1.04E-04	4.10E-05
BaCl2	4.09E-04	2.93E-03	1.22E-03	3.82E-04	4.27E-02	3.85E-04	1.29E-03	1.04E-02
BaO2	0.00E+00	0.00E+00	0.00E+00	1.74E-02	0.00E+00	0.00E+00	1.61E-02	0.00E+00
BaSO4	4.00E-04	2.87E-03	2.28E-02	0.00E+00	4.18E-02	3.77E-04	8.39E-04	1.01E-02
BeO	3.73E-05	1.31E-04	6.52E-05	3.03E-04	6.66E-05	7.38E-05	8.93E-05	4.36E-05
CdO	5.67E-06	6.44E-06	1.08E-05	8.56E-05	6.47E-06	7.60E-06	8.04E-05	3.55E-06
CdSO4	2.76E-05	3.14E-05	5.26E-05	0.00E+00	3.15E-05	3.70E-05	0.00E+00	1.73E-05
CaCl2	0.00E+00	0.00E+00	3.01E-02	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Ca(OH)2	3.32E-01	3.09E-02	3.06E-01	2.44E-01	4.32E-01	1.63E-01	4.31E-01	4.96E-01
Ca3(PO4)2	0.00E+00	1.77E-03	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
CaF2	4.12E-02	0.00E+00	0.00E+00	0.00E+00	5.35E-02	2.02E-02	0.00E+00	6.16E-02
Ca(NO3)2	4.33E-02	3.75E-03	3.81E-02	0.00E+00	3.50E-02	1.32E-02	0.00E+00	4.03E-02
CrO2	6.01E-04	8.02E-04	3.70E-04	5.22E-03	4.80E-04	2.26E-04	2.96E-04	2.12E-04
CoO	6.38E-05	3.29E-03	6.30E-05	5.01E-04	7.45E-05	1.54E-04	2.84E-04	5.04E-05
CuO	2.18E-04	2.97E-03	2.87E-03	1.31E-03	3.03E-02	1.29E-03	6.56E-04	2.42E-03
NaCN	1.48E-06	9.62E-06	3.13E-06	2.60E-06	0.00E+00	0.00E+00	7.95E-07	2.99E-05
Fe2O3	6.04E-02	1.97E-01	4.06E-02	9.89E-02	3.41E-02	1.83E-02	1.79E-01	5.20E-02
FeS2	0.00E+00	0.00E+00	1.58E-05	1.17E-04	0.00E+00	0.00E+00	2.23E-04	0.00E+00
Fe2(SO4)3	0.00E+00	0.00E+00	4.31E-02	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
PbO	1.04E-04	1.44E-03	8.82E-04	1.47E-04	3.39E-04	3.01E-04	6.04E-04	1.54E-04
MgF2	2.86E-01	0.00E+00	3.75E-03	6.34E-03	1.74E-01	3.09E-01	4.73E-05	1.59E-01
Mg(OH)2	5.02E-02	2.81E-01	1.03E-01	1.71E-01	3.05E-02	5.43E-02	2.77E-01	2.79E-02
Mg(NO3)2	3.41E-02	1.56E-02	3.26E-02	0.00E+00	2.60E-02	4.62E-02	0.00E+00	2.37E-02
MnO	5.15E-03	6.47E-03	2.55E-02	1.56E-02	8.15E-03	2.11E-04	2.50E-03	3.70E-03
MoO2	4.68E-05	5.04E-04	3.70E-04	2.74E-04	0.00E+00	0.00E+00	6.65E-05	0.00E+00
HgO	3.47E-07	4.94E-06	5.38E-06	1.44E-06	2.59E-06	0.00E+00	2.60E-06	8.20E-06
NiO	8.86E-05	3.89E-03	6.26E-04	6.10E-04	4.18E-04	3.02E-04	5.26E-04	1.47E-04
P2O5	1.65E-05	1.75E-01	1.29E-01	7.20E-04	0.00E+00	0.00E+00	3.60E-03	0.00E+00
KOH	2.37E-03	1.64E-02	2.84E-03	7.81E-03	1.71E-03	3.67E-03	2.51E-03	5.43E-03
KCl	1.04E-03	7.21E-03	1.25E-03	0.00E+00	7.53E-04	1.62E-03	0.00E+00	2.39E-03
KF	4.08E-04	0.00E+00	0.00E+00	0.00E+00	2.95E-04	6.33E-04	0.00E+00	9.36E-04
K2CO3	4.86E-04	6.72E-03	1.17E-03	6.41E-03	3.51E-04	7.53E-04	2.06E-03	1.11E-03
SeO2	9.35E-07	3.24E-04	1.24E-04	0.00E+00	3.37E-05	0.00E+00	5.65E-06	8.97E-06
Ag2O	2.18E-04	8.03E-05	4.39E-05	1.75E-03	1.35E-05	7.92E-04	1.09E-03	7.23E-06
Na2B4O7	7.97E-03	1.88E-03	1.04E-03	9.78E-03	0.00E+00	0.00E+00	4.36E-04	0.00E+00
NaNO3	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
NaOH	2.82E-03	1.56E-02	1.32E-02	3.62E-03	1.83E-02	3.84E-03	3.37E-03	8.30E-03
Na3PO4	0.00E+00	1.88E-03	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Na3UO4	3.20E-05	3.71E-03	1.50E-04	8.62E-04	7.15E-04	1.50E-04	8.02E-04	3.25E-04
NaCl	1.04E-03	7.00E-03	4.86E-03	0.00E+00	6.71E-03	1.41E-03	0.00E+00	3.05E-03
Tl2O	1.38E-06	8.78E-06	2.44E-05	0.00E+00	1.52E-05	0.00E+00	2.09E-06	3.76E-06
SiO2	1.65E-02	9.96E-03	1.05E-02	1.88E-02	0.00E+00	0.00E+00	5.81E-03	0.00E+00
SnO2	0.00E+00	0.00E+00	2.37E-04	3.63E-04	0.00E+00	0.00E+00	0.00E+00	0.00E+00
VO2	2.48E-04	1.70E-03	3.50E-03	1.95E-03	1.17E-02	7.59E-04	9.48E-04	7.30E-03
ZnO	7.75E-05	7.13E-03	3.96E-04	5.37E-04	3.52E-04	2.96E-04	1.26E-03	4.17E-04
U3O8	2.07E-02	5.24E-02	2.87E-03	1.58E-01	1.74E-03	1.01E-01	6.43E-03	1.29E-03
UF4	2.24E-02	0.00E+00	0.00E+00	1.77E-02	1.89E-03	1.13E-01	2.88E-04	1.40E-03
UO3	2.04E-02	5.34E-02	2.93E-03	1.45E-01	1.72E-03	1.03E-01	6.29E-03	1.28E-03
ThO2	2.72E-03	6.05E-03	0.00E+00	1.86E-02	3.79E-04	2.89E-05	8.51E-03	3.47E-04
Th(SO4)2	4.36E-03	2.26E-04	6.43E-03	0.00E+00	6.09E-04	4.65E-05	0.00E+00	5.58E-04

Table C - Pit Waste Composition (Continued)

	Normalized Weight Fraction (of Total Inorganics)							
Component	Pit 1	Pit 2	Pit 3	Pit 4	Pit 5	Pit 6	Burn Pit	Clearwell
Radionuclides								
Cs-137	1.36E-14	7.32E-14	4.07E-14	0.00E+00	1.17E-12	1.67E-12	0.00E+00	8.97E-12
Np-237	0.00E+00	0.00E+00	0.00E+00	1.22E-09	3.59E-08	2.38E-08	1.71E-09	5.38E-09
Pu-238	0.00E+00	1.03E-14	5.71E-15	6.29E-14	3.42E-13	3.81E-13	5.87E-14	0.00E+00
Pu-239	0.00E+00	1.70E-11	9.46E-12	1.39E-11	2.79E-10	1.13E-09	1.29E-11	0.00E+00
Pu-240	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Ra-226	1.08E-10	1.69E-09	9.41E-10	1.09E-10	0.00E+00	0.00E+00	7.96E-11	0.00E+00
Ra-228	1.62E-13	2.83E-12	1.57E-12	1.12E-12	0.00E+00	0.00E+00	7.68E-14	0.00E+00
Ru-106	0.00E+00	5.86E-15	3.26E-15	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Sr-90	6.04E-14	5.14E-14	2.86E-14	2.26E-12	3.03E-13	1.74E-13	7.36E-15	3.29E-13
Tc-99	1.39E-09	9.43E-08	5.24E-08	4.20E-08	3.45E-07	6.63E-08	1.12E-08	4.16E-08
Th-228	1.03E-12	1.50E-12	8.31E-13	6.48E-12	7.15E-14	6.83E-15	2.21E-12	1.18E-13
Th-230	2.84E-07	1.57E-06	8.72E-07	1.89E-07	5.48E-07	9.95E-09	4.42E-07	4.69E-07
U-234	2.03E-07	5.14E-06	2.86E-06	1.41E-06	2.67E-07	3.99E-06	5.51E-07	1.04E-07
U-235/6	4.28E-06	2.38E-04	1.32E-04	3.10E-05	1.62E-06	1.26E-04	3.16E-12	1.30E-06
Total Inorganics (mg/kg)	932,125.84	568,264.87	1,022,676.93	464,534.96	750,615.04	214,435.96	497,590.15	579,642.90
Gaseous Dichloro-								
difluoromethane (mg/kg)	29.60							
Grand Total (mg/kg)	932,238.78	570,358.21	1,022,718.43	464,733.11	750,637.37	214,469.56	497,706.87	579,677.87
% Inorganics								
(including radionuclides)	99.9879	99.6330	99.9959	99.9574	99.9970	99.9840	99.9765	99.9940
% Organics	0.0089	0.3670	0.0041	0.0426	0.0030	0.0160	0.0235	0.0060
% Gasous Components	0.0032							

TABLES D AND E AND FIGURES A-5.1 THROUGH A-5.9

FROM

"THERMOGRAVIMETRIC ANALYSIS OF
SEVEN GEOTECHNICAL SAMPLE GROUPS,"
CRSP-FO-60, COOPERATIVE REMEDY SCREENING PROGRAM,
INTERIM REPORT, UNIVERSITY OF CINCINNATI, APRIL 1994

Date: 10/10/95
Rev.: A RE: CT

WBS No.: 1.1.1.1.1.3.1
ERA/CRU No.: 1/PO-145

Table D - Description of Composite Sample Groups

Group Designation	Group Composition		
	Sample #	Pit #	USCS Classification
NP1	5A*	1	NP
	5B	1	NP
	23A*	4	NP
NP2	40A	5	NP
	40B	5	NP
	41A*	5	NP
	41B	5	NP
	43A	6	NP
	43B	6	NP
SM	9A	2	SM
	9B	2	SM
	52A	CW	SM
	52B	CW	SM
ML	29A*	BP	ML
	46A*	6	ML
	46B	6	ML
MH1	31A	5	MH
	33A	5	MH
	33B	5	MH
	35A*	5	MH
	35B	5	MH
	58A*	5	MH
	58B	5	MH
MH2	11A*	2	MH
	11B	2	MH
	16A*	3	MH
	16B	3	MH
CL	21A*	4	CL
	21B	4	CL
	25A	4	CL

* Sample was part of the representative 17 chosen for hydrometer and G_s tests.

000393

Table E - Summary of TGA Results

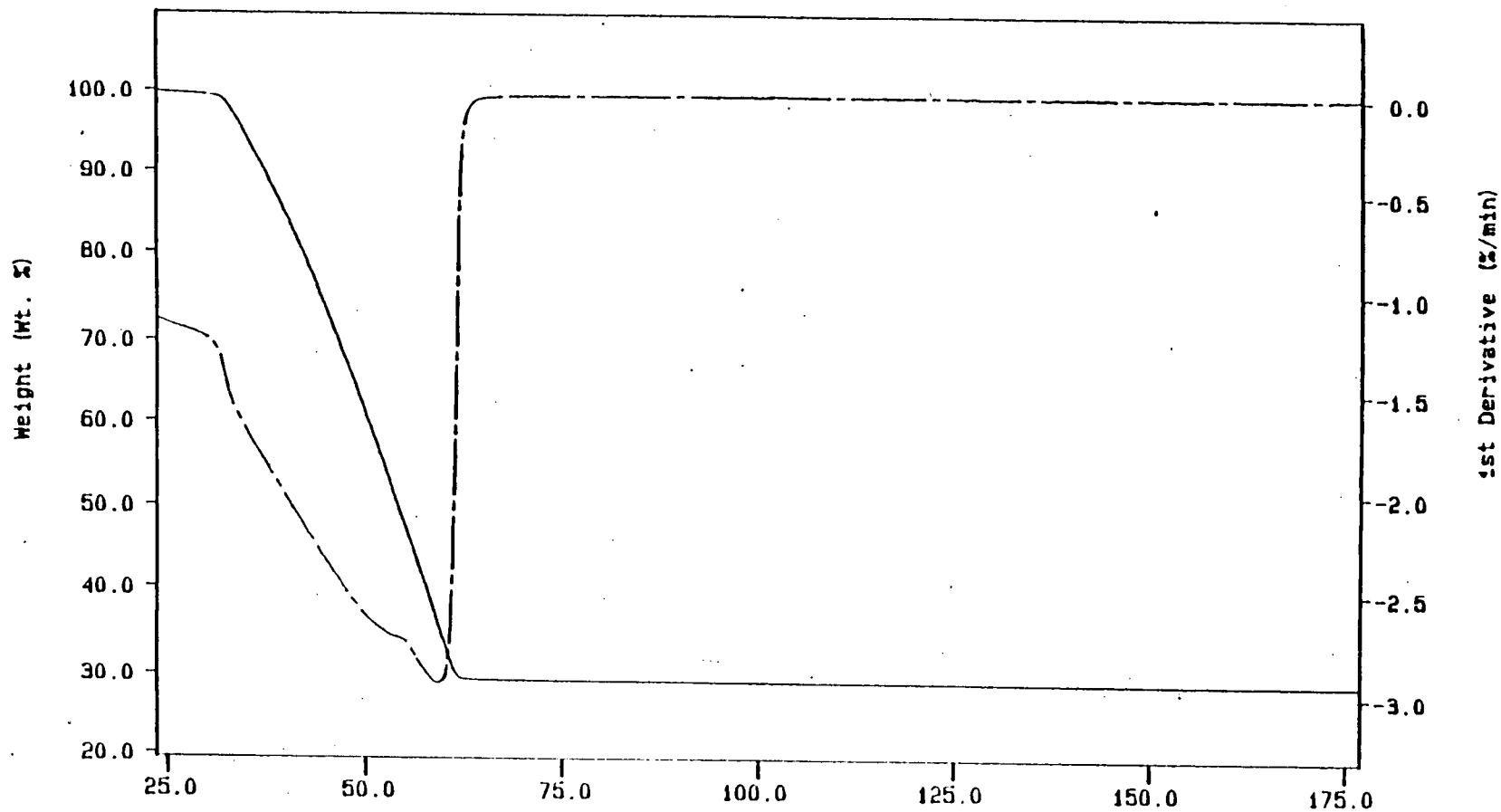
Sample ID (1)	Ramp Rate C/min (2)	Weight of Air Dried Sample, mg (3)	Weight of Sample + Water, mg (4)	Moisture Content, % (air-dried Basis) (5)	Weight of Sample at ~ 105C (6)	Moisture Content, % (Oven-dried Basis) (7)
NP1-TGA1	1	9.474	30.494	222	8.987	239
NP1-TGA2	4	8.944	34.739	288	8.638	302
NP1-TGA3	1	9.749	32.970	238	9.141	261
NP2-TGA1	1	9.319	31.571	239	9.152	245
NP2-TGA2	4	9.360	44.378	374	8.503	422
NP2-TGA3	1	9.754	32.949	238	9.452	249
MH1-TGA1	1	10.450	36.609	250	9.974	267
MH1-TGA2	4	9.620	35.655	271	8.861	302
MH1-TGA3	1	9.670	32.876	240	9.221	257
MH2-TGA1	1	9.087	35.224	288	8.942	294
MH2-TGA2	4	10.324	29.976	190	9.767	207
MH2-TGA3	1	8.960	29.732	232	8.531	249
ML-TGA1	1	9.817	31.308	219	9.729	222
ML-TGA2	4	9.638	34.461	258	9.430	265
ML-TGA3	1	10.443	32.890	215	10.160	224
CL-TGA1	1	9.348	46.048	393	9.023	410
CL-TGA2	4	10.865	37.348	244	10.578	253
CL-TGA3	1	10.514	37.337	255	10.332	261
SM-TGA1	1	10.436	35.345	239	10.232	245
SM-TGA2	4	9.337	38.466	312	8.900	332
SM-TGA3	1	9.456	39.977	323	9.035	342

Column 5 = [(Column 4 - Column 3)/Column 3] x 100%
Column 7 = [(Column 4 - Column 6)/Column 6] x 100%

TGA File Name: np21
Sample Weight: 31.571 mg
Fri Jul 26 15:49:06 1991
NP2-TGA1

PERKIN-ELMER
7 Series Thermal Analysis System

TGA 1st Derivative: np21
Sample Weight: 31.571 mg
Fri Jul 26 15:49:06 1991
NP2-TGA1



jnk & alb

TEMP 1: 30.0 C TIME 1: 0.0 min RATE 1: 1.0 C/min
TEMP 2: 100.0 C TIME 2: 18.0 min RATE 2: 1.0 C/min
TEMP 3: 180.0 C

TEMP 1: 30.0 C TIME 1: 0.0 min RATE 1: 1.0 C/min
TEMP 2: 100.0 C TIME 2: 18.0 min RATE 2: 1.0 C/min
TEMP 3: 180.0 C

Figure A-5.1
Appendix 5
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Date: 10/10/95
Rev.: A RE: CT

WBS No.: 1.1.1.1.1.3.1
ERA/CRU No.: 1/PO-145

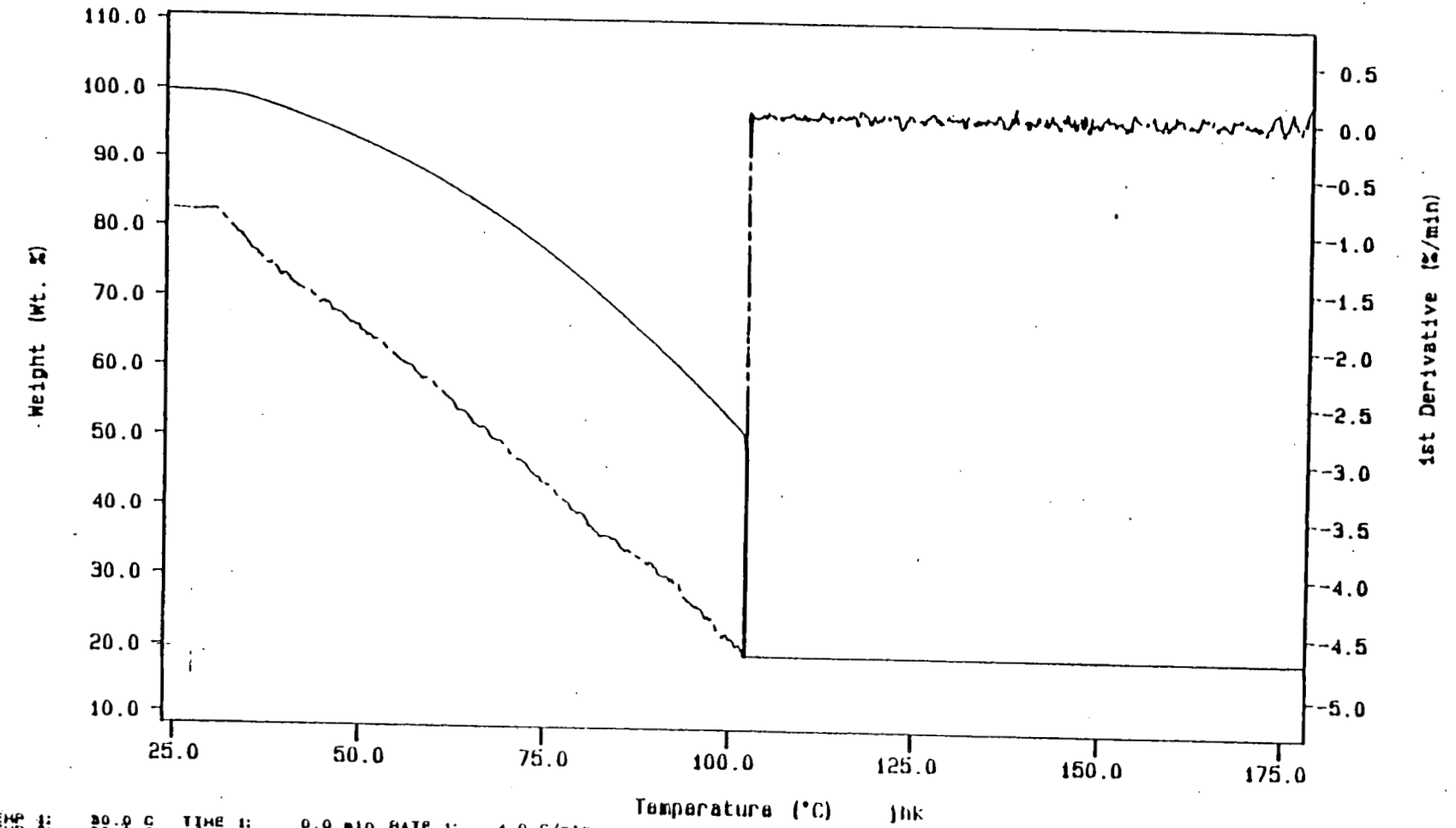
000394

0163

TGA File Name: np22
Sample Weight: 44.378 mg
Fri Jul 26 09:48:38 1991
np2-tga2

PERKIN-ELMER
7 Series Thermal Analysis System

TGA 1st Derivative: np22
Sample Weight: 44.378 mg
Fri Jul 26 09:48:38 1991
np2-tga2



TEMP 1: 30.0 C TIME 1: 0.0 min RATE 1: 4.0 C/min
TEMP 2: 100.0 C TIME 2: 15.0 min RATE 2: 4.0 C/min
TEMP 3: 180.0 C

TEMP 1: 30.0 C TIME 1: 0.0 min RATE 1: 4.0 C/min
TEMP 2: 100.0 C TIME 2: 15.0 min RATE 2: 4.0 C/min
TEMP 3: 180.0 C

Date: 10/10/95
Rev.: A RE: CT

Figure A-5.2
Appendix 5
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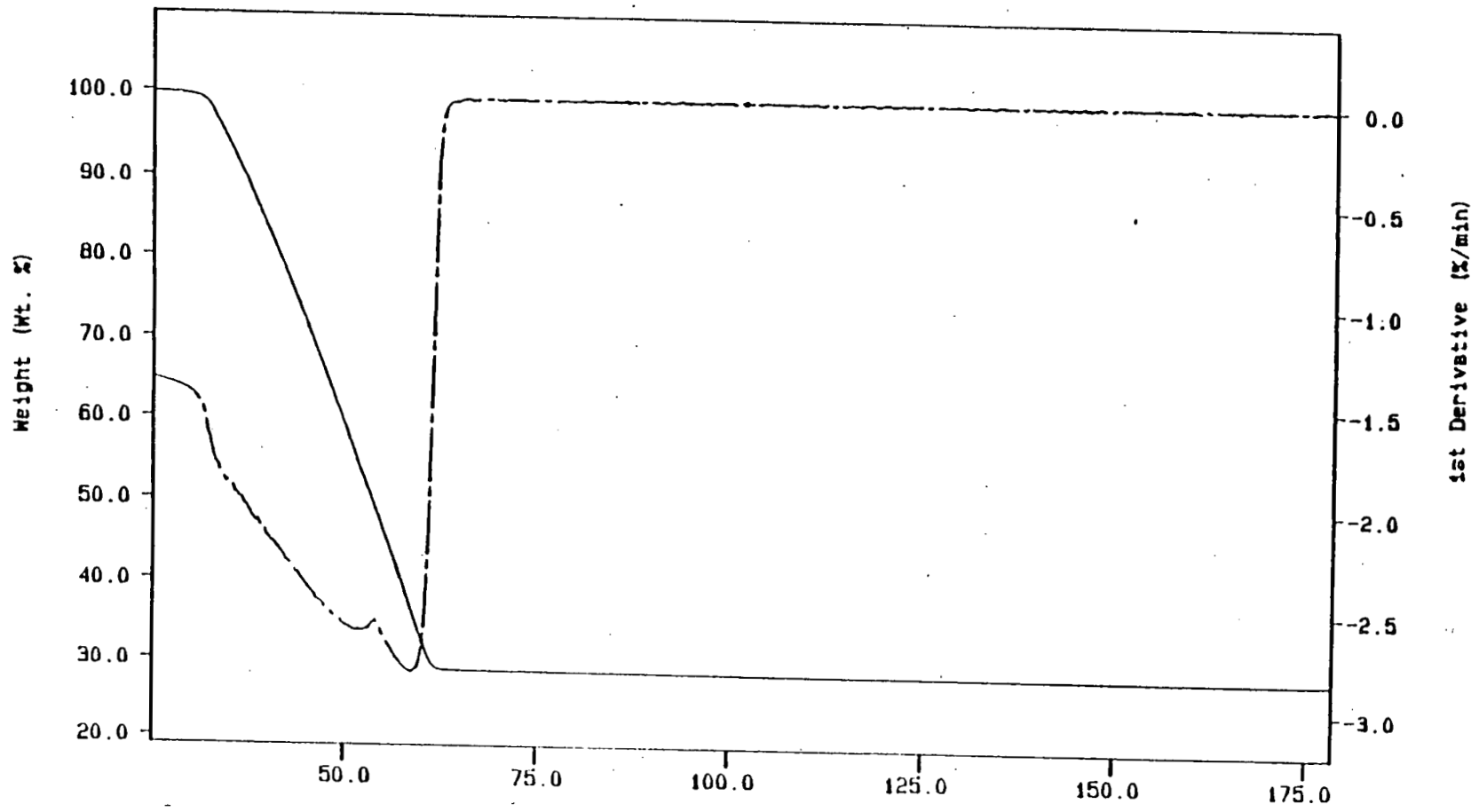
WBS No.: 1.1.1.1.1.3.1
ERA/CRU No.: 1/PO-145

TGA File Name: np23
Sample Weight: 32.949 mg
Fri Jul 26 19:21:23 1991
NP2-TGA3

PERKIN-ELMER
7 Series Thermal Analysis System

TGA 1st Derivative: np23
Sample Weight: 32.949 mg
Fri Jul 26 19:21:23 1991
NP2-TGA3



TEMP 1: 30.0 C TIME 1: 0.0 min RATE 1: 1.0 C/min
TEMP 2: 100.0 C TIME 2: 18.0 min RATE 2: 1.0 C/min
TEMP 3: 180.0 C

jhk

TEMP 1: 30.0 C TIME 1: 0.0 min RATE 1: 1.0 C/min
TEMP 2: 100.0 C TIME 2: 18.0 min RATE 2: 1.0 C/min
TEMP 3: 180.0 C

Date: 10/10/95
Rev.: A RE: CT

Figure A-5.3
Appendix 5
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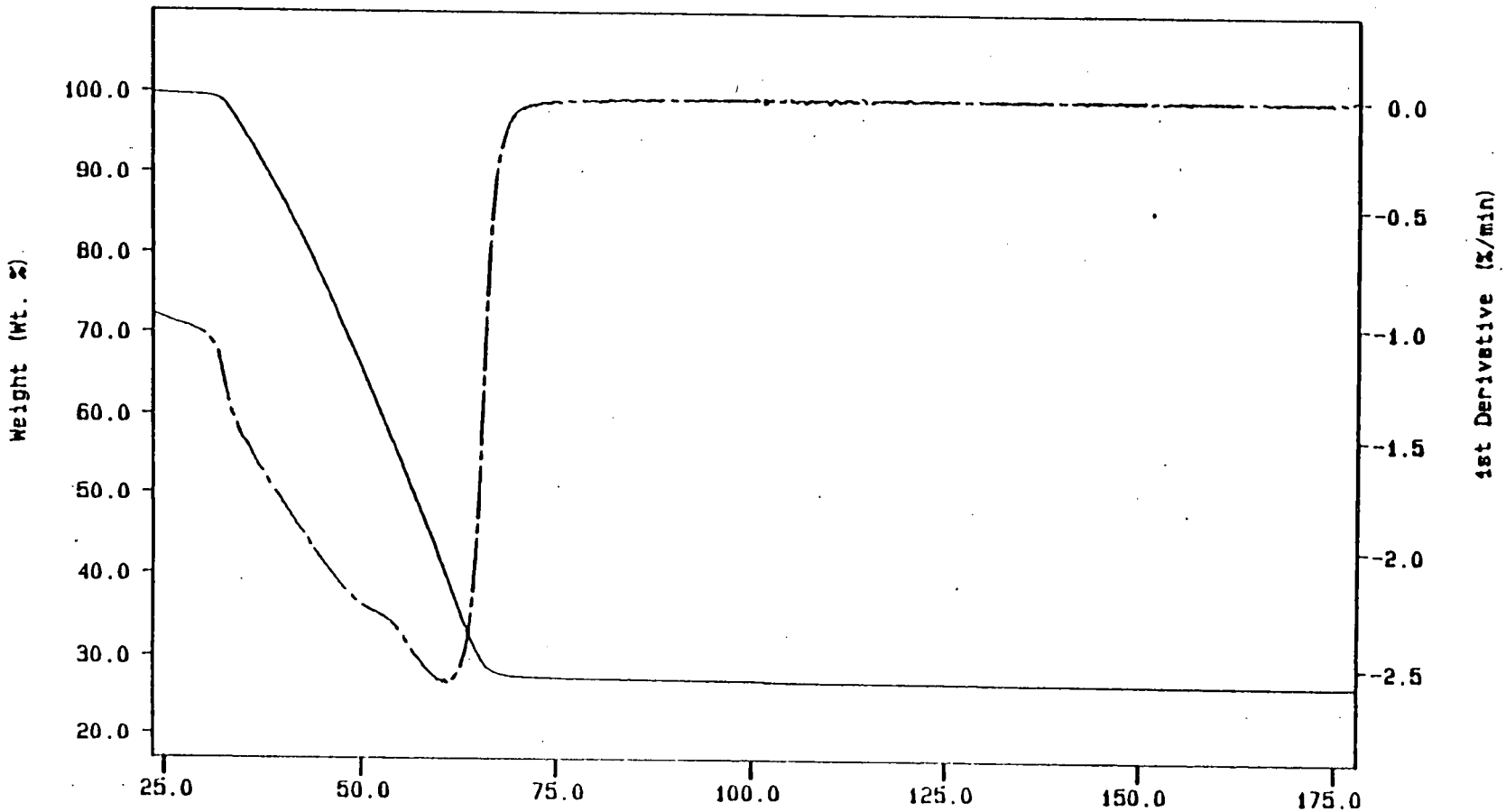
WBS No.: 1.1.1.1.1.3.1
ERA/CRU No.: 1/PO-145

TGA File Name: mh11
Sample Weight: 36.609 mg
Fri Jul 26 18:54:03 1991
MH1-TGA1

PERKIN-ELMER
7 Series Thermal Analysis System

TGA 1st Derivative: mh11
Sample Weight: 36.609 mg
Fri Jul 26 18:54:03 1991
MH1-TGA1



TEMP 1: 30.0 C TIME 1: 0.0 min RATE 1: 1.0 C/min
TEMP 2: 100.0 C TIME 2: 18.0 min RATE 2: 1.0 C/min
TEMP 3: 180.0 C

TEMP 1: 30.0 C TIME 1: 0.0 min RATE 1: -1.0 C/min
TEMP 2: 100.0 C TIME 2: 18.0 min RATE 2: 1.0 C/min
TEMP 3: 180.0 C

Figure A-5.4
Appendix 5
22 of 33

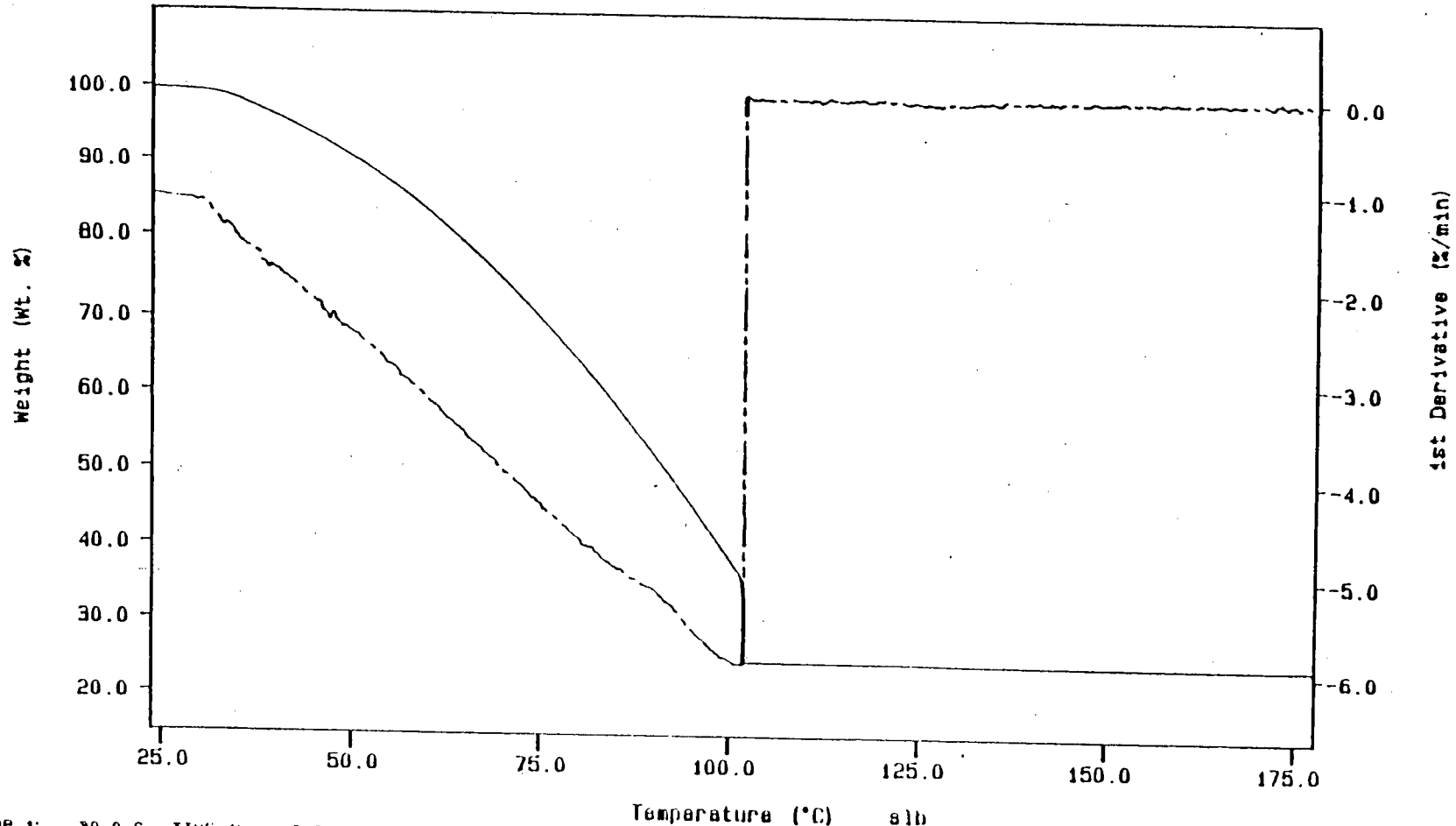
Date: 10/10/95
Rev.: A RE: CT

WBS No.: 1.1.1.1.1.3.1
ERA/CRU No.: 1/PO-145

TGA File Name: mh12
Sample Weight: 35.655 mg
Fri Jul 26 09:55:57 1991
MH1-TGA1

PERKIN-ELMER
7 Series Thermal Analysis System

TGA 1st Derivative: mh12
Sample Weight: 35.655 mg
Fri Jul 26 09:55:57 1991
MH1-TGA1



TEMP 1: 30.0 C TIME 1: 0.0 min RATE 1: 4.0 C/min
TEMP 2: 100.0 C TIME 2: 15.0 min RATE 2: 4.0 C/min
TEMP 3: 180.0 C

TEMP 1: 30.0 C TIME 1: 0.0 min RATE 1: 4.0 C/min
TEMP 2: 100.0 C TIME 2: 15.0 min RATE 2: 4.0 C/min
TEMP 3: 180.0 C

Date: 10/10/95
Rev.: A RE: CT

Figure A-5.5
Appendix 5
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WBS No.: 1.1.1.1.1.3.1
ERA/CRU No.: 1/PO-145

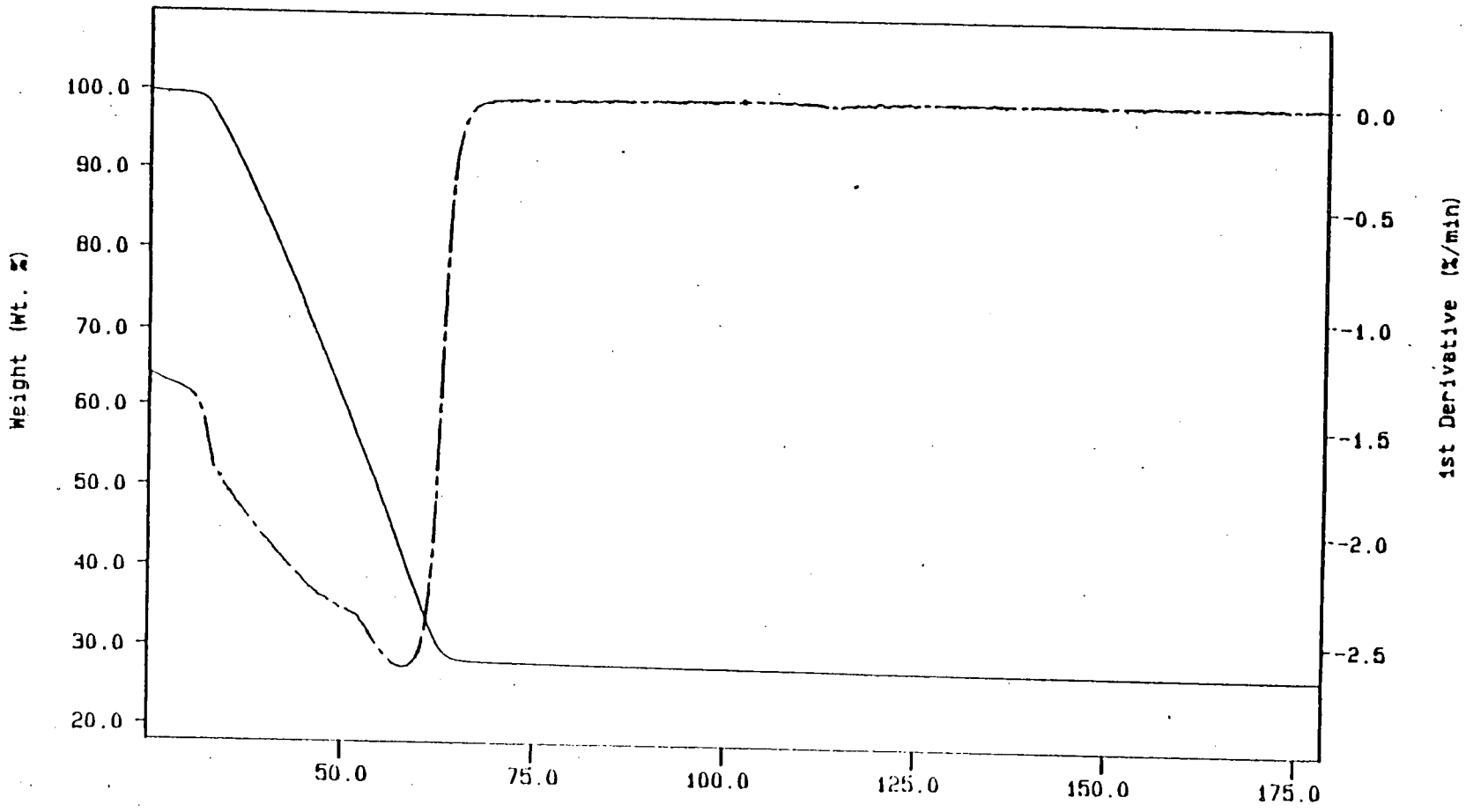
0003138

0163

TGA File Name: mh13
Sample Weight: 32.876 mg
Fri Jul 26 23:09:25 1991
MH1-TGA3

PERKIN-ELMER
7 Series Thermal Analysis System

TGA 1st Derivative: mh13
Sample Weight: 32.876 mg
Fri Jul 26 23:09:25 1991
MH1-TGA3



TEMP 1: 30.0 C TIME 1: 0.0 min RATE 1: 1.0 C/min
TEMP 2: 100.0 C TIME 2: 10.0 min RATE 2: 1.0 C/min
TEMP 3: 180.0 C

TEMP 1: 30.0 C TIME 1: 0.0 min RATE 1: 1.0 C/min
TEMP 2: 100.0 C TIME 2: 10.0 min RATE 2: 1.0 C/min
TEMP 3: 180.0 C

Figure A-5.6

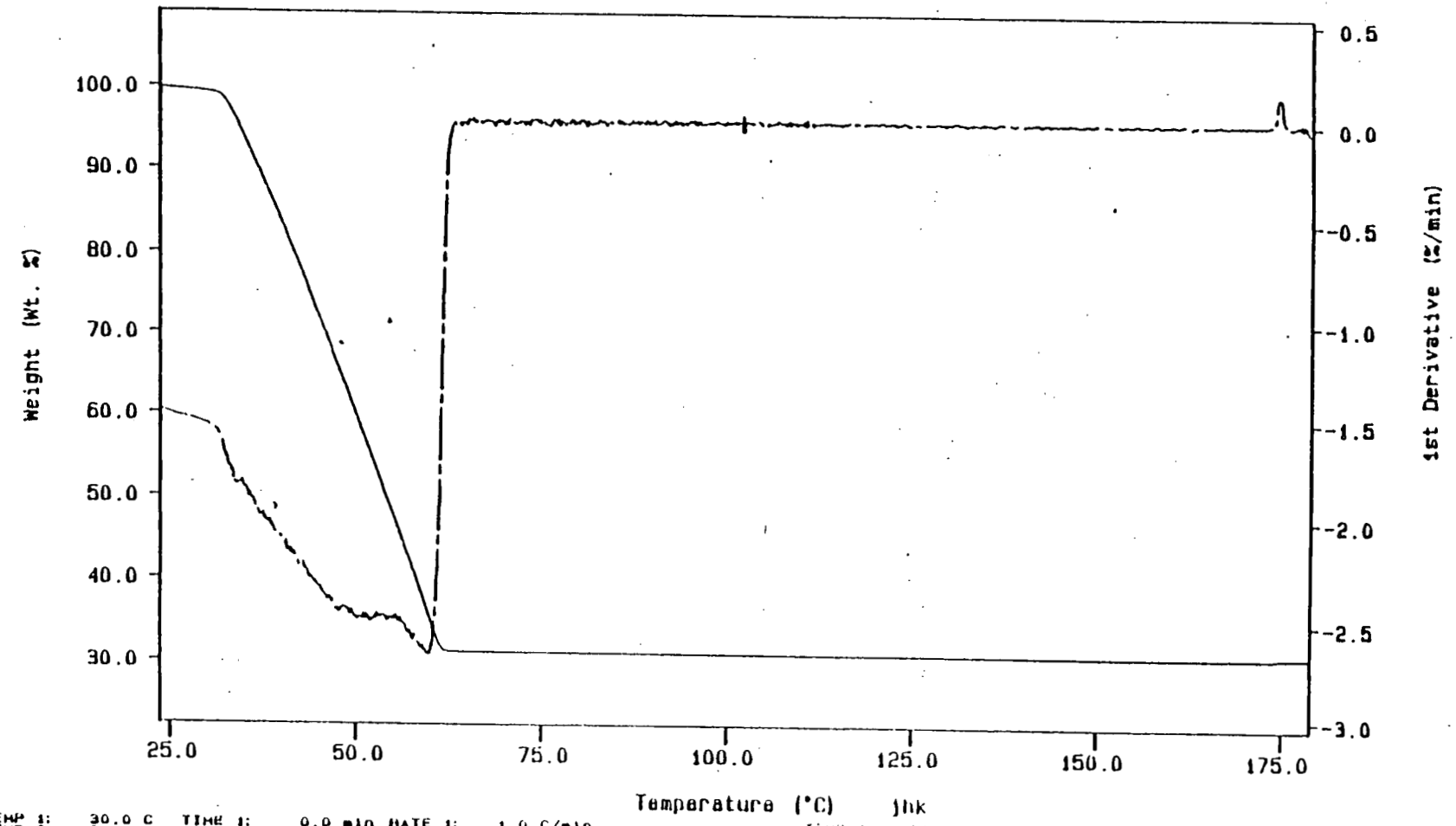
Date: 10/10/95
Rev.: A RE: CT

WBS No.: 1.1.1.1.1.3.1
ERA/CRU No.: 1/PO-145

TGA File Name: ml1
Sample Weight: 31.308 mg
Fri Jul 26 11:28:00 1991
ML-TGA1

PERKIN-ELMER
7 Series Thermal Analysis System

TGA 1st Derivative: ml1
Sample Weight: 31.308 mg
Fri Jul 26 11:28:00 1991
ML-TGA1



TEMP 1: 30.0 C TIME 1: 0.0 min RATE 1: 1.0 C/min
TEMP 2: 100.0 C TIME 2: 10.0 min RATE 2: 1.0 C/min
TEMP 3: 180.0 C

TEMP 1: 30.0 C TIME 1: 0.0 min RATE 1: 1.0 C/min
TEMP 2: 100.0 C TIME 2: 10.0 min RATE 2: 1.0 C/min
TEMP 3: 180.0 C

Figure A-5.7

Date: 10/10/95
Rev.: A RE: CT

WBS No.: 1.1.1.1.1.3.1
ERA/CRU No.: 1/PO-145

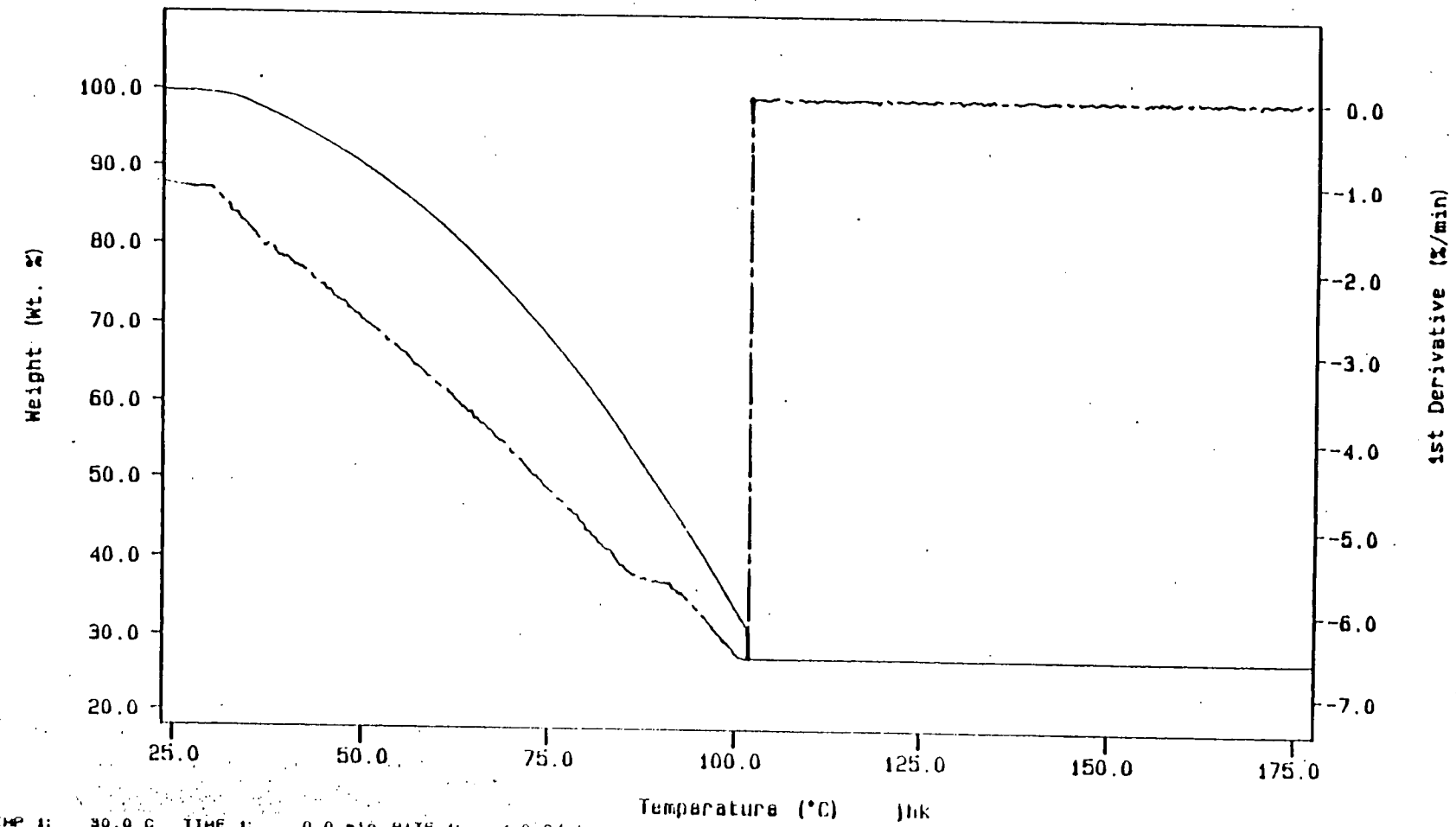
000400

0163

TGA File Name: ml2
Sample Weight: 34.461 mg
Fri Jul 26 16:08:12 1991
ML-TGA2

PERKIN-ELMER
7 Series Thermal Analysis System

TGA 1st Derivative: ml2
Sample Weight: 34.461 mg
Fri Jul 26 16:08:12 1991
ML-TGA2



TEMP 1: 30.0 C TIME 1: 0.0 min RATE 1: 4.0 C/min
TEMP 2: 100.0 C TIME 2: 15.0 min RATE 2: 4.0 C/min
TEMP 3: 180.0 C

jhk

TEMP 1: 30.0 C TIME 1: 0.0 min RATE 1: 4.0 C/min
TEMP 2: 100.0 C TIME 2: 15.0 min RATE 2: 4.0 C/min
TEMP 3: 180.0 C

Date: 10/10/95
Rev.: A RE: CT

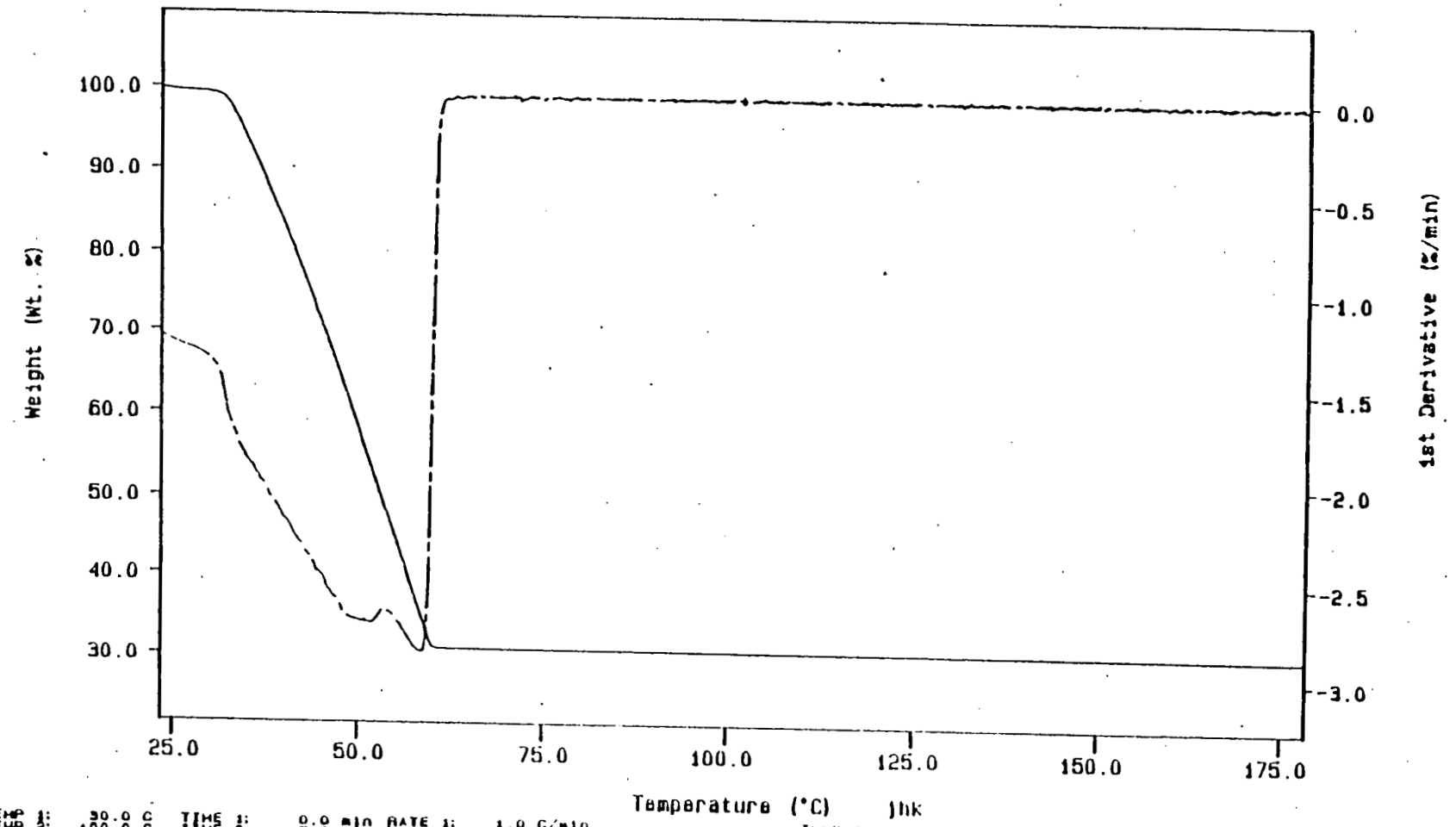
Figure A-5.8

WBS No.: 1.1.1.1.1.3.1
ERA/CRU No.: 1/PO-145

TGA File Name: ml3
Sample Weight: 32.890 mg
Fri Jul 26 14:10:56 1991
ML-TGA3

PERKIN-ELMER
7 Series Thermal Analysis System

TGA 1st Derivative: ml3
Sample Weight: 32.890 mg
Fri Jul 26 14:10:56 1991
ML-TGA3



TEMP 1: 30.0 C TIME 1: 0.0 min RATE 1: 1.0 C/min
TEMP 2: 100.0 C TIME 2: 15.0 min RATE 2: 1.0 C/min
TEMP 3: 160.0 C

TEMP 1: 30.0 C TIME 1: 0.0 min RATE 1: 1.0 C/min
TEMP 2: 100.0 C TIME 2: 15.0 min RATE 2: 1.0 C/min
TEMP 3: 160.0 C

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Figure A-5.9
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WBS No.: 1.1.1.1.1.3.1
ERA/CRU No.: 1/PO-145

TABLES F AND G AND FIGURES A-5.10 THROUGH A-5.13

MODIFIED FROM
REPORT OF EXECUTION OF SURROGATE WASTE DRYING TESTS
PARSONS, OU1, PO-19, REVISION A, AUGUST 1994

Date: 10/10/95
Rev.: A RE: CT

WBS No.: 1.1.1.1.1.3.1
ERA/CRU No.: 1/PO-145

Table F - Specification of Basic Surrogate Materials
(Dry Weights)

Basic Surrogate Material ID	Particle Size Range (mm)	Equivalent U.S. Sieve Series	Description of Material
A	0.075 - 4.76	-4/+200	Sand**
B1	0.002 - 0.075	-200	Ground Silica
B2	0.002 - 0.075	-200	Chemicals*
C	<0.002	N/A	Kaolin
D	<0.002	N/A	Bentonite

* 60 wt% Al_2O_3 + 10 wt% $Ca(OH)_2$ + 30 wt% MgO

** Ohio Department of Transportation Specification 703.02 for Concrete Sand. ASTM C-33 for fine aggregate, or equivalent.

Table G - Surrogate Feed Blends
(Dry Basis)

Surrogate Feed	Basic Surrogate Material ID				Plasticity Index (±15%)	Plastic Limit (±15%)
	A	B	C	D		
	wt%	wt% (B1/B2)	wt%	wt%		
1	80	20 (20/0)	0	0	NP	NP
2	25	50 (20/30)	25	0	15	30
3	0	54 (0/54)	30	16	40	55
4	30	60 (20/40)	10	0	20	20

000405

Surrogate Feed Type 1 - Nonplastic

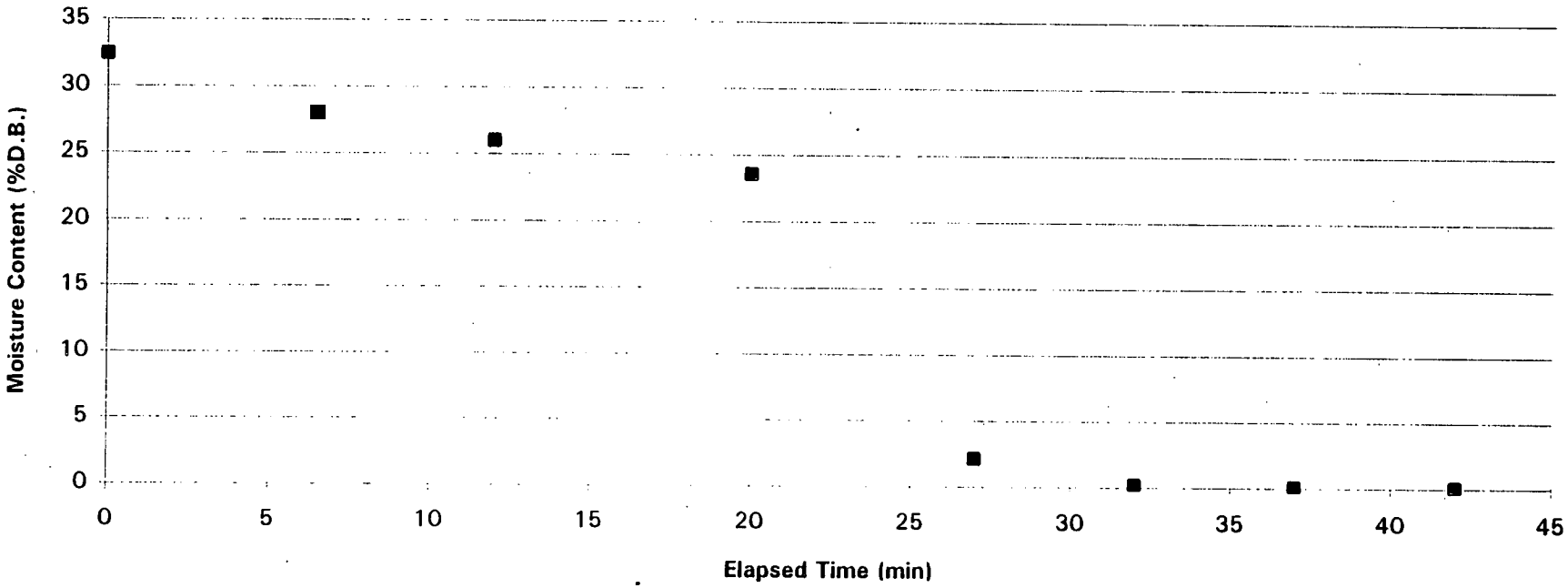

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Figure A-5.10
Appendix 5

WBS No.: 1.1.1.1.1.3.1
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Surrogate Feed Type 2 - Low-Plasticity Silt

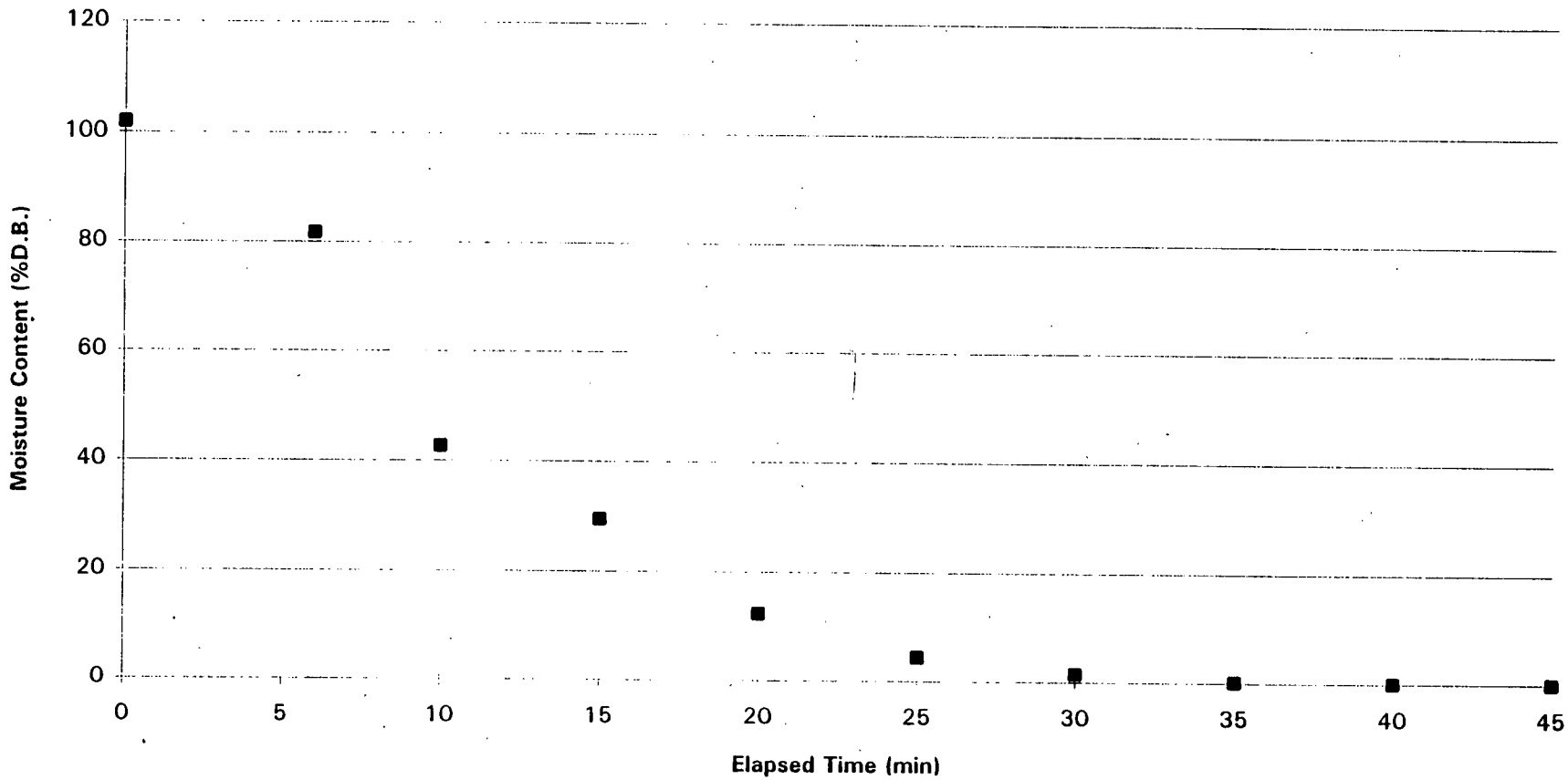

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Figure A-5.11
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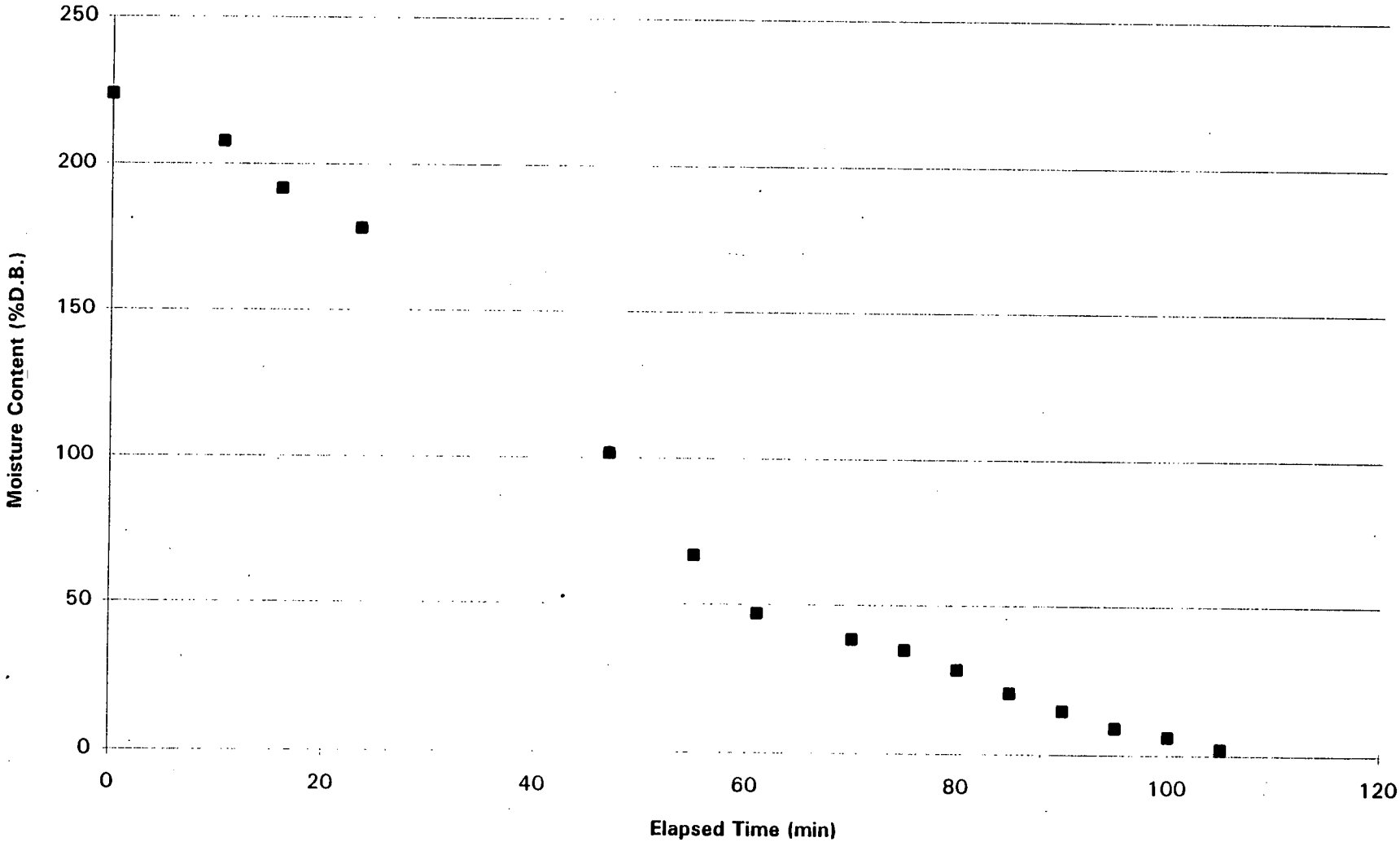
ERA/CRU No.: 1/PO-145

000407

Surrogate Feed Type 3 - High-Plasticity Silt



Date: 10/10/95
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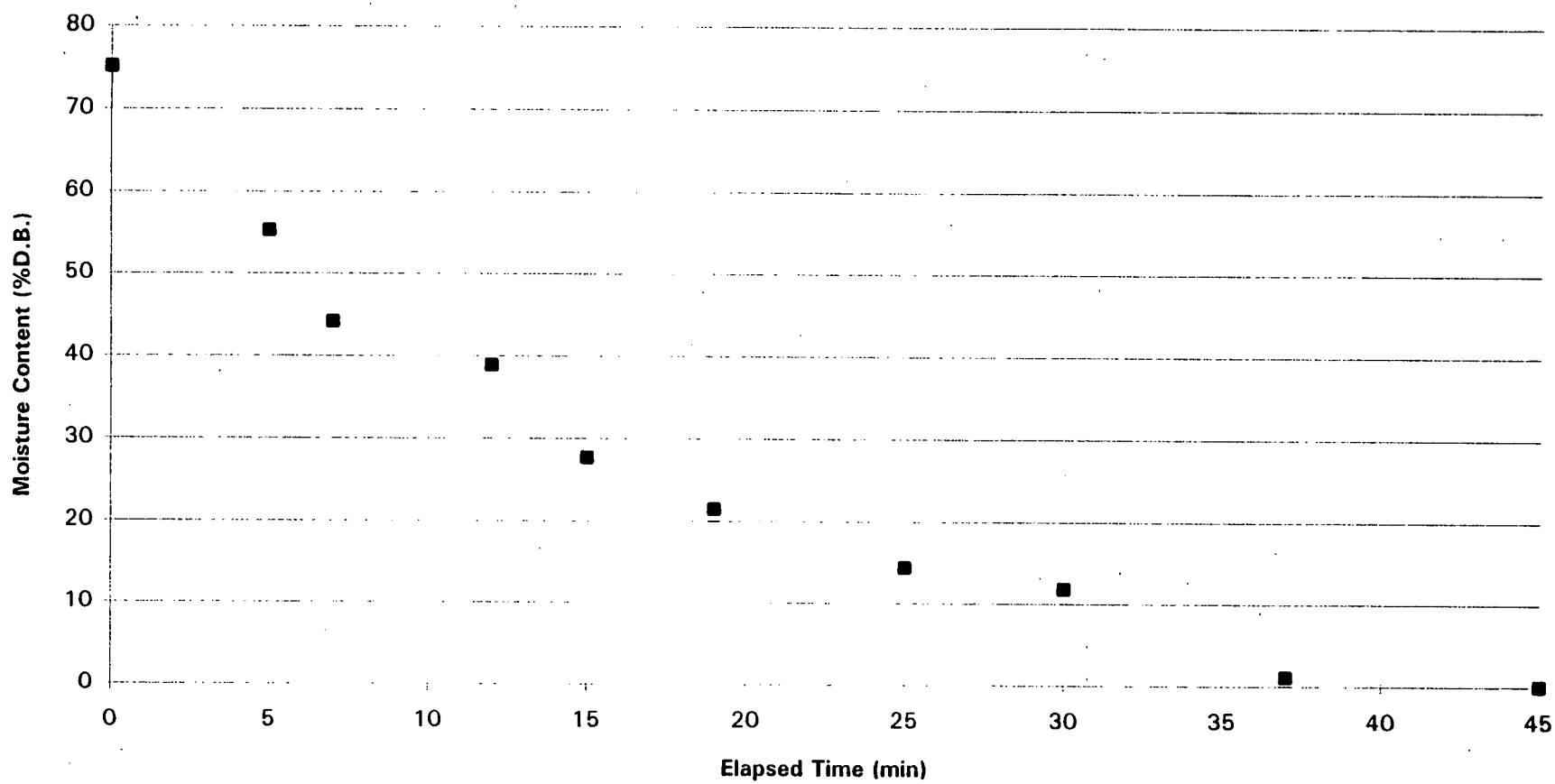
Figure A-5.12
Appendix 5

WBS No.: 1.1.1.1.1.3.1
ERA/CRU No.: 1/PO-145

Surrogate Feed Type 4 - Low-Plasticity Clay



Date: 10/10/95
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Figure A-5.13
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WBS No.: 1.1.1.1.1.3.1
ERA/CRU No.: 1/PO-145

0004008

0163

SECTION 15060
PIPE, FITTINGS, VALVES, AND ACCESSORIES

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Aboveground piping, fittings, valves, and accessories.

1.2 RELATED SECTIONS

A. Section 01010 - General Requirements.

B. Section 15090 - Piping Supports and Anchors.

C. Section 15250 - Insulation.

D. Section 16856 - Heating Cables and Panels.

1.3 REFERENCES, CODES, AND STANDARDS

A. American Society of Mechanical Engineers (ASME):
1. ASME A13.1-81 Scheme for the Identification of Piping Systems (R1985).
2. ASME B16.5-88 Pipe Flanges and Flanged Fittings.
3. ASME B31.3-93 Chemical Plant and Petroleum Refinery Piping.
4. ASME Boiler and Pressure Vessel Code (BPVC), Section IX-92.

B. American Society for Nondestructive Testing (ASNT):
1. ASNT-SNT-TC-1A-92 Recommended Practice, December 1992 Edition.

C. American Society for Testing and Materials (ASTM):
1. ASTM-A53-94 Pipe, Steel, Black and Hot-Dipped, Zinc-Coated Welded and Seamless.
2. ASTM-A105/A105M-95 Forgings, Carbon Steel, for Piping Components.
3. ASTM A182/ Forged or Rolled Alloy Steel

	A182M-94c	Pipe Flanges, Forged Fittings, and Valves and Parts for High-Temperature Service.
4.	ASTM-A193/ A193M-94c	Alloy-Steel and Stainless Steel Bolting Materials for High-Pressure and High-Temperature Service.
5.	ASTM-A194/ A194M-94a	Carbon and Alloy Steel Nuts for Bolts for High-Pressure and High-Temperature Service.
6.	ASTM-A216/ A216M-93	Steel Castings, Carbon, Suitable for Fusion Welding, for High Temperature Service.
7.	ASTM-A234/ A234M-95	Piping Fittings of Wrought Carbon Steel and Alloy Steel for Moderate and Elevated Temperatures.
8.	ASTM-A307-94	Carbon Steel Bolts and Nuts.
9.	ASTM B61-93	Steam or Valve Bronze Castings.
10.	ASTM-B62-93	Composition Bronze or Ounce Metal Castings.

D. American Welding Society (AWS):

1.	AWS A5.1-91	Carbon Steel Electrodes for Shielded Metal Arc Welding.

1.4 SYSTEM DESCRIPTION

A. Design Requirements

1. The pipe, fittings, valves, and accessories shall convey all working fluids between items of process equipment.

1.4 SUBMITTALS

A. Piping drawings, and process and instrumentation diagrams, as applicable.

B. Product Data.

C. Shop drawings.

D. Certificates of Conformance: Manufacturer shall certify and provide data which indicates that all supplied products meet or exceed specification requirements.

E. Test Procedures: Submit written procedures for all required testing. Test procedures shall include criteria for acceptable performance.

F. Detailed description of packaging materials and procedures including cleaning and closure of all openings.

G. Procedure for repair or replacement of piping failing pressure tests.

H. Flushing procedure.

I. Welder qualification, inspector qualifications, procedure qualification records, and welding procedure specification in accordance with the ASME BPVC, Section IX.

J. Pressure test reports.

1.6 QUALITY ASSURANCE

A. Except where more stringent requirements are specified or indicated, the work specified herein shall conform to ASME B31.3.

B. Welding Procedures and Qualifications

1. Welding procedures, welder qualifications, fabrication, assembly, and erection shall be in accordance with ASME B31.3, Chapter V and ASME BPVC, Section IX.
2. Welder and inspector qualifications shall be made available to, and approved by, the FERMCO Construction Contracts Manager.
3. Welding inspections shall be in accordance with ASME B31.3, Chapter VI.
4. Nondestructive testing personnel qualifications shall be in accordance with ASNT SNT-TC-1A.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Packaging

1. Packaging shall conform to acceptable industrial practices. Materials shall be cleaned to remove chips, slag, weld spatter, oil, grease, debris, and other foreign material prior to packaging for shipment. Pipe spool openings shall be covered, capped, or plugged to prevent ingress of foreign materials during shipment and storage. Tape alone shall not be used for sealing openings. Closures used for covering, capping, or plugging openings shall not be made of polyvinyl chloride (PVC) or other plastics that contain chloride.

B. Storage and Handling

1. Spool openings shall remain sealed.
2. Piping materials and prefabricated assemblies shall be stored off the ground and handled with care so that physical damage to the piping materials does not occur. End seals of pipe, flange covers, valve covers, and similar protection shall not be removed until necessary for cleaning, fabrication, inspection, and erection.
3. Piping materials shall be identified, inspected, controlled, and protected in a manner that will assure conformance with the applicable codes and specifications.
4. Care shall be taken in the storage and handling of all piping materials and prefabricated assemblies so that contamination by grease, moisture, or other foreign matter does not occur.
5. Welding rods and electrodes shall be stored, handled, and identified at all times to ensure the use of the proper welding rod. The electrode ovens for the storage of low-hydrogen welding rods must be used to maintain storage humidity.
6. Austenitic stainless steel materials shall be stored separately from carbon steel materials.

PART 2 PRODUCTS

2.1 PRODUCTS/EQUIPMENT

A. Product Shipping Requirements

1. The Subcontractor shall be responsible for the delivery of all job related materials and/or equipment to the job site. All furnished materials and equipment shall be delivered clean, undamaged, and in a workable condition.
2. Flanges, pipe, fittings, spool pieces, and valves, whether flanged, screwed, or socket welded, shall be shipped with protective end and/or flange covers.
3. All piping shall be thoroughly cleaned prior to shipping to remove grease, oil, mill scale, and other foreign matter.

B. Piping and Valve Specification

1. All piping and valve materials shall meet the requirements as indicated on the attached piping material data sheets.

2.2 MATERIALS

A. Procurement

1. All piping materials shall be procured in accordance with the piping material data sheets.
2. Quarter turn valves shall be used to the maximum extent practical in the liquid and air piping services.
3. For slurry applications (including drains), quarter turn, full port valves shall be used, if practicable.

2.3 FABRICATION

A. Welding

1. All welding shall be in accordance with the applicable codes.
2. All socket welds shall be made by shielded metal arc or gas tungsten arc welding process.

3. Socket weld joints shall be assembled so that the space between the end of the pipe and the bottom of the socket is no less than 1/16 inch and no more than 1/8 inch.

B. Shop Assembly

1. Any parts made in a fabrication shop shall be completely shop assembled prior to shipment to the site.

C. Shop/Factory Finish

1. All carbon steel parts shall be prime coated after fabrication.

2.4 SOURCE QUALITY CONTROL

A. Testing

1. Shop testing shall be in accordance with ASME B31.3.

B. Inspection

1. Inspection shall be conducted in accordance with ASME B31.3.

2.5 LABELING

A. Valve Identification

1. Each valve shall be identified with the unique valve number, as shown on the Subcontractor Piping and Instrumentation Diagrams, embossed on a stainless steel identification tag permanently attached to the valve by a stainless steel wire. Lettering shall be a minimum of 3/8 inch high. The tag shall not be attached to any part of the valve which may interfere with valve operation.
2. Valve identification tags on insulated valves shall be located outside the insulation jacketing and be easily accessible for inspection.

B. Pipe Identification

1. Identify the flow medium and the flow direction for all piping systems including insulated pipe by labeling adjacent to each valve, adjacent to where

the pipe passes through a wall or floor, adjacent to abrupt pipe directional change, and at intervals of 50 feet along exposed pipe. Pipes shall be labeled as indicated on the Subcontractor Piping and Instrumentation Diagrams and in accordance with ASME A13.1.

2. Content, size, material type, line number, and insulation requirements for each pipeline shall be identified on the drawings as follows:

Example SL - 2" - A - 7000 - ET

Medium Code	Size	Material Code	Line Number	Insulation
SL*	2"	A	7000***	ET**

* See attached piping material data sheet service index for medium codes.
** ET indicates that the pipeline is electric heat traced.
*** Use different number series for each service.

C. Product Marking

1. All piping materials, welding rods, and electrodes shall be marked and identified in accordance with the applicable codes.

PART 3 EXECUTION

3.1 EXAMINATION

A. Examination shall be in accordance with ASME B31.3.

3.2 PREPARATION

A. Protection

1. All welding/fabricating activities shall be protected from inclement weather at all times.

B. Primer Application

1. All non-insulated carbon steel piping shall be prime coated after fabrication.

3.3 ERECTION/INSTALLATION/APPLICATION

A. Layout, Cutting, and Fitting Up

1. All piping, tubing, fittings, components, welding, bonding, fabrication, erection, and assembly shall be in accordance with ASME B31.3. Piping 2 inches in diameter and smaller shall be field routed and supported in accordance with Section 15090 of this specification package.
2. Slurry pipelines shall be sized to maintain a velocity in the 4 to 7 feet per second range to prevent settling of solids.

B. Flanged Joints

1. All flanged joints shall be assembled in accordance with ASME B31.3.
2. Where a raised-face flange mates with a flat-face flange, it shall be substituted with a flat-face flange of the material type specified on the attached Piping Material Data Sheet.
3. Flat ring-type gaskets shall be used between steel flanges equipped with raised serrated faces.
4. Where metallic flanges are bolted to non-metallic flanges, both shall be flat-faced flanges. Full-face gaskets shall be used.
5. When valves, fittings, or equipment having cast iron flanges are used, mating flanges shall be flat faced with full-faced gaskets.
6. Flange isolation kits shall be used between dissimilar metal flanges where galvanic corrosion may occur.

3.4 FIELD QUALITY ASSURANCE

A. Inspections and Tests

1. Piping shall be hydrostatically or pneumatically pressure tested in accordance with ASME B31.3.
2. All pressure vessels, equipment, in-line instruments, gauge glasses, flow meter, and all other pressure parts of instruments shall not be included in these tests if they will be damaged by the test pressure.

3. Equipment which is not to be subjected to the pressure test shall be disconnected from the piping and a pipe spool inserted in its place, or the equipment may be isolated by way of a single-line blind.

B. Hydrostatic Testing

1. Potable water or other approved fluids shall be used for hydrostatic pressure testing of piping systems in accordance with ASME B31.3.
2. All test pressures shall be maintained a minimum of 10 minutes before visual examination of joints begins. Hydrostatic test pressures shall be as shown in the following table:

SERVICE	MEDIUM CODE	DESIGN PRESSURE (psig)	TEST PRESSURE (psig)
Drain	DR	100	150
Condensate	LC	100	150
Slurry	SL	100	150
Process Water	TW	100	150
Live Steam	LS	150	225
Backwash	BW	100	150
Cooling Water Supply	WS	100	150
Cooling Water Return	WR	100	150
Process Wastewater	CE	100	150

C. Pneumatic Testing

1. Pneumatic test pressures shall be as shown in the following table:

SERVICE	MEDIUM CODE	DESIGN PRESSURE	TEST PRESSURE
Plant Air	PA	100 psig	110 psig
Instrument Air	IA	100 psig	110 psig
Fuel Gas	FG	100 psig	110 psig
Off-Gas	OG	-35 in w.g.	15 psig

D. Hydrostatic/Pneumatic Test Reports

1. The Subcontractor shall provide a report for each piping system tested containing the following information:
   a. Date of test.
   b. Line designation number.
   c. Test fluid.
   d. Type of test.
   e. Pressure applied.
   f. Start time.
   g. Completion time
   h. Total time at test pressure.
   i. Certification by examiner of acceptability.
   j. Calibration test gauge number and calibration date.
   k. Comments, if any.

3.5 CLEANING

A. System Cleaning and Flushing

1. The interior and exterior of all pipe shall be kept clean at all times.
2. After erection and welding of piping, all lines except air and gas shall be flushed with potable water prior to leak testing or hydrostatic testing. Upon completion of flushing, lines shall be drained at all low points.

END OF SECTION

ATTACHMENT 1 OF SECTION 15060

Latest Rev					SERVICE INDEX (FOR GENERAL REFERENCE ONLY; SEE PIPING MATERIAL DATA SHEETS FOR SPECIFIC DETAILS)										
Page					MAT'L CODE (SPEC)	FLANGE RATING	MAX PRESS	TEMP RANGE	SERVICE	PIPE MATERIAL	BOLTS	SMALL FITTINGS	VALVES	
										CRSN ALLOW	GASKETS		BODY	TRIM
					A	150# RF	ASME B16.5	-20° F TO 750° F	DRAIN (DR), SLURRY (SL), PROCESS WASTEWATER (CE), CONDENSATE (LC), LIVE STEAM (LS), COOLING WATER (WS)(WR), BACKWASH (BW), FUEL GAS (FG), OFF-GAS (OG)	CARBON STEEL 0.063	B7 304 SS GRAPHITE	SW AND SCREWED	CS	
					W	150# RF	ASME B16.5	-20° F TO 250° F	PLANT AIR (PA), INSTRUMENT AIR (IA), PROCESS WATER (TW)	CARBON STEEL 0.063	ASTM A307 RUBBER	SCREWED	BRONZE AND CS	

PARSONS ERA PROJECT	SHEET 1 OF 1	JOB NUMBER	DOCUMENT NUMBER	REV
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024000

0163

SERVICE:	PIPING MATERIAL DATA SHEET (SEE SERVICE INDEX)	MAT'L CODE (SPEC)	A
		PAGE 1	OF 3

RATING: CLASS 150
FACING: RF
MATERIAL:CARBON STEEL

CORROSION ALLOWANCE: 0.063
PRESSURE LIMIT: PER ASME/ANSI B16.5
TEMPERATURE LIMIT: -20°F TO 750°F

CODE NUMBER	ENCODER	SIZE FROM	TO	DESCRIPTION	NOTES	REV
				PIPE		
		1/2" - 2"		SEAMLESS CARBON STEEL, ASTM A53 GRADE B, EXTRA STRONG, PLAIN ENDS		
		2-1/2" - LARGER		SEAMLESS CARBON STEEL, ASTM A53 GRADE B, STANDARD WEIGHT, BEVELED ENDS		
				FLANGES		
		1/2" - 2"		CLASS 150, CARBON STEEL, RF, ASTM A105, SOCKETWELD (XS BORE)		
		2-1/2" - LARGER		CLASS 150, CARBON STEEL, RFSF, ASTM A105, WELD NECK (STANDARD WEIGHT BORE)		
				ORIFICE FLANGES		
		2-1/2" - LARGER		CLASS 300, CARBON STEEL, ASTM A105, RF WITH 1/2" SCREWED TAPS AND JACK SCREWS, WELD NECK (STANDARD WEIGHT BORE)		
				FITTINGS		
		1/2" - 2"		CLASS 3000, CARBON STEEL, ASTM A105, SOCKETWELD		
		1/2" - 2"		CLASS 3000, SCREWED CARBON STEEL, ASTM A105;		
				THREADOLET	1	
				PLUG, ROUNDHEAD	1	
				CAP	1	
				PLUG, HEX HEAD	4	
		2-1/2" - LARGER		SEAMLESS CARBON STEEL, BUTT WELD ENDS, ASTM A234 GRADE WPB		

PARSONS ERA PROJECT	JOB NUMBER	DOCUMENT NO.	Rev
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SERVICE:	PIPING MATERIAL DATA SHEET (SEE SERVICE INDEX)	MAT'L CODE (SPEC)	A
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CODE NUMBER	ENCODER	SIZE FROM	SIZE TO	DESCRIPTION	NOTES	REV
				SWAGES		
		1/2" - 8"		SCHEDULE 80 CARBON STEEL, ASTM A234, GRADE WPB, PREPARE ENDS AS REQUIRED (BEVELED, PLAIN OR THREADED)	2	
				GASKETS		
		1/2" - LARGER		CLASS 150, SPIRAL WOUND, 304SS WITH FLEXIBLE GRAPHITE FILLER 1/8" THICK.		
				BOLTING		
		1/2" - LARGER		STUD BOLTS WITH 2 HEAVY HEX NUTS, ASTM A193 GR B7/ASTM A194 GR 2H		
				PIPING INSTRUMENT CONNECTIONS		
				PRIMARY INSTRUMENT CONNECTIONS TO PIPING:		
				TEMPERATURE CONN. 1-1/2" FLANGED VALVE@ PRESS CONN. 3/4" SW/SCRD VALVE@ ORIFICE FLG. 1/2" SW/SCRD		
				BALL VALVES		
		1/2" - 2"		CLASS 600, CARBON STEEL, ASTM A105, THREE PIECE, SOCKETWELD, CHROME PLATED BALL, TFE SEATS, WRENCH OPERATOR		
		2-1/2" - 4"		CLASS 150, CARBON STEEL, ASTM A216, GRADE WCB, RFSF FLANGE, CHROME PLATED BALL, TFE SEATS, WRENCH OPERATOR		
		6" - LARGER		CLASS 150, CARBON STEEL, ASTM A216, GRADE WCB, RFSF, CHROME PLATED BALL, TFE SEATS, GEAR OPERATOR		
				PLUG VALVES		
		1/2" - 2"		CLASS 150, CARBON STEEL, ASTM A216, GRADE WCB, THREADED ENDS, REINFORCED PTFE SEATS	5	
		2-1/2" - LARGER		CLASS 150, CARBON STEEL, ASTM A216, GRADE WCB, RF FLANGED ENDS, REINFORCED PTFE SEATS	5	

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CODE NUMBER	ENCODER	SIZE FROM	TO	DESCRIPTION	NOTES	REV
				CHECK VALVES		
		1/2" - 2"		CLASS 150, CAST STEEL, ASTM A216, GRADE WCB, RF FLANGE, SWING TYPE	3	
		2-1/2" - LARGER		CLASS 150, CAST STEEL, ASTM A216, GRADE WCB, RF, FLANGE, CHROME TRIM, BOLTED COVER, INTEGRAL SEAT, SWING TYPE	3	
				GATE VALVES		
		1/2" - 2"		CLASS 150, CARBON STEEL, ASTM A105, CHROME TRIM, O S AND Y, SOCKETWELD ENDS		
		2-1/2" - LARGER		CLASS 150, CAST STEEL, ASTM A216, GRADE WCB, RF FLANGE, CHROME TRIM, O S AND Y, SOLID WEDGE DISC, INTEGRAL SEAT		
				GLOBE VALVES		
		1/2" - 2"		CLASS 800, CARBON STEEL, ASTM A105, SOCKETWELD, WELDED BONNET, 12% CHROME TRIM, HANDWHEEL OPERATOR		
		2-1/2" - LARGER		CLASS 150, CARBON STEEL, ASTM A216 GRADE WCB.RF FLANGE, 12% CHROME TRIM, HANDWHEEL OPERATOR		
				PIPE NIPPLES		
				CARBON STEEL, ASTM A53, GRADE B		
		1/2" - 2"		SCH 160, TBE, SMLS 3" LONG		
		1/2" - 2"		SCH 160, TBE, SMLS 6" LONG		
		1/2" - 2"		SCH 160, POE-TOE, SMLS 3" LONG		
		1/2" - 2"		SCH 160, POE-TOE, SMLS 6" LONG		
				STEAM TRAPS		
		1/2" - 2"		CLASS 600, SCREWED, DISC TYPE, INTEGRAL STRAINER, LOW CARBON CHROME-MOLY BODY, ASTM A-182, GRADE F-11		
				NOTES		
				1. USE FOR UNVALVED VENTS AND DRAINS. 2. USE SWAGES WHERE SMALL END IS 2" AND SMALLER. USE WELD REDUCER WHERE SMALL END IS 2-1/2" AND LARGER. 3. INSTALL IN HORIZONTAL POSITION OR WITH FLOW UP. 4. USE FOR PROCESS DRAINS. 5. USE FOR FUEL GAS ONLY, DEAD-TIGHT SHUTOFF IS REQUIRED.		

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PIPING MATERIAL DATA SHEET SERVICE: (SEE SERVICE INDEX)	MAT'L CODE W (SPEC) PAGE 1 OF 3

RATING: CLASS 150
FACING: RF
MATERIAL: GALVANIZED CARBON STEEL

CORROSION ALLOWANCE: 0.0625"
PRESSURE LIMIT: to 150 psig
TEMPERATURE LIMIT: -20°F TO 250°F

CODE NUMBER	ENCODER	SIZE FROM	SIZE TO	DESCRIPTION	NOTES	REV
				PIPE		
		1/2" - 2"		SEAMLESS GALVANIZED CARBON STEEL, ASTM A53, GRADE A, EXTRA STRONG, THREAD AND COUPLE ENDS		
		2-1/2" - LARGER		SEAMLESS CARBON STEEL, ASTM A53, GRADE A, STANDARD WEIGHT, BEVELED ENDS		
				FLANGES		
		1/2" - 2"		CLASS 150, GALVANIZED CARBON STEEL, RF, ASTM A105, SCREWED (XS BORE)		
		2-1/2" - LARGER		CLASS 150, CARBON STEEL, RFSF, ASTM A105, WELD NECK (STD WT BORE)		
				ORIFICE FLANGES		
		2-1/2 " - LARGER		CLASS 300, CARBON STEEL, ASTM A105, RF WELD NECK WITH 1/2" SCREWED TAPS AND JACK SCREWS (STD WT BORE)		
				FITTINGS		
		1/2" - 2"		CLASS 3000, GALVANIZED CARBON STEEL, ASTM A105, SCREWED		
		1/2" - 2"		CLASS 3000, GALVANIZED CARBON STEEL, ASTM A105, SCREWED		
				THREADOLET	1	
				PLUG, ROUNDHEAD	1	
				CAP	1	
				PLUG, HEX HEAD	3	
		2-1/2 " - LARGER		SEAMLESS CARBON STEEL, STANDARD WEIGHT, ASTM 234, GRADE WPB, BUTT WELD ENDS		

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RATING: CLASS 150
FACING: RF
MATERIAL: GALVANIZED CARBON STEEL

CORROSION ALLOWANCE: 0.0625"
PRESSURE LIMIT: 150 psig
TEMPERATURE LIMIT: -20°F TO 250°F

			SWAGES		
		1/2" - 8"	SCHEDULE 80, CARBON STEEL, ASTM A234, GRADE WPB, PREPARE ENDS AS REQUIRED (BEVELED OR THREADED)	2	
			GASKETS		
		1/2" - LARGER	CLASS 150, RED RUBBER, 1/8" THICK	4	
			BOLTING		
		1/2" - LARGER	MACHINE BOLT WITH 1 HEAVY HEX NUTS, ASTM A307, GRADE B (CADMIUM PLATED)		
			PIPING INSTRUMENT CONNECTIONS		
			PRIMARY INSTRUMENT CONNECTIONS TO PIPING: TEMPERATURE CONN 1-1/2" FLG'D VALVE AT PRESS CONN'S 3/4" SCRD VALVE AT ORIFICE FLGE 1/2" SCRD		
			BALL VALVES		
		1/2" - 2"	200 WOG, BRONZE, THREADED ENDS, REINFORCED TFE SEATS, CHROME-PLATED BALL, WRENCH OPERATOR		
		2 1/2" - 4"	CLASS 150, CARBON STEEL, RF FLANGE, ASTM A216, GRADE WCB, TFE SEATS, CHROME-PLATED BALL, WRENCH OPERATOR		
		6" - LARGER	CLASS 150, CARBON STEEL, ASTM A216, GRADE WCB, RFSF, CHROME PLATED BALL, TFE SEATS, GEAR OPERATOR		
			CHECK VALVES		
		1/2" - 2"	CLASS 150, BRONZE, THREADED ENDS, ASTM B61, SWING TYPE, BRONZE TRIM		
		2 1/2" - LARGER	CLASS 150, CARBON STEEL, RF FLANGE, ASTM A216, GRADE WCB, CHROME TRIM, BOLTED COVER, INTEGRAL SEAT, SWING TYPE.		

PIPING MATERIAL DATA SHEET SERVICE: (SEE SERVICE INDEX)	MAT'L CODE W (SPEC) PAGE 3 OF 3

RATING: CLASS 150
FACING: RF
MATERIAL: GALVANIZED CARBON STEEL

CORROSION ALLOWANCE: 0.0625"
PRESSURE LIMIT: 150 psig
TEMPERATURE LIMIT: -20°F TO 250°F

	GATE VALVES
1/2" - 2"	CLASS 150, BRONZE, THREADED ENDS, ASTM B62, BRONZE BONNET, HANDWHEEL OPERATOR
2 1/2" - LARGER	CLASS 150, CARBON STEEL, RF FLANGE, ASTM 216, GRADE WCB, O.S.& Y, CHROME TRIM, HANDWHEEL OPERATOR
	GLOBE VALVES
1/2" - 2"	CLASS 150, BRONZE, THREADED ENDS, ASTM B62, BRONZE TRIM, HANDWHEEL OPERATOR
2 1/2" - LARGER	CLASS 150, CARBON STEEL, RF FLANGE, ASTM A216, GRADE WCB, O.S.&Y CHROME TRIM, HANDWHEEL OPERATOR
	PIPE NIPPLES
1/2" - 2"	SCH 160, TBE, SMLS, 3" LONG
1/2" - 2"	SCH 160, TBE, SMLS, 6" LONG
1/2" - 2"	SCH 160, POE-TOE, SMLS, 3" LONG
1/2" - 2"	SCH 160, POE-TOE, SMLS, 6" LONG

NOTES

1. USE FOR UNVALVED VENTS AND DRAINS.
2. USE SWAGES WHERE SMALL END IS 2" AND SMALLER. USE WELD REDUCER WHERE SMALL END IS 2-1/2" AND LARGER.
3. USE FOR PROCESS DRAINS.
4. USE WITH ORIFICE FLANGES ONLY.

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SECTION 15090
PIPING SUPPORTS AND ANCHORS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Design of all piping supports and anchors.

B. Furnishing and installing all piping system hangers, supports, clamps, rods, turnbuckles, bracing, rolls, plates, brackets, saddles, restraints, anchors, and other support elements as required.

1.2 RELATED SECTIONS

A. Section 01010 - General Requirements.

B. Section 15060 - Pipe, Fittings, Valves, and Accessories.

1.3 REFERENCES, CODES, AND STANDARDS

A. American Society for Testing and Materials (ASTM):
1. ASTM A36/A36M-94 Structural Steel.

B. American National Standards Institute (ANSI)/American Society of Mechanical Engineers (ASME):
1. ANSI/ASME B31.3-93 Chemical Plant and Petroleum Refinery Piping.

C. Manufacturers Standardization Society (MSS):
1. MSS-SP-58-93 Pipe Hangers and Supports - Materials, Design, and Manufacture.
2. MSS-SP-69-91 Pipe Hangers and Supports - Selection and Application.
3. MSS-SP-89-91 Pipe Hangers and Supports - Fabrication and Installation Practices.

D. American Welding Society (AWS):

1. AWS A5.1-91 Carbon Steel Electrodes for Shielded Metal Arc Welding.
2. AWS D1.1-94 Structural Steel Welding Code.

1.4 SYSTEM DESCRIPTION

A. Design Requirements

1. All pipe anchors, guides, and auxiliary steel shall be of bolted or welded construction incorporating a design safety factor of five.
2. Anchors and guides shall be used to prevent excessive forces or moments on pipe or equipment caused by hydraulic surges.
3. Hangers and support types for all process lines shall be selected to withstand all static and dynamic load conditions and shall take into consideration limitations imposed by the surrounding structures, equipment, adjacent piping, ventilation and heating ductwork, and electrical trays. The consideration shall be given to the following loads:
   a. Weight of the pipe, valves, fittings, insulation materials, hanger components, and normal fluid contents.
   b. Weight of the hydrostatic test fluid or cleaning fluid, if normal operating fluid density is less than test or cleaning fluid.
   c. Loads imposed during erection.
4. Support Spacing:
   a. Hangers and supports shall be spaced in accordance with ASME B31.3 and the attached allowable pipe spans chart. Due consideration shall be given to assure that the sag of the pipe between supports is within limits that will permit drainage and avoid excessive bending stresses from concentrated loads.
5. Restrictions:
   a. Pipe support assemblies shall be used only for supporting pipelines. Electrical trays, instrument trays, cable, or tubing shall be supported from separate assemblies unless

written approval has been received from the FERMCO Construction Contracts Manager. Pipe hanger rods or supports shall not pass through heat or ventilating ducts and electrical or instrument trays.

6. Pipe shoes:
   a. Pipe shoes for steam and condensate piping shall be 12 inches long, attached to the longitudinal run of pipe, and centered on the structural member.
7. Heat Traced Pipe:
   a. Electric-traced pipe lines shall rest on support steel, adjustable roller hangers, or an adjustable pipe roll and base attached to a horizontal steel member. Insulation shall be cut away at support to facilitate installation.

1.5 SUBMITTALS

A. Certificate of Conformance: Manufacturer shall certify and provide data which indicate that all products supplied meet or exceed specification requirements.

B. Product data.

C. Shop drawings which indicate type and location, arrangement, dimensions, materials, and anchor details.

D. Manufacturer's installation instructions and catalog data.

1.6 QUALITY ASSURANCE

A. All pipe anchors, guides, and auxiliary steel shall be of bolted or welded construction. Welded construction shall comply with AWS D1.1.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Packaging

1. Materials shall be cleaned to remove chips, slag, weld spatter, oil and grease, debris, and other foreign matter prior to packing for shipment.

B. Storage and Handling

1. Piping support materials and piping hanger systems shall be stored off the ground and handled with care so that physical damage or contamination of the materials does not occur.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Grinnell Supply Sales Company.

B. Piping Technology and Products, Inc.

C. Basic Engineers, Inc.

2.2 PRODUCTS/EQUIPMENT

A. Product Shipping Requirements

1. The Subcontractor shall be responsible for the delivery of all job-related materials and/or equipment to the job site.

2.3 MATERIALS

A. Hangers and component parts shall be constructed of galvanized carbon steel and comply with MSS-SP-58 and MSS-SP-69.

B. Pipe clamps shall comply with ASTM A576 and be constructed of galvanized carbon steel.

C. ASTM A36 steel shall be used for all plate and structural shape support components.

2.4 FABRICATION

A. Welding
1. All welding shall be in accordance with AWS A5.1 and AWS D1.1.

B. Shop Assembly
1. Any parts made in the fabricator's shop shall be completely shop assembled, as far as practical, prior to shipment to the site.

C. Shop/Factory Finish
1. All carbon steel parts shall be shop prime coated after fabrication.

2.5 LABELING

A. Product Marking
1. All welding rods and electrodes shall be identified with at least one imprint per rod showing an AWS classification number in accordance with AWS A5.1.

PART 3 EXECUTION

3.1 ERECTION/INSTALLATION/APPLICATION

A. Installation
1. Hanger and support components shall be installed in accordance with MSS-SP-89.

B. Structural Connections for Pipeline Supports
1. Locations: New pipeline supports and/or hangers shall be attached to structural members. The supports shall be located at the following places and at intermediate points so that the maximum support spacing per ASME B31.3 is not exceeded:
   a. For changes in direction on horizontal or sloped lines, refer to the attached allowable pipe spans chart.
   b. Both sides of flanged flow meter joints on horizontal or sloped lines.

c. Within 2 feet on one side of valves on horizontal or sloped lines.

d. The underside of floor or platform steel on vertical lines that pass through the floor or platform.

2. Cold Lines: Hanger rods supporting cold pipelines, or lines whose point of support does not move, may be bolted directly to angle, beam, or supporting members.

3. Prohibited Attachments: Pipelines shall not be attached to the following:

   a. Floor opening pipe sleeves.

   b. Grating or floor plate.

   c. ASME Coded Vessels.

   d. Other pipe hangers or other pipes.

4. Supports shall be provided to avoid the need for temporary supports in the following cases:

   a. Where regular maintenance necessitates the removal of equipment.

   b. Where flanged connections must be broken to remove or insert spectacle blinds.

5. Anchors and guides shall be designed and installed at the locations shown on the Subcontractor piping drawings.

3.2 ADJUSTING

A. At Pumps: Where required, the suction piping and discharge piping adjacent to pumps shall be supported with an adjustable support.

B. Riser Guides: All risers that may sway or vibrate from pump pulsations or mechanical equipment operation shall be guided. The guides/braces shall prevent movement resulting from equipment operation/vibration, but shall not limit or restrain movement of pipe due to thermal expansion. On overflow lines, a brace or restraint shall be installed near the discharge.

C. Vertical Adjustment

1. All rod-type hangers shall be provided with a means of vertical adjustment after erection. If a turnbuckle is used, the right hand thread shall be at the top, so that turning to the right will raise the pipe.

D. Riser Piping

1. Where practical, riser piping shall be supported independently of the connected horizontal piping. Pipe support attachments to riser piping shall be by riser clamps and/or lugs welded to the pipe.

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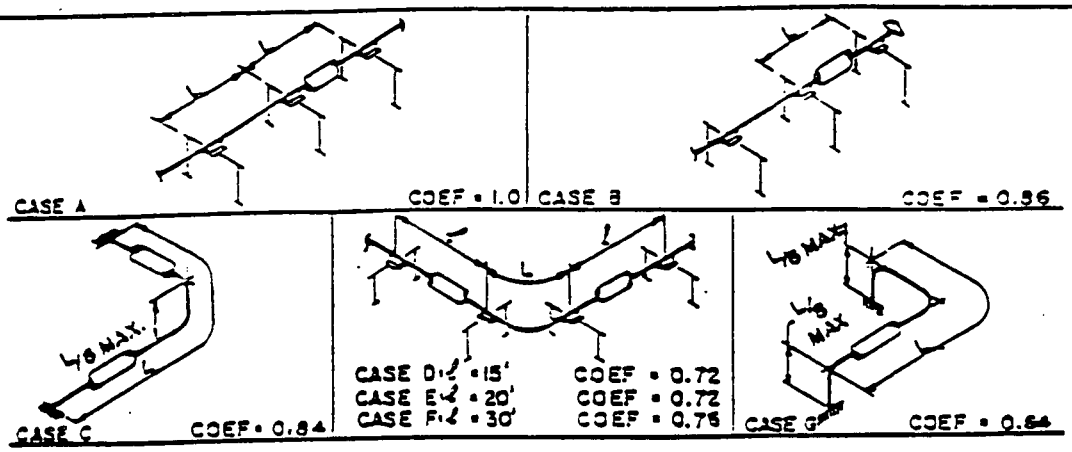
Subject

ALLOWABLE PIPE SPANS



Notes:

1. The limiting factors are deflection and weight stress. Pipe span not entered if weight stress of 6,000 pounds per square inch (psi) is exceeded.
2. The pipe spans are based on carbon steel pipe with modulus of elasticity of 30 x 10^6 psi. This chart can be applicable to alloy pipe.
3. Deflection is based on a compromise between a beam with fixed-ends and for a free-ended beam, d = 17.1 (wl^4/EI).
4. This chart is adequate for standard-wall and extra-strong walled pipe.
5. Boxed figures represent Parsons standard. Job instructions may allow deviation.
6. When using Cases B, C, D, E, F, and G, multiply pipe span by their coefficient.
7. These spans are the maximum to be used under American National Standards Institute B31.3, Piping. Design conditions and other codes should be investigated before using these spans.

PIPE SIZE	1	1 1/4	2	3	4	6	8	10	12	14	16	18	20	24	DEFL
BARE PIPE	—	—	—	—	—	—	—	36	38	42	45	47	50	54	1/4
	14	17	19	24	27	33	38	43	46	49	52	55	58	64	1/2
	15	18	21	25	29	35	40	46	49	[illegible]	55	58	62	68	5/8
	16	19	22	26	30	37	42	48	52	55	58	62	65	71	3/4
	17	21	23	28	32	40	45	—	—	—	—	—	—	—	1
BARE PIPE + WATER	—	—	—	—	—	—	—	31	33	35	36	37	39	42	1/4
	14	17	19	22	25	29	33	36	39	40	42	44	46	48	1/2
	14	18	20	23	26	31	35	39	41	43	45	47	48	52	5/8
	15	19	21	24	27	33	37	41	43	45	47	49	51	—	3/4
	16	20	22	26	29	35	40	—	—	—	—	—	—	—	1
PIPE + 2" INSUL.	—	—	—	—	—	—	—	34	36	39	42	44	47	52	1/4
	12	15	17	22	25	31	36	41	42	46	50	52	56	61	1/2
	13	16	18	23	26	33	38	43	45	49	53	56	59	65	5/8
	13	17	19	24	27	35	40	45	47	52	55	58	62	68	3/4
	14	18	20	26	28	37	42	—	—	—	—	—	—	—	1
PIPE + 2" INSUL. +0.8 WATER	—	—	—	—	—	—	—	31	33	35	36	37	39	42	1/4
	12	15	16	20	23	29	33	36	39	40	42	44	46	48	1/2
	12	16	17	22	25	31	35	39	41	43	45	47	48	52	5/8
	13	17	18	23	26	32	36	41	43	45	47	48	51	—	3/4
	14	18	20	25	29	34	39	—	—	—	—	—	—	—	1

END OF SECTION

SECTION 15171
MOTORS FOR INDIRECT DRYER

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Low voltage, three phase induction motors.

B. Low voltage, single phase induction motors.

1.2 RELATED SECTIONS

A. Section 11182 - Indirect Dryer Performance Specification.

B. Section 16051 - Basic Electrical Materials and Methods for Indirect Dryer.

1.3 REFERENCES

A. American Bearing Manufacturers Association (ABMA):
1. ABMA 9-90 — Load Ratings and Fatigue Life for Ball Bearings.
2. ABMA 11-90 — Load Ratings and Fatigue Life for Roller Bearings.

B. Institute of Electrical and Electronics Engineers (IEEE):
1. IEEE 112-91 — Standard Test Procedure for Polyphase Induction Motors and Generators.

C. National Electrical Manufacturers Association (NEMA):
1. NEMA MG 1-93 — Motors and Generators.
2. NEMA MG 13-84 — Frame Assignments for AC Integral-Horsepower Induction Motors.

D. National Fire Protection Association (NFPA):
1. NFPA 70-96 — National Electrical Code.

1.4 SYSTEM DESCRIPTION

A. Provide electric motors as required for the Indirect Dryer. Each motor shall be selected especially for its respective driven equipment. Each motor shall be adequate for the full range of the driven equipment's performance.

1.5 SUBMITTALS

A. Product Data: Provide data for motors, including full load amps, NEMA frame size, and additional standard nameplate data. Provide efficiency and power factor for each of 1/2, 3/4, and full load. Include catalog sheets and drawings showing voltage, ratings, impedances, normal and short circuit current ratings, dimensions, and enclosure details.

B. Operation and maintenance data. Include assembly drawings and bearing data, including replacement sizes and lubrication instructions.

C. Certificate of Conformance: Provide statement certifying that the materials supplied meet or exceed contract requirements.

D. Testing Procedures: Submit written procedures for all required testing. Test procedures shall include criteria for acceptable performance.

E. Manufacturer's installation instructions. Indicate application conditions and limitations of use stipulated by product testing agency. Include instructions for storage, handling, protection, examination, preparation, installation, and commissioning of products.

F. Recommended Spare Parts Lists: Provide, where applicable.

G. Submit Material Safety Data Sheets for all cutting oils, caulks, sealants, and all similar components.

H. Test Reports: Indicate satisfactory completion of required tests and inspections. Submit results verifying performance in accordance with IEEE 112.

I. Motor Data Sheets: Provide completed motor data sheet (Attachment 1) for each motor provided.

1.6 QUALITY ASSURANCE

A. Conform to NFPA 70 and NEMA MG1.

PART 2 PRODUCTS

The listing of equipment suppliers below in no way precludes the offerer from proposing alternate suppliers of any of the equipment to be furnished within the scope of this specification. This list of suppliers is intended to identify the type of equipment and general quality of that equipment that will be included in the offerer's proposal. It is the offerer's responsibility to propose equipment that is best suited for this project in combined terms of quality and price.

2.1 MANUFACTURERS

A. Reliance Electric.

B. U. S. Motors.

C. General Electric.

2.2 EQUIPMENT

A. General Construction and Requirements

1. Electrical Service: Refer to related sections of the specifications and the drawings for required characteristics.
2. Motors: Design for continuous operation at a temperature of 40 degrees C ambient, and for temperature rise in accordance with NEMA MG 1 limits for insulation class, service factor, and motor enclosure type. Motors to be controlled by variable frequency drives shall be of a design suitable for this type of operation.

3. Visible Nameplate: Indicating motor horsepower, voltage, phase, frequency, rpm, full load amps, locked rotor amps, frame size, manufacturer's name and model number, service factor, power factor, serial number, and bearing numbers. Nameplate shall be stainless steel, permanently attached to the motor frame.
4. Electrical Connection: Conduit connection boxes, threaded for conduit and designed to allow for 90 degree step rotation of the conduit entrance. Oversize conduit boxes shall be provided.
5. Motor Service Factor: Furnish motors with service factors required by table in Paragraph D. Motor size in hp shall be selected to serve the driven equipment over its full performance range as though the service factor is 1.0.
6. Motor voltage shall be 115 V, single-phase for motors 1 hp or less. Other motors shall be 460 V, three-phase.
7. Motors drawing less than 250 W that are intended for intermittent service may be germane to equipment manufacturer and need not conform to these specifications.

B. Three Phase - Squirrel Cage Induction Motors

1. Motors shall be 460 V, three phase, 60 Hz.
2. The motor connection diagram shall be stainless steel, permanently stamped and attached to the motor either inside the conduit box or on the same side as the conduit box.
3. Starting Torque: To be matched to the driven equipment.
4. Starting Current: Not to exceed six times full-load current.
5. Power Output, Locked Rotor Torque, Breakdown or Pullout Torque: NEMA Design B characteristics or as required by the driven equipment.
6. Design, Construction, Testing, and Performance: Conform to NEMA MG 1 for Design B motors.
7. Insulation System: Non-hygroscopic NEMA Class F or better.
8. Testing Procedure: In accordance with IEEE 112, Test Method B. Load test motors to determine

freedom from electrical or mechanical defects and for compliance with performance data.

9. Motor Frames: NEMA MG 13 standard T-frames of steel, aluminum, or cast iron with end brackets of cast iron or aluminum with steel inserts.
10. Bearings: Grease lubricated, anti-friction ball bearings with housings equipped with plugged provision for prelubrication, rated for minimum ABMA 9 and 11, L-10 life of 20,000 hours.
11. Sound Power Levels: To NEMA MG 1.
12. Motors shall be high efficiency type.
13. Motors shall be totally enclosed fan cooled (TEFC).
14. Nominal Efficiency: Meet or exceed values in schedules as given herein at full load and rated voltage when tested in accordance with IEEE 112.
15. Nominal Power Factor: Meet or exceed values in schedules as given herein at full load and rated voltage when tested in accordance with IEEE 112.

C. Performance Schedule: Three Phase - Energy efficient, TEFC.

HP Factor	RPM (Syn)	NEMA Frame	Minimum Percent Efficiency	Minimum Percent Power Factor
1	1200	145T	81	72
1-1/2	1200	182T	83	65
2	1200	184T	85	68
3	1200	213T	85	63
5	1200	215T	86	66
7-1/2	1200	254T	89	68
10	1200	256T	89	75
15	1200	284T	90	72
20	1200	286T	90	76
25	1200	324T	90	71
30	1200	326T	91	79
40	1200	364T	92	78
50	1200	365T	92	81
60	1200	404T	92	83
75	1200	405T	92	80

HP Factor	RPM (Syn)	NEMA Frame	Minimum Percent Efficiency	Minimum Percent Power Factor
100	1200	444T	93	83
125	1200	445T	93	85
1	1800	143T	82	84
1-1/2	1800	145T	84	85
2	1800	145T	84	85
3	1800	182T	87	83
5	1800	184T	88	83
7-1/2	1800	213T	89	85
10	1800	215T	90	84
15	1800	254T	91	86
20	1800	256T	91	85
25	1800	284T	92	84
30	1800	286T	93	86
40	1800	324T	93	83
50	1800	326T	93	85
60	1800	364T	93	87
75	1800	365T	93	87
100	1800	405T	94	86
125	1800	444T	94	87
150	1800	445T	94	88
200	1800	447T	95	87
1-1/2	3600	143T	82	85
2	3600	145T	82	87
3	3600	182T	82	87
5	3600	184T	85	88
7-1/2	3600	213T	86	86
10	3600	215T	86	86
15	3600	254T	88	91
20	3600	256T	89	89
25	3600	284T	90	92
30	3600	286T	91	92
40	3600	324T	91	91
50	3600	326T	90	92

HP Factor	RPM (Syn)	NEMA Frame	Minimum Percent Efficiency	Minimum Percent Power Factor
60	3600	364T	91	93
75	3600	365T	91	91
100	3600	405T	92	92

For motors not in schedule, provide manufacturer's standard high-efficiency motor.

D. Service Factor Schedule

HP	3600 rpm	1800 rpm	1200 rpm	900 rpm
1/6 - 1/3	1.35	1.35	1.35	1.35
1/2	1.25	1.25	1.25	1.15
3/4	1.25	1.25	1.15	1.15
1	1.25	1.15	1.15	1.15
>1 - 150	1.15	1.15	1.15	1.15

E. Single phase motors shall conform to the following respective requirements. The driven equipment supplier shall furnish motor starter, motor type, and motor enclosure type suitable for the application.

1. Single Phase Power - Split Phase Motors
   a. Starting Torque: Less than 150 percent of full load torque.
   b. Starting Current: Up to seven times full load current.
   c. Breakdown Torque: Approximately 200 percent of full load torque.
   d. Drip-Proof Enclosure: Class A (50 degrees C temperature rise) insulation, NEMA Service Factor, prelubricated sleeve or ball bearings.
   e. Enclosed Motors: Class A (50 degrees C temperature rise) insulation, 1.0 Service Factor, prelubricated ball bearings.
2. Single Phase Power - Permanent-Split Capacitor Motors
   a. Starting Torque: Exceeding 1/4 of full load torque.
   b. Starting Current: Up to six times full load current.

c. Multiple Speed: Through tapped windings.

d. Open Drip-Proof or Enclosed Air Over Enclosure: Class A (50 degrees C temperature rise) insulation, minimum 1.0 Service Factor, prelubricated sleeve or ball bearings, automatic reset overload protector.

3. Single Phase Power - Capacitor Start Motors

a. Starting Torque: Three times full load torque.

b. Starting Current: Less than five times full load current.

c. Pull-Up Torque: Up to 350 percent of full load torque.

d. Breakdown Torque: Approximately 250 percent of full load torque.

e. Motors: Capacitor in series with starting winding; provide capacitor-start/capacitor-run motors with two capacitors in parallel with run capacitor remaining in circuit at operating speeds.

f. Drip-Proof Enclosure: Class A (50 degrees C temperature rise) insulation, NEMA Service Factor, prelubricated bearings.

g. Enclosed Motors: Class A (50 degrees C temperature rise).

PART 3 EXECUTION

Not used.

END OF SECTION

ATTACHMENT 1

MOTOR DATA SHEET

MOTOR DATA SHEET

Submit for each motor. Mark N/A if not applicable.

1. Driven Equipment Number _____
2. Driven Equipment Name _____
3. Motor Manufacturer _____
4. Quantity _____
5. Horsepower (hp) _____
6. RPM _____
7. Voltage _____
8. Enclosure Type _____
9. Frame _____
10. Phase/Frequency _____
11. 40 degree C ambient insulation _____
12. Service Factor _____
13. NEMA Design _____
14. Space Heaters _____
15. Full Load Amperes (FLA) _____
16. Locked Rotor Amperes (LRA) _____
17. Efficiency:
    - 1/2 Load _____
    - 3/4 Load _____
    - Full Load _____
18. Power Factor:
    - 1/2 Load _____
    - 3/4 Load _____
    - Full Load _____

SECTION 15250
INSULATION

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Supplying all labor, materials, and equipment required for installing pipe and equipment insulation as specified herein.

1.2 RELATED SECTIONS

A. Section 01010 - General Requirements.

B. Section 15060 - Pipe, Fittings, Valves, and Accessories.

C. Section 15090 - Piping Supports and Anchors.

D. Section 16856 - Heating Cables and Panels.

1.3 REFERENCES, CODES, AND STANDARDS

A. American Society for Testing and Materials (ASTM):

1.	ASTM B209-93	Aluminum and Aluminum-Alloy Sheet and Plate.
2.	ASTM C533-85	Calcium Silicate Block and Pipe Thermal Insulation.
3.	ASTM C552-91	Cellular Glass Thermal Insulation.

1.4 SUBMITTALS

A. Certificate of Conformance: Manufacturer shall certify and provide data which indicate that all products supplied meet or exceed specification requirements.

B. Submit product data and installation manuals.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Insulation Materials

1. Insulation materials shall be identified, inspected, controlled, and protected in a manner that will assure conformance with the referenced codes and standards.
2. Care shall be taken in the storage and handling of all insulation material so that contamination by grease, moisture, or other foreign matter does not occur. Insulation materials shall be stored off the ground, protected from the weather, and handled so that physical damage to the insulation material does not occur.

1.6 SEQUENCING AND SCHEDULING

A. Insulation shall not be installed on the equipment or piping system until the system has passed a hydrostatic pressure test.

PART 2 PRODUCTS

2.1 MATERIALS

A. Cellular glass: Board and molded (rigid), inorganic, 'k' value of 0.345 Btu-inch/hour per square-feet per degree F at 75 degrees F, conforming to ASTM C552 (Type II), to be used for temperatures below 400 degrees F.

B. Calcium Silicate: Preformed pipe covering, flat block or curved block, in accordance with ASTM C533 (Type I), to be used for temperatures above 400 degrees F.

C. Jacketing: Aluminum, Alloy 3003-H14, tempered, 0.020 inches thick, embossed, conforming to ASTM B209.

D. Elbow insulation covers: Aluminum, Alloy 1100, tempered.

E. Bedding Compound: Non-volatile, .008 perm inch; service temperature range of -60 degree F to 180 degree

F; application temperature 40 degree F to 100 degree F, sealant.

2.2 ACCESSORIES

A. Wire: B&S Gage No.16, annealed, 302 or 304 stainless steel.

B. Insulation Bands:
1. Piping: 1/2-inch wide (minimum) by 0.015-inch thick (minimum), 304 stainless steel bands.
2. Equipment: 3/4-inch by 0.015-inch thick (minimum), 304 stainless steel bands.

C. Screws: Number 8, by 3/8-inch, sheet metal type 302 or 304 stainless steel.

D. Adhesives: Fire-resistant adhesive shall be compatible with insulation.

PART 3 EXECUTION

3.1 ERECTION/INSTALLATION/APPLICATION

A. Piping, valves, fittings, flanges, and equipment shall be insulated and jacketed for all systems subjected to freezing temperatures, for hot lines and for steam and condensate lines. Insulated pipe and equipment shall be shown on the Subcontractor's and vendor's piping and instrumentation diagrams and piping drawings.

B. Install materials in accordance with the manufacturer's instructions. Maintain temperatures and conditions required by the manufacturer for installation.

C. Manholes, flanged valves, flanged fittings, and pipeline flanges shall have removable insulation and aluminum jacketing to permit servicing of take-down joints. Removable covers may be fabricated from segments of block insulation or from preformed sectional pipe covering and premolded components. A removable cover shall be of the same material as the adjoining pipe insulation.

D. Fill joints and seams with bedding compound to form smooth surface.

E. All piping and equipment insulation shall be stopped at a sufficient distance from flanges to permit ease of bolt removal. Insulation shall be beveled at a 45-degree angle at this point.

F. Install jacketing with screws on 3-inch centers on all fittings and valves where banding is not possible.

G. Labels indicating "asbestos-free" shall be attached to the outside of all insulation jacketing.
   1. The asbestos-free labels on piping systems shall be located adjacent to all piping identification labels.
   2. The asbestos-free labels on equipment shall be located adjacent to the equipment identification tag.

H. Pipe Insulation
   1. All piping and heat tracing shall be tested before installing insulation.
   2. Piping shall be covered with a minimum of 1-1/2-inch-thick cellular glass or a minimum of 4-inch thick calcium silicate insulation as applicable.
   3. Sectional cellular glass insulation shall be applied in a single layer with joints tightly butted, and shall be secured in place with wire on 12-inch centers.
   4. Aluminum jacketing shall be applied directly over insulation. Minimum lap for longitudinal joints shall be 1 inch, and minimum lap for circumferential joints shall be 2 inches. The jacketing shall be secured in place with bands on 9-inch centers.
   5. Premolded elbow insulation and aluminum elbow covers shall be installed at all elbows. Aluminum jacketing shall be used for all other fittings, valves, flanges, etc.
   6. Lap all seams against weather.

7. Finish insulation at supports, protrusions, and interruptions. At pipe supports, remove only enough insulation to provide a snug fit.

I. Equipment Insulation

1. Apply insulation board directly to equipment surfaces with all joints staggered and tightly butted. Secure insulation in place with stainless steel bands on 18-inch centers.
2. Board insulation shall be cemented to irregular surfaces and all voids shall be filled with bedding compound.
3. Apply aluminum jacketing over insulation with 3-inch minimum lap on longitudinal and circumferential joints.
4. Equipment shall be covered with a minimum of 2-inch-thick insulation.
5. Insulation shall be cut away from all equipment identification nameplates and beveled at a 45-degree angle.
6. All equipment and heat tracing shall be tested before installing insulation.

END OF SECTION

SECTION 16051
BASIC ELECTRICAL MATERIALS AND METHODS FOR INDIRECT DRYER

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Electrical equipment, material, and services required for indirect dryer.
   1. Disconnect switches.
   2. Motor starters.
   3. Selector switches.
   4. Enclosures for electrical equipment.
   5. Molded case circuit breakers.
   6. Variable frequency drives.
   7. Conduit.
   8. Wire and cable.
   9. Instrument cable.
   10. Nameplates.
   11. Wire markers and cable tags.
   12. Splicing and termination components.

1.2 RELATED SECTIONS

A. Section 11182 - Indirect Dryer Performance.

B. Section 15171 - Motors for Indirect Dryer.

C. Section 16856 - Heating Cables and Panel for Indirect Dryer.

1.3 REFERENCES

A. National Fire Protection Association (NFPA):
   1. NFPA 70-96 National Electrical Code.

B. American National Standards Institute (ANSI):
   1. ANSI C80.1-90 Rigid Steel Conduit-Zinc Coated.

C. Underwriters Laboratories, Inc. (UL):

1.	UL 360-86	Liquid-Tight Flexible Steel Conduit.
2.	UL 486A-91	Wire Connectors and Soldering Lugs for Use with Copper Conductors.
3.	UL 510-94	Polyvinyl Chloride, Polyethylene, and Rubber Insulating Tape.

D. National Electrical Manufacturers Association (NEMA):

1.	NEMA AB 1-93	Molded Case Circuit Breakers and Molded Case Switches.
2.	NEMA ICS 1-93	Industrial Controls and Systems General Requirements.
3.	NEMA ICS 2-93	Industrial Controls and Systems, Controllers, Contactors and Overload Relays Rated Not More Than 2000 Volts AC or 750 Volts DC.
4.	NEMA ICS 3.1-90	Safety Standards for Construction and Guide for Selection, Installation and Operation of Adjustable-Speed Drive Systems.
5.	NEMA ICS 6-93	Industrial Controls and Systems Enclosures.
6.	NEMA KS 1-90	Enclosed and Miscellaneous Distribution Equipment Switches (600 Volts Maximum).
7.	NEMA 250-91	Enclosures for Electrical Equipment (1000 Volts Maximum).

E. Code of Federal Regulations (CFR):

1.	29 CFR 1910-92	Occupational Safety and Health Standards.

1.4 SYSTEM DESCRIPTION

A. Design Conditions: As noted in Section 11182. Ambient shall be 40 degrees C.

B. Design Criteria: As noted in Section 11182.

C. Electrical starters, controls, wiring, and conduit required to operate the indirect dryer specified and as indicated on drawings. Where these electrical items are mounted on the same shipping section, they shall be electrically connected using wire or cable and conduit as specified herein. For items not mounted on the same shipping section, electrical interconnection diagrams shall be furnished, conveying clearly how these items are to be wired. Disregard requirements herein for material or equipment not required for the indirect dryer.

1.5 SUBMITTALS

A. Product Data: Provide data for all equipment and materials specified. Include catalog sheets and drawings showing voltage, ratings, impedances, normal and short circuit current ratings, dimensions, and enclosure details.

B. Manufacturer's Installation Instructions: Indicate application conditions and limitations of use stipulated by product testing agency. Include instructions for storage, handling, protection, examination, preparation, installation, and commissioning of products. Provide interconnection wiring diagrams indicating actual point-to-point termination of wiring between electrical switches, controls, starters, and other equipment. Wire terminations and individual wires must be labeled with numbers.

C. Testing Procedures: Submit written procedures for all required testing. Testing procedures shall include criteria for acceptable performance.

D. Certificate of Conformance: Provide statement certifying that the equipment and materials supplied meet or exceed contract requirements.

E. Material Safety Data Sheet (MSDS): Submit MSDSs for cutting oils, caulks, sealants, and all other similar components.

F. Test Reports: Indicate satisfactory completion of required tests and inspections.

1.6 QUALITY ASSURANCE

A. Regulatory Requirements: All products and services performed shall conform to the requirements of NFPA 70.

B. Certifications: All items shall be tested and listed for the purpose intended by Underwriters Laboratories or Factory Mutual, Inc., with label attached.

PART 2 PRODUCTS

2.1 EQUIPMENT

A. Disconnect Switches

1. Nonfusible Switch Assemblies: NEMA KS-1, type HD quick-make, quick-break, visible blade, load interrupter knife switch in type 4 enclosures, conforming to NEMA 250, with externally operable handle interlocked to prevent opening front cover with switch in ON position. Handle lockable in OFF position.
2. Fusible Switch Assemblies: NEMA KS-1, type HD quick-make, quick-break, visible blade, load interrupter knife switch in type 4 enclosures, conforming to NEMA 250, with externally operable handle interlocked to prevent opening front cover with switch in ON position. Handle lockable in OFF position. Fuse Clips: FS W-F-870. Designed to accommodate Class R fuses.

B. Motor Starters

1. Magnetic Motor Controller: NEMA ICS 1 and ICS 2, AC general purpose, circuit breaker, combination, Class A magnetic controller for induction motor. Each controller shall have a control power transformer with two primary fuses, one secondary fuse with other secondary lead grounded.
2. Coil Operating Voltage: 120 volts, 60 hertz.
3. Overload Relay: NEMA ICS 2 bimetal, ambient compensated.

4. Enclosure: NEMA ICS 6, type 4.
5. Selector Switch: Cover mounted, rotary type, on-off.
6. Minimum Size Contactor: Size 1.
7. Circuit Breaker: Instantaneous trip only, minimum 22 kA symmetrical interruption.
8. Pilot Lights: Two push-to-test, industrial type with nameplates.

C. Selector Switches
1. Stainless steel enclosure, NEMA ICS 6, type 4.
2. Two-position, maintained contact (start/stop).
3. Three-position, maintained contact (hand/off/auto).

D. Enclosures for Electrical Equipment
1. All enclosures for electrical equipment shall be type 4, conforming to NEMA ICS 6 or NEMA 250, as appropriate.

E. Molded Case Circuit Breakers
1. NEMA AB 1 with integral thermal and instantaneous magnetic trip in each pole. Provide common trip handle for all poles with capability of physical lockout. Terminals, minimum 75 degrees C rated.
2. Breaker enclosures shall be type 3R, conforming to NEMA 250.

F. Variable Speed Drives
1. Manufacturers:
   a. Cutler Hammer.
   b. Allen Bradley.
   c. Westinghouse.
   d. Substitutions: Submit to the FERMCO Construction Manager for engineering approval. The listing of equipment suppliers in no way precludes the offerer from proposing alternate suppliers of any of the equipment to be furnished within the scope of this specification. This list of suppliers is intended to identify the type of equipment and general quality of that equipment that will be included in the offerer's proposal.

It is the offerer's responsibility to propose equipment that is best suited for this project in combined terms of quality and price.

2. Provide enclosed variable frequency drive suitable for load intended, conforming to the requirements of NEMA ICS 3.1.

3. Ratings
   a. Rated Input Voltage: 480 volts, three phase, 60 Hertz.
   b. Motor Nameplate Voltage: 460 volts, three phase, 60 Hertz.
   c. Displacement Power Factor: Between 1.0 and 0.95, lagging, over entire range of operating speed and load.
   d. Operating Ambient: -10 degrees C to 40 degrees C.
   e. Humidity: 20-90 percent noncondensing.

4. Design
   a. Employ microprocessor-based inverter logic isolated from power circuits.
   b. Employ pulse width modulated inverter system.
   c. Employ switching power supply operating off DC link.
   d. Design for ability to operate drive with motor disconnected from output.
   e. Design to attempt five automatic restarts following fault condition before locking out and requiring manual restart.

5. Product Options and Features
   a. Display: Provide integral digital display to indicate output voltage, output frequency, and output current.
   b. Status Indicators: Separate indicators for overcurrent, overvoltage, ground fault, overtemperature, and input power ON.
   c. Volts per Hertz Adjustment: Manufacturer's standard.
   d. Current Limit: 150 percent of rated for 1 minute.
   e. Acceleration Rate Adjustment: 0.5-30 seconds.
   f. Deceleration Rate Adjustment: 1-30 seconds.

g. Provide hand-off-automatic selector switch and manual speed control.

h. Input Signal: 4-20 mA DC, 250 ohms loop impedance (maximum).

i. Safety Interlocks: Provide terminals for remote contact to inhibit starting under both manual and automatic mode.

j. Control Interlocks: Provide terminals for remote contact to allow starting in automatic mode.

k. Manual Bypass: Provide contactor, motor running overload protection, and short circuit protection for full voltage, nonreversing operation of the motor. Include isolation switch to allow maintenance of inverter during bypass operation.

l. Disconnecting Means: Include integral circuit breaker on the line side of each drive.

2.2 MATERIALS

A. Conduit

1. Rigid steel, heavy wall, galvanized conduit conforming to ANSI C80.1. Conduit shall be 3/4 inch minimum in diameter. Attachment straps, hangers, and struts shall be galvanized.

2. Liquid-tight flexible metal conduit conforming to UL 360. Conduit shall be 3/4 inch minimum in diameter.

B. Wire and Cable

1. Single conductor, 600-volt insulated copper conductor. Conductors for power and lighting branch circuits shall not be smaller than No. 12 AWG. Conductors No. 12 AWG and No. 10 AWG shall be solid. Conductors No. 8 AWG and larger shall be stranded. Conductors for control shall not be smaller than No. 14 AWG stranded. Conductors for Class 1 remote-control and signal circuits shall be enclosed in cable and shall comply with NFPA 70. Conductors for solenoid valves and/or limit switches shall be multiconductor No. 16 AWG, as

required. Power and lighting conductor insulation shall be Type THW, XHHW, or THWN. Conductors required to be rated 90 degrees C in accordance with NFPA 70 shall be type XHHW-2 or THW-2.

2. Any special conductors shall be as required and UL listed for the purpose intended.

C. Instrument Cable

1. Instrumentation cable shall be No. 16 AWG stranded tinned copper conductors. Conductors shall be polyethylene insulated and rated 600 volts, 60 degrees C. Conductors shall be twisted with aluminum-polymer shield; No. 18 AWG stranded, tinned copper drain wire. Cable shall have overall-chrome gray FR-PVC jacket.

D. Nameplates

1. Nameplates shall be engraved, three-layer laminated plastic, 5/16-inch bold style, black letters on white background.

E. Wire Markers and Cable Tags

1. Wire markers shall be single-conductor, slip-on, heat-shrinkable sleeve with typed or printed black letters on a white background. Wire markers shall be similar to W. H. Brady Co. computer-printable "Bradysleeve" or approved equal.
2. Cable tags shall be rectangular, flat, non-heat-shrinkable tags with 1/8-inch-high letters. Cable markers shall be similar to Raychem-type TMS or approved equal.

F. Splicing and Termination Components

1. Wire connectors, UL 486A, as applicable.
2. Insulation tape, UL 510.
3. Provide solderless terminal lugs on stranded conductors.
4. Twist-on splicing connectors (wire nuts) are <u>not</u> acceptable for 480-volt splices.

2.3 FABRICATION

A. Conduit

1. Route conduit parallel or at right angles to equipment lines. Provide conduit supports at approximately 8-foot intervals.
2. Cut conduit square using saw or pipecutter. All cut ends of conduit shall be reamed.
3. Install no more than the equivalent of three 90-degree bends between boxes. Use hydraulic one-shot conduit bender or factory elbows for conduit diameter larger than 1-1/2 inch.
4. Use form 8 conduit bodies to make sharp changes in direction. Avoid moisture traps; provide junction box with weep hole.
5. Provide cast metal boxes such as FS or FD.
6. Provide 1/8-inch nylon pull cord in empty conduits.
7. Final conduit connections to motors or other vibrating equipment shall be made with approximately 3-foot liquid-tight flexible metal conduit.

B. Wire and Cable

1. All wire and cable shall be completely enclosed in conduit or in junction boxes, metal raceway, or panels.
2. Swab conduit before installing cable. Remove burrs, dirt, or other debris.
3. When pulling cable into conduit, use wire pulling compound.
4. Splices shall be made only in outlet or junction boxes.
5. Provide equipment grounding conductor along with phase conductors in all conduits.
6. Multiconductor cables shall contain an integral ground conductor.
7. Grounding conductors shall be connected to equipment with compression lugs. Grounding connections shall be made to clean, dry surfaces. Scale, rust, grease, and dirt shall be removed from surfaces to which grounding connections are to be made.

8. Conductors shall be color coded. Conductors No. 6 AWG and larger shall be identified using colored tape at terminals and splice points. Conductors No. 8 AWG and smaller shall be identified using colored insulation or jacket. Color coding shall be as follows:

480Y/277V	Phase A	Brown
	Phase B	Orange
	Phase C	Yellow
	Neutral (grounded)	Gray
	Ground	Green or bare
208Y/120V	Phase A	Black
	Phase B	Red
	Phase C	Blue
	Neutral (grounded)	White
	Ground	Green or bare
240/120V	Phase	Black
	Phase	Red
	Neutral (grounded)	White
	Ground	Green

C. Nameplates

1. Degrease and clean surfaces to receive nameplates.
2. Install nameplates parallel to equipment lines. Secure nameplates to equipment fronts using self-tapping screws.

D. Wire and Cable Markers

1. Provide wire markers on each conductor in pull boxes and junction boxes, and at each load connection. Provide cable tags in pull boxes for multiconductor cables.
2. Wire and cable tags shall identify panel and circuit number or control wire number, as required.

E. Motor Starters

1. Install motor controllers with selector switches approximately 54 inches above finished floor.

2. Install overload heater elements in motor controllers to match motor characteristics.
3. Provide engraved nameplate identifying motor served.

F. Selector Switches
1. Mount selector switches at a mounting height of 54 inches above the floor, adjacent to the equipment controlled. Provide unistrut mounting supports.

G. Variable Speed Drives
1. Fabrication
   a. Wiring Terminations: Match conductor materials and sizes indicated.
   b. Enclosure: NEMA 250, Type 4.
   c. Finish: Manufacturer's standard enamel.
2. Do not install drive until building environment can be maintained within the service conditions required by the manufacturer.
3. Select and install overload heater elements in motor drives to match installed motor characteristics.
4. Provide engraved plastic nameplates as specified herein.
5. Provide neatly typed label inside each motor drive door identifying motor served, nameplate horsepower, full load amperes, code letter, service factor, and voltage/phase rating.

H. Grounding
1. Provide ground conductor termination lugs (minimum two) adequate for 4/0 wire on each shipping section.
2. Bond all electrical enclosures to any conducting structures on which they are mounted and to ground termination lugs in accordance with NFPA 70.

2.4 SOURCE QUALITY CONTROL

A. Testing
1. Power and Control Wire: All wires shall be tested for continuity. Wire insulation shall be megger tested between each conductor and ground. A 1000-

volt megger shall be used for insulation rated 600 volts. Minimum resistance shall be 100 megohms.

2. Utilization Equipment:
   a. Make electrical connections to utilization equipment in accordance with manufacturer's instructions.
   b. Installation shall conform to the requirements of NFPA 70.
   c. Motor windings shall be checked for continuity.
   d. Motor windings rated 460 volts nominal shall be megger tested with a 1000-volt megger prior to connection of power leads. Minimum acceptable resistance shall be 50 megohms.
   e. Motor and phase rotation shall be checked with a phase rotation tester similar to G. Biddle Company (Catalog No. 56060) or equal on equipment which could be damaged by reverse rotation.
      1) Motor and phase rotation shall be verified before energizing motors.
      2) All motors shall be "bumped" to check for proper direction of rotation prior to performing operational tests on the equipment.

B. Verification of Performance: Record results for testing Article 2.4, Paragraph A above, for submittal.

PART 3 EXECUTION

Not used.

END OF SECTION

SECTION 16856
HEATING CABLES AND PANEL FOR INDIRECT DRYER

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Heat trace power distribution panel.

B. Heating cable.

1.2 RELATED SECTIONS

A. Section 11182 - Indirect Dryer Performance Specification.

B. Section 15250 - Insulation.

C. Section 16051 - Basic Electrical Materials and Methods for Indirect Dryer.

1.3 REFERENCES

A. National Fire Protection Association (NFPA):
1. NFPA 70-96 National Electrical Code.

B. National Electrical Manufacturers Association (NEMA):
1. NEMA AB 1-93 Molded Case Circuit Breakers and Molded Case Switches.
2. NEMA PB 1-90 Panelboards.
3. NEMA ICS 2-93 Industrial Control and Systems Controllers, Contactors, and Overload Relays Rated Not More Than 2000 Volts AC or 750 Volts DC.
4. NEMA ICS 6-93 Industrial Control and Systems Enclosures
5. NEMA 250-91 Enclosures for Electrical Equipment (1000 Volts Maximum).

1.4 SYSTEM DESCRIPTION

A. Heat tracing for tanks, pumps, pipe, and any other outdoor equipment requiring freeze protection with outside temperature at -10 degrees F.

B. Power distribution panel with heat trace freeze protection control package.

1.5 SUBMITTALS

A. Product Data: Provide data for heating cable and control components. Provide manufacturer's catalog "cut sheets" for each type or piece of equipment supplied.

B. Manufacturer's Installation Instructions: Provide installation instructions.

C. Certificates of Conformance: Manufacturer shall certify and provide data which indicate that all supplied products meet or exceed specification requirements.

D. Operation Data: Submit description of operating controls.

E. Maintenance Data: Submit repair methods and parts list of components.

F. Test Procedures: Submit written procedures for all required testing. Test procedures shall include criteria for acceptable performance.

1.6 QUALITY ASSURANCE

A. Manufacturer: Company specializing in manufacturing the products specified in this section, with minimum 3 years experience.

1.7 SEQUENCING AND SCHEDULING

A. Coordinate installation of heating cable with installation of piping and piping insulation.

PART 2 PRODUCTS

The listing of equipment suppliers below in no way precludes the offerer from proposing alternate suppliers of any of the equipment to be furnished within the scope of this specification. This list of suppliers is intended to identify the type of equipment and general quality of that equipment that will be included in the offerer's proposal. It is the offerer's responsibility to propose equipment that is best suited for this project in combined terms of quality and price.

2.1 MANUFACTURERS

A. Raychem.

B. Chromalox.

C. Thermon.

2.2 EQUIPMENT

A. Heat Trace Power Distribution Panel: As required for equipment requiring freeze protection, and consisting of the following:

1. Distribution panelboard with 30 mA GFCI circuit breakers. Panel shall conform to NEMA PB 1 with circuit breakers conforming to NEMA AB 1. Panel shall be rated 100 amp minimum, 120/240 V, 1 phase (or as required by heating cables) with breakers sized for heating cables served and panel amperes adequate for heating cable load served.
2. Selector Switch: Hand-Off-Auto.
3. Contactor: NEMA ICS 2.
4. Contactor coil status light.
5. Enclosure: Type 4X according to NEMA 250.

2.3 MATERIALS

A. Heating Cable
   1. Self-limiting, parallel resistance electric tracing cable. Maximum output temperature 150 degrees F.
   2. Rating: 120 V or as required.

2.4 ACCESSORIES

A. Thermostat: Type 4X according to NEMA ICS 6, adjustable setpoint, suitable for -30 degrees F to 140 degrees F.

B. Pilot light.

C. Power termination kits, splice kits, tee kits, and end seals shall be utilized.

D. Provide stainless steel identification tags for all devices. Include assembly and circuit numbers.

2.5 FABRICATION

A. Provide heat trace power distribution panel separately. Install heating equipment on tanks, filters, pumps, and piping systems as required. Install to allow for heat trace cable to be moved aside for maintenance of piping system.

B. Install in accordance with manufacturer's instructions and NFPA 70.

C. Avoid pinching and making sharp bends in cable.

D. Prevent damage by sharp objects during installation.

E. Do not install electric tracing cables across expansion joints.

F. All electric heat trace cables shall be installed in the 7 and 8 o'clock positions or in the 4 and 5 o'clock positions on horizontal runs of pipes.

G. Accurately record actual locations of heating cable, thermostats, and branch circuit connections.

2.6 SOURCE QUALITY ASSURANCE

A. Test continuity of heating cable.

B. Measure insulation resistance to manufacturer's recommended values. Use test instruments in accordance with manufacturer's instructions.

C. Perform continuity and insulation resistance test on completed cable installation prior to installation of thermal insulation.

D. Measure voltage and current at each unit.

PART 3 EXECUTION

Not used.

END OF SECTION

0163

Basis of Off-Gas Control System Preliminary Draft

Operable Unit 1
Project Order 145

October 1995
Revision A

Environmental Remedial Action Project
Fernald Environmental Management Project
Fernald, Ohio
FERMCO Subcontract No. 2-21487

PARSONS

Fairfield Executive Center
6120 South Gilmore Road
Fairfield, Ohio 45014

000167

BASIS OF OFF-GAS CONTROL SYSTEM

The off-gas control system consists of all components in contact with the off-gas from the rotary dryer exit through the stack. The off-gas control system removes the steam, particulates, and organic and inorganic contaminants from the off-gas before release to the atmosphere. The system is illustrated on the Process Flow Diagram - Drying and Off-Gas Treatment, and begins on drawing SK-F-03911 with the exit of off-gas from the dryer into the cyclone. Following the off-gas from the exit of the cyclone, as illustrated on drawing SK-F-03912, it flows through the spray tower, condenser, scrubber, off-gas heat exchanger, reheater, MEPA filter, carbon beds, HEPA filters, and finally the exhaust fans before exiting through the stack.

The components of the off-gas control system are described in individual specifications, which are in a draft stage at this time; additional detail and revision will be needed prior to procurement. The specifications are as follows:

1) Section 11501 - Scrubber System - Packaged packed-tower type scrubber system with spray tower

2) Section 15060 - Pipe, Fittings, Valves, and Accessories

3) Section 15090 - Piping Supports and Anchors

4) Section 15173 - Motors for Off-Gas Control System - Low voltage three phase and single phase induction motors.

5) Section 15250 - Insulation

6) Section 15755 - Heat Exchangers - Shell and tube and air-to-gas heat recovery heat exchangers.

7) Section 15860 - Fans - Centrifugal fans, industrial pressure blowers, propeller fans, and accessories.

8) Section 15883 - Cyclone - Cyclone with heating jacket.

9) Section 15884 - Carbon Bed Adsorber - Multiple carbon beds.

10) Section 15885 - Air Cleaning Devices - Disposable, extended area panel filters, Medium-Efficiency Particulate Air (MEPA) filters, High-Efficiency Particulate Air (HEPA) filters, filter housing and differential pressure gauges.

11) Section 15890 - Ductwork - Systems, Stack, and Supports.

12) Section 16053 - Basic Electrical Materials and Methods for Off-Gas Control System - Disconnect switches, motor starters, selector switches, enclosures, circuit breakers, variable frequency drives, conduit, wire and cable, instrument cable, and related components.

Off-Gas Control System Procurement Specifications Preliminary Draft

Operable Unit 1
Project Order 145
WBS No. 1.1.1.1.1.3.1
October 1995
Revision A

Environmental Remedial Action Project
Fernald Environmental Management Project
Fernald, Ohio
FERMCO Subcontract No. 2-21487

PARSONS

Fairfield Executive Center
6120 South Gilmore Road
Fairfield, Ohio 45014

U.S. DEPARTMENT OF ENERGY
FERNALD ENVIRONMENTAL MANAGEMENT PROJECT
FERMCO SUBCONTRACT NO. 2-21487

PROJECT ORDER 145
WBS NO. 1.1.1.1.1.3.1
PROCUREMENT SPECIFICATIONS

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END OF SECTION

SECTION 01010
GENERAL REQUIREMENTS

PART 1 GENERAL

1.1 SCOPE

These general requirements form a part of all the technical divisions of these specifications.

PARSONS has prepared these specifications. In all cases where the words "A/E Subcontractor" appear in these specifications, it shall be understood to refer to PARSONS or to such other individuals or organizations acting within the scope of the specific duties entrusted to them.

In all cases where the terms "Vendor" or "Seller" or "Manufacturer" or similar terms appear in these specifications or in the appendices to these specifications, they shall be understood to refer to an individual or firm(s) providing materials, equipment, or services, as noted, under a subcontract to Fernald Environmental Restoration Management Corporation (FERMCO).

In all cases where the term "Subcontractor" appears in these specifications, it shall be understood to refer to the Construction Contractor or Subcontractor.

The Subcontractor shall perform all construction acceptance tests as coordinated and supervised by FERMCO. In addition, before the final acceptance of the work, the Subcontractor shall perform an integrated system construction acceptance test as coordinated and supervised by FERMCO.

The Subcontractor shall provide written procedures for FERMCO's review and approval of all tests to be performed as identified in the drawings and specifications. These procedures shall provide detailed step-by-step operations with sign-off columns and shall be submitted and approved at least 30 days prior to testing.

Generally, all field test instruments shall have been calibrated, within 12 months prior to use on this subcontract, by a calibration laboratory whose calibration equipment and

instruments are fully traceable to National Institute of Standards and Technology (NIST) standards. The Subcontractor shall provide individual certification of calibration and NIST standards traceability for all field test instruments used on this subcontract.

All work shall be accomplished in accordance with the following code requirements:

A. Ohio Basic Building Code (OBBC) 1995.

B. Uniform Building Code (UBC) 1994.

C. Life Safety Code 101 - 1994.

D. 29 CFR 1910 and 1926 - Occupational Safety and Health Administration (OSHA).

E. 10 CFR 835 - Radiation Protection for Occupational Workers.

F. National Fire Codes - All inclusive, including 1995 revisions.

G. DOE Order 6430.1A - General Design Criteria.

H. DOE Order 5400.5 - Radiation Protection of Public and Environment.

1.2 SITE AND SCOPE

The intent of these specification is to describe all work required and necessary to provide the equipment and appurtenances for the Off-Gas Control System of the Remediation System Design Project.

Where applicable, the Subcontractor shall provide all labor, services, materials, and equipment, and shall do all work necessary to accomplish this end within the limits of work as defined in the accepted bid and/or contract.

1.3 LISTS OF MATERIALS, MANUFACTURERS, OR EQUIPMENT SUPPLIERS

A. The listing of materials, equipment, manufacturers' names, or equipment suppliers in these specifications in no way precludes the offerer from proposing alternate materials, equipment, manufacturers' names, or equipment suppliers of any of the items to be furnished within the scope of these specifications. These lists are intended to identify the types and general quality of those items that will be included in the offerer's proposal. It is the offerer's responsibility to propose the materials, manufacturers' names, or equipment that is best suited for this project in combined terms of quality and price.

1.4 SUBMITTALS - SHOP DRAWINGS, SAMPLES, AND OTHER DATA

A. General: Article **SC-25** of FERMCO's Part 4 Invitation for Bid, Special Terms and Conditions Form No. **P-2500,** dated July 1993, shall be supplemented in accordance with the following requirements (any submittals not in conformance with these requirements will be returned without review for correction and resubmittal):

1. Submittals for unrelated items shall not be included in the same transmittal, and each separate submittal shall be coordinated and shall include all drawings and data required for the item or system covered.
2. Submittals shall indicate project name; identification by specification division, section, subsection, and article under which equipment or material is described; and by name, number, and intended use as designated by contract drawings and specifications.
3. When more than one item of equipment is included on a single drawing or catalog cut, each project equipment item must be separately identified thereon, with clear delineation as to which model or catalog number or performance data applies to each project item.
4. Assemble and submit, in logically arranged folders, all instruction bulletins, diagrams,

lubrication schedules, operating instructions, parts lists, and pamphlets for equipment and apparatus furnished, including vendor's or manufacturer's recommended procedure for lifting, handling, and installing equipment.

5. Submittals for equipment to include manufacturer's model number or catalog number, ratings, size, and performance curves and data. Indicate operating point on curves and tabular data for each piece of equipment that curves or data represent.

6. Submit wiring diagrams or connection diagrams for equipment items, accompanied by adequately defined symbols list. Schematic and wiring diagrams must be prepared in accordance with ANSI/IEEE Publication Y32E, "Electrical and Electronics Graphics Symbols and Reference Designations." Individual 8-1/2- by 11-inch elementary and wiring drawings are not acceptable.

7. Indicate all performance data, construction material finishes, and modifications to manufacturer's standard design specified.

8. Locate termination points for all required external wiring.

9. Indicate roughing-in, foundation, and support point dimensions.

10. Submit Material Safety Data Sheets (MSDSs), for all cutting oils, caulks, sealants, lubricants, paints, etc., and all other similar compounds and/or Hazardous Chemicals as defined in 29CFR 1926.59 (Hazard Communication).

11. Submit written test procedures for all required testing. Include criteria for acceptable performance. Submit test reports after completion of tests.

12. The A/E Subcontractor's review of such submittals shall not relieve the Subcontractor from any responsibility for deviations from contract drawings or specifications, unless the Subcontractor has in writing called the A/E Subcontractor's attention to such deviations at the time of submission, nor shall it relieve the Subcontractor from responsibility for errors of any sort in the submittals nor from responsibility

for the proper fitting and construction of the work.

13. Submittals will be reviewed with respect to such factors as quality of draftsmanship, legibility, and evidence that the Subcontractor is aware of the necessity and importance of adequately detailing and illustrating special features and conditions relating to the work. If the A/E Subcontractor determines that the data submitted, in part or in whole, is not within the purview of the A/E Subcontractor's review, such submittal, or part thereof, will be returned to FERMCO unchecked. Dimensions, sizes, construction details, and directive notes shown will be reviewed for accuracy, compliance with the specifications, adequacy, interferences, etc., on a spot check or incomplete basis to establish that the Subcontractor has given such factors careful attention.

14. Any changes marked on submittals during review will be for the purpose of indicating the requirements of the Contract documents, and no change in the contract amount is authorized by such markings.

15. When submittals are found to be satisfactory with respect to the above factors and within the scope of the review outlined above, they will be returned by FERMCO to the Subcontractor bearing certificate attachment permitting the Subcontractor to employ them in the furtherance of the Subcontractor's work under the contract, but only with the express understanding that such permission shall not relieve the Subcontractor of the Subcontractor's responsibilities for the full performance of the work required under the contract in conformance with the contract documents governing such performance, nor for any other deficiencies in the submittals such as inaccuracies, discrepancies, omissions, interferences in the work itself, or with the work of other contractors, whether or not such deficiencies were observed or noted in the course of the review of the shop drawings.

16. The Subcontractor shall verify all field dimensions required for shop drawings.

B. Submittal Requirements: Submittals required include drawings and/or data for all items listed below; refer to Attachment 1 of these specifications:

1. "AA" designates that shop drawings and pertinent performance data and curves are required.
2. "BB" designates that catalog data and pertinent performance data and curves are required.
3. "CC" designates that these items are to be included on a listing giving manufacturer and brief type description for each item. Such listing shall be submitted not later than 30 days after notice to proceed, unless noted otherwise by FERMCO. Note that shop drawings or catalog data may also be required for items included on this list.
4. "DD" designates that samples of finishes are required with full range of color choices and/or patterns submitted.
5. "EE" designates that physical samples of materials are required.
6. "FF" designates that individual certifications for conformity to qualifications and standards specified are required. For equipment items, this indicates that certified equipment drawings are to be submitted.
7. "GG" designates that the technical specifications contain specific submittal requirements.
8. "HH" designates that engineering calculations are required.
9. "II" designates that spare parts list is required.
10. "JJ" designates that an installation, operation, and maintenance manual is required.
11. "KK" indicates that manufacturer's material safety data sheets are required.
12. "LL" indicates that test reports are required for tests noted in the technical specifications.
13. "MM" indicates that wiring diagrams for power, signal, and control wiring are required.

14. "NN" indicates that tests which are to be witnessed by the FERMCO Construction Manager or a representative are required.

1.5 OPERATING MANUALS AND SPARE PARTS LISTS

Copies of a priced recommended spare parts list shall be submitted prior to the shipment of any item of equipment. (See FERMCO's Submittal Schedule).

An Installation, Operation, and Maintenance (IOM) Manual shall be prepared so as to provide optimum operation and maintenance of the equipment and systems being furnished.

The cover of the IOM Manual shall include the following information:

A. Project Title - OU1-Remediation System Design.

B. WBS No. - 1.1.1.1.1.3.1

C. A/E Subcontractor - PARSONS

D. Construction Contracts Manager - FERMCO

E. Subcontractor (Name of Subcontractor, if any)

The IOM Manuals shall be bound into one of more volumes for ease of handling and shall have an index. The manual shall include descriptive literature, drawings, performance curves and rating data, test reports, and spare parts lists. The maintenance section shall divide maintenance procedures into two categories, "Preventive Maintenance" and "Corrective Maintenance," and a subsection for "Safety Precautions." Preventive maintenance shall include cleaning and adjustment instructions. Corrective Maintenance shall include instructions and data arranged in the normal sequence of corrective maintenance (i.e., troubleshooting) (logical effect to cause), then repair and replacement of parts, then the parts list. Safety Precautions shall comprise a list of safety precautions and instructions to be followed before, during, and after making repairs, adjustments, or routine maintenance.

Submit complete sets of final documents as per FERMCO'S Submittal Schedule.

1.6 SPECIFICATION EXPLANATION

A. General: The technical specifications are of the abbreviated, simplified, or streamlined type and include incomplete sentences. Omissions of words or phrases such as "the contractor shall," "in conformity therewith," "shall be," "as noted on the drawings," "according to the plans," "a," "the," and "all" are intentional. Omitted words or phrases shall be supplied by inference in the same manner as they are when a "note" occurs on the drawings.

The Subcontractor shall provide all items, articles, materials, operations, or methods listed, mentioned, or scheduled either on the drawings, or specified herein, or both, including all labor, materials, equipment, and incidentals necessary and required for their completion and installation.

For convenience of reference and to facilitate the letting of contracts, the specifications may be separated into titled divisions. Such separations, however, shall not operate to make the engineer an arbitrator to establish the limits of subcontracts in any manner. The following defines the separations referred to in the specifications.

1. Division: Separate numbered division of specifications (e.g., Div. 16)
2. Section: Separate numbered section of a division (e.g., Sec. 16020)
3. Article: Separate numbered article of a subsection (e.g., Article 2.1)

B. Definitions: Certain terms and words as used throughout the specifications shall be defined as follows, unless otherwise particularly specified:

1. "Provide": Furnish and install, complete, in place.
2. "Indicated": As shown on the drawings and/or specified.

3. "Directed,"
"Authorized,"
"Permitted": Shall be as directed, authorized, or permitted by FERMCO.
4. "Selected": Shall be as selected by the A-E/Subcontractor or FERMCO.
5. "Satisfactory,"
"Acceptable": Satisfactory or acceptable to FERMCO.
6. "Necessary,"
"Required,"
"Suitable": As necessary, required, or suitable for the intended purpose as determined by FERMCO.
7. "Submit": Submit to FERMCO unless otherwise specified.

In all cases where the words "or equal" appear in these specifications, they shall be understood to mean "or approved equal."

1.7 ABBREVIATIONS FOR REFERENCED STANDARDS AND SPECIFICATIONS

A. The following list denotes abbreviations used in the technical portions of these specifications:

Abbreviation	Authority
AASHTO	American Association of State Highway and Transportation Officials.
ACI	American Concrete Institute
ADC	Air Diffusion Council
AGC	Associated General Contractors of America
AISC	American Institute of Steel Construction
AISI	American Iron and Steel Institute
AMCA	Air Movement and Control Association
ANSI	American National Standards Institute

Abbreviation	Authority
APA	American Plywood Association
ARI	Air Conditioning and Refrigeration Institute
ASCE	American Society of Civil Engineers
ASHRAE	American Society of Heating, Refrigerating, and Air Conditioning Engineers
ASME	American Society of Mechanical Engineers
ASTM	American Society for Testing and Materials
AWS	American Welding Society
AWWA	American Water Works Association
CFR	Code of Federal Regulations
DHI	Door and Hardware Institute
FGMA	Flat Glass Marketing Association
FM	Factory Mutual System
GA	Gypsum Association
ICBO	International Conference of Building Officials
IEEE	Institute of Electrical and Electronics Engineers
IMIAC	International Masonry Industry All-Weather Council
MBMA	Metal Building Manufacturers Association
NAAMM	National Association of Architectural Metal Manufacturers
NCMA	National Concrete Masonry Association
NEMA	National Electrical Manufacturers Association
NFPA	National Fire Protection Association
NIST	National Institute of Standards and Technology
ODOT	Ohio Department of Transportation
PCA	Portland Cement Association
PDCA	Painting and Decorating Contractors of America
PCI	Prestressed Concrete Institute

Abbreviation	Authority
PS	United States Department of Commerce, Voluntary Products Standards
SDI	Steel Deck Institute
SDI	Steel Door Institute
SIGMA	Sealed Insulating Glass Manufacturers Association
SJI	Steel Joist Institute
SMACNA	Sheet Metal and Air Conditioning Contractors National Association
SSPC	Steel Structures Painting Council
UL	Underwriters Laboratories, Inc.

1.8 WARRANTIES

A. Execute and assemble documents from subcontractors, suppliers, and manufacturers.

B. Refer to FERMCO's "General Terms and Conditions," Article A.26.

END OF SECTION

ATTACHMENT 1 OF SECTION 01010

PARSONS
ERA PROJECT

Attachment 1 to Section 01010 of Specifications
Submittal Listing
Division 11

Material/Equipment/ Item/Description	Shop Dwgs AA	Cat/ Curves BB	List Only CC	Fin Smpl DD	Phys Smpl EE	Mat/Per Certif FF	Tech Specs GG	Eng'g Calcs HH	Parts List II	IOM Mnls JJ	MSDS KK	Test Rept LL	Wiring Diagram MM	Tests Witnessed NN
Section 11501														
Scrubber System	X	X				X	X		X	X		X	X	X

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PARSONS
ERA PROJECT

Attachment 1 to Section 01010 of Specifications
Submittal Listing
Division 15

Material/Equipment/ Item/Description	Shop Dwgs AA	Cat/ Curves BB	List Only CC	Fin Smpl DD	Phys Smpl EE	Mat/Per Certif FF	Tech Specs GG	Eng'g Calcs HH	Parts List II	IOM Mnls JJ	MSDS KK	Test Rept LL	Wiring Diagram MM	Tests Witnessed NN
Section 15060														
Pipe, Fittings, Valves, and Accessories	X	X				X	X			X		X		
Section 15090														
Piping Supports and Anchors	X	X				X				X				
Section 15173														
Motors - Low Voltage Motors		X				X				X	X	X	X	
Section 15250														
Insulation		X				X				X				
Section 15755														
Heat Exchangers	X	X				X	X	X	X	X		X		X
Section 15860														
Fans	X	X				X	X		X	X		X	X	X

Material/Equipment/ Item/Description	Shop Dwgs AA	Cat/ Curves BB	List Only CC	Fin Smpl DD	Phys Smpl EE	Mat/Per Certif FF	Tech Specs GG	Eng'g Calcs HH	Parts List II	IOM Mnls JJ	MSDS KK	Test Rept LL	Wiring Diagram MM	Tests Witnessed NN
Section 15883														
Cyclone	X	X				X	X	X	X	X		X		X
Section 15884														
Carbon Bed Adsorber	X					X	X		X	X		X		X
Section 15885														
Air Cleaning Devices	X					X	X		X	X		X		X
Section 15890														
Ductwork	X					X	X					X		X

PARSONS
ERA PROJECT

Attachment 1 to Section 01010 of Specifications
Submittal Listing
Division 16

Material/Equipment/ Item/Description	Shop Dwgs AA	Cat/ Curves BB	List Only CC	Fin Smpl DD	Phys Smpl EE	Mat/Per Certif FF	Tech Specs GG	Eng'g Calcs HH	Parts List II	IOM Mnls JJ	MSDS KK	Test Rept LL	Wiring Diagram MM	Tests Witnessed NN
Section 16053														
Basic Electrical														
Materials and Methods														
Disconnect Switches	X	X				X				X	X		X	
Motor Starters	X	X				X				X	X		X	
Selector Switches	X	X				X				X	X		X	
Enclosures for Electrical Equipment		X				X				X	X			
Molded Case Circuit Breakers	X	X				X				X	X		X	
Variable Frequency Drives	X	X				X				X	X	X	X	
Conduit		X				X				X	X			
Wire and Cable		X				X				X	X			
Instrument Cable		X				X				X	X			
Nameplates		X				X				X	X			
Wire Markers and Cable Tags		X				X				X	X			
Splicing and Termination Components		X				X				X	X			

SECTION 11501
SCRUBBER SYSTEM

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Packaged packed-tower type scrubber system with spray tower.

1.2 RELATED SECTIONS

A. Section 01010 - General Requirements.

B. Section 15060 - Pipe, Fittings, Valves, and Accessories.

C. Section 15173 - Motors for Off-Gas Control System.

D. Section 15860 - Fans.

E. Section 15950 - Controls and Instrumentation.

F. Section 16053 - Basic Electrical Materials and Methods for Off-Gas Control System.

1.3 SYSTEM DESCRIPTION

A. Design Requirements

1. The scrubber system shall use a spray tower to remove particulates, and a caustic solution in a packed-bed column scrubber to remove NO_x, SO_2, and dust particulates.

1.4 SUBMITTALS

A. Product Data: Certified performance data. Provide catalog sheets indicating rated capacity, size, model number, and materials of construction.

B. Spare parts recommendations.

C. Current user's list for scrubber system.

D. Shop drawings: Indicate general assembly and wiring diagrams, dimensions, and weights; include anchor settings, sizes, and locations, and nozzle ratings, sizes, and locations.

E. Certificates of conformance to specification requirements.

F. Installation instructions, start-up and troubleshooting instructions, operational and maintenance data, and lubrication instructions.

G. Quality Assurance Submittals:
1. Test Reports.
2. Subcontractor's Field Reports.
3. Manufacturer's Design Data.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Store in a clean, dry place and protect from weather prior to shipment. Provide protection from weather and from damage during transit.

B. Loose items shall be tagged and delivered in a standard commercial package. The package shall be protected from the weather; climate conditions, including temperature and humidity variations; dirt; dust; and other contaminants that could adversely affect assembly and operation.

1.6 WARRANTY

A. The scrubber system shall be warranted by the manufacturer, covering materials and labor.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Air Chem Systems
15222 Connector Lane
Huntington Beach, CA 92649
(714) 897-1017
Contact: Paul Bell

000490

B. EST Corporation
Box 890
Quakertown, PA 18951
(215) 538-7000
Contact: Dan Nagel

C. Air Plastics, Inc.
1224 Castle Drive
Mason, Ohio 45040
(513) 398-8081
Contact: Ray Woll

2.2 PRODUCTS/EQUIPMENT

A. General Construction

1. The scrubber system shall include the following components, which shall be supplied as an integrated unit mounted on a skid.
   a. Spray tower.
   b. Spray tower pumps.
   c. Packed-bed type scrubber.
   d. Column internals (packing, liquid distributors, mist eliminator, packing supports).
   e. Recirculation tank.
   f. Recirculation pump(s).
   g. Instrumentation.
   h. Recirculation piping, vents, drains, and valves.
   i. All system controls and motor starters.
2. The packed column scrubber shall be mounted on the recirculation tank. The column shall be removable for shipment.
3. Materials shall be suitable for specified operating conditions. No aluminum components shall be used.
4. The recirculation tank shall have the following flange connections: drain, recirculation pump suction, liquid sample port, makeup water, and caustic makeup.
5. All connections on the scrubber and recirculation tank shall be flanged.
6. The base skid shall be constructed from carbon steel and epoxy coated.

7. System shall include connections, gaskets, and any other materials needed to provide a complete working system.
8. System connections shall allow for installation of heat exchangers between the spray tower outlet and scrubber inlet.

B. Performance Requirements - Note: Design data are preliminary and will be updated.
1. The system shall operate continuously.
2. Spray tower inlet conditions
   a. Flow rate: 3,692 scfm; 11,887 lb/hr.
   b. Temperature: 266 degrees F.
   c. Solids: 132 lbs/hr, specific gravity = 2.9.
3. Spray tower outlet conditions
   a. Flow rate: 3,578 scfm; 11,436 lb/hr.
   b. Temperature: 201 degrees F.
   c. Solids: 6 lbs/hr.
4. Scrubber inlet conditions
   a. Flow rate: 802 scfm; 3,516 lb/hr.
   b. Temperature: 120 degrees F.
   c. NO_x concentration: Assume 200 ppm, maximum; 25 percent removal efficiency, minimum.
   d. SO_2 concentration: Assume 200 ppm, maximum; 90 percent removal efficiency, minimum.
   e. Dust particulates: 3 lbs/hr inlet reduced to 0.46 lb/hr.
5. Design pressure: TBD.
6. Particle size distribution: TBD.

C. Pumps
1. Type: Centrifugal electric motor driven.
2. Pumps shall have mechanical seals.
3. Pumps shall have flanged suction and discharge connections, drain with plug, and base plate with drain, as appropriate.

D. Design Loads
1. Equipment/structural design shall provide for loads as specified below:
   a. Roof, live load: 20 psf.
   b. Platforms and walkways, live load: 60 psf.
   c. Wind load: Velocity pressure shall be calculated using equation 3 of ASCE 7-93,

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using V = 80 mph basic wind speed and I = 1.07. Design wind pressures and forces shall be in accordance with ASCE 7-93, Table 4.

d. Seismic load: Use provisions of the Uniform Building Code, using Z = 0.13, c = 2.75, I = 1.25, and Rw = reduction factors from Table 16-P. W (total seismic load) shall include all normal operating contents, piping, and attachments.

e. Shop drawings shall state the vertical loads and lateral forces used (wind and seismic) in the design.

2.3 ACCESSORIES

A. Control Requirements:

1. Controls shall be manual, with the exception that the exhaust fan (see Section 15860) and the recirculation pump shall be interlocked such that the fan will not operate unless the recirculation pump is operating.
2. Provide the following items for operation:
   a. Start/stop hand switch or switches for the pump motor.
   b. Sight flow glasses or flow indication for the recirculation line and the air duct.
   c. Sight glasses or indication for the level of the scrubber recirculation tank.
   d. Manually adjustable damper for regulation of air flow through the scrubber.
   e. A 1/2-inch test port for insertion of an air flow monitoring probe. Port shall be mounted in the air duct a minimum of 24 inches downstream and 20 inches upstream of any irregularity in the air duct, such as a bend or a damper.

B. Skid

1. The scrubber system , pump, motor, instrumentation, and controls shall be interconnected and skid mounted.
2. The skid assembly shall have provisions for handling via forklift, and lifting eyes for movement by crane.

2.4 FABRICATION

A. Prior to shipment, the scrubber assembly shall be cleaned of all dirt, dust, grease, grime, weld spatter, and other foreign material. Any open end connections shall be sealed to prevent the entrance of foreign material. Equipment shall be primed and painted in accordance with manufacturer's standard finish.

2.5 LABELING

A. Each item shall have a manufacturer's standard nameplate permanently attached at a location which is easily readable. The nameplate shall contain the following information, as applicable:

1. Item description.
2. Item number.
3. Manufacturer's name.
4. Purchase order number.
5. Date of manufacture.
6. Capacity.

PART 3 EXECUTION

3.1 ERECTION/INSTALLATION

A. The installation of the equipment shall be in accordance with the manufacturer's instructions and design drawings.

B. A copy of the manufacturer's installation instructions and service manual for each piece of the equipment shall be provided.

3.2 FIELD QUALITY ASSURANCE

A. Provide start-up service after completion of installation. Start-up service shall include verification of proper mechanical and electrical installation and conducting of acceptance tests.

B. Tests: Acceptance operating tests shall be performed by the Subcontractor after installation to illustrate conformance to the requirements of this specification.

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If the results are unsatisfactory, the Subcontractor shall adjust or replace the equipment to meet the specification requirements, and retest the equipment.

3.3 DEMONSTRATION

A. Demonstrate ability to meet specified performance. This testing shall be performed at the manufacturer's facility and witnessed by a FERMCO representative. Test procedures and data sheets must be approved by FERMCO prior to the test. The Supplier shall provide notice to FERMCO 2 weeks prior to the test.

END OF SECTION

SECTION 15060
PIPE, FITTINGS, VALVES, AND ACCESSORIES

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Aboveground piping, fittings, valves, and accessories.

1.2 RELATED SECTIONS

A. Section 01010 - General Requirements.

B. Section 15090 - Piping Supports and Anchors.

C. Section 15250 - Insulation.

D. Section 16856 - Heating Cables and Panels.

1.3 REFERENCES, CODES, AND STANDARDS

A. American Society of Mechanical Engineers (ASME):

1. ASME A13.1-81 — Scheme for the Identification of Piping Systems (R1985).
2. ASME B16.5-88 — Pipe Flanges and Flanged Fittings.
3. ASME B31.3-93 — Chemical Plant and Petroleum Refinery Piping.
4. ASME Boiler and Pressure Vessel Code (BPVC), Section IX-92.

B. American Society for Nondestructive Testing (ASNT):

1. ASNT-SNT-TC-1A-92 — Recommended Practice, December 1992 Edition.

C. American Society for Testing and Materials (ASTM):

1. ASTM-A53-94 — Pipe, Steel, Black and Hot-Dipped, Zinc-Coated Welded and Seamless.
2. ASTM-A105/A105M-95 — Forgings, Carbon Steel, for Piping Components.
3. ASTM A182/ — Forged or Rolled Alloy Steel

	A182M-94c	Pipe Flanges, Forged Fittings, and Valves and Parts for High-Temperature Service.
4.	ASTM-A193/ A193M-94c	Alloy-Steel and Stainless Steel Bolting Materials for High-Pressure and High-Temperature Service.
5.	ASTM-A194/ A194M-94a	Carbon and Alloy Steel Nuts for Bolts for High-Pressure and High-Temperature Service.
6.	ASTM-A216/ A216M-93	Steel Castings, Carbon, Suitable for Fusion Welding, for High Temperature Service.
7.	ASTM-A234/ A234M-95	Piping Fittings of Wrought Carbon Steel and Alloy Steel for Moderate and Elevated Temperatures.
8.	ASTM-A307-94	Carbon Steel Bolts and Nuts.
9.	ASTM B61-93	Steam or Valve Bronze Castings.
10.	ASTM-B62-93	Composition Bronze or Ounce Metal Castings.

D. American Welding Society (AWS):

1.	AWS A5.1-91	Carbon Steel Electrodes for Shielded Metal Arc Welding.

1.4 SYSTEM DESCRIPTION

A. Design Requirements

1. The pipe, fittings, valves, and accessories shall convey all working fluids between items of process equipment.

1.4 SUBMITTALS

A. Piping drawings, and process and instrumentation diagrams, as applicable.

B. Product Data.

C. Shop drawings.

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D. Certificates of Conformance: Manufacturer shall certify and provide data which indicates that all supplied products meet or exceed specification requirements.

E. Test Procedures: Submit written procedures for all required testing. Test procedures shall include criteria for acceptable performance.

F. Detailed description of packaging materials and procedures including cleaning and closure of all openings.

G. Procedure for repair or replacement of piping failing pressure tests.

H. Flushing procedure.

I. Welder qualification, inspector qualifications, procedure qualification records, and welding procedure specification in accordance with the ASME BPVC, Section IX.

J. Pressure test reports.

1.6 QUALITY ASSURANCE

A. Except where more stringent requirements are specified or indicated, the work specified herein shall conform to ASME B31.3.

B. Welding Procedures and Qualifications

1. Welding procedures, welder qualifications, fabrication, assembly, and erection shall be in accordance with ASME B31.3, Chapter V and ASME BPVC, Section IX.
2. Welder and inspector qualifications shall be made available to, and approved by, the FERMCO Construction Contracts Manager.
3. Welding inspections shall be in accordance with ASME B31.3, Chapter VI.
4. Nondestructive testing personnel qualifications shall be in accordance with ASNT SNT-TC-1A.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Packaging

1. Packaging shall conform to acceptable industrial practices. Materials shall be cleaned to remove chips, slag, weld spatter, oil, grease, debris, and other foreign material prior to packaging for shipment. Pipe spool openings shall be covered, capped, or plugged to prevent ingress of foreign materials during shipment and storage. Tape alone shall not be used for sealing openings. Closures used for covering, capping, or plugging openings shall not be made of polyvinyl chloride (PVC) or other plastics that contain chloride.

B. Storage and Handling

1. Spool openings shall remain sealed.
2. Piping materials and prefabricated assemblies shall be stored off the ground and handled with care so that physical damage to the piping materials does not occur. End seals of pipe, flange covers, valve covers, and similar protection shall not be removed until necessary for cleaning, fabrication, inspection, and erection.
3. Piping materials shall be identified, inspected, controlled, and protected in a manner that will assure conformance with the applicable codes and specifications.
4. Care shall be taken in the storage and handling of all piping materials and prefabricated assemblies so that contamination by grease, moisture, or other foreign matter does not occur.
5. Welding rods and electrodes shall be stored, handled, and identified at all times to ensure the use of the proper welding rod. The electrode ovens for the storage of low-hydrogen welding rods must be used to maintain storage humidity.
6. Austenitic stainless steel materials shall be stored separately from carbon steel materials.

PART 2 PRODUCTS

2.1 PRODUCTS/EQUIPMENT

A. Product Shipping Requirements

1. The Subcontractor shall be responsible for the delivery of all job related materials and/or equipment to the job site. All furnished materials and equipment shall be delivered clean, undamaged, and in a workable condition.
2. Flanges, pipe, fittings, spool pieces, and valves, whether flanged, screwed, or socket welded, shall be shipped with protective end and/or flange covers.
3. All piping shall be thoroughly cleaned prior to shipping to remove grease, oil, mill scale, and other foreign matter.

B. Piping and Valve Specification

1. All piping and valve materials shall meet the requirements as indicated on the attached piping material data sheets.

2.2 MATERIALS

A. Procurement

1. All piping materials shall be procured in accordance with the piping material data sheets.
2. Quarter turn valves shall be used to the maximum extent practical in the liquid and air piping services.
3. For slurry applications (including drains), quarter turn, full port valves shall be used, if practicable.

2.3 FABRICATION

A. Welding

1. All welding shall be in accordance with the applicable codes.
2. All socket welds shall be made by shielded metal arc or gas tungsten arc welding process.

3. Socket weld joints shall be assembled so that the space between the end of the pipe and the bottom of the socket is no less than 1/16 inch and no more than 1/8 inch.

B. Shop Assembly

1. Any parts made in a fabrication shop shall be completely shop assembled prior to shipment to the site.

C. Shop/Factory Finish

1. All carbon steel parts shall be prime coated after fabrication.

2.4 SOURCE QUALITY CONTROL

A. Testing

1. Shop testing shall be in accordance with ASME B31.3.

B. Inspection

1. Inspection shall be conducted in accordance with ASME B31.3.

2.5 LABELING

A. Valve Identification

1. Each valve shall be identified with the unique valve number, as shown on the Subcontractor Piping and Instrumentation Diagrams, embossed on a stainless steel identification tag permanently attached to the valve by a stainless steel wire. Lettering shall be a minimum of 3/8 inch high. The tag shall not be attached to any part of the valve which may interfere with valve operation.
2. Valve identification tags on insulated valves shall be located outside the insulation jacketing and be easily accessible for inspection.

B. Pipe Identification

1. Identify the flow medium and the flow direction for all piping systems including insulated pipe by labeling adjacent to each valve, adjacent to where

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the pipe passes through a wall or floor, adjacent to abrupt pipe directional change, and at intervals of 50 feet along exposed pipe. Pipes shall be labeled as indicated on the Subcontractor Piping and Instrumentation Diagrams and in accordance with ASME A13.1.

2. Content, size, material type, line number, and insulation requirements for each pipeline shall be identified on the drawings as follows:

Example SL - 2" - A - 7000 - ET

Medium Code	Size	Material Code	Line Number	Insulation
SL*	2"	A	7000***	ET**

* See attached piping material data sheet service index for medium codes.
** ET indicates that the pipeline is electric heat traced.
*** Use different number series for each service.

C. Product Marking
1. All piping materials, welding rods, and electrodes shall be marked and identified in accordance with the applicable codes.

PART 3 EXECUTION

3.1 EXAMINATION

A. Examination shall be in accordance with ASME B31.3.

3.2 PREPARATION

A. Protection
1. All welding/fabricating activities shall be protected from inclement weather at all times.

B. Primer Application
1. All non-insulated carbon steel piping shall be prime coated after fabrication.

3.3 ERECTION/INSTALLATION/APPLICATION

A. Layout, Cutting, and Fitting Up

1. All piping, tubing, fittings, components, welding, bonding, fabrication, erection, and assembly shall be in accordance with ASME B31.3. Piping 2 inches in diameter and smaller shall be field routed and supported in accordance with Section 15090 of this specification package.
2. Slurry pipelines shall be sized to maintain a velocity in the 4 to 7 feet per second range to prevent settling of solids.

B. Flanged Joints

1. All flanged joints shall be assembled in accordance with ASME B31.3.
2. Where a raised-face flange mates with a flat-face flange, it shall be substituted with a flat-face flange of the material type specified on the attached Piping Material Data Sheet.
3. Flat ring-type gaskets shall be used between steel flanges equipped with raised serrated faces.
4. Where metallic flanges are bolted to non-metallic flanges, both shall be flat-faced flanges. Full-face gaskets shall be used.
5. When valves, fittings, or equipment having cast iron flanges are used, mating flanges shall be flat faced with full-faced gaskets.
6. Flange isolation kits shall be used between dissimilar metal flanges where galvanic corrosion may occur.

3.4 FIELD QUALITY ASSURANCE

A. Inspections and Tests

1. Piping shall be hydrostatically or pneumatically pressure tested in accordance with ASME B31.3.
2. All pressure vessels, equipment, in-line instruments, gauge glasses, flow meter, and all other pressure parts of instruments shall not be included in these tests if they will be damaged by the test pressure.

3. Equipment which is not to be subjected to the pressure test shall be disconnected from the piping and a pipe spool inserted in its place, or the equipment may be isolated by way of a single-line blind.

B. Hydrostatic Testing

1. Potable water or other approved fluids shall be used for hydrostatic pressure testing of piping systems in accordance with ASME B31.3.
2. All test pressures shall be maintained a minimum of 10 minutes before visual examination of joints begins. Hydrostatic test pressures shall be as shown in the following table:

SERVICE	MEDIUM CODE	DESIGN PRESSURE (psig)	TEST PRESSURE (psig)
Drain	DR	100	150
Condensate	LC	100	150
Slurry	SL	100	150
Process Water	TW	100	150
Live Steam	LS	150	225
Backwash	BW	100	150
Cooling Water Supply	WS	100	150
Cooling Water Return	WR	100	150
Process Wastewater	CE	100	150

C. Pneumatic Testing

1. Pneumatic test pressures shall be as shown in the following table:

SERVICE	MEDIUM CODE	DESIGN PRESSURE	TEST PRESSURE
Plant Air	PA	100 psig	110 psig
Instrument Air	IA	100 psig	110 psig
Fuel Gas	FG	100 psig	110 psig
Off-Gas	OG	-35 in w.g.	15 psig

D. Hydrostatic/Pneumatic Test Reports

1. The Subcontractor shall provide a report for each piping system tested containing the following information:
   a. Date of test.
   b. Line designation number.
   c. Test fluid.
   d. Type of test.
   e. Pressure applied.
   f. Start time.
   g. Completion time
   h. Total time at test pressure.
   i. Certification by examiner of acceptability.
   j. Calibration test gauge number and calibration date.
   k. Comments, if any.

3.5 CLEANING

A. System Cleaning and Flushing

1. The interior and exterior of all pipe shall be kept clean at all times.
2. After erection and welding of piping, all lines except air and gas shall be flushed with potable water prior to leak testing or hydrostatic testing. Upon completion of flushing, lines shall be drained at all low points.

END OF SECTION

ATTACHMENT 1 OF SECTION 15060

Latest Rev					SERVICE INDEX (FOR GENERAL REFERENCE ONLY; SEE PIPING MATERIAL DATA SHEETS FOR SPECIFIC DETAILS)										
Page					MAT'L CODE (SPEC)	FLANGE RATING	MAX PRESS	TEMP RANGE	SERVICE	PIPE MATERIAL	BOLTS	SMALL FITTINGS	VALVES		
										CRSN ALLOW	GASKETS		BODY	TRIM	
					A	150# RF	ASME B16.5	-20° F TO 750° F	DRAIN (DR), SLURRY (SL), PROCESS WASTEWATER (CE), CONDENSATE (LC), LIVE STEAM (LS), COOLING WATER (WS)(WR), BACKWASH (BW), FUEL GAS (FG), OFF-GAS (OG)	CARBON STEEL 0.063	B7 304 SS GRAPHITE	SW AND SCREWED	CS		
					W	150# RF	ASME B16.5	-20° F TO 250° F	PLANT AIR (PA), INSTRUMENT AIR (IA), PROCESS WATER (TW)	CARBON STEEL 0.063	ASTM A307 RUBBER	SCREWED	BRONZE AND CS		

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SERVICE:	PIPING MATERIAL DATA SHEET (SEE SERVICE INDEX)	MAT'L CODE (SPEC)	A
		PAGE 1	OF 3

RATING: CLASS 150
FACING: RF
MATERIAL:CARBON STEEL

CORROSION ALLOWANCE: 0.063
PRESSURE LIMIT: PER ASME/ANSI B16.5
TEMPERATURE LIMIT: -20°F TO 750°F

CODE NUMBER	ENCODER	SIZE FROM	TO	DESCRIPTION	NOTES	REV
				PIPE		
		1/2" - 2"		SEAMLESS CARBON STEEL, ASTM A53 GRADE B, EXTRA STRONG, PLAIN ENDS		
		2-1/2" - LARGER		SEAMLESS CARBON STEEL, ASTM A53 GRADE B, STANDARD WEIGHT, BEVELED ENDS		
				FLANGES		
		1/2" - 2"		CLASS 150, CARBON STEEL, RF, ASTM A105, SOCKETWELD (XS BORE)		
		2-1/2" - LARGER		CLASS 150, CARBON STEEL, RFSF, ASTM A105, WELD NECK (STANDARD WEIGHT BORE)		
				ORIFICE FLANGES		
		2-1/2" - LARGER		CLASS 300, CARBON STEEL, ASTM A105, RF WITH 1/2" SCREWED TAPS AND JACK SCREWS, WELD NECK (STANDARD WEIGHT BORE)		
				FITTINGS		
		1/2" - 2"		CLASS 3000, CARBON STEEL, ASTM A105, SOCKETWELD		
		1/2" - 2"		CLASS 3000, SCREWED CARBON STEEL, ASTM A105;		
				THREADOLET	1	
				PLUG, ROUNDHEAD	1	
				CAP	1	
				PLUG, HEX HEAD	4	
		2-1/2" - LARGER		SEAMLESS CARBON STEEL, BUTT WELD ENDS, ASTM A234 GRADE WPB		

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SERVICE:	PIPING MATERIAL DATA SHEET (SEE SERVICE INDEX)	MAT'L CODE (SPEC)	A
		PAGE 2	OF 3

CODE NUMBER	ENCODER	SIZE FROM	SIZE TO	DESCRIPTION	NOTES	REV
				SWAGES		
		1/2" - 8"		SCHEDULE 80 CARBON STEEL, ASTM A234, GRADE WPB, PREPARE ENDS AS REQUIRED (BEVELED, PLAIN OR THREADED)	2	
				GASKETS		
		1/2" - LARGER		CLASS 150, SPIRAL WOUND, 304SS WITH FLEXIBLE GRAPHITE FILLER 1/8" THICK.		
				BOLTING		
		1/2" - LARGER		STUD BOLTS WITH 2 HEAVY HEX NUTS, ASTM A193 GR B7/ASTM A194 GR 2H		
				PIPING INSTRUMENT CONNECTIONS		
				PRIMARY INSTRUMENT CONNECTIONS TO PIPING:		
				TEMPERATURE CONN. 1-1/2" FLANGED VALVE@ PRESS CONN. 3/4" SW/SCRD VALVE@ ORIFICE FLG. 1/2" SW/SCRD		
				BALL VALVES		
		1/2" - 2"		CLASS 600, CARBON STEEL, ASTM A105, THREE PIECE, SOCKETWELD, CHROME PLATED BALL, TFE SEATS, WRENCH OPERATOR		
		2-1/2" - 4"		CLASS 150, CARBON STEEL, ASTM A216, GRADE WCB, RFSF FLANGE, CHROME PLATED BALL, TFE SEATS, WRENCH OPERATOR		
		6" - LARGER		CLASS 150, CARBON STEEL, ASTM A216, GRADE WCB, RFSF, CHROME PLATED BALL, TFE SEATS, GEAR OPERATOR		
				PLUG VALVES		
		1/2" - 2"		CLASS 150, CARBON STEEL, ASTM A216, GRADE WCB, THREADED ENDS, REINFORCED PTFE SEATS	5	
		2-1/2" - LARGER		CLASS 150, CARBON STEEL, ASTM A216, GRADE WCB, RF FLANGED ENDS, REINFORCED PTFE SEATS	5	

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SERVICE:	PIPING MATERIAL DATA SHEET (SEE SERVICE INDEX)	MAT'L CODE (SPEC) A PAGE 3 OF 3

CODE NUMBER	ENCODER	SIZE FROM	SIZE TO	DESCRIPTION	NOTES	REV
				CHECK VALVES		
		1/2" - 2"		CLASS 150, CAST STEEL, ASTM A216, GRADE WCB, RF FLANGE, SWING TYPE	3	
		2-1/2" - LARGER		CLASS 150, CAST STEEL, ASTM A216, GRADE WCB, RF, FLANGE, CHROME TRIM, BOLTED COVER, INTEGRAL SEAT, SWING TYPE	3	
				GATE VALVES		
		1/2" - 2"		CLASS 150, CARBON STEEL, ASTM A105, CHROME TRIM, O S AND Y, SOCKETWELD ENDS		
		2-1/2" - LARGER		CLASS 150, CAST STEEL, ASTM A216, GRADE WCB, RF FLANGE, CHROME TRIM, O S AND Y, SOLID WEDGE DISC, INTEGRAL SEAT		
				GLOBE VALVES		
		1/2" - 2"		CLASS 800, CARBON STEEL, ASTM A105, SOCKETWELD, WELDED BONNET, 12% CHROME TRIM, HANDWHEEL OPERATOR		
		2-1/2" - LARGER		CLASS 150, CARBON STEEL, ASTM A216 GRADE WCB.RF FLANGE, 12% CHROME TRIM, HANDWHEEL OPERATOR		
				PIPE NIPPLES		
				CARBON STEEL, ASTM A53, GRADE B		
		1/2" - 2"		SCH 160, TBE, SMLS 3" LONG		
		1/2" - 2"		SCH 160, TBE, SMLS 6" LONG		
		1/2" - 2"		SCH 160, POE-TOE, SMLS 3" LONG		
		1/2" - 2"		SCH 160, POE-TOE, SMLS 6" LONG		
				STEAM TRAPS		
		1/2" - 2"		CLASS 600, SCREWED, DISC TYPE, INTEGRAL STRAINER, LOW CARBON CHROME-MOLY BODY, ASTM A-182, GRADE F-11		
				NOTES		
				1. USE FOR UNVALVED VENTS AND DRAINS. 2. USE SWAGES WHERE SMALL END IS 2" AND SMALLER. USE WELD REDUCER WHERE SMALL END IS 2-1/2" AND LARGER. 3. INSTALL IN HORIZONTAL POSITION OR WITH FLOW UP. 4. USE FOR PROCESS DRAINS. 5. USE FOR FUEL GAS ONLY, DEAD-TIGHT SHUTOFF IS REQUIRED.		

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PIPING MATERIAL DATA SHEET
SERVICE: (SEE SERVICE INDEX)

MAT'L CODE W
(SPEC)
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RATING: CLASS 150
FACING: RF
MATERIAL: GALVANIZED CARBON STEEL

CORROSION ALLOWANCE: 0.0625"
PRESSURE LIMIT: to 150 psig
TEMPERATURE LIMIT: -20°F TO 250°F

CODE NUMBER	ENCODER	SIZE FROM	TO	DESCRIPTION	NOTES	REV
				PIPE		
		1/2" - 2"		SEAMLESS GALVANIZED CARBON STEEL, ASTM A53, GRADE A, EXTRA STRONG, THREAD AND COUPLE ENDS		
		2-1/2" - LARGER		SEAMLESS CARBON STEEL, ASTM A53, GRADE A, STANDARD WEIGHT, BEVELED ENDS		
				FLANGES		
		1/2" - 2"		CLASS 150, GALVANIZED CARBON STEEL, RF, ASTM A105, SCREWED (XS BORE)		
		2-1/2" - LARGER		CLASS 150, CARBON STEEL, RFSF, ASTM A105, WELD NECK (STD WT BORE)		
				ORIFICE FLANGES		
		2-1/2 " - LARGER		CLASS 300, CARBON STEEL, ASTM A105, RF WELD NECK WITH 1/2" SCREWED TAPS AND JACK SCREWS (STD WT BORE)		
				FITTINGS		
		1/2" - 2"		CLASS 3000, GALVANIZED CARBON STEEL, ASTM A105, SCREWED		
		1/2" - 2"		CLASS 3000, GALVANIZED CARBON STEEL, ASTM A105, SCREWED		
				THREADOLET	1	
				PLUG, ROUNDHEAD	1	
				CAP	1	
				PLUG, HEX HEAD	3	
		2-1/2 " - LARGER		SEAMLESS CARBON STEEL, STANDARD WEIGHT, ASTM 234, GRADE WPB, BUTT WELD ENDS		

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RATING: CLASS 150
FACING: RF
MATERIAL: GALVANIZED CARBON STEEL

CORROSION ALLOWANCE: 0.0625"
PRESSURE LIMIT: 150 psig
TEMPERATURE LIMIT: -20°F TO 250°F

			SWAGES		
		1/2" - 8"	SCHEDULE 80, CARBON STEEL, ASTM A234, GRADE WPB, PREPARE ENDS AS REQUIRED (BEVELED OR THREADED)	2	
			GASKETS		
		1/2" - LARGER	CLASS 150, RED RUBBER, 1/8" THICK	4	
			BOLTING		
		1/2" - LARGER	MACHINE BOLT WITH 1 HEAVY HEX NUTS, ASTM A307, GRADE B (CADMIUM PLATED)		
			PIPING INSTRUMENT CONNECTIONS		
			PRIMARY INSTRUMENT CONNECTIONS TO PIPING: TEMPERATURE CONN 1-1/2" FLG'D VALVE AT PRESS CONN'S 3/4" SCRD VALVE AT ORIFICE FLGE 1/2" SCRD		
			BALL VALVES		
		1/2" - 2"	200 WOG, BRONZE, THREADED ENDS, REINFORCED TFE SEATS, CHROME-PLATED BALL, WRENCH OPERATOR		
		2 1/2" - 4"	CLASS 150, CARBON STEEL, RF FLANGE, ASTM A216, GRADE WCB, TFE SEATS, CHROME-PLATED BALL, WRENCH OPERATOR		
		6" - LARGER	CLASS 150, CARBON STEEL, ASTM A216, GRADE WCB, RFSF, CHROME PLATED BALL, TFE SEATS, GEAR OPERATOR		
			CHECK VALVES		
		1/2" - 2"	CLASS 150, BRONZE, THREADED ENDS, ASTM B61, SWING TYPE, BRONZE TRIM		
		2 1/2" - LARGER	CLASS 150, CARBON STEEL, RF FLANGE, ASTM A216, GRADE WCB, CHROME TRIM, BOLTED COVER, INTEGRAL SEAT, SWING TYPE.		

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PIPING MATERIAL DATA SHEET SERVICE: (SEE SERVICE INDEX)	MAT'L CODE W (SPEC) PAGE 3 OF 3

RATING: CLASS 150
FACING: RF
MATERIAL: GALVANIZED CARBON STEEL

CORROSION ALLOWANCE: 0.0625"
PRESSURE LIMIT: 150 psig
TEMPERATURE LIMIT: -20°F TO 250°F

	GATE VALVES
1/2" - 2"	CLASS 150, BRONZE, THREADED ENDS, ASTM B62, BRONZE BONNET, HANDWHEEL OPERATOR
2 1/2" - LARGER	CLASS 150, CARBON STEEL, RF FLANGE, ASTM 216, GRADE WCB, O.S.& Y, CHROME TRIM, HANDWHEEL OPERATOR
	GLOBE VALVES
1/2" - 2"	CLASS 150, BRONZE, THREADED ENDS, ASTM B62, BRONZE TRIM, HANDWHEEL OPERATOR
2 1/2" - LARGER	CLASS 150, CARBON STEEL, RF FLANGE, ASTM A216, GRADE WCB, O.S.&Y CHROME TRIM, HANDWHEEL OPERATOR
	PIPE NIPPLES
1/2" - 2"	SCH 160, TBE, SMLS, 3" LONG
1/2" - 2"	SCH 160, TBE, SMLS, 6" LONG
1/2" - 2"	SCH 160, POE-TOE, SMLS, 3" LONG
1/2" - 2"	SCH 160, POE-TOE, SMLS, 6" LONG

NOTES

1. USE FOR UNVALVED VENTS AND DRAINS.
2. USE SWAGES WHERE SMALL END IS 2" AND SMALLER. USE WELD REDUCER WHERE SMALL END IS 2-1/2" AND LARGER.
3. USE FOR PROCESS DRAINS.
4. USE WITH ORIFICE FLANGES ONLY.

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SECTION 15090
PIPING SUPPORTS AND ANCHORS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Design of all piping supports and anchors.

B. Furnishing and installing all piping system hangers, supports, clamps, rods, turnbuckles, bracing, rolls, plates, brackets, saddles, restraints, anchors, and other support elements as required.

1.2 RELATED SECTIONS

A. Section 01010 - General Requirements.

B. Section 15060 - Pipe, Fittings, Valves, and Accessories.

1.3 REFERENCES, CODES, AND STANDARDS

A. American Society for Testing and Materials (ASTM):
1. ASTM A36/A36M-94 Structural Steel.

B. American National Standards Institute (ANSI)/American Society of Mechanical Engineers (ASME):
1. ANSI/ASME B31.3-93 Chemical Plant and Petroleum Refinery Piping.

C. Manufacturers Standardization Society (MSS):
1. MSS-SP-58-93 Pipe Hangers and Supports - Materials, Design, and Manufacture.
2. MSS-SP-69-91 Pipe Hangers and Supports - Selection and Application.
3. MSS-SP-89-91 Pipe Hangers and Supports - Fabrication and Installation Practices.

D. American Welding Society (AWS):

1. AWS A5.1-91 Carbon Steel Electrodes for Shielded Metal Arc Welding.
2. AWS D1.1-94 Structural Steel Welding Code.

1.4 SYSTEM DESCRIPTION

A. Design Requirements

1. All pipe anchors, guides, and auxiliary steel shall be of bolted or welded construction incorporating a design safety factor of five.
2. Anchors and guides shall be used to prevent excessive forces or moments on pipe or equipment caused by hydraulic surges.
3. Hangers and support types for all process lines shall be selected to withstand all static and dynamic load conditions and shall take into consideration limitations imposed by the surrounding structures, equipment, adjacent piping, ventilation and heating ductwork, and electrical trays. The consideration shall be given to the following loads:
   a. Weight of the pipe, valves, fittings, insulation materials, hanger components, and normal fluid contents.
   b. Weight of the hydrostatic test fluid or cleaning fluid, if normal operating fluid density is less than test or cleaning fluid.
   c. Loads imposed during erection.
4. Support Spacing:
   a. Hangers and supports shall be spaced in accordance with ASME B31.3 and the attached allowable pipe spans chart. Due consideration shall be given to assure that the sag of the pipe between supports is within limits that will permit drainage and avoid excessive bending stresses from concentrated loads.
5. Restrictions:
   a. Pipe support assemblies shall be used only for supporting pipelines. Electrical trays, instrument trays, cable, or tubing shall be supported from separate assemblies unless

written approval has been received from the FERMCO Construction Contracts Manager. Pipe hanger rods or supports shall not pass through heat or ventilating ducts and electrical or instrument trays.

6. Pipe shoes:
   a. Pipe shoes for steam and condensate piping shall be 12 inches long, attached to the longitudinal run of pipe, and centered on the structural member.
7. Heat Traced Pipe:
   a. Electric-traced pipe lines shall rest on support steel, adjustable roller hangers, or an adjustable pipe roll and base attached to a horizontal steel member. Insulation shall be cut away at support to facilitate installation.

1.5 SUBMITTALS

A. Certificate of Conformance: Manufacturer shall certify and provide data which indicate that all products supplied meet or exceed specification requirements.

B. Product data.

C. Shop drawings which indicate type and location, arrangement, dimensions, materials, and anchor details.

D. Manufacturer's installation instructions and catalog data.

1.6 QUALITY ASSURANCE

A. All pipe anchors, guides, and auxiliary steel shall be of bolted or welded construction. Welded construction shall comply with AWS D1.1.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Packaging

1. Materials shall be cleaned to remove chips, slag, weld spatter, oil and grease, debris, and other foreign matter prior to packing for shipment.

B. Storage and Handling

1. Piping support materials and piping hanger systems shall be stored off the ground and handled with care so that physical damage or contamination of the materials does not occur.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Grinnell Supply Sales Company.

B. Piping Technology and Products, Inc.

C. Basic Engineers, Inc.

2.2 PRODUCTS/EQUIPMENT

A. Product Shipping Requirements

1. The Subcontractor shall be responsible for the delivery of all job-related materials and/or equipment to the job site.

2.3 MATERIALS

A. Hangers and component parts shall be constructed of galvanized carbon steel and comply with MSS-SP-58 and MSS-SP-69.

B. Pipe clamps shall comply with ASTM A576 and be constructed of galvanized carbon steel.

C. ASTM A36 steel shall be used for all plate and structural shape support components.

2.4 FABRICATION

A. Welding

1. All welding shall be in accordance with AWS A5.1 and AWS D1.1.

B. Shop Assembly

1. Any parts made in the fabricator's shop shall be completely shop assembled, as far as practical, prior to shipment to the site.

C. Shop/Factory Finish

1. All carbon steel parts shall be shop prime coated after fabrication.

2.5 LABELING

A. Product Marking

1. All welding rods and electrodes shall be identified with at least one imprint per rod showing an AWS classification number in accordance with AWS A5.1.

PART 3 EXECUTION

3.1 ERECTION/INSTALLATION/APPLICATION

A. Installation

1. Hanger and support components shall be installed in accordance with MSS-SP-89.

B. Structural Connections for Pipeline Supports

1. Locations: New pipeline supports and/or hangers shall be attached to structural members. The supports shall be located at the following places and at intermediate points so that the maximum support spacing per ASME B31.3 is not exceeded:
   a. For changes in direction on horizontal or sloped lines, refer to the attached allowable pipe spans chart.
   b. Both sides of flanged flow meter joints on horizontal or sloped lines.

c. Within 2 feet on one side of valves on horizontal or sloped lines.

d. The underside of floor or platform steel on vertical lines that pass through the floor or platform.

2. Cold Lines: Hanger rods supporting cold pipelines, or lines whose point of support does not move, may be bolted directly to angle, beam, or supporting members.

3. Prohibited Attachments: Pipelines shall not be attached to the following:

   a. Floor opening pipe sleeves.

   b. Grating or floor plate.

   c. ASME Coded Vessels.

   d. Other pipe hangers or other pipes.

4. Supports shall be provided to avoid the need for temporary supports in the following cases:

   a. Where regular maintenance necessitates the removal of equipment.

   b. Where flanged connections must be broken to remove or insert spectacle blinds.

5. Anchors and guides shall be designed and installed at the locations shown on the Subcontractor piping drawings.

3.2 ADJUSTING

A. At Pumps: Where required, the suction piping and discharge piping adjacent to pumps shall be supported with an adjustable support.

B. Riser Guides: All risers that may sway or vibrate from pump pulsations or mechanical equipment operation shall be guided. The guides/braces shall prevent movement resulting from equipment operation/vibration, but shall not limit or restrain movement of pipe due to thermal expansion. On overflow lines, a brace or restraint shall be installed near the discharge.

C. Vertical Adjustment

1. All rod-type hangers shall be provided with a means of vertical adjustment after erection. If a turnbuckle is used, the right hand thread shall be at the top, so that turning to the right will raise the pipe.

D. Riser Piping

1. Where practical, riser piping shall be supported independently of the connected horizontal piping. Pipe support attachments to riser piping shall be by riser clamps and/or lugs welded to the pipe.

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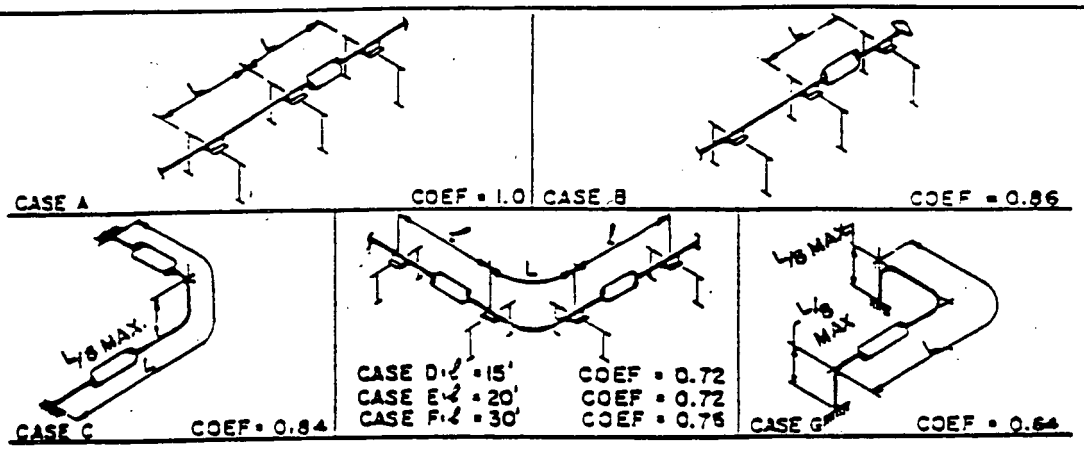
Subject

ALLOWABLE PIPE SPANS



Notes:

1. The limiting factors are deflection and weight stress. Pipe span not entered if weight stress of 6,000 pounds per square inch (psi) is exceeded.
2. The pipe spans are based on carbon steel pipe with modulus of elasticity of 30 x 10^6 psi. This chart can be applicable to alloy pipe.
3. Deflection is based on a compromise between a beam with fixed-ends and for a free-ended beam. d = 17.1 (wl^4/EI).
4. This chart is adequate for standard-wall and extra-strong walled pipe.
5. Boxed figures represent Parsons standard. Job instructions may allow deviation.
6. When using Cases B, C, D, E, F, and G, multiply pipe span by their coefficient.
7. These spans are the maximum to be used under American National Standards Institute B31.3, Piping. Design conditions and other codes should be investigated before using these spans.

PIPE SIZE	1	1½	2	3	4	6	8	10	12	14	16	18	20	24	DEFL
BARE PIPE	—	—	—	—	—	—	—	36	38	42	45	47	50	54	1/4
	14	17	19	24	27	33	38	43	46	49	52	55	58	64	1/2
	15	18	21	25	29	35	40	46	49	52	55	58	62	68	5/8
	16	19	22	26	30	37	42	48	52	55	58	62	65	71	3/4
	17	21	23	28	32	40	45	—	—	—	—	—	—	—	1
BARE PIPE + WATER	—	—	—	—	—	—	—	31	33	35	36	37	39	42	1/4
	14	17	19	22	25	29	33	36	39	40	42	44	46	48	1/2
	14	18	20	23	26	31	35	39	41	43	45	47	48	52	5/8
	15	19	21	24	27	33	37	41	43	45	47	49	51	—	3/4
	16	20	22	26	29	35	40	—	—	—	—	—	—	—	1
PIPE + 2" INSUL.	—	—	—	—	—	—	—	34	36	39	42	44	47	52	1/4
	12	15	17	22	25	31	36	41	42	46	50	52	56	61	1/2
	13	16	18	23	26	33	38	43	45	49	53	56	59	65	5/8
	13	17	19	24	27	35	40	45	47	52	55	58	62	68	3/4
	14	18	20	26	28	37	42	—	—	—	—	—	—	—	1
PIPE + 2" INSUL. +0.8 WATER	—	—	—	—	—	—	—	31	33	35	36	37	39	42	1/4
	12	15	16	20	23	29	33	36	39	40	42	44	46	48	1/2
	12	16	17	22	25	31	35	39	41	43	45	47	48	52	5/8
	13	17	18	23	26	32	36	41	43	45	47	49	51	—	3/4
	14	18	20	25	29	34	39	—	—	—	—	—	—	—	1

END OF SECTION

SECTION 15173
MOTORS FOR OFF-GAS CONTROL SYSTEM

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Low voltage, three phase induction motors.

B. Low voltage, single phase induction motors.

1.2 RELATED SECTIONS

A. Section 01010 - General Requirements.

B. Section 11501 - Scrubber System.

C. Section 15681 - Water Chillers.

D. Section 15712 - Induced Draft Cooling Towers.

E. Section 15860 - Fans.

F. Section 16053 - Basic Electrical Materials and Methods for Off-Gas Control System.

1.3 REFERENCES

A. American Bearing Manufacturers Association (ABMA):
1. ABMA 9-90 — Load Ratings and Fatigue Life for Ball Bearings.
2. ABMA 11-90 — Load Ratings and Fatigue Life for Roller Bearings.

B. Institute of Electrical and Electronics Engineers (IEEE):
1. IEEE 112-91 — Standard Test Procedure for Polyphase Induction Motors and Generators.

C. National Electrical Manufacturers Association (NEMA):
1. NEMA MG 1-93 — Motors and Generators.

2. NEMA MG 13-84 Frame Assignments for AC Integral-Horsepower Induction Motors.

D. National Fire Protection Association (NFPA):
1. NFPA 70-96 National Electrical Code.

1.4 SYSTEM DESCRIPTION

A. Provide electric motors as required for the Off-Gas Control System. Each motor shall be selected especially for its respective driven equipment. Each motor shall be adequate for the full range of the driven equipment's performance.

1.5 SUBMITTALS

A. See Section 01010 for submittal requirements.

B. Motor Data Sheets: Provide completed motor data sheet (Attachment 1) for each motor provided.

C. Test Reports: Indicate satisfactory completion of required tests and inspections. Submit results verifying performance in accordance with IEEE 112.

1.6 QUALITY ASSURANCE

A. Conform to NFPA 70 and NEMA MG 1.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Reliance Electric.

B. U. S. Motors.

C. General Electric.

2.2 EQUIPMENT

A. General Construction and Requirements

1. Electrical Service: Refer to related sections of the specifications and the drawings for required characteristics.
2. Motors: Design for continuous operation at a temperature of 40 degrees C ambient, and for temperature rise in accordance with NEMA MG 1 limits for insulation class, service factor, and motor enclosure type. Motors to be controlled by variable frequency drives shall be of a design suitable for this type of operation.
3. Visible Nameplate: Nameplate to indicate motor horsepower, voltage, phase, frequency, rpm, full load amps, locked rotor amps, frame size, manufacturer's name and model number, service factor, power factor, serial number, and bearing numbers. Nameplate shall be stainless steel, permanently attached to the motor frame.
4. Electrical Connection: Conduit connection boxes, threaded for conduit and designed to allow for 90 degree step rotation of the conduit entrance. Oversize conduit boxes shall be provided.
5. Motor Service Factor: Furnish motors with service factors required here by table in Paragraph D. Motor size in hp shall be selected to serve the driven equipment over its full performance range as though the service factor is 1.0.
6. Motor voltage shall be 115 V, single-phase for motors 1 hp or less. Other motors shall be 460 V, three-phase.
7. Motors drawing less than 250 W that are intended for intermittent service may be germane to equipment manufacturer and need not conform to these specifications.

B. Three Phase - Squirrel Cage Induction Motors

1. Motors shall be 460 V, three phase, 60 Hz.
2. The motor connection diagram shall be stainless steel, permanently stamped and attached to the motor either inside the conduit box or on the same side as the conduit box.

3. Starting Torque: To be matched to the driven equipment.
4. Starting Current: Not to exceed six times full-load current.
5. Power Output, Locked Rotor Torque, Breakdown or Pullout Torque: NEMA Design B characteristics or as required by the driven equipment.
6. Design, Construction, Testing, and Performance: Conform to NEMA MG 1 for Design B motors.
7. Insulation System: Non-hygroscopic NEMA Class F or better.
8. Testing Procedure: In accordance with IEEE 112, Test Method B. Load test motors to determine freedom from electrical or mechanical defects and for compliance with performance data.
9. Motor Frames: NEMA MG 13 standard T-frames of steel, aluminum, or cast iron with end brackets of cast iron or aluminum with steel inserts.
10. Bearings: Grease lubricated, anti-friction ball bearings with housings equipped with plugged provision for prelubrication, rated for minimum ABMA 9 and 11, L-10 life of 20,000 hours.
11. Sound Power Levels: To NEMA MG 1.
12. Motors shall be high efficiency type.
13. Motors shall be totally enclosed fan cooled (TEFC).
14. Nominal Efficiency: Meet or exceed values in schedules as given herein at full load and rated voltage when tested in accordance with IEEE 112.
15. Nominal Power Factor: Meet or exceed values in schedules as given herein at full load and rated voltage when tested in accordance with IEEE 112.

C. Performance Schedule: Three Phase - Energy efficient, TEFC.

HP Factor	RPM (Syn)	NEMA Frame	Minimum Percent Efficiency	Minimum Percent Power Factor
1	1200	145T	81	72
1-1/2	1200	182T	83	65
2	1200	184T	85	68
3	1200	213T	85	63
5	1200	215T	86	66
7-1/2	1200	254T	89	68
10	1200	256T	89	75
15	1200	284T	90	72
20	1200	286T	90	76
25	1200	324T	90	71
30	1200	326T	91	79
40	1200	364T	92	78
50	1200	365T	92	81
60	1200	404T	92	83
75	1200	405T	92	80
100	1200	444T	93	83
125	1200	445T	93	85
1	1800	143T	82	84
1-1/2	1800	145T	84	85
2	1800	145T	84	85
3	1800	182T	87	83
5	1800	184T	88	83
7-1/2	1800	213T	89	85
10	1800	215T	90	84
15	1800	254T	91	86
20	1800	256T	91	85
25	1800	284T	92	84
30	1800	286T	93	86
40	1800	324T	93	83
50	1800	326T	93	85
60	1800	364T	93	87

HP Factor	RPM (Syn)	NEMA Frame	Minimum Percent Efficiency	Minimum Percent Power Factor
75	1800	365T	93	87
100	1800	405T	94	86
125	1800	444T	94	87
150	1800	445T	94	88
200	1800	447T	95	87
1-1/2	3600	143T	82	85
2	3600	145T	82	87
3	3600	182T	82	87
5	3600	184T	85	88
7-1/2	3600	213T	86	86
10	3600	215T	86	86
15	3600	254T	88	91
20	3600	256T	89	89
25	3600	284T	90	92
30	3600	286T	91	92
40	3600	324T	91	91
50	3600	326T	90	92
60	3600	364T	91	93
75	3600	365T	91	91
100	3600	405T	92	92

D. Service Factor Schedule

HP	3600 rpm	1800 rpm	1200 rpm	900 rpm
1/6 - 1/3	1.35	1.35	1.35	1.35
1/2	1.25	1.25	1.25	1.15
3/4	1.25	1.25	1.15	1.15
1	1.25	1.15	1.15	1.15
>1 - 150	1.15	1.15	1.15	1.15

E. Single phase motors shall conform to the following respective requirements. The driven equipment supplier shall furnish motor starter, motor type, and motor enclosure type suitable for the application.

1. Single Phase Power - Split Phase Motors
   a. Starting Torque: Less than 150 percent of full load torque.
   b. Starting Current: Up to seven times full load current.
   c. Breakdown Torque: Approximately 200 percent of full load torque.
   d. Drip-Proof Enclosure: Class A (50 degrees C temperature rise) insulation, NEMA Service Factor, prelubricated sleeve or ball bearings.
   e. Enclosed Motors: Class A (50 degrees C temperature rise) insulation, 1.0 Service Factor, prelubricated ball bearings.
2. Single Phase Power - Permanent-Split Capacitor Motors
   a. Starting Torque: Exceeding 1/4 of full load torque.
   b. Starting Current: Up to six times full load current.
   c. Multiple Speed: Through tapped windings.
   d. Open Drip-Proof or Enclosed Air Over Enclosure: Class A (50 degrees C temperature rise) insulation, minimum 1.0 Service Factor, prelubricated sleeve or ball bearings, automatic reset overload protector.
3. Single Phase Power - Capacitor Start Motors
   a. Starting Torque: Three times full load torque.
   b. Starting Current: Less than five times full load current.
   c. Pull-Up Torque: Up to 350 percent of full load torque.
   d. Breakdown Torque: Approximately 250 percent of full load torque.
   e. Motors: Capacitor in series with starting winding; provide capacitor-start/capacitor-run motors with two capacitors in parallel with run capacitor remaining in circuit at operating speeds.
   f. Drip-Proof Enclosure: Class A (50 degrees C temperature rise) insulation, NEMA Service Factor, prelubricated bearings.

g. Enclosed Motors: Class A (50 degrees C temperature rise).

PART 3 EXECUTION

Not used.

END OF SECTION

ATTACHMENT 1

MOTOR DATA SHEET

MOTOR DATA SHEET

Submit for each motor. Mark N/A if not applicable.

1. Driven Equipment Number _____
2. Driven Equipment Name _____
3. Motor Manufacturer _____
4. Quantity _____
5. Horsepower (hp) _____
6. RPM _____
7. Voltage _____
8. Enclosure Type _____
9. Frame _____
10. Phase/Frequency _____
11. 40 degree C ambient insulation _____
12. Service Factor _____
13. NEMA Design _____
14. Space Heaters _____
15. Full Load Amperes (FLA) _____
16. Locked Rotor Amperes (LRA) _____
17. Efficiency:
    - 1/2 Load _____
    - 3/4 Load _____
    - Full Load _____
18. Power Factor:
    - 1/2 Load _____
    - 3/4 Load _____
    - Full Load _____

SECTION 15250
INSULATION

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Supplying all labor, materials, and equipment required for installing pipe and equipment insulation as specified herein.

1.2 RELATED SECTIONS

A. Section 01010 - General Requirements.

B. Section 15060 - Pipe, Fittings, Valves, and Accessories.

C. Section 15090 - Piping Supports and Anchors.

D. Section 16856 - Heating Cables and Panels.

1.3 REFERENCES, CODES, AND STANDARDS

A. American Society for Testing and Materials (ASTM):

1.	ASTM B209-93	Aluminum and Aluminum-Alloy Sheet and Plate.
2.	ASTM C533-85	Calcium Silicate Block and Pipe Thermal Insulation.
3.	ASTM C552-91	Cellular Glass Thermal Insulation.

1.4 SUBMITTALS

A. Certificate of Conformance: Manufacturer shall certify and provide data which indicate that all products supplied meet or exceed specification requirements.

B. Submit product data and installation manuals.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Insulation Materials

1. Insulation materials shall be identified, inspected, controlled, and protected in a manner that will assure conformance with the referenced codes and standards.
2. Care shall be taken in the storage and handling of all insulation material so that contamination by grease, moisture, or other foreign matter does not occur. Insulation materials shall be stored off the ground, protected from the weather, and handled so that physical damage to the insulation material does not occur.

1.6 SEQUENCING AND SCHEDULING

A. Insulation shall not be installed on the equipment or piping system until the system has passed a hydrostatic pressure test.

PART 2 PRODUCTS

2.1 MATERIALS

A. Cellular glass: Board and molded (rigid), inorganic, 'k' value of 0.345 Btu-inch/hour per square-feet per degree F at 75 degrees F, conforming to ASTM C552 (Type II), to be used for temperatures below 400 degrees F.

B. Calcium Silicate: Preformed pipe covering, flat block or curved block, in accordance with ASTM C533 (Type I), to be used for temperatures above 400 degrees F.

C. Jacketing: Aluminum, Alloy 3003-H14, tempered, 0.020 inches thick, embossed, conforming to ASTM B209.

D. Elbow insulation covers: Aluminum, Alloy 1100, tempered.

E. Bedding Compound: Non-volatile, .008 perm inch; service temperature range of -60 degree F to 180 degree

F; application temperature 40 degree F to 100 degree F, sealant.

2.2 ACCESSORIES

A. Wire: B&S Gage No.16, annealed, 302 or 304 stainless steel.

B. Insulation Bands:
   1. Piping: 1/2-inch wide (minimum) by 0.015-inch thick (minimum), 304 stainless steel bands.
   2. Equipment: 3/4-inch by 0.015-inch thick (minimum), 304 stainless steel bands.

C. Screws: Number 8, by 3/8-inch, sheet metal type 302 or 304 stainless steel.

D. Adhesives: Fire-resistant adhesive shall be compatible with insulation.

PART 3 EXECUTION

3.1 ERECTION/INSTALLATION/APPLICATION

A. Piping, valves, fittings, flanges, and equipment shall be insulated and jacketed for all systems subjected to freezing temperatures, for hot lines and for steam and condensate lines. Insulated pipe and equipment shall be shown on the Subcontractor's and vendor's piping and instrumentation diagrams and piping drawings.

B. Install materials in accordance with the manufacturer's instructions. Maintain temperatures and conditions required by the manufacturer for installation.

C. Manholes, flanged valves, flanged fittings, and pipeline flanges shall have removable insulation and aluminum jacketing to permit servicing of take-down joints. Removable covers may be fabricated from segments of block insulation or from preformed sectional pipe covering and premolded components. A removable cover shall be of the same material as the adjoining pipe insulation.

D. Fill joints and seams with bedding compound to form smooth surface.

E. All piping and equipment insulation shall be stopped at a sufficient distance from flanges to permit ease of bolt removal. Insulation shall be beveled at a 45-degree angle at this point.

F. Install jacketing with screws on 3-inch centers on all fittings and valves where banding is not possible.

G. Labels indicating "asbestos-free" shall be attached to the outside of all insulation jacketing.
   1. The asbestos-free labels on piping systems shall be located adjacent to all piping identification labels.
   2. The asbestos-free labels on equipment shall be located adjacent to the equipment identification tag.

H. Pipe Insulation
   1. All piping and heat tracing shall be tested before installing insulation.
   2. Piping shall be covered with a minimum of 1-1/2-inch-thick cellular glass or a minimum of 4-inch thick calcium silicate insulation as applicable.
   3. Sectional cellular glass insulation shall be applied in a single layer with joints tightly butted, and shall be secured in place with wire on 12-inch centers.
   4. Aluminum jacketing shall be applied directly over insulation. Minimum lap for longitudinal joints shall be 1 inch, and minimum lap for circumferential joints shall be 2 inches. The jacketing shall be secured in place with bands on 9-inch centers.
   5. Premolded elbow insulation and aluminum elbow covers shall be installed at all elbows. Aluminum jacketing shall be used for all other fittings, valves, flanges, etc.
   6. Lap all seams against weather.

7. Finish insulation at supports, protrusions, and interruptions. At pipe supports, remove only enough insulation to provide a snug fit.

I. Equipment Insulation

1. Apply insulation board directly to equipment surfaces with all joints staggered and tightly butted. Secure insulation in place with stainless steel bands on 18-inch centers.
2. Board insulation shall be cemented to irregular surfaces and all voids shall be filled with bedding compound.
3. Apply aluminum jacketing over insulation with 3-inch minimum lap on longitudinal and circumferential joints.
4. Equipment shall be covered with a minimum of 2-inch-thick insulation.
5. Insulation shall be cut away from all equipment identification nameplates and beveled at a 45-degree angle.
6. All equipment and heat tracing shall be tested before installing insulation.

END OF SECTION

SECTION 15755
HEAT EXCHANGERS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Shell and tube type heat exchangers.

B. Air-to-gas heat exchangers.

1.2 RELATED SECTIONS

A. Section 01010 - General Requirements.

1.3 REFERENCES

A. American Society of Mechanical Engineers (ASME):
   1. ASME Boiler and Pressure Vessel Code - 1992, Section VIII.

B. Tubular Exchanger Manufacturers Association (TEMA):
   1. TEMA Standards - 1988.

1.4 SYSTEM DESCRIPTION

A. Design Requirements
   1. The heat exchangers shall provide cooling of the off-gas to condense water vapor and heating of the off-gas to facilitate operation of the carbon bed adsorbers.

1.5 SUBMITTALS

A. Shop Drawings: Indicate dimensions, sizes, weights, material thicknesses, and nozzle locations, sizes, and ratings.

B. Product Data: Provide data on ratings and dimensions for accessories.

C. Design Data: Provide product literature, drawings, and calculations that indicate heat exchangers meet or exceed specified requirements.

D. Test Reports: Indicate tube bundle pressure tests.

E. Certificates: Certify that heat exchangers and components meet or exceed specified requirements.

F. Manufacturer's Instructions: Indicate installation and support requirements.

G. Operation and Maintenance Data: Include start-up and shutdown instructions, assembly drawings, and spare parts lists.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Store in a clean, dry place and protect from weather prior to shipment. Provide protection from weather and from damage during transit.

B. Loose items, if any, shall be tagged and delivered in a standard commercial package.

1.7 WARRANTY

A. Warranty: Heat exchangers shall be warranted by the manufacturer, covering materials and labor.

PART 2 PRODUCTS

2.1 SHELL AND TUBE TYPE HEAT EXCHANGER

A. Manufacturers:
1. Bell and Gossett.
2. Hughes-Anderson.
3. Berdell Industries.
4. ITT Standard.

B. Tubes: U-tube type with 3/4-inch OD minimum, seamless stainless steel tubes suitable for 100 psi/full vacuum working pressure.

C. Shell: Carbon steel with flanged nozzles and appropriate supports.

D. Heads: Fabricated carbon steel with stainless steel tube sheets and flanged nozzles.

E. Water Chamber and Tube Bundle: Removable for inspection and cleaning.

F. Design: Gas stream in tubes and cooling water in shell. Heat exchanger components shall be in conformance with TEMA standards. Heat exchangers shall conform to the ASME Boiler and Pressure Vessel Code, Section VIII, for manufacture of tubular heat exchangers and heat exchanger shells.

G. Performance: See Attachment 1 - Data Sheets. Note: Design data are preliminary and will be updated.

H. Heat exchangers shall be provided with:
1. Shell: Pressure gauge connection with pigtail siphon, vacuum breaker.
2. Tube-Side Inlet: Thermometer well, pressure gauge connection including pressure gauge and valved drain.
3. Tube-Side Outlet: Thermometer well for temperature regulator sensor, ASME rated pressure and temperature relief valve, thermometer well, pressure gauge connection including pressure gauge, and valved drain connection.

2.2 AIR-TO-GAS HEAT EXCHANGERS

A. Heat exchangers may be of finned coil, shell and tube, or plate-type heat recovery design.

B. Performance: See Attachment 1 - Data Sheets. Note: Design data are preliminary and will be updated.

C. If air-to-gas heat exchangers are of shell and tube design, the requirements of Article 2.1 above shall apply with the following exception:

1. The air stream shall be in the shell and the gas stream in the tubes.

D. Materials of construction shall be suitable for the service described in the data sheets.

2.3 FABRICATION

A. Prior to shipment, the equipment shall be cleaned of all dirt, dust, grease, grime, scale, oxides, weld spatter, and other foreign materials. All burrs and sharp edges shall be ground smooth. Exterior surfaces shall be primed and painted in accordance with the manufacturer's standard finish. Open end connections shall be sealed to prevent the entrance of foreign material.

2.4 LABELING

A. Each item shall have a manufacturer's standard nameplate permanently attached at a location which is easily readable. The nameplate shall contain the following information, as applicable:

1. Item description.
2. Item number.
3. Manufacturer's name.
4. Purchase order number.
5. Date of manufacture.
6. Capacity.

2.5 SOURCE QUALITY CONTROL

A. The Seller shall perform and provide a written report of the standard mechanical inspection of the heat exchangers and their components, including hydrostatic test of all pressure parts in accordance with ASME Boiler and Pressure Vessel Code, Section VIII, and TEMA standards.

2.6 EXTRA MATERIALS

A. Provide any special tools required to perform maintenance and repair work.

B. Provide two sets of replacement gaskets.

2.7 DESIGN LOADS

A. Equipment/structural design shall provide for loads as specified below:

1. Roof, live load: 20 psf.
2. Platforms and walkways, live load: 60 psf.
3. Wind load: Velocity pressure shall be calculated using equation 3 of ASCE 7-93, using V = 80 mph basic wind speed and I = 1.07. Design wind pressures and forces shall be in accordance with ASCE 7-93, Table 4.
4. Seismic load: Use provisions of the Uniform Building Code, using Z = 0.13, c = 2.75, I = 1.25, and Rw = reduction factors from Table 16-P. W (total seismic load) shall include all normal operating contents, piping, and attachments.
5. Shop drawings shall state the vertical loads and lateral forces used (wind and seismic) in the design.

PART 3 EXECUTION

3.1 ERECTION/INSTALLATION

A. Install in accordance with manufacturer's instructions and design drawings.

B. Install to permit removal of tube bundle with minimum disturbance to installed equipment and piping.

C. Pitch shell to completely drain condensate.

3.2 FIELD QUALITY ASSURANCE

A. Tests: Acceptance operating tests shall be performed by the Subcontractor after installation. If the results are unsatisfactory, the Subcontractor shall adjust or replace the equipment to meet the specification requirements, and retest the equipment.

B. Inspection: The Subcontractor shall notify the FERMCO Construction Manager of testing and inspection activities at least 24 hours prior to the start of all tests and/or inspections.

END OF SECTION

ATTACHMENT 1 OF SECTION 15755

DATA SHEETS

HEAT EXCHANGER DATA SHEET

EQUIPMENT NAME/NO.: Off-gas Condenser
PROJECT ORDER: 145
PROJECT TITLE: Remediation System Design
QUANTITY: 2
DESIGN DUTY: 9 x 10E6 Btu/hr
SERVICE: Cyclone Off-Gas

PERFORMANCE OF ONE UNIT					
		TUBE SIDE		SHELL SIDE	
Fluid		Saturated Off-Gas		Cooled Water	
Total Flow		11,500		572,000 lb/hr	
		INLET	OUTLET	INLET	OUTLET
Liquid					
Molecular Weight				18	18
Density	lb/ft³			62.27	62.11
Thermal Cond.	Btu/(hr ft °F)			.36	
Specific Heat	Btu/(lb °F)			1.0	1.0
Viscosity	CP			.88	.75
Surface Tension	dyne/cm			72	71
Bubble Point	°F			212	212
Vapor					
Molecular Weight		22			
Density	lb/ft³	.075			
Thermal Cond.	Btu/(hr ft °F)	.015			
Specific Heat	Btu/(lb °F)	.347			
Viscosity	CP	.0118			
Latent Heat	Btu/(lb °F)				
Dew Point	°F				
Non-Condensables					
Molecular Weight					
Heat Transfer Rate - Service*				Clean*	
Maximum Allowable Pressure Drop	psi			8	
Temperature	°F	266	120	77	91
Pressure	psig			60	
Pressure Drop	psi	*		*	
Velocity	ft/sec				
Fouling Resistance, neglecting solids build-up			0.0005		0.0005
		TUBE SIDE		SHELL SIDE	
Design Pressure	psig	100/full vac.		125	
Test Pressure	psig	per Code		per Code	
Design Temperature	°F	400		250	
Corrosion Allowance		-		-	
Number of Passes		4-6 , *		1-2 , *	
Heat Transfer Area	ft²	*		*	
Flow Arrangement		Parallel	Series	Parallel	Series

HEAT EXCHANGER DATA SHEET

CONSTRUCTION*		
Shell Diameter, Length (OD) (ID)	Baffle Type	Wt - Bundle & Shell
# Tubes/Shell	# Spacing	Wt - Bundle
O.D. x Length in. ft.	Segment Cut %	Wt - Full of Water
Thickness in. (Avg.) in. (Min.)	Impingement Baff Yes No	eV² Inlet Nozzle
Tube Pitch	Expansion Joint Yes No	eV² Bundle Entr.
TEMA Class	Ex. Joint Des. Temp	eV² Bundle Exit
Code Reg.	Surface Prep	Specifications
Code Stamp	Paint	
Removable Tube Bundle	Insulation Yes No	

MATERIALS (MARK STRESS RELIEVED - SR, RADIOGRAPHED - XR)*			
Tubes	316 SS	Shell	CS
Tubesheet	316 SS	Shell Cover	CS
Baffles/Tube Supports		Shell Flange	CS
Tie Rods and Spacers		Channel/Bonnet	
Long Baffle		Channel Cover	
Gasket Shell Side		Channel Flange	
Gasket Tube Side		Floating Head Cover	
Bolting		Expansion Joint	

NOZZLES*	TUBE SIDE			SHELL SIDE		
	#	SIZE	RATING & FACING	#	SIZE	RATING & FACING
Inlet						
Outlet						
Vent						
Drain						
Pressure Gauge (Ea. Nozzle)						
Thermowell (Ea. Nozzle)						
Interconnecting						
Manufacturer, Model No.			*			*

REMARKS:

*Information to be provide by Supplier.

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HEAT EXCHANGER DATA SHEET

EQUIPMENT NAME/NO.: Off-gas Heat Exchanger

PROJECT ORDER: 145

PROJECT TITLE: *Remediation System Design*

QUANTITY: 1

DESIGN DUTY: 460,000 Btu/hr

SERVICE: Scrubber Off-Gas

PERFORMANCE OF ONE UNIT

		TUBE SIDE		SHELL SIDE	
Fluid		Saturated Off-Gas		Chilled Water	
Total Flow		3440 lb/hr		26,000 lb/hr	
		INLET	OUTLET	INLET	OUTLET
Liquid					
Molecular Weight				18	18
Density	lb/ft³			62.42	62.42
Thermal Cond.	Btu/(hr ft °F)			.34	
Specific Heat	Btu/(lb °F)			1.0	1.0
Viscosity	CP			1.63	1.42
Surface Tension	dyne/cm			75.5	74.5
Bubble Point	°F			212	212
Vapor					
Molecular Weight		28			
Density	lb/ft³	.075			
Thermal Cond.	Btu/(hr ft °F)	.015			
Specific Heat	Btu/(lb °F)	.241			
Viscosity	CP	.02			
Latent Heat	Btu/(lb °F)				
Dew Point	°F				
Non-Condensables					
Molecular Weight					
Heat Transfer Rate - Service*				Clean*	
Maximum Allowable Pressure Drop	psi			8	
Temperature	°F	112	50	40	45
Pressure	psig			80	
Pressure Drop	psi	*		*	
Velocity	ft/sec				
Fouling Resistance, neglecting solids build-up			0.0005		0.0005
		TUBE SIDE		SHELL SIDE	
Design Pressure	psig	100/full vac.		100	
Test Pressure	psig	per Code		per Code	
Design Temperature	°F	250		250	
Corrosion Allowance		-		-	
Number of Passes		4-6 , *		1-2 , *	
Heat Transfer Area	ft²	*		*	
Flow Arrangement		Parallel	Series	Parallel	Series

HEAT EXCHANGER DATA SHEET

CONSTRUCTION*		
Shell Diameter, Length (OD) (ID)	Baffle Type	Wt - Bundle & Shell
# Tubes/Shell	# Spacing	Wt - Bundle
O.D. x Length in. ft.	Segment Cut %	Wt - Full of Water
Thickness in. (Avg.) in. (Min.)	Impingement Baff Yes No	eV² Inlet Nozzle
Tube Pitch	Expansion Joint Yes No	eV² Bundle Entr.
TEMA Class	Ex. Joint Des. Temp	eV² Bundle Exit
Code Reg.	Surface Prep	Specifications
Code Stamp	Paint	
Removable Tube Bundle	Insulation Yes No	

MATERIALS (MARK STRESS RELIEVED - SR, RADIOGRAPHED - XR)*			
Tubes	316 SS	Shell	CS
Tubesheet	316 SS	Shell Cover	CS
Baffles/Tube Supports		Shell Flange	CS
Tie Rods and Spacers		Channel/Bonnet	
Long Baffle		Channel Cover	
Gasket Shell Side		Channel Flange	
Gasket Tube Side		Floating Head Cover	
Bolting		Expansion Joint	

NOZZLES*		TUBE SIDE			SHELL SIDE		
		#	SIZE	RATING & FACING	#	SIZE	RATING & FACING
Inlet							
Outlet							
Vent							
Drain							
Pressure Gauge	(Ea. Nozzle)						
Thermowell	(Ea. Nozzle)						
Interconnecting							
Manufacturer, Model No.				*			*

REMARKS:

* Information to be provided by Supplier.

HEAT EXCHANGER DATA SHEET

EQUIPMENT NAME/NO.: Off-Gas Reheater
PROJECT ORDER: 145
PROJECT TITLE: OU-1 Remediation System Design
QUANTITY: 1
DESIGN DUTY:
SERVICE: Off-Gas
DRAWING NO.:

PERFORMANCE OF ONE UNIT					
		GAS SIDE		AIR SIDE	
Fluid		Off-Gas		Hot Air	
Total Flow	lb/hr	3,260		TBD	
		INLET	OUTLET	INLET	OUTLET
Liquid					
Molecular Weight					
Density	lb/ft³				
Thermal Cond.	Btu/(hr ft °F)				
Specific Heat	Btu/(lb °F)				
Viscosity	CP				
Surface Tension	ft-lb/ft²				
Bubble Point	°F				
Vapor					
Molecular Weight		28		29	
Density	lb/ft³	.12		.088	
Thermal Cond.	Btu/(hr ft °F)	.015		.024	
Specific Heat	Btu/(lb °F)	.241		.243	
Viscosity	CP	.02		.024	
Latent Heat	Btu/(lb °F)				
Dew Point	°F				
Non-Condensables:					
Molecular Weight					
Heat Transfer Rate - Btu/hr-ft²-°F	Service:	*	Clean:	*	
Maximum Allowable Pressure Drop	psi	*		*	
Temperature (Normal)	°F	50	95	TBD	TBD
Pressure	psig				
Pressure Drop	psi	.25		1.0	
Velocity	ft/sec				
Fouling Resistance			0.0005		0.0005
		GAS SIDE		AIR SIDE	
Design Pressure	psig	50/full vac.		50	
Test Pressure	psig	Code		Code	
Design Temperature	°F	150		400	
Corrosion Allowance		.125		.0625	
Number of Passes		1 to 2 , *		1 , *	
Heat Transfer Area	ft²	*		*	
Flow Arrangement		Parallel	Series	Parallel	Series

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HEAT EXCHANGER DATA SHEET

CONSTRUCTION *		
	GAS SIDE	AIR SIDE
Shell Diameter/Width, Length (OD) (ID)	Baffle Type	Wt - Bundle & Shell
# Tubes/Shell	# Spacing	Wt - Bundle
O.D. x Length In. ft.	Segment Cut %	Wt - Full of Water
Thickness	Impingement Baff Yes No	Rho - V^2 Inlet Nozzle
Tube Pitch	Expansion Joint Yes No	Rho - V^2 Bundle Entr.
TEMA Class	Ex. Joint Des. Temp	Rho - V^2 Bundle Exit
Code Reg.	Surface Prep	Specifications
Code Stamp	Paint	
Removable Tube Bundle	Insulation Yes No	

MATERIALS (MARK STRESS RELIEVED - SR, RADIOGRAPHED - XR) *	
Tubes	Shell
Tubesheet	Shell Cover
Baffles/Tube Supports	Shell Flange
Tie Rods and Spacers	Channel/Bonnet
Long Baffle	Channel Cover
Gasket Shell Side	Channel Flange
Tasket Tube Side	Floating Head Cover
Bolting	Expansion Joint

NOZZLES *	GAS SIDE			AIR SIDE		
	#	SIZE	RATING & FACING	#	SIZE	RATING & FACING
Inlet						
Outlet						
Vent						
Drain						
Pressure Gauge (Ea. Nozzle)						
Thermowell (Ea. Nozzle)						
Interconnecting						
Manufacturer, Model No.			*			*

REMARKS:

* Information to be provided by the manufacturer.

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Rev.: A RE: DJ (A1) 6 of 6 ERA/CRU No.: 1/PO-145

000549

SECTION 15860
FANS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Furnish all labor, materials, equipment components, and services necessary to design, construct, and install the equipment as defined in the specification and as shown on the drawings referenced in Article 1.3.

B. Centrifugal fans.

C. Industrial pressure blowers.

D. Propeller fans.

E. Motors and drives.

F. Fan accessories.

1.2 RELATED SECTIONS

A. Section 01010 - General Requirements.

B. Section 15173 - Motors for Off-Gas Control System.

C. Section 15245 - Vibration Isolation.

D. Section 16053 - Basic Electrical Material and Methods for Off-Gas Control System.

1.3 REFERENCE DRAWINGS

A. See Section 01011 for the Schedule of Drawings.

1.4 REFERENCES

A. American Bearing Manufacturers Association (ABMA):
1. ABMA 9-90 Load Ratings and Fatigue Life for Ball Bearings.

2. ABMA 11-90 Load Ratings and Fatigue Life for Roller Bearings.

B. American Welding Society (AWS):
1. AWS D1.1-94 Structural Welding Code - Steel.
2. AWS D1.3-89 Structural Welding Code - Sheet Steel.
3. AWS D9.1-90 Sheet Metal Welding.

C. Air Movers and Controllers Association (AMCA):
1. AMCA 99-86 Standards Handbook.
2. AMCA 210-85 Laboratory Methods of Testing Fans for Rating Purposes.
3. AMCA 300-87 Test Code for Sound Rating Air Moving Devices.
4. AMCA 301-76 Method of Calculating Fan Sound Ratings from Laboratory Test Data.

D. American National Standards Institute (ANSI):
1. ANSI/ASME N509-89 Nuclear Power Plant Air Cleaning Units and Components.

E. National Electrical Manufacturers Association (NEMA):
1. NEMA MG 1-93 Motors and Generators.

F. National Fire Protection Association (NFPA):
1. NFPA 70-93 National Electrical Code.

G. Sheet Metal and Air Conditioning Contractors National Association (SMACNA):
1. SMACNA 85 HVAC Duct Construction Standards - Metal and Flexible.

1.5 SYSTEM DESCRIPTION

A. Performance Requirements
1. The fan shall be capable of producing and maintaining a volume flow rate at the temperature and pressure shown on the data sheet. The design shall allow for non-overloading of fan or drive specified on the data sheet.
2. The rotating unit of the fan shall be statically and dynamically balanced at the factory for

vibration-free performance through maximum catalog rated speed. The maximum vibration shall be in accordance with the requirements of ANSI/ASME N509, Paragraph 5.7.3.

3. The fan speed shall not exceed 80 percent of the first critical speed of any component when operating at maximum speed.
4. Performance Ratings: Conform to AMCA 210 and bear the AMCA Certified Rating Seal.
5. Sound Ratings: AMCA 301, tested to AMCA 300, and bear AMCA Certified Sound Rating Seal.
6. Fabrication: Conform to AMCA 99.
7. Performance Base: At 580 feet elevation.
8. Temperature Limit: Maximum 150 degrees F.

1.6 SUBMITTALS

A. All submittals shall be approved prior to ordering equipment.

B. Shop Drawings: Indicate components, assembly, dimensions, weights and loadings, required clearances, and location and size of field connections.

C. Product Data: Provide data on centrifugal fan and accessories including fan curves with specified operating point clearly plotted, sound power levels for both fan inlet and outlet at rated capacity, and electrical characteristics and connection requirements.

D. Certificates of Conformance: Manufacturer shall certify and provide data indicating that all products supplied meet or exceed this specification.

E. Maintenance Data: Include instructions for lubrication, motor and drive replacement, spare parts list, and wiring diagrams.

F. Submit manufacturer's installation instructions.

G. Operation and Maintenance Data: Include start-up instructions, maintenance data, parts lists, controls, and accessories. Include troubleshooting guide.

H. Provide templates for anchor bolt placement in concrete pads. Deliver the templates to the concrete installer so that work by others is not delayed.

1.7 QUALITY ASSURANCE

A. Manufacturer: Company specializing in manufacturing the products specified in this section with a minimum of 3 years documented experience. The manufacturer shall be capable of issuing catalog and technical data on the total product being supplied.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Comply with manufacturer's installation instructions for the rigging, unloading, and transporting of units.

B. Supply the products on site in factory-fabricated protective containers with factory-installed shipping skids and lifting lugs.

C. Store in a clean dry place protected from weather and construction traffic.

1.9 PROJECT CONDITIONS

A. Environmental Requirements.
1. Environment: Outdoor, low-level radioactive, contaminated area.
2. Plant Condition:
   a. Location: Fernald, Ohio.
   b. Elevation: 578 feet above sea level.
   c. Ambient Temperature: -10 to 110 degrees F.
   d. Barometric Pressure: 29.31 inches Hg. Absolute (mean at 70 degrees F).
   e. Relative Humidity: 20 to 95 percent.

1.10 SEQUENCING AND SCHEDULING

Not used.

1.11 WARRANTY

A. Provide a 2-year warranty to include coverage for complete assembly, including materials and labor.

1.12 MAINTENANCE

A. Furnish service and maintenance of complete assembly for 1 year from the date of system start-up.

B. Provide two spare fan belts for each fan supplied.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Greenheck Company.

B. Hartzell Fan Incorporated.

C. Twin City Company.

D. Buffalo Forge Company.

2.2 EQUIPMENT

A. Industrial Pressure Blowers

1. Radial blade wheel shall be fabricated from heavy gage steel plate. Continuous welding, rivets, or bolts shall be used depending on the wheel design. A tapered bore shall assure the integrity of the wheel-shaft connection.
2. The housing shall be constructed of welded steel. Welding shall be in accordance with AWS D1.1. and AWS D9.1.
3. The fan shaft shall be turned stock, ground, and polished to correct tolerance to prevent slipping or shaft cutting by fan wheel. The fan wheel shall be keyed to shaft and secured with minimum of two set screws. A fan shaft seal shall be provided.
4. The fan bearings shall be self-aligning, anti-friction, taper-lock, double spherical roller type

and shall have a minimum ABMA L-10 bearing life based on 100,000 hours. All bearings shall be split pillow block mounted, and with external grease fittings with dust excluding seals.

5. Provide frame-type common mounting base for fan and motor.
6. The fan shall be high pressure industrial type and constructed in accordance with AMCA Class IV Standard.
7. The manufacturer shall supply a nameplate attached to the housing in an accessible position. The nameplate shall have the following permanently embossed on it: Manufacturer's name and address, equipment number, cfm, rpm, static pressure in w.g., bhp, purchase order number, and model and serial numbers.
8. The fan accessories shall be as specified on the data sheet.

B. Centrifugal Fans

1. Backward inclined wheel and inlet: Aluminum construction with smooth curved inlet flange, heavy back plate, backwardly curved blades welded or riveted to flange and back plate; cast iron hub riveted to back plate and keyed to shaft with set screws.
2. Forward curved wheel and inlet: Galvanized steel construction with inlet flange, back plate, shallow blades with inlet and tip curved forward in direction of airflow, mechanically secured to flange and back plate; steel hub swaged to back plate and keyed to shaft with set screw.
3. Housing: Heavy gage steel, spot welded for AMCA 99 Class I and II fans, and continuously welded for Class III, adequately braced, designed to minimize turbulence with spun inlet bell and shaped cut-off. Factory finish before assembly with enamel or prime coat. Prime coating on aluminum parts is not required.
4. Bearings: ABMA 9, L-50 life at 100,000 hours heavy duty pillow block type, self-aligning, grease-lubricated ball bearings, or ABMA 11 L-50

life at 400,000 hours pillow block type, self-aligning, grease-lubricated roller bearings.

5. Shafts: Hot rolled steel, ground and polished, with key-way, protectively coated with lubricating oil and shaft guard.
6. The manufacturer shall supply a nameplate attached to the housing in an accessible position. The nameplate shall have the following permanently embossed on it: Manufacturer's name and address, equipment number, cfm, rpm, static pressure in w.g., bhp, purchase order number, and model and serial numbers.
7. The fan accessories shall be as specified on the data sheet.

C. Propeller Fans: Provide axial propeller fans, direct or belt driven as indicated in Attachment A.

1. Wheel and Housing: Heavy-duty stamped steel propeller consisting of six steel blades securely attached to a heavy-gage steel hub by means of steel rivets, heavily reinforced on each side. The fan frame and venturi shall be constructed of heavy-gage painted steel with the fan assembly bolted to the venturi for ease of removal and service.
2. Bearings: ABMA 9, L-50 life at 200,000 hours heavy-duty pillow block type, self-aligning, grease-lubricated ball bearings.
3. Shafts: Hot-rolled steel, ground and polished, with key-way, protectively coated with lubricating oil and shaft guard.
4. The manufacturer shall supply a nameplate attached to the housing in an accessible position. The nameplate shall have the following permanently embossed on it: Manufacturer's name and address, equipment number, cfm, rpm, static pressure in w.g., bhp, purchase order number, and model and serial numbers.
5. The fan accessories shall be as specified on the data sheet.

D. V-Belt Drive: Cast iron or steel sheaves, dynamically balanced, keyed. Variable and adjustable pitch sheaves

for motors 10 hp and under, selected so required rpm is obtained with sheaves set at mid-position. Fixed sheave for over 10 hp, matched belts, and drive rated as recommended by manufacturer or minimum 1.5 times nameplate rating of the motor.

E. Electrical Characteristics and Components (see attached data sheet)

1. Motor: Shall conform to Section 15173, NEMA MG1.
2. Wiring Termination: Provide terminal lugs to match branch circuit conductor quantities, sizes, and materials indicated. Enclose terminal lugs in terminal box sized according to NFPA 70.
3. Wiring terminations shall be sized to conform to NFPA 70 and shall conform to Section 16053.

2.3 ACCESSORIES

A. Adjustable Inlet Vanes: Steel construction with blades supported at both ends with two permanently lubricated bearings, variable mechanism out of air stream terminating in single control lever.

B. Belt Guard: Fabricate to SMACNA 85; of 12 gage thick, 3/4 inch diamond mesh wire screen welded to steel angle frame or equivalent, prime coated. Secure to fan or fan supports without short circuiting vibration isolation, with provision for adjustment of belt tension, lubrication, and use of tachometer with guard in place.

C. Inlet/Outlet Screens: Galvanized steel welded grid.

D. Access Doors: Shaped to conform to scroll, with quick opening latches and gaskets.

E. Scroll Drain: 1/2 inch steel pipe coupling welded to low point of fan scroll.

F. Heavy duty (aluminum motor operated) shutters. Motor shall be operated from 460 volt source.

G. Aluminum wire guard of 1/2-inch mesh screen.

PART 3 EXECUTION

3.1 EXAMINATION

A. The installer must examine the areas and conditions under which the fans are to be installed and notify the Subcontractor in writing of the conditions which are detrimental to proper completion of the work. The work will not continue until the unsatisfactory conditions have been corrected in a manner acceptable to the installer.

3.2 PREPARATION

Not used.

3.3 ERECTION/INSTALLATION/APPLICATION

A. Install in accordance with manufacturer's written installation instructions. Install units plumb and level firmly anchored in location indicated. Maintain the manufacturer's recommended clearances.

B. Provide for connection to electrical service. Refer to Section 16053. Verify that the electrical wiring installation is in accordance with manufacturer's wiring submittal. Do not proceed with equipment start-up until the wiring installation is acceptable to the manufacturer and the equipment installer.

C. Align fans on concrete foundations, sole plates, and sub-bases. Level, grout, and bolt in place.

D. Install units on vibration isolators. Refer to Section 15245.

E. Provide flexible connections to ductwork where required.

F. Start up fans in accordance with manufacturer's start-up instructions and in the presence of a manufacturer's technical representative. Test the controls and

demonstrate compliance with the requirements of the specifications.

3.4 FIELD QUALITY ASSURANCE

A. Fan operation testing shall only occur when filters are in place, bearings are lubricated, and duct work is clean.

B. The acceptance operating tests shall be performed by the Subcontractor after installation.

C. The Subcontractor shall notify the FERMCO Construction Manager of the testing and inspection activities at least 24 hours prior to the start of all tests and inspections.

3.5 ADJUSTING

A. The Subcontractor shall adjust, repair, or replace the equipment if the results of the acceptance operating tests are unsatisfactory. The equipment shall then be tested again to ensure that the equipment meets the specification requirements.

B. The fans shall not be placed in sustained operation until the initial balancing of the mechanical systems interfacing with the fans has been performed.

3.6 CLEANING

Not used.

3.7 DEMONSTRATION

A. Supply service of factory trained representative for a period of 2 days to supervise testing, start-up, and instruction on operation and maintenance to Owner.

3.8 PROTECTION

Not used.

3.9 SCHEDULES

Not used.

END OF SECTION

APPENDIX A

FAN DATA SHEETS

(LATER: Will be provided prior to final specification preparation for FERMCO review)

SECTION 15883
CYCLONE

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Cyclone with heating air jacket.

1.2 RELATED SECTIONS

A. Section 01010 - General Requirements.

1.3 REFERENCES, CODES, AND STANDARDS

A. American Society of Mechanical Engineers (ASME):
1. ASME Boiler and Pressure Vessel Code (BPVC), Section IX-92.

B. American Society for Testing and Materials (ASTM):
1. ASTM A36/A36M-93 Standard Specification for Structural Steel.

C. American Welding Society (AWS):
1. AWS A5.1-91 Carbon Steel Electrodes for Shielded Metal Arc Welding.

1.4 SYSTEM DESCRIPTION

A. Design Requirements
1. The cyclone shall remove solid particulates from the dryer off-gas.

1.5 SUBMITTALS

A. Shop Drawings: Indicate dimensions; sizes; weights and point loadings; material thickness; and locations, sizes, and ratings of nozzles.

B. Product Data: Provide data indicating rated capacities and accessories.

C. Manufacturer's Installation Instructions: Indicate assembly and installation instructions.

D. Design Calculations: For material thickness and supports (including seismic, wind, and snow loads).

E. Operation and Maintenance Data: Include operation and maintenance instructions and spare parts list.

F. Certificate: Certify that equipment meets of exceeds the requirements of this specification section.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Store in a clean, dry place and protect from weather prior to shipment. Provide protection from weather and from damage during transit.

B. Loose items, if any, shall be tagged and delivered in a standard commercial package.

1.7 WARRANTY

A. Warranty: Cyclone shall be warranted by the manufacturer including parts and labor.

PART 2 PRODUCTS

2.1 EQUIPMENT

A. Manufacturers:
1. Entech Environmental Systems, Inc.
2. Flex-Kleen Corp.
3. Beckhart & Hiester, Inc.

B. Cyclone dust collector consisting of cyclone with heating air jacket and structural stand incorporating airtight dust storage and discharge.

C. Dust Storage: 4 cubic foot minimum dust storage capacity; Dust Discharge: rotary airlock valve.

D. Cyclone Efficiency: 90 percent of 10 micron pit waste particulates.

E. Materials: Manufacturer's standard hardened steel for abrasive dust service. End connections shall be flanged - 150 lb class. Structural steel supports shall be in accordance with ASTM A36/A36M.

F. Welding: Shall be in accordance with ASME BPVC Section IX and AWS A5.1.

G. Performance Requirements - Note: Design data are preliminary and will be updated.

1. Suitable for continuous operation
2. Inlet Conditions
   a. Dryer Gas Stream
      1) Flow rate: 13,075 lbs/hr.
      2) Temperature: 240 degrees F.
      3) Solids particulates: 1,320 lbs/hr, specific gravity = 2.9.
   b. Heating Air Stream
      1) TBD.
3. Outlet Conditions
   a. Dryer Gas Stream
      1) Flow rate: 11,887 lbs/hr.
      2) Temperature: 266 degrees F.
      3) Solids particulates: 132 lbs/hr, specific gravity = 2.9.
   b. Heating Air Stream
      1) TBD.
4. Particulate Removal Requirement
   a. Solids Removal: 1,188 lb/hr.
   b. Cyclone Pressure Drop: 2.5 to 5 inches H_2O.
5. Design Pressure: TBD.
6. Particle size distribution: 100 percent <200 mesh.

H. Equipment shall be provided with lifting and hold down lugs.

I. Provide pressure taps where required to test the pressure drop across the cyclone.

J. Equipment/structural design shall provide for loads as specified below:

1. Roof, live load: 20 psf.
2. Platforms and walkways, live load: 60 psf.
3. Wind load: Velocity pressure shall be calculated using equation 3 of ASCE 7-93, using V = 80 mph basic wind speed and I = 1.07. Design wind pressures and forces shall be in accordance with ASCE 7-93, Table 4.
4. Seismic load: Use provisions of the Uniform Building Code, using Z = 0.13, c = 2.75, I = 1.25, and Rw = reduction factors from Table 16-P. W (total seismic load) shall include all normal operating contents, piping, and attachments.
5. Shop drawings shall state the vertical loads and lateral forces used (wind and seismic) in the design.

2.2 FABRICATION

A. Prior to shipment, the equipment shall be cleaned of all dirt, dust, grease, grime, weld spatter, and other foreign materials. All burrs and sharp edges shall be ground smooth. Exterior surfaces of steel components shall be primed and painted in accordance with the manufacturer's standard finish. Open-end connections shall be sealed to prevent the entrance of foreign material.

2.3 LABELING

A. Each item shall have a manufacturer's standard nameplate permanently attached at a location which is easily readable. The nameplate shall contain the following information, as applicable:

1. Item description.
2. Item number.
3. Manufacturer's name.
4. Purchase order number.
5. Date of manufacture.
6. Capacity.

PART 3 EXECUTION

3.1 ERECTION/INSTALLATION

A. Install equipment in accordance with manufacturer's instructions and design drawings.

3.2 FIELD QUALITY ASSURANCE

A. Tests: Perform leak testing to ensure that there are no air leaks in the cyclone system. Perform pressure drop and solids removal testing across the cyclone to ensure conformance with this specification. If the results are unsatisfactory, the Subcontractor shall adjust or replace the equipment to meet the specification requirements and retest the equipment.

END OF SECTION

SECTION 15884
CARBON BED ADSORBER

PART 1 GENERAL

1.1 SECTION INCLUDES

A. This specification covers furnishing all materials, equipment, labor, and engineering necessary to design, fabricate, prepare for shipment, and deliver multiple Carbon Bed Adsorbers as specified below.

B. Materials to be furnished shall be in accordance with this specification and attached data sheets.

C. Seller shall furnish any special tools required for assembly, installation, start-up, operation, or maintenance of the equipment.

1.2 RELATED SECTIONS

A. Section 01010 - General Requirements.

B. Section 15060 - Pipe, Fittings, Valves, and Accessories.

1.3 REFERENCE DRAWINGS

A. See Section 01011 for the Schedule of Drawings.

1.4 REFERENCES

A. American Society of Mechanical Engineers (ASME):
1. ASME Boiler and Pressure Vessel Code (BPVC), Section IX-92.
2. ASME B16. 5-88 Pipe Flanges and Flanged Fittings.

B. American Welding Society (AWS):
1. AWS D1.1-92 Structural Welding Code Steel.

C. American Society of Civil Engineers (ASCE):

1. ASCE 7-93 Minimum Design Loads for Buildings and Other Structures.

D. Uniform Building Code (UBC) - 1991 Edition.

1.5 SYSTEM DESCRIPTION

A. Design Requirements

1. Seller shall supply two identical sets of Carbon Beds, which will be operated in alternating fashion (i.e., one set on-line and the other set regenerating).
2. Each Carbon Bed shall be a complete unit, including shell, activated carbon, and all necessary internals, and shall be ready for operation when properly installed.
3. Carbon Bed design shall be Seller's standard design to the maximum extent practicable.
4. For process requirements see attached Data Sheet.
5. Carbon Beds shall be designed, fabricated, tested, and prepared for shipment in accordance with ASME Boiler and Pressure Vessel Code.
6. All connections shall be 150 psig ANSI raised-face flanges, in accordance with ASME B16.5.
7. Manholes, handholes, blanked connections, etc., shall be furnished complete with studs, nuts, gaskets, covers, etc.
8. Carbon Beds shall be rated for 5 psig pressure, 30-inch WC vacuum, and 250 degrees F. ASME code stamp is NOT required.
9. Carbon Beds shall be sized by the vendor to meet process requirements.
10. Equipment shall be designed to meet the following criteria:
    a. Units shall be dust tight and weatherproof.
    b. Wind Load:
        1) Basic wind speed: 80 mph
        2) Importance factor: I = 1.07
        3) Exposure category: C

        Use ASCE 7-93 for determining wind load combinations.

c. Snow Load:
   1) Ground snow load: P_g = 25 psf
   2) Importance factor: I = 1.0
   3) Exposure factor: C_e = 0.8
   4) Thermal factor: C_t = 1.0
   Use ASCE 7 for determining snow loads.

d. Seismic load: Use provisions of the Uniform Building Code, using Z = 0.13, C = 2.75, I = 1.25, and R_w = reduction factors from Table 16-P. W (total seismic load) shall include all normal operating content, piping, and attachments.

11. The attached drawings and specifications stipulate minimum requirements for a complete system. Seller shall verify the design based on Seller's calculations, experience, and expertise. Any deviations from the proposed design shall be documented and explained in Seller's proposal. Seller shall be responsible for delivering a complete, operable system.

B. Performance Requirements
1. The system shall operate continuously.
2. Inlet off-gas conditions
   a. Flowrate: 715 scfm
   b. Temperature: 95 degrees F
   c. Radon in gas: 3 nCi/L
   d. Solids flowrate: 0.4 lb/hr
3. Carbon beds shall remove at least 97 percent of the inlet radon in gas stream.

1.6 SUBMITTALS

A. At Proposal: 10 copies and one reproducible (Mylar), if applicable, shall be submitted for the following:
1. Arrangement drawings which clearly show arrangement of equipment, overall dimensions, weights, and clearances.
2. Catalog cuts and pertinent technical information.
3. Preliminary foundation loads and anchor location.
4. List of optional equipment which, in the Seller's opinion, increases the efficiency or reliability, or simplifies the maintenance of the system. All

suggested optional equipment shall include a rational explanation of why the accessory is desirable.

5. Any exception to this specification shall be clearly identified in the Seller's proposal. If there are no exceptions, the Seller shall state "No Exceptions." The proposal may be considered non-responsive without this information.
6. Quality assurance/quality control procedures.

B. After Award: Within 6 weeks of award of purchase order, the Seller shall submit 10 copies and one reproducible (Mylar), if applicable, of the following information for approval prior to start of fabrication:
   1. Shop drawings
      a. Certified prints showing at least the following:
         1) Arrangement drawings which clearly show arrangement of equipment, overall dimensions, weights, and clearances for operation and maintenance.
         2) Complete dimensional and interface information of equipment supports and connections with other components.
         3) "Not-to-exceed" loads at each support interface.
   2. Product Data
      a. Submit 10 copies of manufacturer's catalog and descriptive data on:
         1) Standard equipment.
         2) Specialties.
         3) Accessories.

         The catalog and descriptive data shall be clearly marked indicating the material that pertains to the components being furnished.
   3. Instructions for the system's erection and disassembly, 10 copies.

C. During Fabrication
   1. Inspection during Manufacturing: Prior to the painting of the components of the unit but after completion of fabrication, the FERMCO Construction Manager shall have an opportunity to inspect the

unit at the location of manufacture. The Seller shall furnish copies of reports describing resolutions of disagreements and non-conformance discovered during inspections. The Seller shall notify the FERMCO Construction Manager 7 working days prior to the inspection.

D. At Delivery

1. Ten copies of instruction manuals and parts list covering installation, operation, and maintenance of all equipment provided.
2. Ten copies and two reproducibles (Mylars) of as-built drawings.

1.7 QUALITY ASSURANCE

A. The Seller's standard quality assurance/quality control procedures shall apply.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Packing and Shipping: The Seller's standard preparation for shipment is acceptable provided it includes the following:

1. Units shall be shipped completely assembled, ready for installation.
2. Units shall be skid mounted for ease of handling and crated where necessary to protect any fragile components.
3. All loose parts shall be bagged and securely attached to the unit.

B. The equipment shall be prepared for shipment using such crating, pallets, cradles, temporary bracing, etc. as may be required to prevent damage during shipment with normal handling. Any openings into equipment shall be closed to prevent entry of rain or foreign matter. Closure materials shall be of such durable nature as might be expected to provide several months of protection for equipment when stored in an exposed outdoor location prior to installation.

C. Acceptance at Site: The FERMCO Construction Manager's representative will receive and inspect equipment at time of delivery.

1.9 PROJECT CONDITIONS

A. Environmental Requirements
1. Environment: Outdoor, low-level radioactive, contaminated area.
2. Plant Condition:
   a. Location: Fernald, Ohio.
   b. Elevation: 578 feet above sea level.
   c. Ambient Temperature: -10 to 110 degrees F.
   d. Barometric Pressure: 29.31 inches Hg. absolute (mean at 70 degrees F).
   e. Relative humidity: 20 to 95 percent.

1.10 WARRANTY

A. Warranty shall be in accordance with FERMCO general provisions.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Tigg Corporation.

B. Charcoal Service Corporation.

C. Barnebey-Sutcliffe Corporation.

2.2 PRODUCTS/EQUIPMENT

A. General Construction
1. Carbon beds shall be a vessel constructed of 1/4-inch thick carbon steel shell with bottom inlet nozzle, top outlet nozzle, carbon inlet, and condensate drain.
2. No corrosion allowance is required, but interior surfaces shall be epoxy coated for protection against the possible presence of low concentrations of acid gases (CO_2, SO_2, and NO_2).

3. Gaskets shall be Teflon™ or spiral metallic type.
4. Exterior finish shall be manufacturer's standard.
5. Bed shall be composed of coconut shell-derived, granular activated carbon with high specific surface area (>1000 m^2/g), mesh size 6 by 12, bulk density 0.49 g/ce.

2.3 MATERIALS

A. All materials shall be manufacturer's standard unless noted otherwise on the drawings or in the specifications.

2.4 FABRICATION

A. The equipment and material shall be neatly finished. All exposed metal parts, whether normally visible or not, shall be smooth and free from burrs or fins. Steel shall be well formed to shape and size and free from defects impairing strength, durability, and appearance. Shearing and punching shall leave clean, true lines and surfaces. Where possible, fit and assemble work in shop, ready for erection.

B. All equipment and materials shall be thoroughly cleaned inside before shipment. Outside surfaces shall be cleaned free of grease, rust, and scale and then painted in accordance with the manufacturer's standard or Section 09900 of this specification package, as applicable.

C. All welding shall be performed indoors and the surface of parts to be welded shall be free from rust, scale, paint, grease, or other foreign matter. All spatter shall be removed after welding. Minimum preheat and interpass temperatures shall conform to the requirements of AWS D1.1. Tolerances shall not exceed those specified in accordance with AWS D1.1. Welders, welding operators, and welding procedures shall be qualified or pre-qualified in accordance with AWS D1.1.

2.5 LABELING

A. Each item shall have a manufacturer's standard nameplate permanently attached at a location which is easily readable. The nameplate shall contain the following information, as applicable:

1. Item description.
2. Item number.
3. Manufacturer's name.
4. Purchase order number.
5. Date of manufacture.
6. Capacity.

PART 3 EXECUTION

3.1 ERECTION/INSTALLATION/APPLICATION

A. Install equipment in accordance with manufacturer's recommendations.

B. Prepare equipment for operation in accordance with manufacturer's recommendations.

END OF SECTION

SECTION 15885
AIR CLEANING DEVICES

PART 1 GENERAL

1.1 SECTION INCLUDES

A. All labor, materials, equipment components, and services necessary to design, construct, and install the equipment as defined in the specification.

B. Disposable, extended area panel filters.

C. Medium-Efficiency Particulate Air (MEPA) filters.

D. High-Efficiency Particulate Air (HEPA) filters.

E. HEPA/MEPA filter housing.

F. Filter differential pressure gauges.

1.2 RELATED SECTIONS

A. Section 01010 - General Requirements.

B. Section 15060 - Pipe, Fittings, Valves, and Accessories.

1.3 REFERENCE DRAWINGS

A. See Section 01011 for the Schedule of Drawings.

1.4 REFERENCES

A. American Refrigeration Institute (ARI):
1. ARI 850-93 Commercial and Industrial Air Filter Equipment.

B. American Society of Heating, Refrigeration, and Air Conditioning Engineers (ASHRAE):

1. ASHRAE 52-76 — Method of Testing Air Cleaning Devices Used in General Ventilation for Removing Particulate Matter.

C. American Society of Mechanical Engineers (ASME):

1. ASME N509-89 — Nuclear Power Plant Air Cleaning Units and Components.
2. ASME N510-89 — Testing of Nuclear Air Cleaning Systems.
3. ASME SEC IX-92 — Qualification Standard for Welding and Brazing Procedures, Welders, Brazers, and Welding and Brazing Operators.

D. United States Military Specification (MIL):

1. MIL-F-51068E-81 — Filter, Particulate, High-Efficiency, Fire-Resistant.
2. MIL-F-51079D-80 — Filter Medium, Fire-Resistant, High-Efficiency.

E. Underwriter's Laboratories, Inc. (UL):

1. UL 586-90 — Test Performance of High-Efficiency Particulate Air Filter Units.
2. UL 900-87 — Test Performance of Air Filter Units.

F. Energy Research and Development Administration (ERDA):

1. ERDA-76-21-79 — Nuclear Air Cleaning Handbook.

1.5 SYSTEM DESCRIPTION

A. Design Requirements

1. The filters shall remove dust particles from gases prior to their exhausting to the atmosphere.

1.6 SUBMITTALS

A. All submittals shall be approved prior to ordering equipment.

B. Shop Drawings: Indicate filter assembly, filter frames, and dimensions.

C. Product Data: Provide data on filter media, filter performance data, filter assembly, filter frames, and dimensions.

D. The manufacturer shall submit a complete report on HEPA/MEPA filter housing leak test.

E. Manufacturer's Installation Instructions: Submit written installation instructions, and assembly and change-out procedures.

F. Certificates of Conformance: Manufacturer shall certify and provide data which indicate that all supplied products meet or exceed the requirements of this specification.

G. Operation and Maintenance Data: Include instructions for operation, changing, and periodic cleaning.

1.7 QUALITY ASSURANCE

A. The manufacturer shall set up and operate a quality control/sampling system which will ensure a 99 percent confidence limit in the elements meeting specification.

B. The FERMCO Construction Manager's representative shall be provided the opportunity to witness all tests and has the right to inspect and approve all material prior to shipping to site. A 2-week notice shall be provided to the Operating Contractor for all off-site testing.

C. Air cleaning devices shall conform to ARI 850.

D. HEPA filters shall be nuclear grade, UL 586 Class I approved and certified in accordance with MIL-F-51068E

and MIL-F-51079D. HEPA filters shall be Dioctyl Phthalate (DOP) smoke efficiency tested and certified at the filter manufacturer's facility and the DOE HEPA filter testing facility in Oak Ridge, Tennessee, as per ERDA 76-21.

E. Filter Housing Test: Prior to shipment from the factory, each housing shall be blanked off at the inlet and outlet and tested by the pressure decay method. The pressure decay leak test of both the housing and of the filter-to-frame seal at each filter position shall be performed in two separate tests in accordance with ASME N509 and ASME N510. The leak rate shall not be greater than 0.005 scfm/ft^2 at 10 inches w.g. Soap bubble leak detection shall be conducted at 1.5 times the operating pressure if required, and as specified by the designers. All visible leaks and/or all defective frames shall be repaired by the manufacturer with no increase in cost. All welder certifications shall be in accordance with ASME SEC IX.

1.8 DELIVERY, STORAGE, AND HANDLING

A. The manufacturer shall prepare the HEPA/MEPA filter housing and accessories for shipment to prevent damage by handling, weather, or storage. Containers, crates, and boxes shall be clearly marked and paletted for handling via fork truck.

B. Each filter shall be encased in a tight-fitting linerboard sleeve that fits within the carton to reduce damage in transit. The top and bottom of the filter shall be protected with a folded linerboard cushion. All filter carton material (including the exterior carton, linerboard sleeve, and linerboard cushion) shall be tested for strength and certified to meet all construction requirements of applicable freight classification.

C. The manufacturer shall prepare the prefilter, MEPA, and HEPA filter elements for shipment to prevent damage by handling, weather, or storage. Containers, crates, and

boxes shall be clearly marked and palletted for handling via fork truck.

D. Acceptance at Site: The FERMCO Construction Manager's representative will receive and inspect equipment at time of delivery.

1.9 PROJECT CONDITIONS

A. Environmental Requirements
1. Environment: Outdoor, low-level radioactive, contaminated area.
2. Plant Condition:
   a. Location: Fernald, Ohio.
   b. Elevation: 578 feet above sea level.
   c. Ambient Temperature: -10 to 110 degrees F.
   d. Barometric Pressure: 29.31 inches Hg. Absolute (mean at 70 degrees F).
   e. Relative Humidity: 20 to 95 percent.

1.10 WARRANTY

A. Warranty shall be in accordance with FERMCO general provisions.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Flanders Filters, Inc.

B. Charcoal Service Corporation

C. Torit Division, Donaldson Company

D. American Air Filter

2.2 PRODUCT/EQUIPMENT

A. Disposable, Extended Area Panel Filters
1. Media: UL 900 Class 2, pleated, non-woven, reinforced cotton fabric, supported and bonded to

welded wire grid by corrugated aluminum separators.

a. Frame: Galvanized steel.

b. Nominal size: 24 by 24 inches.

c. Nominal thickness: 4 inches.

2. Rating, ASHRAE 52:

a. Dust spot efficiency: 25-30 percent.

b. Weight arrestance: 90-92 percent.

c. Initial resistance at 500 fpm face velocity: 0.25 inch w.g.

B. MEPA filters

1. Performance

a. Nominal capacity - 1000 cfm at 0.40 inch water pressure drop.

b. Filter shall be rated as 95 percent minimum efficiency according to ASHRAE 52-76.

c. The filter elements are to operate from ambient temperature to 250 degrees F.

2. Construction

a. The filters shall be 24 inches by 24 inches by 11-1/2 inches (nominal) gasket seal. The filter medium shall be glass fiber, formed into a flat sheet with a wet strength, water repellent binder. Nominal operating temperature: ambient to 250 degrees F. Gaskets will be 1/4-inch by 3/4-inch cross section closed cell elastomer or neoprene located on upstream face of filter.

b. Each filter element shall be constructed by pleating a continuous flat sheet of medium back and forth over spacers or without spacers. The element shall be permanently bonded to the frame with a fire-retardant sealant. The perimeter of the filter face shall be sealed to its mounting frame. Frame shall be 3/4-inch fire retardant plywood, flame spread less than 25, or galvanized steel.

c. Filter element shall meet all requirements of UL 900 Class 1.

d. Provide manufacturer's standard face guard on upstream and downstream faces.

e. Incineration of filter element shall reduce element volume to 5 percent original volume.

C. HEPA Filters

1. Performance

a. Nominal capacity - 1000 cfm at 1.0 inch water pressure drop (maximum).

b. HEPA filter elements are to operate from ambient temperature up to 250 degrees F.

c. Filter shall be rated as 99.97 percent minimum certified efficiency when DOP tested with 0.3 micron particles at 100 percent and 20 percent rated flows.

2. Construction

a. The filters shall be 24 inches by 24 inches by 11-1/2 inches (nominal) gasket seal type. The filter medium shall be glass fiber formed into a flat sheet with a wet strength, water repellant binder. Nominal operating temperature: ambient to 250 degrees F. Gaskets shall be 1/4-inch by 3/4-inch cross-section closed cell elastomer or neoprene expanded rubber located on upstream face of filter.

b. Each filter element shall be constructed by folding a flat sheet of medium back and forth over spacers or without spacers. The element shall be permanently bonded to the frame with a fire retardant sealant. The sealing gasket shall be permanently bonded to the upstream face of the filter frame. The frame shall be 3/4-inch plywood or galvanized steel.

c. Provide manufacturer's standard face guard on upstream and downstream faces.

d. Incineration of filter assembly shall reduce volume to 5 percent of original volume.

e. The HEPA filter frame shall be labeled, certifying:

1) The manufacturer's name.

2) The manufacturer's unique code UL registration number indicating compliance with UL 586.

3) Filter efficiency based on DOP testing.

4) Resistance at the test air flow rate.
5) Filter part number and serial number.
6) Test air flow direction.
7) Type "B"/"nuclear grade" filter.

D. HEPA/MEPA Filter Housing Assemblies

1. The supplier shall provide factory assembled and tested HEPA/MEPA filter housings. Each assembly unit shall be on a 304L stainless steel construction with the following components:

a. Each HEPA/MEPA Filter Housing

1) Filter housing shall handle exhaust air cfm in accordance with the air filter schedule.

2) Each HEPA filter housing shall be supplied with prefilter section, test sections, and HEPA filter section. MEPA filter housing will not require test section. Test sections shall be located on the upstream and downstream of HEPA filter no greater than 28 inches deep in the direction of airflow. Sections shall be constructed in such a manner that adjoining test chambers are isolated from each other to permit individual testing of each HEPA filter and its supporting framework in parallel and/or in series for its efficiency per ASME N510. The upstream and downstream test chambers shall contain identical mixing devices to mix and disperse a uniform challenge air/aerosol ahead of the filter and the effluent from the filter being tested. Challenge aerosol inlet ports, and upstream and downstream sample ports shall be provided for each HEPA filter. All mixing devices shall be designed to swing aside when testing has been completed. The filter test sections shall be constructed in accordance with the applicable design parameters of ASME N509.

3) Filter housing shall be constructed from 11- and 14-gage 300 series stainless steel. The housing shall be a side servicing bank type arrangement that does not require the air to change direction through the housing as it enters or exits the housing. The housing shall be 100 percent seam-welded on all joints across the pressure boundaries and shall be reinforced to withstand up to 30 inches w.g. negative pressure. All joints and seams shall be welded airtight and free from all burrs and sharp edges. All mechanical components and filter slide plates shall be 300 series stainless steel.

4) The housing shall have removable access doors with separate access doors for the prefilters. Both the removable rod and locking arm shall be operated through the door opening. A rubber lip on the perimeter of the door shall effect a seal between the housing and the access door. There shall be four tie-down latches per access door. They shall pivot away from the door opening so that they do not impede the bag-out process. The filter-locking mechanism and access door shall interface in such a manner that the door cannot be closed until the filters are correctly seated in the housing and sealed on the knife edge.

5) Each HEPA filter door shall be equipped with a metal pocket for the housing instruction. Each manual shall contain complete, detailed information including installation, operation, maintenance, and spare parts. The manual shall be contained in a weatherproof bag. Each metal pocket on the access door shall have a painted aluminum label with the manufacturer's name, the housing model number, prefilter model number, HEPA

filter model number, PVC bag number, and manufacturer's order number permanently engraved on the label.

6) On the upstream side of prefilter and filter position, there shall be a smooth inlet design that provides a maximum 3/4-inch depth recess around the upstream perimeter of the prefilter or filter to limit the buildup of contaminants in crevices or fillets that would have been caused by the junction of the filter's integral frame and the housing wall. All flanges of the housing that connect to the system shall turn to the outside.

7) The filter-locking mechanism in the housing shall be a replaceable locking tray. Filter-locking mechanism and hardware components shall be 300 series stainless steel. The housing shall have a locking arm to operate the mechanism which engages and disengages the filter on the internal sealing frame. The rod shall be part of the filter-locking mechanism and shall be replaceable.

8) Housing shall have a bag-out port inside the access door which shall be hemmed on its outer edges to prevent tearing of the bag. There shall be two continuous ribs on the outside of the port to hold the bag's elastic-shock cord and the safety strap during the bag-out operation. Housing shall be provided with a durable, 8 mil, amber colored, transparent finish PVC bag. The bag shall have an elastic-shock cord hemmed into the opening for firm fit when stretched around the bag-out port. Mittens shall be incorporated into the bag for added convenience and safety. The bag shall have its stock number rolled into the hem for easy identification when reordering.

9) A nylon safety strap shall be provided with each bag-out port to prevent the bag from slipping off during the bag-out procedure. A cinching strap shall also be provided with each bag-out port to tie off the slack in the bag while the ventilation system is operating.

10) The filter-to-housing seal shall be effected by means of a continuous knife edge on the sealing frame on the housing that mates to a continuous perimeter channel on the face of the filter, which has been filled with a viscous, non-drying fluid, or mates to a neoprene expanded rubber face gasket.

11) Each filter housing shall have a permanent factory-attached, clearly visible nameplate affixed to the casing with the following information:
    a) Manufacturer's name.
    b) Model number.
    c) Serial number.
    d) Purchase order number.
    e) Direction of air flow.
    f) Equipment number.
    g) Number of filters.

    Nameplates will be located on filter element removal side.

12) Sample ports (1 inch NPT half couplings with plugs) shall be located across each individual filter assembly for on-site testing. The housing inlet side sample ports shall be located on the door side of the housing. The ports shall be located at approximately the 1/3 points across the housing (8 inch spacing), at two per filter, which equates to six ports on the inlet side. The housing downstream ports shall be located on the door side of the housing. These ports shall be located at approximately the 1/4 points across each filter (6 inch

spacing), three per filter, which equates to nine ports.

E. Filter Differential Pressure Gauges

1. Direct Reading Dial: 2-inch-diameter diaphragm, actuated dial in metal case, vent valves, black figures on white background, front recalibration adjustment, range 0-4.0 inches w.g.
2. Accessories: Static pressure tips with integral compression fittings, 1/4-inch plastic tubing, two-way or three-way vent valves.

PART 3 EXECUTION

3.1 INSTALLATION

A. Install air cleaning devices in accordance with manufacturer's instructions.

B. Prevent passage of unfiltered air around filters with felt, rubber, or neoprene gaskets.

C. Install filter differential pressure gauge static pressure tips upstream and downstream of filters. Mount filter differential pressure gauges on outside of filter housing or filter plenum, in accessible position. Adjust and level.

D. Do not operate fan system until filters (temporary or permanent) are in place. Replace temporary filters used during construction and testing with a clean set before normal operation begins.

3.2 FIELD QUALITY ASSURANCE

A. Final acceptance of the HEPA filter housings shall be contingent on each assembly passing the in-place DOP test with the filter housings installed in their respective systems. Acceptance requirement is 0.03 percent maximum penetration of 0.3 micron particles when tested at 100 percent of rated flow. Defective housings shall be repaired or replaced by the manufacturer with no increase in cost. The testing shall be conducted by the operating contractor.

END OF SECTION

SECTION 15890
DUCTWORK

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Furnish all labor, materials, equipment, and services necessary to construct, install, and test the complete and operable ductwork systems and accessories as defined in this specification and as shown on the drawings referenced in Article 1.3.

B. Design, furnish, and install stack, stack guy wire supports, and deadman.

C. Items furnished by others but installed under this contract:
   1. Isokinetic sampler.

1.2 RELATED SECTIONS

A. Section 01010 - General Requirements.

1.3 REFERENCE DRAWINGS

A. See Section 01011 for the Schedule of Drawings.

1.4 REFERENCES

A. American National Standards Institute (ANSI):
   1. ANSI N13.1-69 — Guide to Sampling Airborne Radioactive Materials in Nuclear Facilities.
   2. ANSI N510-89 — Testing of Nuclear Air Cleaning Systems.

B. American Society for Testing and Materials (ASTM):

1. ASTM A36/A36M-94 — Structural Steel.
2. ASTM A90/A90M-93 — Standard Test Method for Weight of Coating on Zinc-Coated (Galvanized) Iron or Steel Articles.
3. ASTM A307-94 — Carbon Steel Externally and Internally Threaded Standard Fastener.
4. ASTM A380-94 — Standard Practice for Cleaning and Descaling Stainless Steel Parts, Equipment, and Systems.
5. ASTM A525-93 — Specification for Steel Sheet, Zinc-Coated (Galvanized) by the Hot-Dip Process, General Requirements.
6. ASTM A527/A527M-90 — Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) by the Hot-Dip Process.
7. ASTM A666-94 — Standard Specification for Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar.

C. American Welding Society (AWS):

1. AWS D1.1-94 — Structural Welding Code.
2. AWS D1.3-94 — Structural Welding Code-Sheet.
3. AWS D9.1-94 — Sheet Metal Welding.

D. Sheet Metal and Air Conditioning Contractors National Association (SMACNA):

1. SMACNA-75 — Accepted Industrial Practice for Industrial Duct Construction.
2. SMACNA-77 — Round Industrial Duct Construction Standard.
3. SMACNA-85 — HVAC Duct Construction Standards.

E. Building Officials and Code Administrations International (BOCA):

1. Ohio Basic Building Code (OBBC 95).

F. American Society of Civil Engineers (ASCE):
1. ASCE 7-93 Minimum Design Loads for Buildings and Other Structures.

G. Energy Research and Development Administration (ERDA):
1. ERDA 76-21-79 Nuclear Air Cleaning Handbook.

1.5 SYSTEM DESCRIPTION

A. Design Requirements
1. Minimum carrying velocities for exhaust ductwork: 2500 fpm (ERDA 76-21).
2. Minimum stack velocity: 3500 fpm.

B. Performance Requirements
1. The system has been designed for optimum performance. Any subsequent alternations to the design must be submitted for approval by the Subcontractor prior to fabrication and show that the proposed alterations will still provide the original design volume.

1.6 SUBMITTALS

A. All submittals shall be approved prior to ordering material.

B. Shop drawings shall include, but not limited to, the following:
1. Overall two-line duct layout, dimensioned with respect to the building and connections to equipment.
2. Elevations and sections as required to show clearances, methods of support, and details of installation.
3. Distance from bottom of ducts to finished floor.
4. Design, calculation, and drawing of stack and stack supports.
5. Dimensions of each duct section.
6. Location of duct and stack supports, and the loads imposed on each fastener or anchor.

7. Details of duct supports, including hanger locations, types, connections to duct, and connections to building and auxiliary steel.
8. Location and details of auxiliary equipment, including: isolation valves, backdraft dampers, test ports, instrument ports, duct drains, and clean-outs.
9. Prior to submitting shop drawings, the Subcontractor shall check all duct layouts against existing conditions and the FERMCO Construction Manager's final equipment drawings to ensure there is no conflict between the equipment drawings and the ductwork, stack, supports, platforms, and required access space. Subcontractor shall submit, in writing, verification that the above-coordination has been completed.
10. Shop drawings shall be on sheets no larger than 24 inches by 36 inches and not less than 1/4 inch equal to 1 foot scale to clearly show required data.

C. Submit documentation on welding procedures, list of welders, and welding operator's certifications in accordance with AWS D1.1 and AWS D1.3.

D. Submit certificates of conformance: Manufacturer shall certify and provide data which indicates that all supplied products meet or exceed requirements of this specification.

E. Submit all test procedures for approval 7 - 14 days prior to performance of test.

F. Submit all ventilation system testing results and air balancing reports.

1.7 QUALITY ASSURANCE

A. All shop drawings shall be approved by the FERMCO Construction Manager or a representative.

B. The FERMCO Construction Manager, or a representative, shall be provided the opportunity to witness any and

all tests specified herein. The Subcontractor shall be provided the opportunity to witness unit construction. The FERMCO Construction Manager shall be provided 7 days notice for all tests at the job-site. The Subcontractor shall be provided 14 days notice for all tests or unit construction away from the job site. All factory specified testing shall be accomplished by the manufacturer at the factory by schedule as required to meet delivery commitments.

C. Perform work in accordance with SMACNA construction standards listed in Article 1.4.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Duct sections shall be wrapped with heavy plastic film or equivalent at the ends, or capped completely with a minimum of 3/4-inch plywood boards secured to the flanges to ensure the flange integrity and to avoid damage and/or potential intrusion of dirt/debris and rain water.

B. The supplier shall be responsible for ensuring that the total integrity of the ductwork and stack is maintained, particularly the roundness/shape of every duct section. The supplier shall also provide all the necessary internal/external support for protection of material during handling, shipping, and unloading.

C. The duct sections shall be provided with suitable attachments to facilitate off-loading and erection without bending, scuffing, and/or denting of the finished product.

D. Use of chain or metal straps for lifting or holding down the ductwork shall be prohibited. Only plastic or cloth material that will not damage or scratch/indent the duct surface finish shall be used.

1.9 PROJECT CONDITIONS

A. Environmental Requirements

1. Environment: Outdoor, low-level radioactive, contaminated area.
2. Plant Condition:
   a. Location: Fernald, Ohio.
   b. Elevation: 578 feet above sea level.
   c. Ambient Temperature: -10 to 110 degrees F.
   d. Barometric Pressure: 29.31 inches Hg. Absolute (mean at 70 degrees F).
   e. Relative Humidity: 20 to 95 percent.

1.10 WARRANTY

A. Warranty shall be in accordance with FERMCO general provisions.

PART 2 PRODUCTS

2.1 PRODUCTS/EQUIPMENT

A. Ductwork: All exhaust and supply ductwork shall be fabricated from galvanized steel and shall conform to ASTM A525 and ASTM A527 galvanized steel sheet, lock-forming quality, having G60 zinc coating in conformance with ASTM A90.

B. Stack and Stack Supports

1. Stack and stack supports shall be designed and fabricated in accordance with, but not limited to, the following requirements:
   a. Basic wind speed of 80 mph (per OBBC [1992]). I = Importance factor = 1.07 (exposure C).
   b. Determine the design wind loads using factors and coefficients as stipulated in ASCE 7.
   c. Base design from the combination of loads and strength requirements as stipulated in the OBBC.
   d. Calculations and drawings shall be checked, signed, and stamped by a licensed Professional Engineer registered in the State of Ohio.

2. Stack shall be constructed from no thinner than 10-gage steel, all welded construction, except the isokinetic sampler shall have flanged connections. Flanged joints shall be sealed by neoprene rubber gaskets.
3. Stack shall be fabricated by butt welding using the gas tungsten arc welding (GTAW methods in accordance with AWS D9.1 or D1.3).
4. Welding procedures, welders, and welding operators shall be qualified in accordance with AWS D1.1 and AWS D1.3. In addition, unless otherwise specified, samples of typical longitudinal, girth, and 45-degree branch-outlet welds, in the thinnest material that will be used for the ductwork, shall be prepared to demonstrate the welder's ability to make such welds in this material.
5. All surfaces shall be cleaned of rust and mill scale, and applied with prime coat and finish coats of corrosion-resistant lead-free paint to all exposed surfaces in accordance with the manufacturer's standard or Section 09900, as applicable.
6. Guy wires and associated hardware
   a. Seven-wire strand, high-strength grade.
   b. Minimum wire breaking strength: 10,800 pounds.
   c. Turnbuckle, clevises, and bearing swivels must have a minimum capacity of 10,800 pounds.
   d. Guy wires to be located by Subcontractor so that no interference occurs with the process equipment.
   e. Expanding or cone anchors to be designed and located by the Subcontractor.
   f. The stack shall be constructed so that it remains functional following a design basis earthquake, severe natural phenomenon, or man-made event. Stack location and height shall also consider intakes on the facility and adjacent facilities to preclude uptake.
7. Isokinetic air sampling system shall be installed in compliance with ANSI N13.1. The sampling position along the stack shall be a minimum of

eight diameters downstream from the point of air stream entering the stack.

8. The stack sampling station will require a well-lit access platform for inspections and/or service. It shall consist of suitable structural steel platforms, handrails, ladders, walkways, etc. This station shall be accessible for sample filter changing 24 hours per day, 365 days per year, and should be weather protected, accessible, and located inside the building if possible. This sampling station shall also be designed to accommodate US EPA Method 5 compliance testing and comply with all OSHA requirements.

2.2 ACCESSORIES

A. Sealant: Non-hardening, water-resistant, fire resistive, compatible with mating materials; liquid used alone, or with tape or heavy mastic.

B. Flexible Connections: Flexible connection fabric shall be 30 ounces per square yard, finished weight, glass cloth coated with neoprene.

C. Fasteners: All screwed fasteners used in galvanized ductwork shall be constructed of cadmium plated or galvanized steel. All riveted connections in galvanized ductwork must be made with 3/16-inch diameter steel pop rivets or flat-head, tinned iron rivets.

D. Reinforcing bars and angles shall be of the same material as the ducts of casing on which they are used.

2.3 FABRICATION

A. Fabricate duct and duct supports in accordance with SMACNA industrial duct construction standards listed in Article 1.4 and level 4 duct construction requirements stipulated in ERDA 76-21. Sheet metal thickness and reinforcement of all welded ductwork shall be per Table 5.1 of ERDA 76-21 with a minimum thickness of 16 gage to ensure the reliability of the weld.

B. Formed longitudinal seams in all ducts, 18 gage and lighter, shall be inside grooved or Pittsburgh lock seams. Transverse joints shall be as recommended in SMACNA.

C. Longitudinal seams in all ducts 16 gage and heavier shall be full penetration continuous butt-welded in accordance with AWS D1.3. All weld material shall be removed from inside ductwork, leaving a smooth surface at all seams.

D. Construct tees, bends, and elbows with radius of not less than 1-1/2 times width of duct on center line. All changes in duct size or elevation, tee connections, and branch laterals shall be made with separate fittings of all-welded construction. All 90-degree tees and 45-degree branch laterals up to 12-inch diameter tap size shall have a smooth entrance into the tap, produced by machine or press forming. Welded seams must be ground free of any weld build up, burrs, or irregularities, and coated with a corrosion resistant paint.

E. Transform duct sizes gradually, not exceeding 30 degrees divergence and 45 degrees convergence.

F. All supports and sway bracing shall be constructed of galvanized steel. Sizes and types shall be as shown on the construction drawings. Horizontal runs shall be supported by one-piece clamp band and two suspension supports. In general, one support per 10 feet of duct is adequate. Arrangements of many fittings close together will require additional supports.

G. Flanged joints shall be sealed by neoprene rubber gaskets.

H. Welding procedures, welders, and welding operators shall be qualified in accordance with AWS D1.1 and D1.3. In addition, unless otherwise specified, workmanship samples of typical longitudinal, girth, and 45-degree branch-outlet welds in the thinnest material that will be used for ductwork shall be prepared to

demonstrate the welder's ability to make such welds in this material.

I. Exterior duct and duct supports shall be designed and fabricated in accordance with, but not limited to, the following requirements:

1. Basic wind speed of 80 mph (per OBBC [1995]). I = Importance factor = 1.07 (exposure C).
2. Determine the design wind loads using factors and coefficients as stipulated in ASCE 7.
3. Base design from the combination of loads and strength requirements as stipulated in the OBBC.
4. Calculations and drawings shall be checked, signed, and stamped by a licensed Professional Engineer, registered in the State of Ohio.
5. Snow Load:
   a. The ground snow load shall be 25 psf, per OBBC Section 1112.2.
   b. Snow loads, including balanced and unbalanced loads, shall be determined in accordance with ASCE 7. The importance factor for snow loads shall be 1.0.
6. Seismic Load: Use provisions of the Uniform Building Code, using Z = 0.13, c = 2.75, I = 1.25, and Rw = reduction factors from Table 16.P. W (total seismic load) shall include all normal operating contents, piping, and attachments.

J. Ductwork Testing

1. Acceptability criteria for welds shall be in accordance with Section 10 of AWS D1.1.
2. The duct shall be pressure leak tested in accordance with ANSI N510.
3. The end (blank-off testing) flanges shall be used on the pressure leak test. Plate thickness shall be 8 gage or heavier with the required reinforcement. Mating flanges surfaces shall be cold formed 3-inch by 3/8-inch flat bars in accordance with ASTM A666.
4. The maximum permissible leak rates shall be established in accordance with the recommendations given/noted in the ERDA 76-21, Table 5.6 for "Level 4" Duct Class Construction.

5. Duration of testing shall be 15 minutes. Ductwork shall be tested at 12 inches w.g., negative.
6. The complete setup for the pressure leak test shall be the responsibility of the supplier. The test shall be performed in the supplier's shop/ facility.

PART 3 EXECUTION

3.1 EXAMINATION

A. Inspection of the ductwork and stack will be made at the ductwork fabrication site by the FERMCO Construction Manager, or a representative, for the following stages of fabrication:
1. At some established midpoint to check materials of construction and welding during fabrication.
2. At completion of fabrication to witness pressure leak testing and to check dimensions, cleanliness, and shipping preparation.

B. Visual inspection of the exterior weld joints, and the interior surface texture of all welded joints in the ductwork and stack shall be performed in accordance with AWS D9.1 by the FERMCO Construction Manager or a representative.

3.2 ERECTION/INSTALLATION/APPLICATION

A. Ductwork Installation
1. Hangers and supports for ductwork and stack shall be rigidly attached to the structural steel, concrete, or to outside grade. Additional steel for duct supports shall be furnished and installed where required. The distance between hangers shall not be more than 8 feet unless noted otherwise on the drawings. Material shall be in accordance with ASTM A36 and ASTM A307.
2. Hangers for horizontal round ducts with a diameter of 18 inches or less shall be 1-inch by 1/8-inch stainless steel bands closely formed to the lower half but not attached to the duct. Hangers shall be located close to transverse joints.

3. Hangers for horizontal round ducts with a diameter over 18 inches shall be 1-1/2 inch by 3/16-inch stainless steel bands closely formed to the lower half but not attached to the duct. Hangers shall be located close to transverse joints.
4. Vertical ducts shall be supported with knee braces or hanger rods hung from knee braces. Knee braces shall be welded to a vertical support member of the tower perpendicular to the airstream to support the ducts.
5. Ducts passing through exterior walls and existing manway shall be counterflashed as described in the architectural specifications.
6. Seal all joints, seams, fastener penetrations, and connections in ductwork with duct sealant. Ductwork shall not leak as detected by auditory inspection.

B. Inspection After Installation - After the ductwork is installed, inspect it to verify that:
1. All flexible connections are supplied and are of the construction specified.
2. All isolation valves are installed with the adjustment devices per the appropriate specifications.
3. All instrument ports and test ports are installed, in the correct positions, and opening through duct wall is full inside port dimension, per the appropriate specifications.
4. All ducts are of the size and in the location shown on the drawings.
5. All fittings are of the type and size shown on the drawings.
6. All ducts are supported as shown in SMACNA-77 and/or on the drawings.
7. All ducts are free of obstructions as evidenced by air flow through each intake or discharge opening, detected by sight, sound, or feel.

3.3 ADJUSTING

A. Test the duct system for leaks using the procedures of ANSI N510.

3.4 CLEANING

A. After fabrication, the exterior surfaces shall be cleaned for removal of weld flux, scale, oil, grease, shop soil, visible rust, or other foreign matter.

B. Interior surfaces shall be cleaned in accordance with ASTM A380.

C. Interior surfaces shall be tested for presence of contaminants and shall be cleaned thoroughly for removal of embedded iron, organics, weld flux, slag, residual oil, and visible rust.

D. Supplier shall use only new stainless steel wire brush, non-chloride pickling solutions, fine abrasive grinding disk or flapper wheels that shall not damage the surface finish.

END OF SECTION

SECTION 16053

BASIC ELECTRICAL MATERIALS AND METHODS FOR Off-GAS CONTROL SYSTEM

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Electrical equipment, material, and services required for scrubber system:

1. Disconnect switches.
2. Motor starters.
3. Selector switches.
4. Enclosures for electrical equipment.
5. Molded case circuit breakers.
6. Variable frequency drives.
7. Conduit.
8. Wire and cable.
9. Instrument cable.
10. Nameplates.
11. Wire markers and cable tags.
12. Splicing and termination components.

1.2 RELATED SECTIONS

A. Section 01010 - General Requirements.

B. Section 15173 - Motors for Off-Gas Control System.

C. Section 15681 - Water Chillers.

D. Section 15712 - Induced Draft Cooling Towers.

E. Section 15755 - Heat Exchangers.

F. Section 15860 - Fans.

G. Section 15883 - Cyclone.

H. Section 15885 - Air Cleaning Devices.

1.3 REFERENCES

A. National Fire Protection Association (NFPA):

1.	NFPA 70-96	National Electrical Code.

B. American National Standards Institute (ANSI):

1.	ANSI C80.1-90	Rigid Steel Conduit-Zinc Coated.

C. Underwriters Laboratories, Inc. (UL):

1.	UL 360-86	Liquid-Tight Flexible Steel Conduit.
2.	UL 486A-91	Wire Connectors and Soldering Lugs for Use with Copper Conductors.
3.	UL 510-94	Polyvinyl Chloride, Polyethylene, and Rubber Insulating Tape.

D. National Electrical Manufacturers Association (NEMA):

1.	NEMA AB 1-93	Molded Case Circuit Breakers and Molded Case Switches.
2.	NEMA ICS 1-93	Industrial Controls and Systems General Requirements.
3.	NEMA ICS 2-93	Industrial Controls and Systems, Controllers, Contactors and Overload Relays Rated Not More Than 2000 Volts AC or 750 Volts DC.
4.	NEMA ICS 3.1-90	Safety Standards for Construction and Guide for Selection, Installation and Operation of Adjustable Speed Drive Systems.
5.	NEMA ICS 6-93	Industrial Controls and Systems Enclosures.
6.	NEMA KS 1-90	Enclosed and Miscellaneous Distribution Equipment Switches (600 Volts Maximum).
7.	NEMA 250-91	Enclosures for Electrical Equipment (1000 Volts Maximum).

1.4 SYSTEM DESCRIPTION

A. Design Conditions: As noted in Section 11501. Ambient shall be 40 degrees C.

B. Design Criteria: As noted in Section 11501.

C. Electrical starters, controls, wiring, and conduit required to operate the scrubber system specified and as indicated on drawings. Where these electrical items are mounted on the same shipping section, they shall be electrically connected using wire or cable and conduit as specified herein. For items not mounted on the same shipping section, electrical interconnection diagrams shall be furnished, conveying clearly how these items are to be wired. Disregard requirements herein for material or equipment not required for the off-gas control system.

1.5 SUBMITTALS

A. See Section 01010 for submittal requirements.

B. Manufacturer's Installation Instructions: Provide interconnection wiring diagrams indicating actual point-to-point termination of wiring between electrical switches, controls, starters, and other equipment. Wire terminations and individual wires must be labeled with numbers.

1.6 QUALITY ASSURANCE

A. Regulatory Requirements: All products and services performed shall conform to the requirements of NFPA 70.

B. Certifications: All items shall be tested and listed for the purpose intended by Underwriters Laboratories or Factory Mutual, Inc., with label attached.

PART 2 PRODUCTS

2.1 EQUIPMENT

A. Disconnect Switches

1. Nonfusible Switch Assemblies: NEMA KS-1, type HD quick-make, quick-break, visible blade, load interrupter knife switch in type 4 enclosures, conforming to NEMA 250, with externally operable handle interlocked to prevent opening front cover with switch in ON position. Handle lockable in OFF position.
2. Fusible Switch Assemblies: NEMA KS-1, type HD quick-make, quick-break, visible blade, load interrupter knife switch in type 4 enclosures, conforming to NEMA 250, with externally operable handle interlocked to prevent opening front cover with switch in ON position. Handle lockable in OFF position. Fuse Clips: FS W-F-870. Designed to accommodate Class R fuses.

B. Motor Starters

1. Magnetic Motor Controllers: NEMA ICS 1 and ICS 2, AC general purpose, circuit breaker, combination, Class A magnetic controller for induction motor. Each controller shall have a control power transformer with two primary fuses, one secondary fuse with other secondary lead grounded.
2. Coil Operating Voltage: 120 volts, 60 hertz.
3. Overload Relay: NEMA ICS 2 bimetal, ambient compensated.
4. Enclosure: NEMA ICS 6, type 4.
5. Selector Switch: Cover mounted, rotary type, on-off.
6. Minimum Size Contactor: Size 1.
7. Circuit Breaker: Instantaneous trip only, minimum 22 kA symmetrical interruption.
8. Pilot Lights: Two push-to-test, industrial type with nameplates.

C. Selector Switches

1. Stainless steel enclosure, NEMA ICS 6, type 4.
2. Two-position, maintained contact (start/stop).

3. Three-position, maintained contact (hand/off/auto).

D. Enclosures for Electrical Equipment

1. All enclosures for electrical equipment shall be type 4, conforming to NEMA ICS 6 or NEMA 250, as appropriate.

E. Molded Case Circuit Breakers

1. NEMA AB 1 with integral thermal and instantaneous magnetic trip in each pole. Provide common trip handle for all poles with capability of physical lockout. Terminals, minimum 75 degrees C rated.
2. Breaker enclosures shall be type 3R, conforming to NEMA 250.

F. Variable Speed Drives

1. Manufacturers:
   a. Cutler Hammer.
   b. Allen Bradley.
   c. Westinghouse.
   d. Substitutions: Submit to the FERMCO Construction Manager for engineering approval. The listing of equipment suppliers in no way precludes the offerer from proposing alternate suppliers of any of the equipment to be furnished within the scope of this specification. This list of suppliers is intended to identify the type of equipment and general quality of that equipment that will be included in the offerer's proposal. It is the offerer's responsibility to propose equipment that is best suited for this project in combined terms of quality and price.
2. Provide enclosed variable frequency drive suitable for load intended, conforming to the requirements of NEMA ICS 3.1.
3. Ratings
   a. Rated Input Voltage: 480 volts, three phase, 60 Hertz.
   b. Motor Nameplate Voltage: 460 volts, three phase, 60 Hertz.

c. Displacement Power Factor: Between 1.0 and 0.95, lagging, over entire range of operating speed and load.

d. Operating Ambient: -10 degrees C to 40 degrees C.

e. Humidity: 20-90 percent noncondensing.

4. Design

a. Employ microprocessor-based inverter logic isolated from power circuits.

b. Employ pulse width modulated inverter system.

c. Employ switching power supply operating off DC link.

d. Design for ability to operate drive with motor disconnected from output.

e. Design to attempt five automatic restarts following fault condition before locking out and requiring manual restart.

5. Product Options and Features

a. Display: Provide integral digital display to indicate output voltage, output frequency, and output current.

b. Status Indicators: Separate indicators for overcurrent, overvoltage, ground fault, overtemperature, and input power ON.

c. Volts per Hertz Adjustment: Manufacturer's standard.

d. Current Limit: 150 percent of rated for 1 minute.

e. Acceleration Rate Adjustment: 0.5-30 seconds.

f. Deceleration Rate Adjustment: 1-30 seconds.

g. Provide hand-off-automatic selector switch and manual speed control.

h. Input Signal: 4-20 mA DC, 250 ohms loop impedance (maximum).

i. Safety Interlocks: Provide terminals for remote contact to inhibit starting under both manual and automatic mode.

j. Control Interlocks: Provide terminals for remote contact to allow starting in automatic mode.

k. Manual Bypass: Provide contactor, motor running overload protection, and short

circuit protection for full voltage, nonreversing operation of the motor. Include isolation switch to allow maintenance of inverter during bypass operation.

1. Disconnecting Means: Include integral circuit breaker on the line side of each drive.

2.2 MATERIALS

A. Conduit

1. Rigid steel, heavy wall, galvanized conduit conforming to ANSI C80.1. Conduit shall be 3/4 inch minimum in diameter. Attachment straps, hangers, and struts shall be galvanized.
2. Liquid-tight flexible metal conduit conforming to UL 360. Conduit shall be 3/4 inch minimum in diameter.

B. Wire and Cable

1. Single conductor, 600-volt insulated copper conductor. Conductors for power and lighting branch circuits shall not be smaller than No. 12 AWG. Conductors No. 12 AWG and No. 10 AWG shall be solid. Conductors No. 8 AWG and larger shall be stranded. Conductors for control shall not be smaller than No. 14 AWG stranded. Conductors for Class 1 remote-control and signal circuits shall be enclosed in cable and shall comply with NFPA 70. Conductors for solenoid valves and/or limit switches shall be multiconductor No. 16 AWG, as required. Power and lighting conductor insulation shall be Type THW, XHHW, or THWN. Conductors required to be rated 90 degrees C in accordance with NFPA 70 shall be type XHHW-2 or THW-2.
2. Any special conductors shall be as required and UL listed for the purpose intended.

C. Instrument Cable

1. Instrumentation cable shall be No. 16 AWG stranded tinned copper conductors. Conductors shall be polyethylene insulated and rated 600 volts, 60 degrees C. Conductors shall be twisted with

aluminum-polymer shield; No. 18 AWG stranded, tinned copper drain wire. Cable shall have overall-chrome gray FR-PVC jacket.

D. Nameplates

1. Nameplates shall be engraved, three-layer laminated plastic, 5/16-inch bold style, black letters on white background.

E. Wire Markers and Cable Tags

1. Wire markers shall be single-conductor, slip-on, heat-shrinkable sleeve with typed or printed black letters on a white background. Wire markers shall be similar to W. H. Brady Co. computer-printable "Bradysleeve" or approved equal.
2. Cable tags shall be rectangular, flat, non-heat-shrinkable tags with 1/8-inch-high letters. Cable markers shall be similar to Raychem-type TMS or approved equal.

F. Splicing and Termination Components

1. Wire connectors, UL 486A, as applicable.
2. Insulation tape, UL 510.
3. Provide solderless terminal lugs on stranded conductors.
4. Twist-on splicing connectors (wire nuts) are <u>not</u> acceptable for 480-volt splices.

2.3 FABRICATION

A. Conduit

1. Route conduit parallel or at right angles to equipment lines. Provide conduit supports at approximately 8-foot intervals.
2. Cut conduit square using saw or pipecutter. All cut ends of conduit shall be reamed.
3. Install no more than the equivalent of three 90-degree bends between boxes. Use hydraulic one-shot conduit bender or factory elbows for conduit diameter larger than 1-1/2 inch.
4. Use form 8 conduit bodies to make sharp changes in direction. Avoid moisture traps; provide junction box with weep hole.

5. Provide cast metal boxes such as FS or FD.
6. Provide 1/8-inch nylon pull cord in empty conduits.
7. Final conduit connections to motors or other vibrating equipment shall be made with approximately 3-foot liquid-tight flexible metal conduit.

B. Wire and Cable

1. All wire and cable shall be completely enclosed in conduit or in junction boxes, metal raceway, or panels.
2. Swab conduit before installing cable. Remove burrs, dirt, or other debris.
3. When pulling cable into conduit, use wire pulling compound.
4. Splices shall be made only in outlet or junction boxes.
5. Provide equipment grounding conductor along with phase conductors in all conduits.
6. Multiconductor cables shall contain an integral ground conductor.
7. Grounding conductors shall be connected to equipment with compression lugs. Grounding connections shall be made to clean, dry surfaces. Scale, rust, grease, and dirt shall be removed from surfaces to which grounding connections are to be made.
8. Conductors shall be color coded. Conductors No. 6 AWG and larger shall be identified using colored tape at terminals and splice points. Conductors No. 8 AWG and smaller shall be identified using colored insulation or jacket. Color coding shall be as follows:

480Y/277V	Phase A	Brown
	Phase B	Orange
	Phase C	Yellow
	Neutral (grounded)	Gray
	Ground	Green or bare
208Y/120V	Phase A	Black
	Phase B	Red
	Phase C	Blue
	Neutral (grounded)	White
	Ground	Green or bare
240/120V	Phase	Black
	Phase	Red
	Neutral (grounded)	White
	Ground	Green

C. Nameplates

1. Degrease and clean surfaces to receive nameplates.
2. Install nameplates parallel to equipment lines. Secure nameplates to equipment fronts using self-tapping screws.

D. Wire and Cable Markers

1. Provide wire markers on each conductor in pull boxes and junction boxes, and at each load connection. Provide cable tags in pull boxes for multiconductor cables.
2. Wire and cable tags shall identify panel and circuit number or control wire number, as required.

E. Motor Starters

1. Install motor controllers with selector switches approximately 54 inches above finished floor.
2. Install overload heater elements in motor controllers to match motor characteristics.
3. Provide engraved nameplate identifying motor served.

F. Selector Switches

1. Mount selector switches at a mounting height of 54 inches above the floor, adjacent to the equipment controlled. Provide unistrut mounting supports.

G. Variable Speed Drives

1. Fabrication
   a. Wiring Terminations: Match conductor materials and sizes indicated.
   b. Enclosure: NEMA 250, Type 4.
   c. Finish: Manufacturer's standard enamel.
2. Do not install drive until building environment can be maintained within the service conditions required by the manufacturer.
3. Select and install overload heater elements in motor drives to match installed motor characteristics.
4. Provide engraved plastic nameplates.
5. Provide neatly typed label inside each motor drive door identifying motor served, nameplate horsepower, full load amperes, code letter, service factor, and voltage/phase rating.

H. Grounding

1. Provide ground conductor termination lugs (minimum two) adequate for 4/0 wire on each shipping section.
2. Bond all electrical enclosures to any conducting structures on which they are mounted and to the ground termination lugs in accordance with NFPA 70.

2.4 SOURCE QUALITY CONTROL

A. Testing

1. Power and Control Wire: All wires shall be tested for continuity. Wire insulation shall be megger tested between each conductor and ground.
   A 1000-volt megger shall be used for insulation rated 600 volts. Minimum resistance shall be 100 megohms.

2. Utilization Equipment:

a. Make electrical connections to utilization equipment in accordance with manufacturer's instructions.

b. Installation shall conform to the requirements of NFPA 70.

c. Motor windings shall be checked for continuity.

d. Motor windings rated 460 volts nominal shall be megger tested with a 1000-volt megger prior to connection of power leads. Minimum acceptable resistance shall be 50 megohms.

e. Motor and phase rotation shall be checked with a phase rotation tester similar to G. Biddle Company (Catalog No. 56060) or equal on equipment which could be damaged by reverse rotation.

1) Motor and phase rotation shall be verified before energizing motors.

2) All motors shall be "bumped" to check for proper direction of rotation prior to performing operational tests on the equipment.

B. Verification of Performance: Record for submittal, the results of testing, Article 2.4, Paragraph A above.

PART 3 EXECUTION

Not used.

END OF SECTION

Loadout Facilities

SECTION 02111
WASTE LOADOUT SYSTEM

PART 1 GENERAL

1.1 SECTION INCLUDES

A. This section includes the requirements for the design, engineering support, fabrication, delivery, and installation assistance for the waste loadout system. The following equipment are included in this system:
1. Railcar track weigh scale.
2. Front end loader.
3. Railcar lid bridge crane system.

1.2 SYSTEM DESCRIPTION

A. Four empty railcars are transferred from north to south into the Loadout Facility by the on-site yard locomotive, and decoupled from the engine. At the opposite end of the rail spur, the cars are coupled to an in-plant railcar mover. The car mover moves the railcars into the various areas of the facility.

B. The Loadout Facility consists of three discrete areas. Area 1 is the railcar loading area, Area 2 is the lid handling area, and Area 3 is the railcar decontamination area. The facility equipment is located under roof to prevent exposure to precipitation. Further modeling is to be performed to determine the requirements for confinement. The facility will have a curbed concrete floor, sloped to a sump to provide confinement for any liquids, such as windblown precipitation.

C. The first railcar is moved to the second area of the facility, where the lid is removed. Here, operators on adjacent structural steel platforms disconnect the lid latches from both sides of the car. Then, the operator remotely maneuvers the lifting beam with the overhead bridge crane to secure the beam to the two lifting lugs on the lid. The crane is then actuated to lift the lid

from the car and transfer it to the side, where it is stored at grade level.

D. Next, the operators insert a plastic liner into the railcar. The top of the liner is draped over the side of the railcar to prevent contamination during loading.

E. The railcar is then moved by the car mover to the first area, where it is loaded with waste via a front end loader. The blended waste is transferred from the storage area to the railcar with a front end loader, which travels up gradual inclined ramps to load the railcar. Multiple ramps are provided to more uniformly load the railcar, but the car mover may be required to provide limited car movement to obtain the full capacity of the railcar.

F. The first area will incorporate an integral track scale to provide local indication of the net weight of the railcar. The net weight will be recorded on the shipping manifest along with the serial number of the car.

G. During loading of the railcar, composite grab samples of the waste will be taken for analysis of the waste to ensure compliance with the disposal site waste acceptance criteria and DOT requirements. Since the results of the waste sample analysis will not be completed until after the car is filled, the serial number of the car will be referenced to the sample and the car will be held on site until this information is obtained and a shipping manifest prepared.

H. Once the car is filled, the car mover moves the filled car back to the second area. Here, the top of the liner is placed over the waste and sealed. The lid is then replaced by the overhead bridge crane system and secured by latches.

I. The car mover then moves the car to the third stage of the facility. Here, the car is uncoupled from the train and surveyed to comply with DOT requirements. Any gross surface contamination is removed, and smears

taken and counted to determine the removable contamination level. In addition, the car surface dose rate measurements are taken and recorded. During decontamination of the first car, the second car is staged by the car mover in the second area for lid removal and liner placement. The sequence continues until the second car is ready for decontamination. At that time, the car mover advances the string of cars, thus coupling the first and second cars, until the second car is positioned in the decontamination area.

J. The sequence continues for all remaining cars until the train of four cars is completed. Then, the yard locomotive transfers the four car train to an on-site holding area until the sampling analysis is complete and a shipping manifest can be prepared.

K. If the waste sampling analysis shows that a particular car does not meet all of the shipping and disposal requirements, then the car is removed from the train and returned by the yard locomotive to the separate unloading spur at the loadout facility. Once the lid is removed, a backhoe or other suitable equipment is used to remove the waste from the car and transfer it back to the blending area via a dump truck. Here, it is reblended with other waste to meet the shipping and disposal requirements. Details of this unloading facility and equipment will be developed in final design.

L. The Waste Loadout Facility will be operated one shift (8 hours) per day, 5 days per week, 360 days per year, and will be designed for a loadout rate of 120 tph.

PART 2 PRODUCTS

2.1 EQUIPMENT

A. The railcar weigh scale consists of a pit mounted, electronic track scale to indicate and record the net weight of the railcar. Scale range shall be 100 tons minimum and 200 tons maximum, with an accuracy of 50 pounds over the entire range. The track will be

supported by a structural steel frame and mounted on electronic load cells in a concrete pit. The output of the scale will be a local readout of the railcar net weight, as well as a hard copy printout of the final net weight for record keeping for the shipping manifest.

B. The front end loader is a diesel engine driven, rubber tired vehicle, with a 4½ cubic yard bucket. It shall handle materials in full bucket with material densities of up to 150 pounds per cubic foot. The loader will be operated manually with an operator located in an enclosed cab with HEPA air filtration. The loader will have an articulated frame design with center hinge point and a general purpose steel bucket. The minimum clear lifting height shall be 10 feet, measured with the bucket rolled to dump position.

C. The lid bridge crane system consists of one 2-ton overhead bridge crane with two 1-ton hoists for handling the railcar lid. Each electric hoist is mounted to an electric trolley that runs on the bridge, and the hook of each hoist is connected to opposite ends of a lifting beam (spreader bar). The lifting beam is maneuvered remotely by the operator to engage the lifting hooks on the lid for handling. The hoists are to be wire rope type with electric dynamic braking and mechanical safety brakes. The bridge crane incorporates a festoon system for electric power supply and control from a local control station of the facility.

END OF SECTION

SITE IMPROVEMENTS PLAN

Description

0163

DESCRIPTION OF SITE PREPARATION ACTIVITIES

Operable Unit 1
Project Order 145

October 1995
Revision B

Environmental Remedial Action Project
Fernald Environmental Management Project
Fernald, Ohio
FERMCO Subcontract No. 2-21487

PARSONS

25 Merchant Street
Cincinnati, Ohio 45246

000617

DESCRIPTION OF SITE PREPARATION ACTIVITIES

The Site Improvement Plan comprises the drawings and specifications for the early civil improvements necessary to prepare the site for the construction and operation of the OU1 remediation facilities. The plan includes the following documents:

1) Drawings

(1) Site Plan: These drawings depict the general improvements to the site. The major improvements are:

a) Site clearing and grading for the construction of the waste processing facility. Site grading will use the existing grades as much as practical in order to minimize the use of ramps and conveyors.

b) The embankment for the new rail spur to the south end of the loadout area. Fill from the site will be used for the rail embankment.

c) The stormwater management pond, which collects rainwater from the entire OU1 process area (approximately 11 acres) and retains it for pumping to the Biodenitrification Surge Lagoon. The stormwater management pond is sized for a 25-year, 24-hour storm based on FEMP design requirements. The excavation of the stormwater management pond will provide the fill needed for the other parts of the OU1 processing area.

d) The storm spillway which, in the event of a storm greater than the 25-year, 24-hour storm, directs overflow from the stormwater management pond to the existing drainage ditch north of the existing rail spur. The spillway is sized for a 100-year, 24-hour storm.

e) Access roads to the waste pits.

f) The railcar washdown station and control point for exit of full railcars to the rail spur.

g) A warehouse for storage of spare parts for excavation and processing equipment.

h) A diesel fuel station for fueling excavation and other equipment. The diesel fuel tanks are located in the clean area for easy access for vehicles filling the tanks. The fuel pumps are located in the controlled area for easy access by all the equipment.

i) A railcar maintenance facility to provide minor railcar and locomotive service. See Site Plan Sketch SK-G-03936.

Items e, f, g, h, and i are shown for general location only; these items are not included in the early site improvements. A changeout and restroom facility for workers entering and leaving the processing area has recently been completed to meet construction and operating needs for the OU1 remediation facilities.

(2) Site Grading Plan and Details: These drawings show the grading for the berms for the stormwater management pond and culverts.

(3) Utility Plan: These drawings show the location of subsurface utilities. The only subsurface utilities to be installed for the OU1 processing area are water lines for fire protection, and the force main from the stormwater management pond pumping station to the Biodenitrification Surge Lagoon. All other utilities, including natural gas, wastewater, and process water, will be installed in overhead pipe racks and are shown in the Plant Facilities Engineering package. It is necessary to ensure that existing utilities selected for tie-in of the new utilities will remain in operation throughout this project.

(4) Civil Specifications: These 11 specification sections include the following areas:

a) Section 02110, Site Clearing, including removal of surface debris, clearing and grubbing, removal of existing fencing and utilities, and topsoil excavation.

b) Section 02200, Earthwork, including excavation for pads, pavements, structures, and roadways; trenching; fill compaction; site preparation and restoration; erosion control; and backfilling and compaction.

c) Section 02270, Erosion Control, including soil erosion and sedimentation control for areas which are graded or disturbed.

d) Section 02300, Boring and Jacking, including rock excavation, backfill, and shoring required for installation of underground utilities underneath the rail tracks.

e) Section 02510, Asphaltic Concrete Paving, including asphalt paving, aggregate bases under asphalt paving and slabs, and crushed stone around buildings.

f) Section 02667, Site Water Lines, including pipe, fittings, accessories, valves, valve boxes, and fire hydrants for underground site water lines.

g) Section 02713, Detention Pond Geosynthetics, including geosynthetic materials and installation for the stormwater management pond.

h) Section 02720, Site Drainage, including outfall protection, storm drainage, catch basins, and manholes.

i) Section 02733, Pump Station, including installation of the lift station.

j) Section 02831, Chain Link Fences.

k) Section 02900, Seeding, including seed and mulch to stabilize disturbed areas, and maintenance of seeded areas.

These 11 specifications cover all main areas of the early site improvement work. Additional reference specifications will be included in the next issue of the design package.

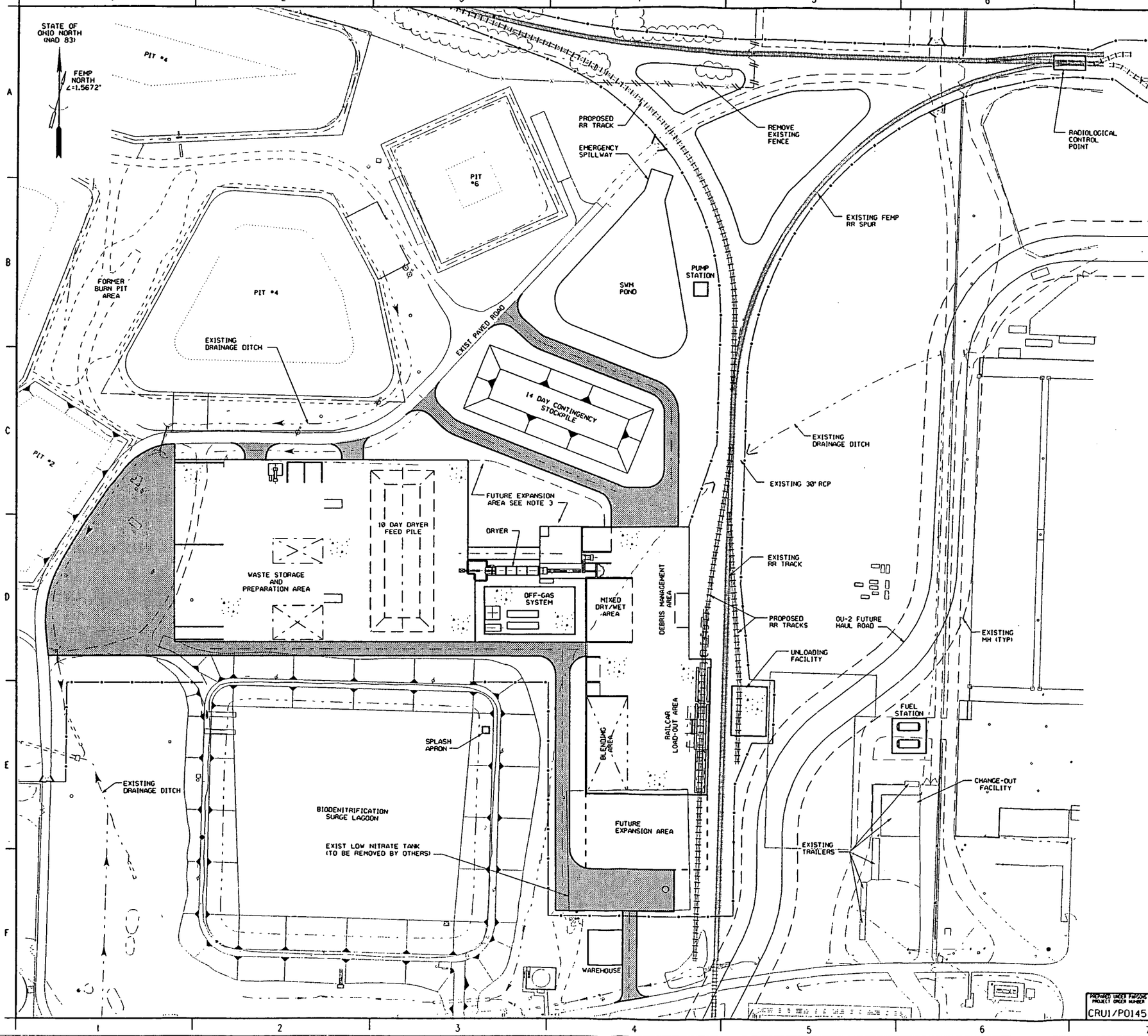
(5) Description of Utility Requirements: This document describes the provision of utilities to support the waste treatment process.

(6) Design of On-Site Rail Improvements: This document describes the rail upgrades and construction required to support the shipment of treated waste, including the receiving, loading, storing, and moving of full and empty railcars. This document depicts some tracks for railcar storage that are not yet included in the Civil Site Plan.

(7) Off-Site Rail Upgrades: This document describes the work to be performed by CSX to repair or upgrade the rail, switches, trestles, and culverts and other features from the FEMP to Cottage Grove, Indiana, and describes the operational sequencing of receiving empty railcars, filling and staging them, and moving them off site.

Site Plan

R91g00135.m(1078.ws412) po145@ws412. Fri Oct 20 13:47:01 CDT 1995



NOTES

1. EXISTING CONDITIONS SHOWN ON THIS DRAWING WERE PREPARED FROM FEMP SITE PROVIDED DATA FROM THE DOCUMENTS LISTED BELOW.

   EXISTING SITE DATA SOURCE (IN PLANT FILES)
   FEMP 1992 FLYOVER SURVEY
   FEMP CONTRACTOR PROJECT DESIGN DOCUMENTS

2. DESIGN AND CONSTRUCTION OF WAREHOUSE, FUEL STATION, RAILROAD TRACKS, RAILCAR WASH STATION, RADIOLOGICAL CONTROL POINT AND ACCESS ROADS WILL BE DONE BY OTHERS.

3. IF ADDITIONAL EXPANSION AREA IS NECESSARY, 14 DAY CONTINGENCY STOCKPILE AND THE ACCESS ROAD SOUTH OF THE STOCKPILE WILL BE REMOVED.

LEGEND

EXISTING		PROPOSED
	ROAD/PAVEMENT	
	RAILROAD	
	STRUCTURE	
	FENCE	
	CONCRETE PAD	

REF DWG NO.	DRAWING TITLE

PRELIMINARY
NOT FOR CONSTRUCTION

0 25 50 100 150 200 250
SCALE IN FEET

REV. NO.	ISSUE OR REVISION PURPOSE - DESCRIPTION	A-E	FERNCO	DATE
B	ISSUED FOR 30% DESIGN REVIEW (CLIENT COMMENTS, INCORPORATED)			
A	ISSUED FOR 30% DESIGN REVIEW			

INITIALS AND 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
OU1 REMEDIATION SYSTEM DESIGN
SITE IMPROVEMENT

DRAWING TITLE
CIVIL
SITE PLAN

DRAWN BY	DATE	LEAD ENGINEER	DATE	CHECKED BY	DATE
R. ESPARZA	08/08/95				

PLANT/BLDG. NO.	FLOOR	SCALE	CLASS
		1" = 50'	

SUBMITTED FOR APPROVAL | FERNCO CRU APPROVAL | DATE

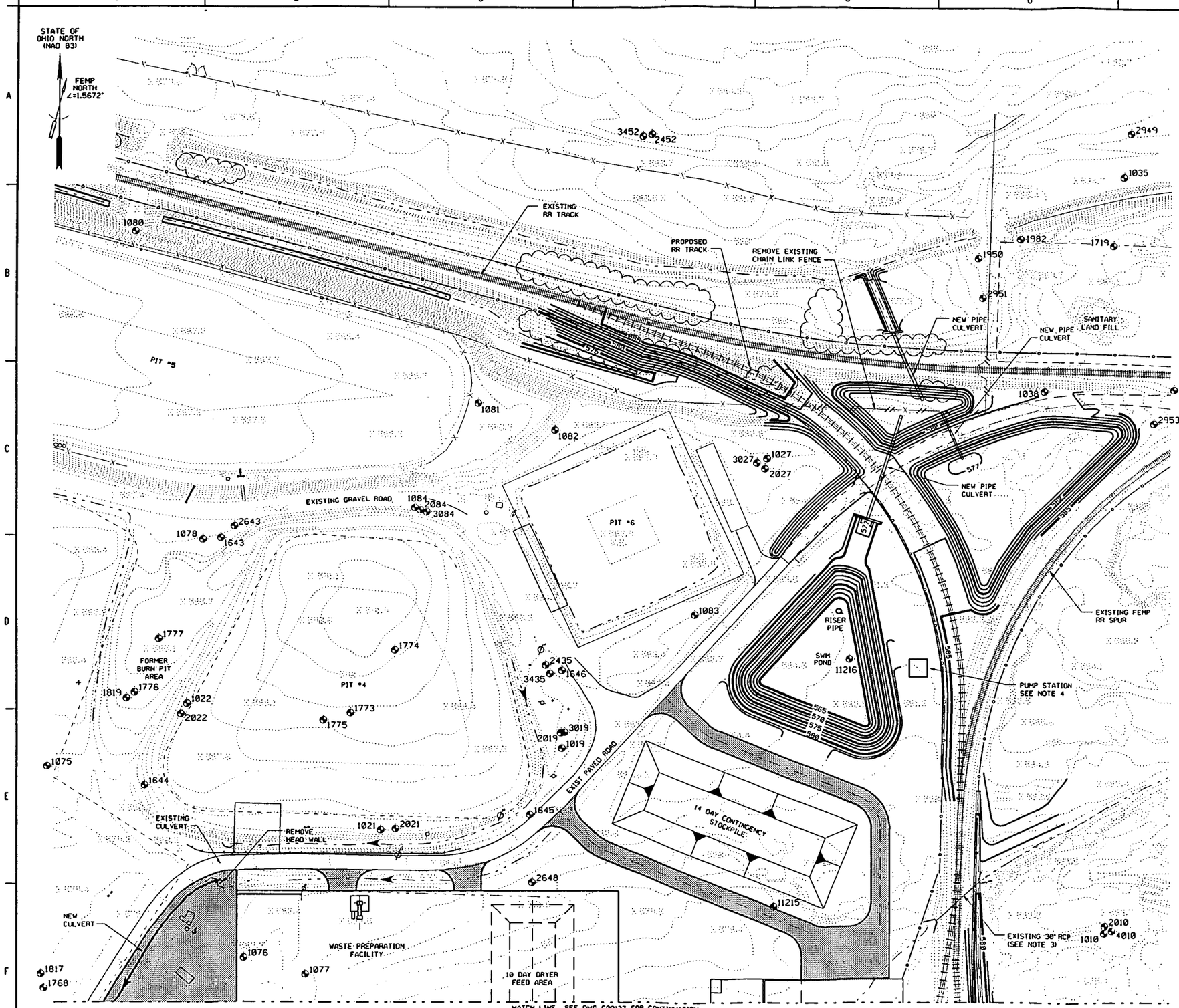
000621

A-E	DATE	DOE PROJECT NO.	FEMP PROJECT NO.	DRAWING INDEX CODE NO.	SHEET NO.	REV. NO.
			WBS 00-90701	91X-5900-G-00135		B

PREPARED UNDER PARSONS PROJECT ORDER NUMBER: CRU1/PO145

Grading Plan

R91g00136.m(1071.ws412) po145@ws412. Fri Oct 20 08:31:47 CDT 1995



NOTES

1. EXISTING CONDITIONS SHOWN ON THIS DRAWING WERE PREPARED FROM FEMP SITE PROVIDED DATA FROM THE DOCUMENTS LISTED BELOW.

   EXISTING SITE DATA SOURCE (IN PLANT FILES)
   FEMP 1992 FLYOVER SURVEY
   FEMP CONTRACTOR PROJECT DESIGN DOCUMENTS

2. FOR DETAILED EQUIPMENT LAYOUT, SEE MATERIAL HANDLING DRAWINGS 91X-5900-M-00147 AND 91X-5900-M-00148.

3. EXISTING 30" RCP SHALL BE ABANDONDED AND PLUGGED WITH FLOWABLE FILL, BOTH HEADWALLS AND A MINIMUM OF 10 L.F. OF RCP AT INLET SHALL BE REMOVED.

4. STORM WATER TO BE CONVEYED TO BIODENITRIFICATION SURGE LAGOON (BSL). LOCATION OF LIFT STATION AND ROUTE FORCE MAIN TO BSL IS TO BE DETERMINED.

LEGEND

EXISTING		PROPOSED
	ROAD/PAVEMENT	
	RAILROAD	
	STRUCTURE	
	FENCE	
2010	MONITORING WELL	
x 582.1	SPOT ELEVATIONS	582.1
585	CONTOURS	585

REF DWG NO.	DRAWING TITLE
91X-5900-G-00137	GRADING PLAN, SHT 2 OF 2

PRELIMINARY
NOT FOR CONSTRUCTION

0 50 100 250 500
SCALE IN FEET

REV. NO.	ISSUE OR REVISION PURPOSE - DESCRIPTION	A-E	FERNCO	DATE
B	ISSUED FOR 30% DESIGN REVIEW (CLIENT COMMENTS INCORPORATED)			
A	ISSUED FOR 30% DESIGN REVIEW			

DETAILS AND 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
OU1 REMEDIATION SYSTEM DESIGN
SITE IMPROVEMENT

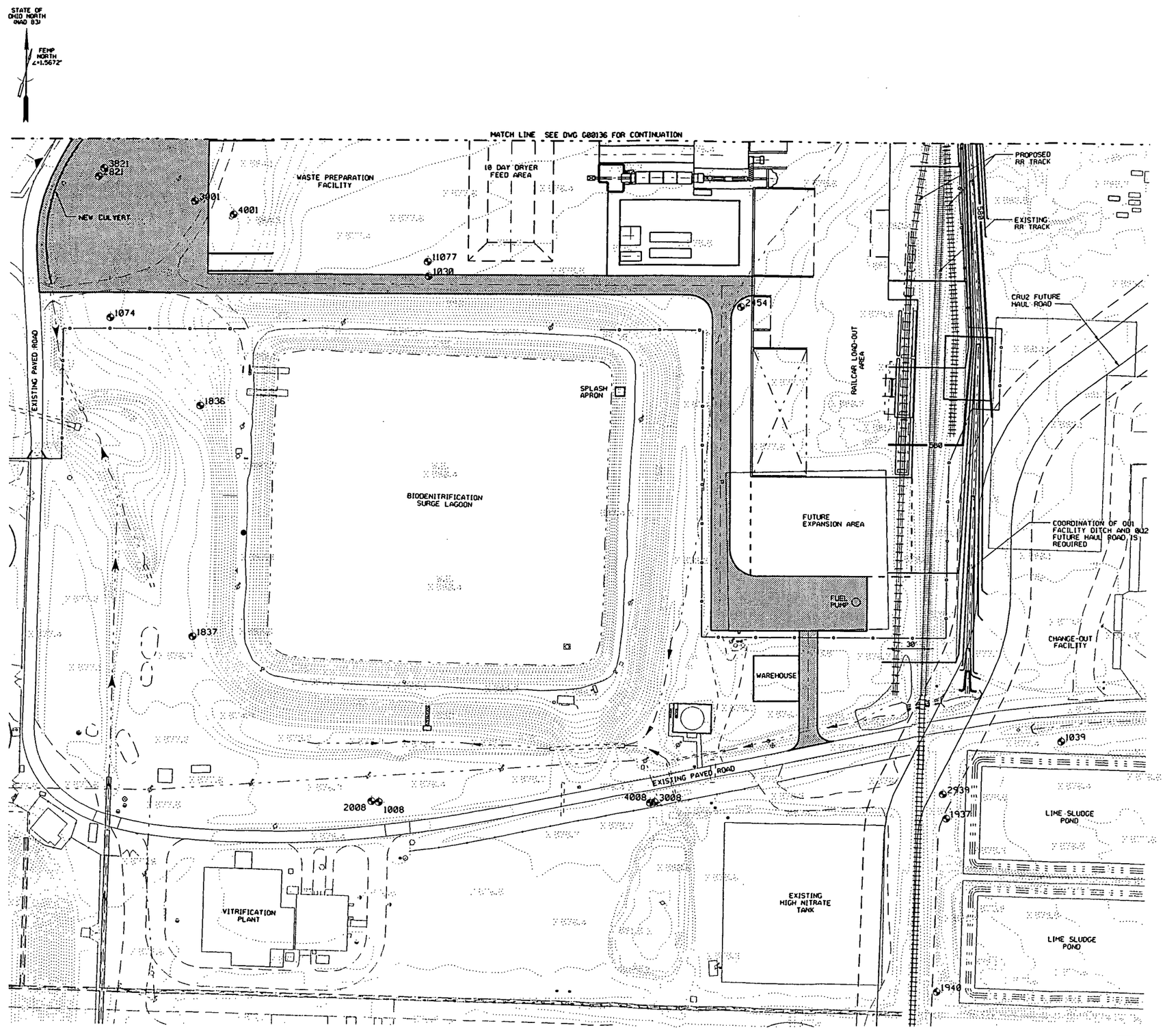
DRAWING TITLE
CIVIL
GRADING PLAN
SHEET 1 OF 2

DRAWN BY	DATE	LEAD ENGINEER	DATE	CHECKED BY	DATE
Y. AFSHAR	7-28-95				
PLANT/BLDG. NO.		FLOOR		SCALE 1"=40'	CLASS

SUBMITTED FOR APPROVAL — A-E — DATE
FERNCO OAI APPROVAL — DATE
000622

PREPARED UNDER PARSONS PROJECT ORDER NUMBER	A-E DOE PROJECT NO.	FEMP PROJECT NO.	DRAWING INDEX CODE NO.	SHEET NO.	REV. NO.
CRU1/P0145		00-90701	91X-5900-G-00136		B

R91g00137.m(1073.ws412) po145@ws412. Fri Oct 20 08:35:03 CDT 1995



NOTES

1. EXISTING CONDITIONS SHOWN ON THIS DRAWING WERE PREPARED FROM FEMP SITE PROVIDED DATA FROM THE DOCUMENTS LISTED BELOW.

EXISTING SITE DATA SOURCE (IN PLANT FILES)
FEMP 1992 FLYOVER SURVEY
FEMP CONTRACTOR PROJECT DESIGN DOCUMENTS
FIELD-RUN SURVEY OF AREA IS NOT AVAILABLE

LEGEND

EXISTING		PROPOSED
	ROAD/PAVEMENT	
	RAILROAD	
	STRUCTURE	
	FENCE	
2010	MONITORING WELL	
x 582.1	SPOT ELEVATIONS	582.1
585	CONTOURS	585

REF DWG NO.	DRAWING TITLE
91X-5900-G-00136	GRADING PLAN, SHT 1 OF 2

PRELIMINARY
NOT FOR CONSTRUCTION

0 20 40 100 200
SCALE IN FEET

REV. NO.	ISSUE OR REVISION PURPOSE - DESCRIPTION	A-E	FERNCO	DATE
B	ISSUED FOR 30% DESIGN REVIEW (CLIENT COMMENTS INCORPORATED)			
A	ISSUED FOR 30% DESIGN REVIEW			

INITIALS AND 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
OU1 REMEDIATION SYSTEM DESIGN
SITE IMPROVEMENT

DRAWING TITLE
CIVIL
GRADING PLAN
SHEET 2 OF 2

DRAWN BY	DATE	LEAD ENGINEER	DATE	CHECKED BY	DATE
Y. AFSHAR	9-1-95				

PLANT/BLDG NO.	FLOOR	SCALE	CLASS
		1"=40'	

SUBMITTED FOR APPROVAL — A-E — DATE
FERNCO CRU APPROVAL — DATE
000623

OU1 PROJECT NO.	FEMP PROJECT NO.	DRAWING INDEX CODE NO.	SHEET NO.	REV. NO.
	00-90701	91X-5900-G-00137		B

PREPARED UNDER PARSONS PROJECT ORDER NUMBER
CRU1/P0145

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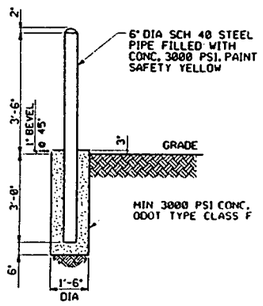
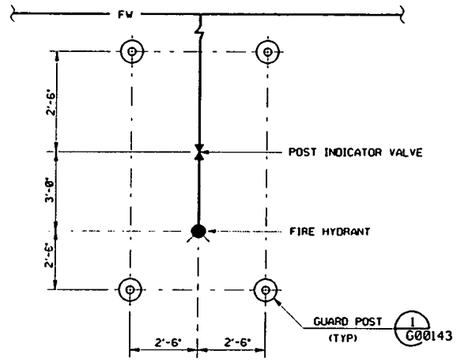


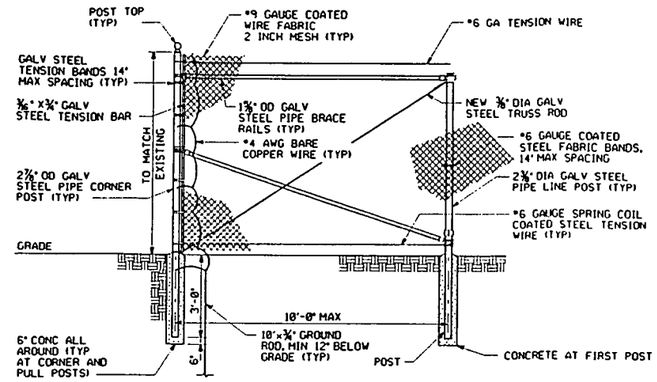
TYPICAL EXTERIOR GUARD POST DETAIL (1 / G00143) REF G00000

NTS



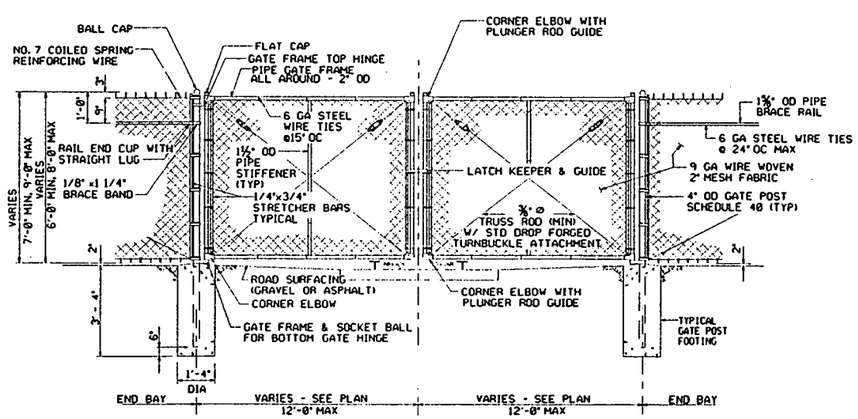
GUARD POST LOCATIONS (2 / G00143) REF G00000

N T S



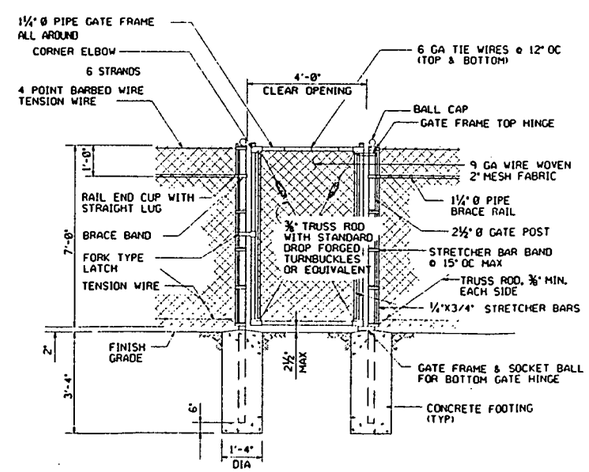
PULL POST FENCE DETAIL (3 / G00143) REF G00000

NTS



DOUBLE SWING GATE FOR RAILROAD (4 / G00143) REF G00000

NTS



PERSONNEL GATE (5 / G00143) REF G00000

NOT TO SCALE

NOTES

1. UNLESS OTHERWISE NOTED ALL MATERIALS SHALL CONFORM TO THE STATE OF OHIO DEPARTMENT OF TRANSPORTATION (ODOT) CONSTRUCTION AND MATERIAL SPECIFICATIONS DATED JANUARY 1, 1995.
2. SEE DRAWINGS 91X-5900-G-00135, 91X-5900-G-00136 AND 91X-5900-G-00137 FOR LOCATION OF DETAILS.

REF DWG NO.	DRAWING TITLE

PRELIMINARY
NOT FOR CONSTRUCTION

REV. NO.	ISSUE OR REVISION PURPOSE - DESCRIPTION	A-E	FERNCO	DATE
A	ISSUED FOR 30% DESIGN REVIEW			

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
OU1 REMEDIATION SYSTEM
SITE IMPROVEMENT

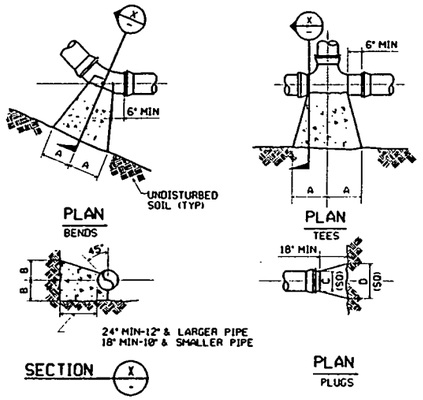
DRAWING TITLE
CIVIL
DETAILS - MISCELLANEOUS
SHEET 1 OF 4

DRAWN BY	DATE	LEAD ENGINEER	DATE	CHECKED BY	DATE
R. ESPARZA	07/30/95				
PLANT/BLDG. NO.		FLOOR		SCALE: AS NOTED	CLASS
SUBMITTED FOR APPROVAL		FERNCO CRU APPROVAL			

000624

PREPARED UNDER PARSONS PROJECT GROUP NUMBER	A-E DOE PROJECT NO.	DATE	FEMP PROJECT NO.	DATE	DRAWING INDEX CODE NO.	SHEET NO.	REV. NO.
CRU1/P0145			WBS 1.1.1.1.1.3.1 00-90701		91X-5900-G-00143		A

R91g00144.m(1032.ws412) po145@ws412. Sun Oct 8 12:29:37 CDT 1995

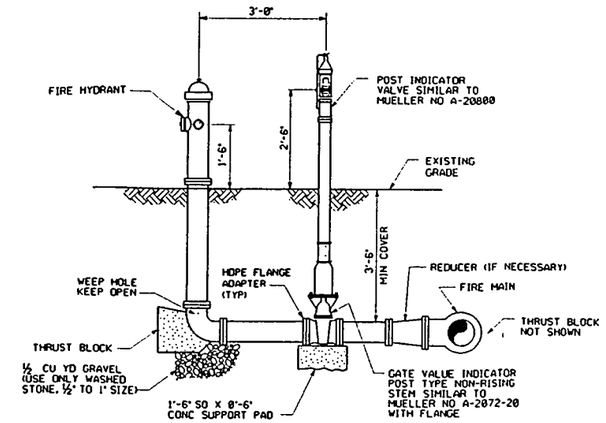


TYPE	SIZE	1/4 BENDS		1/8 BENDS		1/16 BENDS		TEES		PLUGS	
		A	B	A	B	A	B	A	B	C	D
2000 PSF SOIL	6"	16"	10"	9"	10"	5"	8"	10"	12"	10"	21"
	8"	22"	13"	12"	13"	8"	10"	13"	16"	12"	29"
	10"	26"	17"	14"	17"	10"	13"	16"	20"	14"	36"
	12"	29"	21"	16"	21"	11"	16"	18"	24"	16"	41"
	16"	38"	27"	-	-	-	-	24"	30"	-	-
	20"	42"	30"	-	-	-	-	27"	30"	-	-
	24"	48"	30"	-	-	-	-	36"	30"	-	-

NOTE: BASED ON 150 PSI STATIC PRESSURE PLUS A.W.W.A. WATER HAMMER. ALL BEARING SURFACES TO BE CARRIED TO UNDISTURBED GROUND.

THRUST BLOCK DETAILS

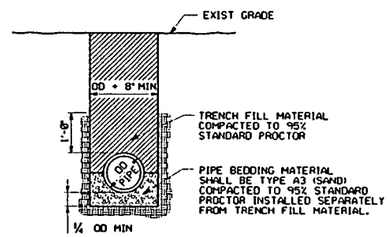
(SEE NOTE 2) NTS — REF 1 G00144 G00000



FIRE HYDRANT W/ POST INDICATOR VALVE DETAIL

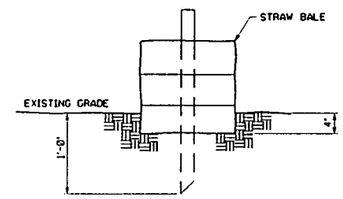
NTS — REF 2 G00144 G00000

NOTE: FLANGE ADAPTOR'S AND DI SPOOL PIPE SHALL BE USED AT ALL TRANSITIONS OF UNLIKE PIPING MATERIAL.



TYPICAL PIPE BEDDING DETAIL

NTS — REF 3 G00144 G00000

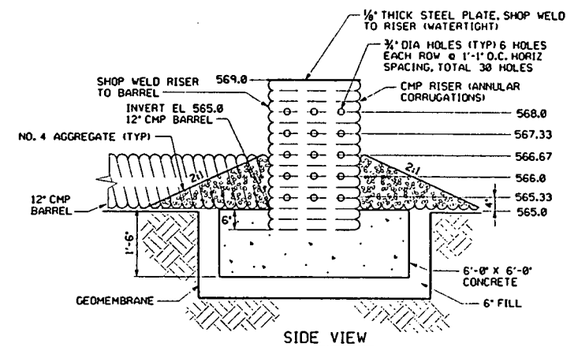


NOTE:

1. STRAW BALES TO BE USED WHEN NATURAL GROUND IS LEVEL OR SLOPING AWAY FROM PROJECT.
2. PLACE STRAW BALES APPROXIMATELY PARALLEL TO BOTTOM OF FILL SLOPE AND AROUND THE CATCH BASINS INLETS.
3. STRAW BALES SHALL BE STANDARD SIZE 18"x18"x48".
4. FOR EROSION CONTROL MAINTENANCE SEE SPECIFICATIONS.

STRAW BALE DETAIL

NTS — REF 4 G00144 G00000

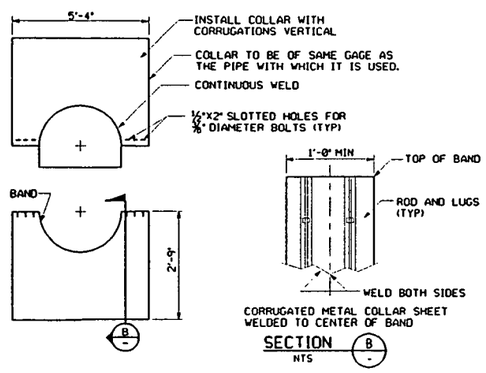


SIDE VIEW

RISER PIPE - SWM

DETAIL

NTS — REF 5 G00144 G00000



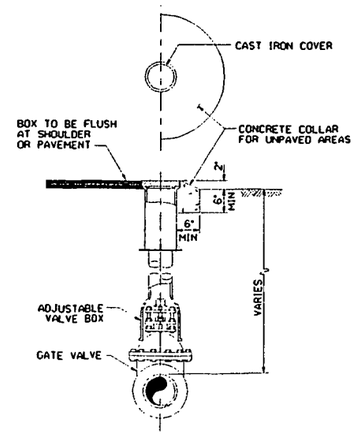
NOTES:

1. UNASSEMBLED COLLARS SHALL BE MARKED BY PAINTING OR TAGGING TO IDENTIFY MATCHING PAIRS.
2. THE LAP BETWEEN THE TWO HALF SECTIONS INCLUDING BOLTS AND BETWEEN THE PIPE AND CONNECTING BAND SHALL BE CAULKED WITH ASPHALT MASTIC AT TIME OF INSTALLATION.
3. EACH COLLAR SHALL BE FURNISHED WITH TWO ½" DIA RODS WITH STANDARD TANK LUGS FOR CONNECTING COLLARS TO PIPE.

CORRUGATED METAL ANTI-SEEP COLLAR

DETAIL

NTS — REF 6 G00144 G00000



VALVE BOX

NOT TO SCALE — REF 7 G00144 G00000

NOTE: VALVE SIZE 12" MAXIMUM

NOTES

1. UNLESS OTHERWISE NOTED ALL MATERIALS SHALL CONFORM TO THE STATE OF OHIO DEPARTMENT OF TRANSPORTATION (ODOT) CONSTRUCTION AND MATERIAL SPECIFICATIONS DATED JANUARY 1, 1995.
2. THRUST BLOCKS SHALL BE INSTALLED ON ALL ELBOW BENDS, TEES AND PLUGS ON ALL UNDERGROUND PIPE 4 INCHES AND LARGER.
3. SEE DRAWINGS 91X-5900-G-00135, 91X-5900-G-00136 AND 91X-5900-G-00137 FOR LOCATION OF DETAILS.

REF DWG NO.	DRAWING TITLE

PRELIMINARY
NOT FOR CONSTRUCTION

REV. NO.	ISSUE OR REVISION PURPOSE - DESCRIPTION	A-E	FERNCO	SWE
A	ISSUED FOR 30% DESIGN REVIEW			

INITIALS AND 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
OU1 REMEDIATION SYSTEM DESIGN
SITE IMPROVEMENT

DRAWING TITLE
CIVIL
DETAILS - MISCELLANEOUS
SHEET 2 OF 4

DRAWN BY	DATE	LEAD ENGINEER	DATE	CHECKED BY	DATE
R. ESPARZA	07/31/95				

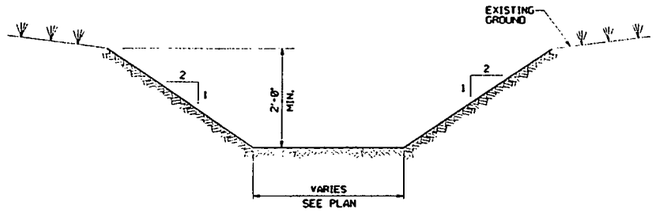
PLANT/BLDG NO. | FLOOR | SCALE: AS NOTED | CLASS

SUBMITTED FOR APPROVAL | FERNCO OU1 APPROVAL 000625

A-E DATE | DOE PROJECT NO. | TEMP PROJECT NO. VBS 1.1.1.1.1.3.1 00-90701 | DRAWING INDEX CODE NO. 91X-5900-G-00144 | SHEET NO. | REV. NO. A

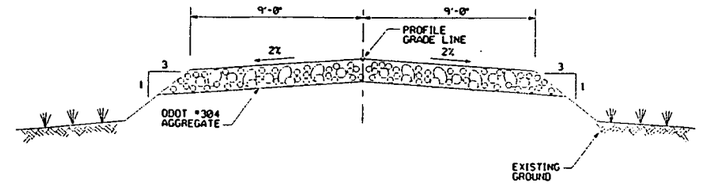
PREPARED UNDER PARSONS PROJECT ORDER NUMBER CRU1/P0145

R91g00145.m(1034.ws412) po145@ws412. Sun Oct 8 12:43:59 CDT 1995



NOTES:
1. FOR DITCH INVERT ELEVATION SEE PLANS

TYPICAL SEEDED DITCH DETAIL (1) REF G00145 G00000
NTS



GRAVEL ROAD (2) REF G00145 G00000
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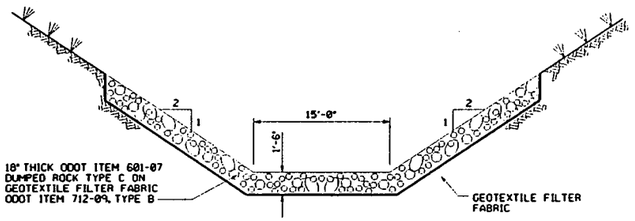
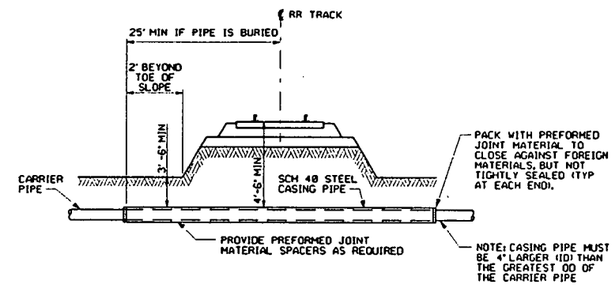
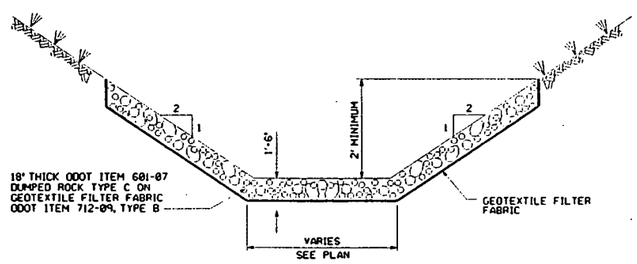


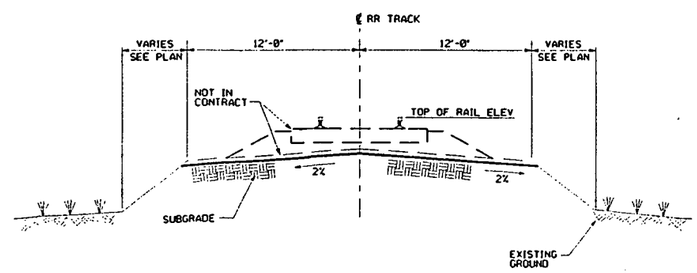
EMERGENCY SPILLWAY DETAIL (3) REF G00145 G00000
NTS



PIPELINES CROSSING UNDER RR TRACKS (TYP) (4) REF G00145 G00136
NTS



TYPICAL FLAT BOTTOM DITCH DETAIL (5) REF G00145 G00136
NTS



RAILROAD SECTION (TYP) (6) REF G00145 G00000
NTS

NOTES

1. UNLESS OTHERWISE NOTED ALL MATERIALS SHALL CONFORM TO THE STATE OF OHIO DEPARTMENT OF TRANSPORTATION (ODOT) CONSTRUCTION AND MATERIAL SPECIFICATIONS DATED JANUARY 1, 1995.
2. SEE DRAWINGS 91X-5900-G-00135, 91X-5900-G-00136 AND 91X-5900-G-00137 FOR LOCATION OF DETAILS.

REF DWG NO.	DRAWING TITLE

PRELIMINARY
NOT FOR CONSTRUCTION

REV. NO.	ISSUE OR REVISION PURPOSE - DESCRIPTION	A-E	FERNCO	DATE
A	ISSUED FOR 30% DESIGN REVIEW			

INITIALS AND 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
OU1 REMDIATION SYSTEM DESIGN
SITE IMPROVEMENT

DRAWING TITLE
CIVIL
DETAILS
SHEET 3 OF 4

DRAWN BY	DATE	LEAD ENGINEER	DATE	CHECKED BY	DATE
R. ESPARZA	08/06/95				

PLANT/BLDG. NO.	FLOOR	SCALE	CLASS
		AS NOTED	

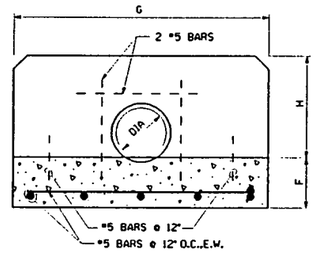
SUBMITTED FOR APPROVAL | FERNCO CRU APPROVAL

A-E DATE | DATE

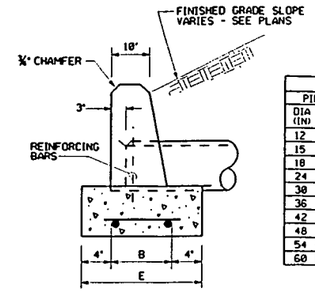
000626

PREPARED UNDER PARSONS PROJECT ORDER NUMBER	A-E PROJECT NO.	TEMP PROJECT NO.	DRAWING INDEX CODE NO.	SHEET NO.	REV. NO
CRU1/P0145		WBS 1.1.1.1.1.3.1 00-90701	91X-5900-G-00145		A

R91g00146.m(1036.ws412) po145@ws412. Sun Oct 8 12:46:19 CDT 1995



FRONT ELEVATION



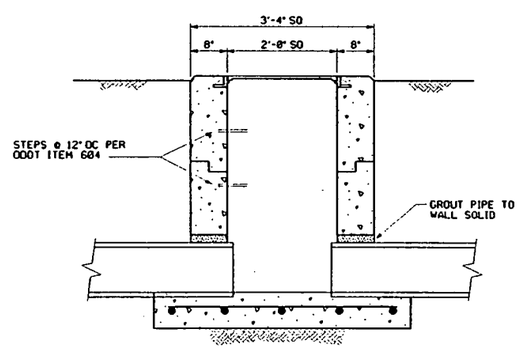
END ELEVATION

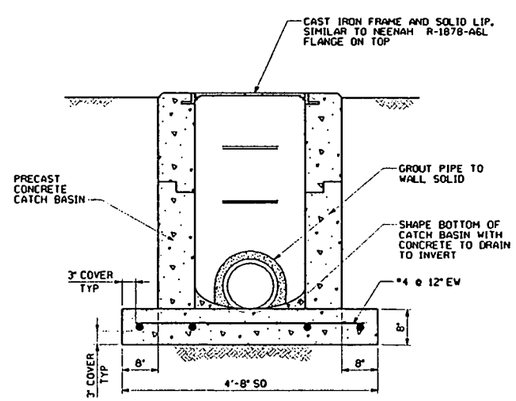
DIMENSIONS						
PIPE SIZE		WALL			FOOTING	
DIA (IN)	AREA (SQ FT)	G	H	B	E	F
12	0.79	4'-0"	2'-0"	1'-2"	1'-10"	1'-0"
15	1.23	5'-0"	2'-2"	1'-2"	1'-10"	1'-2"
18	1.77	6'-0"	2'-6"	1'-3"	1'-11"	1'-3"
24	3.14	8'-0"	3'-0"	1'-4"	2'-0"	1'-4"
30	4.91	10'-0"	3'-6"	1'-6"	2'-2"	1'-6"
36	7.07	12'-0"	4'-0"	1'-8"	2'-4"	1'-8"
42	9.62	14'-0"	4'-6"	1'-10"	2'-6"	2'-0"
48	12.57	16'-0"	5'-0"	2'-1"	2'-9"	2'-0"
54	15.90	18'-0"	5'-6"	2'-4"	3'-0"	2'-0"
60	19.63	20'-0"	6'-0"	2'-6"	3'-2"	2'-0"

STRAIGHT HEADWALL DETAIL

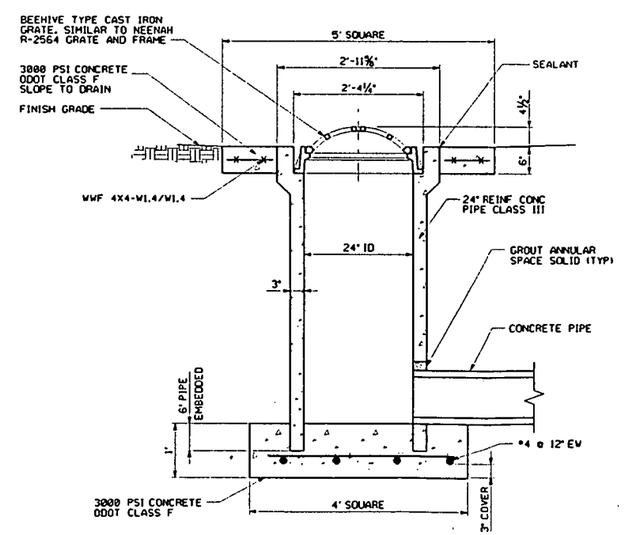
NOTE:
1. ALL REINFORCING SHALL HAVE A MINIMUM COVER OF 2" EXCEPT WHERE INDICATED.

STRAIGHT HEADWALL DETAIL — NTS — 1 C00146 REF C00000





MANHOLE DETAIL — NTS — 2 C00146 REF C00000



CATCH BASIN DETAIL — NTS — 3 C00146 REF C00136

NOTES

1. UNLESS OTHERWISE NOTED ALL MATERIALS SHALL CONFORM TO THE STATE OF OHIO DEPARTMENT OF TRANSPORTATION (ODOT) CONSTRUCTION AND MATERIAL SPECIFICATIONS DATED JANUARY 1, 1995.
2. SEE DRAWINGS 91X-5900-G-00135, 91X-5900-G-00136 AND 91X-5900-G-00137 FOR LOCATION OF DETAILS.

REF DWG NO.	DRAWING TITLE

PRELIMINARY
NOT FOR CONSTRUCTION

REV. NO.	ISSUE OR REVISION PURPOSE - DESCRIPTION	A-E	FERNCO	DATE
A	ISSUED FOR 30% DESIGN REVIEW			

DETAILS AND 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
OU1 REMEDIATION SYSTEM DESIGN
SITE IMPROVEMENT

DRAWING TITLE
CIVIL
DETAILS - MISCELLANEOUS
SHEET 4 OF 4

DRAWN BY	DATE	LEAD DRAFTER	DATE	CHECKED BY	DATE
R. ESPARZA	07/30/95				

PLANT/BLDG. NO	FLOOR	SCALE	CLASS
		AS NOTED	

SUBMITTED FOR APPROVAL — FERNCO CRU APPROVAL

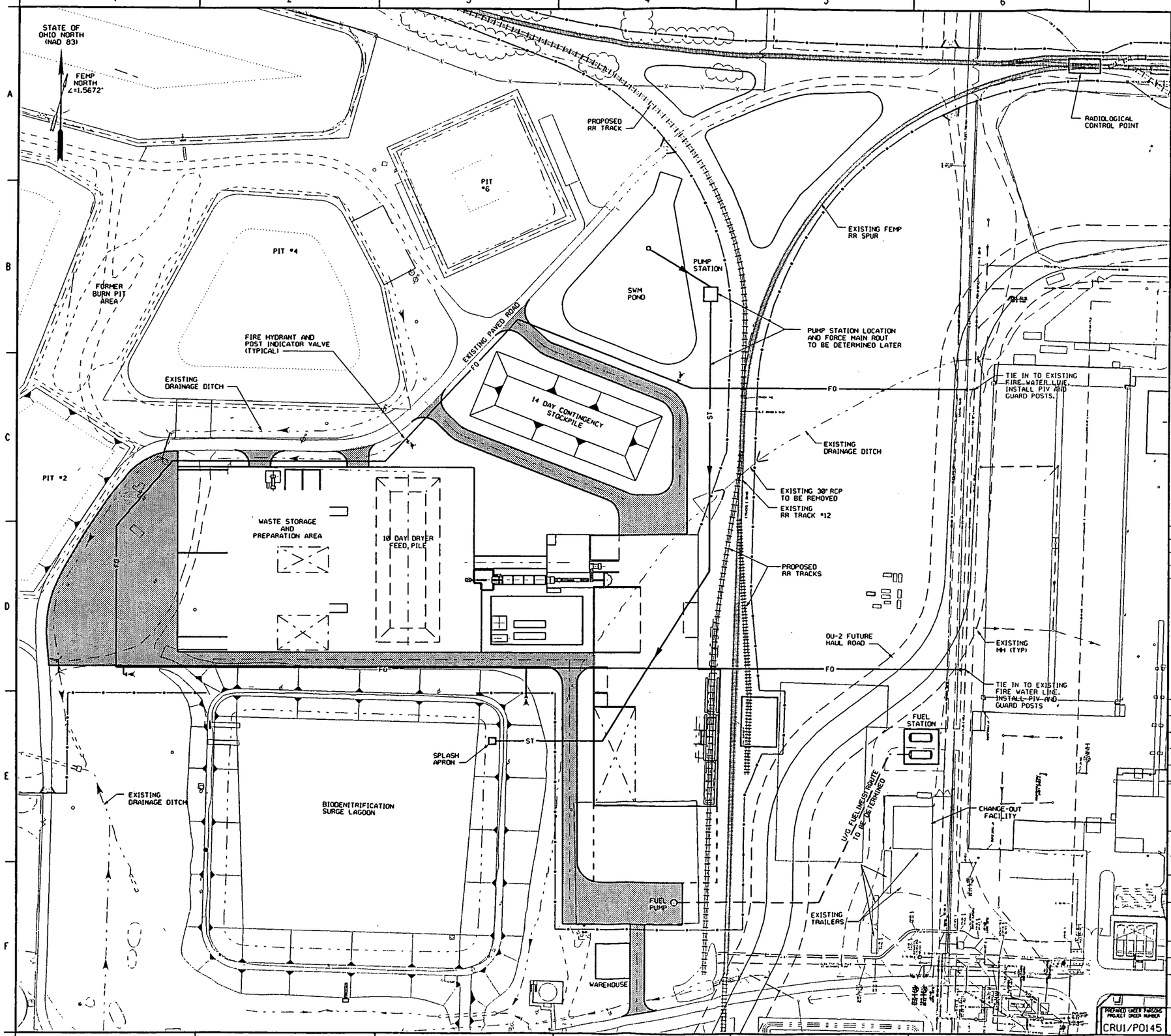
000627

A-E DOE PROJECT NO.	DATE	FTMP PROJECT NO.	DATE	DRAWING INDEX CODE NO.	SHEET NO.	REV. NO
		WBS 1.1.1.1.1.3.1 00-90701		91X-5900-G-00146		A

PREPARED UNDER PARSONS PROJECT ORDER NUMBER CRU1/P0145

Utility Plan

R91g00141.m(1075.ws412) po145@ws412. Fri Oct 20 09:14:22 CDT 1995



NOTES

1. EXISTING CONDITIONS SHOWN ON THIS DRAWING WERE PREPARED FROM FEMP SITE PROVIDED DATA FROM THE DOCUMENTS LISTED BELOW.

EXISTING SITE DATA SOURCE (IN PLANT FILES)
FEMP 1992 FLYOVER SURVEY
FEMP CONTRACTOR PROJECT DESIGN DOCUMENTS

LEGEND

EXISTING		PROPOSED
	ROAD/PAVEMENT	
	RAILROAD	
	STRUCTURE	
	FENCE	
	FIRE HYDRANT	
	POST INDICATOR VALVE	
	FIREWATER LINE	—FO—
	STORMWATER LINE	—ST—

REF DWG NO.	DRAWING TITLE

PRELIMINARY
NOT FOR CONSTRUCTION

0 25 50 100 150 200 250
SCALE IN FEET

REV. NO.	ISSUE OR REVISION PURPOSE - DESCRIPTION	A-E	FERNCO	DATE
B	ISSUED FOR 30% DESIGN REVIEW (CLIENT COMMENTS INCORPORATED)			
A	ISSUED FOR 30% DESIGN REVIEW			

INITIALS AND 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
OU1 REMEDIATION SYSTEM DESIGN
SITE IMPROVEMENT

DRAWING TITLE
CIVIL
UTILITY PLAN

DRAWN BY	DATE	LEAD ENGINEER	DATE	CHECKED BY	DATE
K. TANG	08/08/95				
PLANT/BLDG. NO.		FLOOR		SCALE 1" = 50'	CLASS
SUBMITTED FOR APPROVAL		FERNCO DRU APPROVAL			

000628

A-E	DATE		DATE			
DOE PROJECT NO.	FEMP PROJECT NO. WBS 00-90701	DRAWING REF. CODE NO. 91X-5900-G-00141		SHEET NO.	REV. NO. B

Civil Specifications

SECTION 02110
SITE CLEARING

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Remove surface debris.

B. Clear site of plant life and grass, where it affects construction only.

C. Remove fencing.

D. Remove only designated underground and aboveground utilities.

E. Topsoil excavation.

1.2 RELATED SECTIONS

A. Section 01010 - General Requirements.

B. Section 02200 - Earthwork.

C. Section 02270 - Slope Protection and Erosion Control.

D. Section 02831 - Chain Link Fences and Gates.

1.3 REFERENCE DRAWINGS

A. See Section 01011 for the Schedule of Drawings.

1.4 QUALITY ASSURANCE

A. Erosion and sedimentation control shall comply with requirements of Section 02270.

PART 2 PRODUCTS

Not used.

PART 3 EXECUTION

3.1 PREPARATION

A. Verify that existing utilities designated to remain are staked, flagged, and identified.

3.2 ERECTION/INSTALLATION/APPLICATION

A. Clearing:
1. Clear only areas required for access to site and execution of work. Obtain written approval of clearing limits from FERMCO.
2. Remove trees and shrubs within marked areas indicated.
3. Clear undergrowth and deadwood without disturbing subsoil.
4. Provide dust control using clean, potable water to the satisfaction of FERMCO.

B. Removal:
1. Remove debris, rock, and extracted plant life.
2. Remove existing fence to the limits shown on the Site Plan, 91X-5900-G-00135. The requirements of Section 02831 apply. Stockpile chain in a tied roll, and stack posts in a neat pile at location on site determined by FERMCO.

C. Topsoil Excavation:
1. Excavate topsoil from areas to be graded.
2. Stockpile in area designated on site to a height not exceeding 8 feet. Protect from erosion. Remove excess topsoil not re-used from the stockpile to a site designated by FERMCO.

3.3 PROTECTION

A. Locate, identify, and protect from damage all utilities that remain.

B. Protect trees, plant growth, and features designated to remain as final landscaping.

C. Protect survey benchmarks, monitoring wells, and existing structures from damage or displacement.

D. Construct temporary roads and maintain existing roadways at the construction site, including dust control.

END OF SECTION

SECTION 02200
EARTHWORK

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Excavating for gravel pad, slabs, pavement, underground ductbanks, structure, and roadway.

B. Excavating trenches for utilities.

C. Compacted fill from top of utility bedding to subgrade elevations.

D. Testing of compaction.

E. Site preparation.

F. Site restoration.

G. Erosion control.

H. Backfilling and compaction.

I. Removal of existing fence and railroad track.

1.2 RELATED SECTIONS

A. Section 01010 - General Requirements.

B. Section 02667 - Site Water Lines.

C. Section 02720 - Site Drainage.

D. Section 16118 - Underground Ductbanks and Ducts.

1.3 REFERENCE DRAWINGS

A. See Section 01011 for the Schedule of Drawings.

1.4 REFERENCES

A. Ohio Department of Transportation (ODOT):

1. Construction and Material Specifications, January 1, 1994.

B. American Association of State Highway and Transportation Officials (AASHTO):

1. AASHTO M43-88 — Standard Specification for Sizes of Aggregate for Road and Bridge Construction (ASTM D448).

C. American Society for Testing and Materials (ASTM):

1. ASTM C136-93 — Standard Test Method for Sieve Analysis of Fine and Coarse Aggregates (AASHTO T27).
2. ASTM D422-63 — Standard Test Method for Particle-Size Analysis of Soils (R 1990).
3. ASTM D698-91 — Test Method for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft [600 kN-m/m]).
4. ASTM D1556-90 — Standard Test Method for Density and Unit Weight of Soil in Place by the Sand-Cone Method (AASHTO T191).
5. ASTM D2487-93 — Standard Classification of Soils for Engineering Purposes (Unified Soil Classification System).
6. ASTM D2922-91 — Standard Test Methods for Density of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth).
7. ASTM D3017-88 — Standard Test Method for Water Content of Soil and Rock in Place by Nuclear Methods (Shallow Depth) (R 1993) (AASHTO T239).

8. ASTM D4318-93 Standard Test Method for Liquid Limit, Plastic Limit, and Plasticity Index of Soils.

D. Occupational Safety and Health Administration, Labor, Code of Federal Regulations (CFR):
1. 29 CFR 1926.650, Subpart P - Excavations.

1.5 SYSTEM DESCRIPTION

A. This section involves work which requires earthwork, excavation, hauling, stockpiling, backfilling, and compaction relating to the slabs, building foundation, structure, pavement, water line, electrical ductbanks, storm sewer, and roadway.

B. Definitions
1. Utility: Any buried pipe, conduit, or cable.

1.6 SUBMITTALS

A. Provide submittals per Section 01010.

1.7 QUALITY ASSURANCE

A. Verify that the existing utilities are as shown on drawings, and resolve any differences or conflicts with proposed work prior to excavating.

B. If tests indicate materials do not meet specified requirements, change material and retest at no cost to FERMCO.

C. Unless otherwise specified, all inspection and test reports shall be filed with FERMCO after the inspection or test.

D. As-built location and elevation of constructed utilities, and existing utilities encountered during construction, by field survey, shall be signed and sealed by a surveyor registered in the State of Ohio. Refer to Section 02667.

PART 2 PRODUCTS

2.1 EQUIPMENT

A. The Subcontractor shall supply all proper equipment necessary for the timely execution of the work, in the requisite numbers, sizes, and capacities.

2.2 MATERIALS

A. Fill Materials

1. ODOT Item 304 - Aggregate: Crushed carbonate stone, crushed gravel, and crushed air-cooled slag; ASTM C136 within the following limits:

Sieve Size	Percent Passing
2 inches	100
1 inch	70 to 100
3/4 inch	50 to 90
Number 4	30 to 60
Number 30	9 to 33
Number 200	0 to 13

2. ODOT Item 703 - Aggregate: Crushed stone; shall conform to AASHTO M43, size number 57, and within the following limits:

Sieve Size	Percent Passing
1-1/2 inches	100
1 inch	95 to 100
1/2	25 to 60
Number 4	0 to 10
Number 8	0 to 5

3. Subsoil Type S1: Excavated and re-used material, graded, free of lumps larger than 3 inches, rocks larger than 2 inches, and debris; conforming to ASTM D2487 Group Symbol CL, ML, SC.
4. Subsoil Type S2: Imported material, graded, free of lumps larger than 3 inches, rocks larger than 2 inches, and debris; conforming to ASTM D2487 Group Symbol CL, ML, SC.

5. Fine Aggregate Type A3: Sand - natural river or bank sand; washed; free of silt, clay, loam, friable or soluble materials, and organic matter; graded in accordance with ASTM C136 and D2487; within the following limits:

Sieve Size	Percent Passing
No. 4	90-100
No. 50	7-40
No. 200	0-10

C. Water: Clean, uncontaminated, fresh, and free of debris.

D. Topsoil: Excavated and re-used material; graded; free of roots, rocks larger than 1/2 inch, subsoil, debris, weeds, and foreign matter not suitable for subsequent seeding operations and maintenance; conforming to ASTM D2487 Group Symbol OH. When feasible, topsoil shall be salvaged from the work area and stockpiled for re-use.

PART 3 EXECUTION

3.1 EXAMINATION

A. Before starting the project, the Subcontractor shall visit the site, examine all portions in detail, and become familiar with the project site. Should any portion or item not be as set forth by the contract documents, the Subcontractor shall immediately notify FERMCO in writing and request further direction or clarification.

B. Grading of site shall prevent ponding of water. Use a minimum slope of 1 percent. All grading will direct water toward the site's storm drainage system.

3.2 PREPARATION

A. Identify required lines, levels, contours, and datum. Identify location and elevation of existing utilities prior to construction or fabrication of materials.

B. The Subcontractor shall remove all rails and ties to the limits stated on the drawing. Track is to be removed in whole sections.

C. Excavation shall be done with extreme care to protect any monitoring wells, above- and below-grade utilities, and any other fence, structures, benchmarks, wells, and other items which will remain. All of these items are to be identified, flagged, protected, and the appropriate permits obtained prior to initiating work. The Subcontractor shall notify FERMCO immediately if any damage occurs to existing utilities, structures, etc. as a result of work. Subcontractor shall replace, at the Subcontractor's own expense, items damaged as a result of work.

D. Cut out soft areas of subgrade not capable of in situ compaction. Backfill with Fill Type S1 or S2 materials and compact to density equal to or greater than requirements for subsequent backfill material. The Subcontractor shall notify FERMCO of unusual or unsuitable soil conditions when they are encountered.

E. Sediment control measures shall be in place prior to the start of any earth moving.

F. The stockpile perimeter shall be protected with proper stormwater, erosion, and silt migration protection as per ODOT Items 207 and 670 specifications.

G. Backfill material shall be placed in 8-inch maximum loose lifts and each lift compacted in accordance with the table in Article 3.3, Paragraph J.

H. Cut trenches sufficiently wide to enable installation and allow inspection in accordance with 29 CFR 1926.650, Subpart P.

I. Remove lumped subsoil, boulders, and rock up to 1/3 cubic yard, measured by volume.

J. Correct areas overexcavated with Fill Type S1 or S2 material and compact to density equal to or greater

than requirements for subsequent backfill material, at no additional cost to FERMCO.

K. Correct unauthorized excavation at no cost to FERMCO.

L. Filling and Backfilling

1. Backfill areas to contours and elevations shown. Backfill trenches to final elevations. Use unfrozen and unsaturated materials.
2. Granular Fill Type A3: Place and compact materials in continuous layers not exceeding 6 inches compacted depth.
3. Soil Fill Type S1 or S2: Place and compact material in continuous layers not exceeding 8 inches compacted depth.
4. Maintain optimum moisture content (within ±3 percent) of fill materials to attain required compaction density of 95 percent of maximum dry density as determined by ASTM D698 (Standard Proctor density).
5. Backfill systematically as early as possible to allow maximum time for natural settlement. Do not backfill over porous, wet, frozen, or spongy/unsuitable subgrade surfaces.
6. Unsatisfactory substrate:
   a. Where unsatisfactory subsurface conditions (whether existing or in area of backfill) are observed, excavate unsatisfactory material to satisfactory substrate as approved by FERMCO.
   b. Backfill with fill material required for specific area. Compact to density required for the area.
7. Employ a placement method so as not to disturb or damage foundations or utilities in trenches.

M. Clean up and restore areas disturbed by and during construction operations and/or occupied by Subcontractor's temporary facilities.

N. Excess debris and waste generated as a result of the work shall be containerized by the Subcontractor as described in Part 6, Statement of Work, of the Invitation for Bid.

O. Dust Control: Provide dust control using potable water.

3.3 FIELD QUALITY ASSURANCE

A. The Subcontractor shall coordinate and pay for all field quality control related to soils compaction testing.

B. Laboratory Tests: The following laboratory tests shall be completed for each sample of soil materials of each type of soil to be used for fill. A sample shall be obtained each time a change in appearance of the fill material is noted by FERMCO.

1. Grain-size analysis in accordance with ASTM D422.
2. Moisture-density relations of soils in accordance with ASTM D698.
3. Liquid-limit, plastic-limit, and plasticity-index in accordance with ASTM D4318.

C. Frequency of Tests:

1. Frequency of in-place density testing performed in accordance with ASTM D1556, ASTM D2922, or ASTM D3017 shall be whichever of the following requires the greatest number of tests.
   a. Once each day of work of filling and backfilling.
   b. Once every layer of fill.
   c. Once every 100 cubic yards of fill.
   d. Once every 20 cubic yards of backfilling.
   e. Every 1,000 square feet under gravel pad and concrete.

D. Compaction testing will be performed in accordance with ASTM C136, ASTM D1556, ASTM D698, ASTM D2922, and ASTM D3017.

E. If tests indicate that work does not meet specified requirements, remove work, replace, compact, and retest.

F. If, during the course of the project and in the opinion of FERMCO, a source of supply is changed or the

characteristics of the materials change or have varied, then the applicable testing shall be repeated.

G. All inspection and field test reports shall be filed with FERMCO within 48 hours after fill has been compacted and tested. Lab tests shall be submitted 48 hours prior to fill placement.

H. The Subcontractor shall notify FERMCO of testing/inspection activities at least 24 hours prior to the start of all tests or inspections.

I. Tolerances
   1. Grading and Filling: ±1 inch of indicated finish subgrade.

J. Compaction Requirements
   1. Minimum Compaction Requirement:

Location	Required Compaction
Under concrete slabs, footings, and pavement	95 percent Standard Proctor (ASTM D698)
Trenches	95 percent Standard Proctor (ASTM D698)
Crushed Aggregate Area	90 percent Standard Proctor (ASTM D698)

3.4 CLEANING

A. Leave the site in a condition suitable for final grading, surfacing, or stabilization.

END OF SECTION

SECTION 02270
EROSION CONTROL

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Soil erosion and sedimentation control for areas of the Subcontractor's work area which are graded or disturbed as a part of the contract work.

B. Maintenance and removal of all temporary erosion control facilities.

1.2 RELATED SECTIONS

A. Section 01010 - General Requirements.

B. Section 02110 - Site Clearing.

C. Section 02200 - Earthwork.

D. Section 02900 - Soil Preparation and Seeding.

1.3 REFERENCE DRAWINGS

A. See Section 01011 for the Schedule of Drawings.

1.4 REFERENCES

A. State of Ohio, Department of Transportation (ODOT):
   1. Construction and Material Specifications, January 1, 1995 (ODOT). Except as supplemented or otherwise modified herein and/or shown on the construction drawings, the entire work under this section shall be in compliance with the provisions of ODOT.
   2. Standard Construction Drawings.

B. Occupational Safety and Health Administration (OSHA):
   1. 29 CFR 1910.1200 Hazard Communication Standard.

1.5 SYSTEM DESCRIPTION

A. The Subcontractor shall have full responsibility for construction, maintenance, and removal of temporary erosion control measures.

B. Items to be protected from sedimentation deposits shall include (but shall not be limited to) all downstream property, natural waterways, streams, lakes, ponds, catch basins, drainage ditches, roads, gutters, and natural buffer zones.

1.6 SUBMITTALS

A. Submit a list of equipment that will be used in this work.

B. Submit evidence of a 5-year minimum of experience doing this kind of work.

C. Material Safety Data Sheet (MSDS): MSDSs shall be submitted to FERMCO Industrial Hygiene (IH) for any chemical compound or material used on the project. MSDSs shall be submitted at least 2 to 3 weeks in advance to FERMCO IH for review prior to the chemical compound or material arriving on site. The listing of hazardous chemicals/materials present, labeling of containers, and employee training and protective measure programs shall be in accordance with 29 CFR 1910.1200 (Hazard Communication Standard).

D. Prior to the placement of debris into containers, the Subcontractor shall submit a detailed waste handling plan in accordance with the Subcontract, Part 6, Scope of Work for approval by FERMCO and FERMCO Quality Assurance.

1.7 QUALITY ASSURANCE

A. Subcontractor shall use experienced workers and materials that conform to these specifications.

B. Subcontractor shall inspect sediment control measures periodically and after each rain exceeding 0.25 inches to evaluate the effectiveness of the control measures.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Store materials in a dry area, free from wetting and physical damage.

PART 2 PRODUCTS

2.1 ACCESSORIES

A. Bales: Hay or straw bales shall be reasonably free of weed seed and such foreign materials as may detract from their effectiveness or be injurious to desired plant growth.

B. String: Jute twine.

C. Stakes: Stakes shall meet requirements of ODOT Standard Construction Drawing MC-11.

D. Riprap: Riprap shall meet the requirements of ODOT 601.04.

E. Filter Fabric: Spunbound 7.5 oz/sy.

PART 3 EXECUTION

3.1 EXAMINATION

A. Protective Measures

1. Construct protective devices as specified herein, and as required on the Contract Drawings.
2. Berms and Diversion Ditches: Miscellaneous berms and diversion ditches shall be provided to protect sloping areas from erosion.
   a. Locate to direct runoff as required. Size to prevent overflowing.
   b. Utilize hay-bale check-dams to filter out the suspended matter, as required.

c. Filter fabric shall be placed under all riprap (stone apron).

3. Silt Barriers: Conform to requirements on the construction drawings.

4. Stockpile areas for soil materials shall also be protected from erosion within 30 days.

5. Prior to any earth moving as specified in Section 02200 of this specification package, straw bales shall be installed around the perimeter of the work zone and around existing catch basins.

3.2 FIELD QUALITY ASSURANCE

A. FERMCO shall inspect sediment control measures periodically and after each rain exceeding 0.25 inches.

B. The Subcontractor shall clean out, maintain, and adjust sediment control measures as directed by FERMCO to prevent sediment from leaving the work zone.

3.3 ADJUSTING

A. Removal of Sedimentation Accumulation

1. Remove accumulated sediments, debris, and obstructions as necessary. In no case shall sediment build up to a depth greater than 1/2 the height of the protective device. Respread on site in a manner not to adversely affect protective procedures and consistent with site regulations, Subcontract, Part 6, Scope of Work.

B. Removal of Temporary Erosion Control Facilities

1. Erosion control facilities shall be removed at the direction of FERMCO after the disturbed areas are stabilized with grass or rock.

3.4 CLEANING

A. Remove and manage debris and excess materials in accordance with the Subcontract, Part 6, Scope of Work.

3.5 PROTECTION

A. Utilities

1. Existing underground utilities shall be identified and marked by the Subcontractor prior to any work in the contract area.
2. Existing catch basins and drains are to be protected by sediment control measures prior to any earth work.

END OF SECTION

SECTION 02300
BORING AND JACKING

PART 1 GENERAL

This section covers materials and construction required for installation of stormwater pipeline and fire water pipeline underneath railroad tracks.

1.1 SECTION INCLUDES

A. Rock excavation: The removal of materials classified as rock and the disposal of the excavated material in conformity with the lines, grades, and dimensions shown on the construction drawings. Under this section only, rock is classified as hard material in place that cannot be excavated by pneumatic, hydraulic, or hand tools. Material classified as rock shall be removed by other suitable means. Use of explosives is prohibited.

B. Unauthorized excavation: Excavation not required by the specifications or drawings or not authorized in writing by FERMCO.

C. Backfill: Excavated material or other earth materials required to fill excavated pits. Backfill shall be placed and compacted to the same density as the surrounding soil. Backfilling of pits shall be brought to the lines and grade existing before excavation.

D. Shoring: A structure, such as a metal hydraulic, mechanical, or timber shoring system, which supports the sides of an excavation and is designed to prevent cave-ins.

1.2 RELATED SECTIONS

A. Section 01010 - General Requirements.

B. Section 02200 - Earthwork.

C. Section 02270 - Erosion Control.

1.3 REFERENCE DRAWINGS

A. See Section 01011 for the Schedule of Drawings.

1.4 REFERENCES

A. American Society for Testing and Materials (ASTM), Annual Book of Standards:

1. ASTM A139-90 — Standard Specifications for Electric-Fusion (Arc)-Welded Steel Pipe (NPS 4 and Over).

B. American Water Works Association (AWWA), AWWA Standards:

1. ANSI/AWWA C203-91 — AWWA Standard for Coal-Tar Protective Coatings and Linings for Steel Water Pipelines - Enamel and Tape - Hot-Applied.

C. Occupational Health and Safety Administration (OSHA), Code of Federal Regulations 29 CFR 1926, Subpart P - Excavations, 1989.

1.5 SYSTEM DESCRIPTION

A. This section involves work which requires earthwork, excavation, hauling, stockpiling, backfilling, and compaction relating to the boring and jacking for stormwater pipeline and fire water pipelines.

B. Definitions:

1. Utility: Any buried pipe, conduit, or cable.

1.6 SUBMITTALS

A. Submit written notice of intent to begin boring and jacking operations to FERMCO a minimum of 7 days before beginning work.

1.7 PROJECT/SITE CONDITIONS

A. Location of underground utilities based on information provided by the Facilities Manager. Contractor shall be

aware that utilities may exist which are not shown on the construction drawings. Contractor shall verify location of all utilities before construction.

1.8 SEQUENCING/SCHEDULING

A. The Contractor shall coordinate and schedule boring and jacking operations concurrently with installation of stormwater pipeline and fire water pipeline.

PART 2 PRODUCTS

2.1 MATERIALS

A. Boring and Jacking:

1. Steel casing pipe shall have diameter sufficient to accommodate pipes as specified on the construction drawings. Steel casing pipe shall be spiral or straight seam welded steel pipe conforming to ASTM A139, Grade B, with a minimum wall thickness of 0.312 inches.

PART 3 EXECUTION

3.1 INSTALLATION/APPLICATION/ERECTION

A. Before excavation begins, provide erosion and sediment control to minimize erosion and the transport of sediment beyond the limits of the Contractor's work area. Methods of control shall conform to Section 02270.

B. Excavate boring and receiving pits to the width, length, and depth necessary for boring and jacking operations.

C. Pits shall be located a minimum of 2 feet beyond toe-of-slopes, and a minimum of 3 feet beyond far bank of ditches or swales.

D. Materials excavated from pits shall be stockpiled in areas designated by FERMCO, and in accordance with OSHA 29 CFR 1926, Subpart P - Excavations. Excavated materials or equipment shall not be placed on pavement or shoulders of roadway.

E. Boring and jacking operations shall begin immediately after excavation of the pits has been completed.

F. Bored installations shall be a bored-hole diameter essentially the same as the outside diameter of the casing pipe to be installed.

G. Casing pipe shall be jacked into boring as soon as possible after boring is made. Lengths of casing pipe as long as practical shall be used. Joints between sections of casing pipe shall be welded as recommended for joining the particular type of pipe.

H. Care shall be taken to ensure that casing pipe installed by boring and jacking is at the proper alignment and grade.

I. Boring, jacking, or driving casing pipe under existing railway shall be accomplished without jetting, sluicing, or wetboring.

J. After casing pipe is installed, the carrier pipes shall be installed in such a manner as to protect coating, lining, and joint integrity. Each carrier pipe shall be placed in proper horizontal and vertical alignment using wooden blocking/wedges or prefabricated pipe collars spaced radially around pipe and secured firmly in place. Blocking or collars shall be installed around the pipes such that joints do not touch. Spacing of blocking or collars shall be no greater than 10 feet on center longitudinally in casing pipe.

K. Promptly backfill excavated pits as directed by FERMCO. Backfill materials shall be placed in 6-inch layers and tamped. Backfilling of pits shall be brought to the lines and grade existing before excavation in accordance with Section 02200.

L. Excavated material not used as backfill for pits shall be disposed of in areas designated by FERMCO.

3.2 PROTECTION

A. Protect excavation by shoring, bracing, sheet piling, underpinning, or other methods required to prevent cave-in of loose soil into excavation. Protection shall be in accordance with OSHA 29 CFR 1926, Subpart P - Excavations.

3.3 CLEANING

A. Leave the site in a condition suitable for final grading, surfacing, or stabilization.

END OF SECTION

SECTION 02510
ASPHALTIC CONCRETE PAVING

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Asphalt paving.

B. Aggregate base under asphalt paving.

C. Crushed stone around building.

D. Aggregate base under truck unloading slab.

1.2 RELATED SECTIONS

A. Section 01010 - General Requirements.

B. Section 02200 - Earthwork.

1.3 REFERENCE DRAWINGS

A. See Section 01011 for the Schedule of Drawings.

1.4 REFERENCES

A. American Society for Testing And Materials (ASTM):
1. ASTM D698-91 Test Method for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 lb-lbf/ft^3).

B. State of Ohio, Department of Transportation Construction and Material Specifications, January 1, 1995 (ODOT). Except as supplemented or otherwise modified herein and/or shown on the construction drawings, the entire work under this section shall be in compliance with the provisions of ODOT.

1.5 ENVIRONMENTAL REQUIREMENTS

A. Weather Limitations: Bituminous plant mixtures shall be placed only when the surface is dry and when weather conditions are such that proper handling, finishing, and compaction can be accomplished. In no case, however, shall bituminous plant mixtures be placed when the surface temperature is below the minimum temperature established in the following table:

Course Thickness	Minimum Surface Temperature
3.0 inches and over	35 degrees F*
1.5 to 2.9 inches	40 degrees F
1.0 to 1.4 inches	50 degrees F
Less than 1.0 inch	60 degrees F
Variable Intermediate, 0 to 3.0 inches	40 degrees F

* In lieu of 35 degrees F, a minimum air temperature of 40 degrees F shall be used when paving on an aggregate base, subbase, or subgrade. In addition to the above surface temperature requirements, no surface courses shall be placed when the air temperature is less than 40 degrees F.

1.6 SUBMITTALS

A. Submit under provisions of Section 01010.

PART 2 PRODUCTS

2.1 MATERIALS

A. Bituminous aggregate base shall meet the requirements of ODOT Item 301.

1. Composition: The gradation of the aggregate portion of the mix shall be within the limits of the following table:

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Sieve	Total Percent Passing
2-inch	100
1-inch	75-100
1/2-inch	50-85
No. 4	25-60
No. 8	15-45
No. 16	10-35
No. 50	3-18
No. 200	1-7

B. Aggregate base shall meet the requirements of ODOT Item 304.

1. Aggregate: The aggregate shall be crushed carbonate stone, crushed gravel, crushed air-cooled slag, granulated slag, a mixture of crushed and granulated slags, or other types of suitable materials meeting the requirements of this item. Crushed carbonate stone, crushed gravel, crushed air-cooled slag, or mixtures of crushed and granulated slags shall meet the following gradation requirements.

Sieve	Total Percent Passing
2-inch	100
1-inch	70-100
3/4-inch	50-90
No. 4	30-60
No. 30	7-30
No. 200	0-13

C. Asphalt concrete shall meet the requirements of ODOT Item 403.

1. Composition: Coarse aggregate (No. 8) and fine aggregate shall be combined in such proportions

that the resulting blend shall be as directed by the laboratory. The blend shall be within the following limits.

Sieve	Total Percent Passing
1/2-inch	100
3/8-inch	90-100
No. 4	45-75
No. 16	15-45
No. 50	3-22
No. 200	0-8

Bitumen content shall be as directed by the laboratory within the following limits.

Bitumen (Percent of total mix) 4.5-12.0

D. Tack coat shall meet the requirements of ODOT Item 407.
   1. Material: The bituminous material shall meet the applicable requirements of 702 and shall be one of the following: 702.02 RC-70, RC-250, or 702.04 RS-1; SS-1, SS-1h, CRS-1, CSS-1, or CSS-1h. Cut-back asphalt 702.02 may be used only after September 15 and before May 15.

E. Prime coat shall meet the requirements of ODOT Item 408.
   1. Material: The bituminous material shall meet the applicable requirements of 702 and shall be one of the following: 702.02 RC-70, RC-250, MC-30, MC-70, MC-250, or 702.03 Primer 20.

F. Joint sealant shall meet the requirements of ODOT Item 407.
   1. Material: The bituminous material shall be one of the following:
      a. SS-1.
      b. CSS-1.

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PART 3 EXECUTION

3.1 EXAMINATION AND PREPARATION

A. Verify gradients and elevations of base.

B. Verify that compacted subgrade is dry.

3.2 BASE CONSTRUCTION

A. Fill areas to contours and elevations, using unfrozen materials.

B. Place base materials in continuous layers not exceeding 8 inches depth.

C. Compact to 95 percent of optimum moisture content in accordance with ASTM D698.

D. Maintain optimum moisture content of fill materials to attain required compaction density.

3.3 PLACING ASPHALT PAVEMENT

A. Apply tack coat in accordance with manufacturer's instructions.

B. Place asphalt within 24 hours of priming base surfaces. Place in two courses to thickness shown on the drawings.

C. Compact pavement by rolling to achieve even and smooth finish, without roller marks. Hand-compact in areas inaccessible to rolling equipment.

3.4 TOLERANCES

A. Flatness: Maximum variation of 1/4 inch measured with 10-foot straight edge.

B. Compacted Scheduled Thickness: Within 1/4 inch of design thickness.

C. Variation from True Elevation: Within 1/2 inch.

3.5 FIELD QUALITY CONTROL

A. Perform work in accordance with ODOT requirements.

B. Contractor shall coordinate and pay for all testing, which shall be performed by an independent testing laboratory.

C. All inspections and tests shall be filed with FERMCO.

D. The Contractor shall notify FERMCO of testing/inspection activities at least 24 hours prior to the start of all tests or inspections.

END OF SECTION

SECTION 02667
SITE WATER LINES

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Pipe, fittings, and accessories for underground fire water line.

B. Valves, valve boxes, fire hydrants, and pipe detector tape.

C. Testing and reporting results.

1.2 RELATED SECTIONS

A. Section 01010 - General Requirements.

B. Section 02200 - Earthwork.

1.3 REFERENCE DRAWINGS

A. See Section 01011 for the Schedule of Drawings.

1.4 REFERENCES

A. American Water Works Association (AWWA):

1. AWWA C105/A21.5-93 Polyethylene Encasement for Ductile Iron Pipe Systems.
2. AWWA C111/A21.11-90 Rubber-Gasket Joints for Ductile Iron and Grey-Iron Pressure Pipe and Fittings.
3. AWWA C151/A21.51-91 Ductile-Iron Pipe, Centrifugally Cast, for Water or Other Liquids.
4. AWWA C500-93 Metal-Seated Gate Valves for Water Supply Service.
5. AWWA C600-93 Installation of Ductile-Iron Water Mains and Their Appurtenances.

6. AWWA C906-90 Polyethylene (PE) Pressure Pipe and Fittings, 4-inch through 63-inch, for Water Distribution.

B. American Society for Testing and Materials (ASTM):

1. ASTM D3035-93 Standard Specification for Polyethylene (PE) Plastic Pipe (DR-PR) Based on Controlled Outside Diameter.

C. American Concrete Institute (ACI):

1. ACI 318/318R Rev. 92 Building Code Requirements for Reinforced Concrete.

1.5 SUBMITTALS

A. Product Data: Provide data on pipe materials, pipe fittings, valves, accessories, and methods and equipment for fusion welding.

B. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.

1.6 QUALITY ASSURANCE

A. Piping and Valves: Manufacturer's name and pressure rating marked on valve body and pipe.

B. The Subcontractor shall arrange and pay for an as-built survey of as-completed conditions, conducted by a professional surveyor registered in the State of Ohio. An as-built site, utility, and grading plan shall be submitted to FERMCO. The Surveyor shall seal and sign the plan.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Deliver, store, protect, and handle products to site.

B. Deliver and store valves in shipping containers with labeling in place.

PART 2 PRODUCTS

2.1 MATERIALS

A. Pipe

1. Ductile Iron Pipe: AWWA C151.
   a. Fittings: Ductile iron, standard thickness.
   b. Joints: AWWA C111, push-on, rubber gasket.
   c. Jackets: AWWA C105, polyethylene encasement.
   d. Material Class 55 ductile iron, cement lined.
   e. For wet tap, use either dual compression seal tapping sleeve or mechanical joint tapping sleeve.
   f. For dry tap, use a mechanical joint cutting-in sleeve and tapped tee.
2. High-Density Polyethylene (HDPE) Pipe: AWWA C906 (PE 3408), ASTM D3035, SDR 11 for 150 psi pressure rating.
   a. Fittings: AWWA C906.
   b. Joints: Butt fusion, flanged gasket joints at interface connections with ductile iron pipe, water hydrants, and valves.
   c. Trace Wire: Magnetically detectable conductor, brightly colored plastic covering, with "Water Service" imprinted in large letters.

B. Gate Valves

1. AWWA C500, iron body, bronze trim, nonrising stem with square nut, single wedge, Class 125, flanged ends, control rod, post indicator, or extension box and valve key.

C. Bedding Materials

1. Bedding: Fill Type A3, sand as specified in Section 02200.

2.2 ACCESSORIES

A. Concrete: Conforming to ACI 318, with a 28-day average compression strength of 3,000 psi.

B. Valve Box: To fit over gate valves. Adjustable height. Cast iron or post indicator type.

PART 3 EXECUTION

3.1 EXAMINATION

A. Provide field survey services to lay out all utilities and facilities. Establish two permanent benchmarks on site, referenced to established control points. Record locations of utilities and facilities, with horizontal and vertical data, on project record documents.

B. Verify that service connection and water main size, location, and invert are as indicated.

C. Verify interface connections between HDPE flanges and ductile iron pipe/valves.

D. For dry tap, determine extent of outage required to isolate the main. Notify all affected facility owners of the expected outage, and make preparations to provide alternate water service to critical activities, as required.

3.2 PREPARATION

A. Remove scale and dirt, on inside and outside, before assembly.

B. Prepare for assembly of pipe connections to equipment with flanges or unions.

3.3 ERECTION/INSTALLATION/APPLICATION

A. Bedding

1. Excavate pipe trench in accordance with Section 02200 and AWWA C600 for work of this section. Hand-trim excavation for accurate placement of pipe to elevations indicated.
2. Place bedding material at trench bottom; level fill materials in one continuous layer not exceeding 6 inches compacted depth; compact per Section 02200.

3. Backfill around sides and to top of pipe with fill, tamped in place and compacted per Section 02200.
4. Maintain optimum moisture content of bedding material to attain required compaction density.

B. Installation - Pipe
1. Install pipe to indicated elevation to within tolerance of 5/8 inch. Make a wet tap into existing water line, or shut off water supply to the subject line and install cutting-in sleeve and tapped tee (dry tap). If a dry tap is performed, flush, pressure test, and disinfect the existing main before restoring service.
2. Install ductile iron piping and fittings in accordance with AWWA C600.
3. Route pipe in a straight line.
4. Install pipe to allow for expansion and contraction without stressing pipe or joints.
5. Install access fittings to permit disinfection of water system and pressure testing.
6. Form and place concrete for thrust blocks at each elbow or change of direction of pipe main.
7. Establish elevations of buried piping to ensure not less than 3.5 feet of cover.
8. Backfill trench in accordance with Section 02200.
9. Install HDPE piping in accordance with AWWA C906. Install magnetic trace wire continuously over pipe.

C. Installation - Valves
1. Set valves and/or post indicator on solid bearing.
2. Center and plumb valve box over valve, if required.

3.4 FIELD QUALITY ASSURANCE

A. Field inspection will be performed by supplier and witnessed by FERMCO.

B. The new pipes shall be hydrostatically tested prior to tie-in. This test shall be run at 50 psi above the working pressure of the water main and held within specifications for 2 hours.

$$Allowable\ Leakage = \frac{LD\sqrt{p}}{498,168}$$

L = Length of Pipe in Test in Feet
D = Diameter of Pipe in Inches
p = Test Pressure (Operating Pressure + 50 psi)

Answer = Allowable Leakage in Cubic Feet over a 2-Hour Period.

C. Compaction testing will be performed in accordance with Section 02200.

D. If tests indicate work does not meet specified requirements, remove work, replace, and retest at no cost to Owner.

END OF SECTION

SECTION 02713
DETENTION POND GEOSYNTHETICS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Geosynthetic materials and installation.

B. Use of geosynthetics for erosion control is specified in Section 02270.

1.2 RELATED SECTIONS

A. Section 01010 - General Requirements.

1.3 REFERENCE DRAWINGS

A. See Section 01011 for the Schedule of Drawings.

1.4 REFERENCES

A. American Society for Testing and Materials (ASTM):

1. ASTM D638-91 — Standard Test Method for Tensile Properties of Plastics.
2. ASTM D746-79 — Standard Test Method for Brittleness Temperature of Plastics and Elastomers by Impact.
3. ASTM D1004-90 — Standard Test Method for Initial Tear Resistance of Plastic Film and Sheeting.
4. ASTM D1204-84 — Standard Test Method for Linear Dimensional Changes of Nonrigid Thermoplastic Sheeting or Film at Elevated Temperatures.
5. ASTM D1505 E1-85 — Standard Test Method for Density of Plastics by the Density-Gradient Technique.

B. Federal Test Method Standard (FTMS):

1. FTMS 101B-71 Method 2065, Puncture Resistance and Elongation Test.

1.5 SYSTEM DESCRIPTION

A. This specification describes the supply and installation of a high-density polyethylene (HDPE) unsupported flexible membrane liner for a stormwater detention pond.

1.6 SUBMITTALS

A. Submit samples under provisions of Division 1.

B. Material suppliers shall submit certificates of conformance stating that materials supplied meet or exceed the specifications.

C. Materials Source: Submit name of materials suppliers. Provide materials from same source throughout the work. Change of source requires FERMCO's approval.

D. Provide detailed technical specifications on materials proposed for use.

E. Installers shall submit details of liner layout, showing weld locations, penetrations, corners, and boot sleeves, to FERMCO for approval.

F. Installer shall have a minimum of 5 years of experience on similar work and shall submit such experience data to FERMCO.

1.7 QUALITY ASSURANCE

A. The liner shall be manufactured under stringent quality control surveillance, which will ensure compliance with the requirements of these specifications. The manufacturer's written certification of compliance with these specifications shall be submitted to FERMCO.

B. All materials shall be clearly marked with manufacturer's name and product designation.

1.8 DELIVERY, STORAGE, AND HANDLING

A. The Liner Subcontractor shall review, inspect, and place into proper storage all materials received on site until their installation. All such materials shall be inspected to verify their conformance with the requirements of these specifications and that they are free of defects. Any nonconforming or defective materials shall be clearly marked and promptly repaired per approved procedure or removed from the job site.

B. Sufficient quantities of materials shall be stockpiled to meet project schedule and requirements. Materials shall be stored on site at locations designated by FERMCO.

1.9 PROJECT CONDITIONS

Not used.

1.10 SEQUENCING AND SCHEDULING

A. The Liner Subcontractor shall provide a sequence and schedule of work for the approval of FERMCO.

1.11 WARRANTY

A. The Liner Subcontractor shall provide a written warranty that the installed liner system is free of defects in materials and/or workmanship, and will continue to serve its intended purpose from the date of installation completion for a period of 20 years under normal service conditions.

1.12 MAINTENANCE

Not used.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. HDPE liner shall be Gundline HD by GSE Lining Technologies Systems Inc., or approved equal.

B. Materials manufactured by others may be submitted to FERMCO for consideration.

2.2 EQUIPMENT

A. The Liner Subcontractor shall use appropriate installation and welding equipment per the manufacturer's instructions.

B. Welding Equipment: The welding equipment used shall be capable of continuously monitoring and controlling the extrusion/fusion zone. The fillet-extrusion welding device provides continuous dynamic integration of the extrudate into the sheet material through the means of rotating tips in the nozzle. The composition of the extrudate (welding rod) is identical to the flexible membrane liner. This method of seaming is applied for all tees, patches, "fishmouths," and detail work. The fusion welding device employs a hot wedge (hot shoe) and compression. The system lifts both layers of flexible membrane liner off the subgrade, and fusion is brought about by melting the sheets against the hot wedge and compressing the two melted surfaces together, resulting in a total integration of the layers.

2.3 MATERIALS

A. The liner membrane shall be designed and manufactured specifically for the purpose of containment of liquids in hydraulic structures. It shall be manufactured from new, first-quality HPDE resin and shall meet the physical requirements indicated in the Physical Properties Table.

B. Typical Physical Properties:

Typical Properties	Test Method	Gage (Nominal) 40 mil (1.00 mm)
Density g/cc. (Min.)	ASTM D1505	0.94
Tensile Properties (Typical) 1. Tensile Strength at Break (Pounds/inch width) 2. Tensile Strength at Yield (Pounds/inch width) 3. Elongation at Break (Percent) 4. Elongation at Yield (Percent)	ASTM D 638 Type IV Dumbbell at 2 ipm	 160 95 700 13
Tear Resistance Initiation, lbs. (Typical)	ASTM D1004 Die C	30
Low Temperature Brittleness, F (Typical)	ASTM D746 Procedure B	-112
Dimensional Stability, Percent Change Each Direction (Max.)	ASTM D1204 212 degrees F 1 hr.	±2
Puncture Resistance, Pounds (Typical)	FTMS 101B Method 2065	52

2.4 ACCESSORIES

A. Accessories, including pipe boots, shall be by Gundle Lining Systems, Inc., or approved equal.

2.5 FABRICATION

Not used.

PART 3 EXECUTION

3.1 EXAMINATION

Not used.

3.2 PREPARATION

A. The soil beneath the liner shall be sterilized to prevent the growth of vegetation. The herbicide used shall be as recommended by a local agricultural authority in consideration of the species most likely to contaminate the subgrade during the time the subgrade is exposed, and shall be approved prior to use by FERMCO.

B. The earthen surface shall be smooth and true to grade (within the grading tolerance of plus or minus 0.1 foot) with no exposed rocks, stones, sticks, roots, or other sharp objects or debris of any kind.

C. Before starting installation of the liner, the Liner Subcontractor shall inspect the substrate for suitability with the requirements of the liner. The liner installer shall certify in writing that the surface on which the membrane is to be installed is acceptable before commencing work.

D. During the time of liner installation, the Liner Subcontractor shall be responsible for protection and maintenance of the exposed subgrade until final acceptance of the liner, including maintenance of the moisture content of the underlying clay materials.

3.3 ERECTION/INSTALLATION/APPLICATION

A. Verify gradients and elevation of subbase.

B. Verify that subgrade is dry.

C. HDPE liner shall be placed directly over subgrade. HDPE liner shall be placed and anchored in such a manner that placement of overlying materials will not

excessively stretch or tear the fabric. Provide minimum laps of 12 inches or per manufacturer's instructions. Work out all wrinkles to the satisfaction of FERMCO.

D. Appropriate measures shall be taken during installation to provide sufficient slack in the liner to avoid the generation of excessive stresses in the liner due to temperature changes.

E. Field seams shall be made using either the hot wedge (fusion) welding or the fillet-extrusion welding process. Field seams shall be made only when weather conditions are favorable. The contact surfaces shall be free of dirt, dust, moisture, or other foreign material. The contact surfaces shall be aligned with sufficient overlap and bonded in accordance with the liner manufacturer's recommended procedures. Wrinkles shall be smoothed out, and seams shall be inspected by nondestructive testing techniques to verify their integrity.

3.4 FIELD QUALITY ASSURANCE

A. The liner installer shall conduct a fully documented quality assurance/quality control program to ensure that all installation work is performed which will result in a secure, watertight liner. All quality control inspection and testing shall be performed by qualified personnel who are thoroughly knowledgeable about all installation procedures and techniques used. Three copies of all inspection and test reports generated by the Subcontractor shall be submitted to FERMCO not later than the second work day following their generation. As a minimum, the quality control program shall provide for written verification of the results of all of the following inspections and tests.

B. Weld Quality Control and Testing

1. A test weld, 3 feet long, from each welding machine shall be run each day prior to liner welding and under the same conditions as exist for the liner welding.
   a. Samples of weld shall be cut from the test weld 1/4 inch to 1/2 inch wide and pulled by hand in the peel and shear modes.
   b. The weld should exhibit a film tearing bond (FTB).
   c. The test weld shall be marked with the time of day, date, ambient temperature, and welding machine used in its production.
   d. The weld sample shall be kept for subsequent testing on laboratory tensiometer equipment in accordance with the applicable ASTM tests. If either sample fails through the weld, the welding machine shall be adjusted as appropriate and another test weld produced and tested until satisfactory results are achieved. A calibrated, hand-operable tensile testing machine shall be furnished by the Liner Subcontractor for the purpose of tensile testing.
2. All welds, on completion of the work, shall be tightly bonded. Any membrane area showing injury due to excessive scuffing, puncture, or distress from any cause shall be replaced or repaired with an additional piece of HDPE membrane.
3. A quality control technician shall follow behind each seam crew and perform a visual inspection of the seamed area. Defective seams should be marked and repaired in accordance with manufacturer's published repair procedure.
4. No "fishmouths" shall be allowed within the seam area. Where "fishmouths" occur, the material shall be cut and overlapped, and an overlap-extrusion weld shall be applied.
5. All field seams (100 percent) shall be tested nondestructively. Fillet-extrusion welds are tested with a vacuum chamber. Hot wedge welds are pressure tested, pressurizing the gap created by the split face design of the hot wedge.

3.5 **ADJUSTING**

Not used.

3.6 **CLEANING**

Not used.

3.7 **DEMONSTRATION**

Not used.

3.8 **PROTECTION**

A. Provide protection from damage until anchorage and welding of seams has been accomplished and all testing and inspections are completed.

3.9 **SCHEDULES**

Not used.

END OF SECTION

SECTION 02720
SITE DRAINAGE

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Outfall protection.

B. Storm drainage.

C. Catch basins.

D. Manholes.

1.2 RELATED SECTIONS

A. Section 01010 - General Requirements.

B. Section 02200 - Earthwork.

C. Section 02270 - Erosion Control.

D. Section 02506 - Crushed Aggregate Paving.

1.3 REFERENCE DRAWINGS

A. See Section 01011 for the Schedule of Drawings.

1.4 REFERENCES

A. American Concrete Institute (ACI):

1.	ACI SP-66-88	ACI Detailing Manual.
2.	ACI 301-89	Specifications for Structural Concrete for Buildings.
3.	ACI 318M/318RM-92	Building Code Requirements for Reinforced Concrete.

Note: Amend Subparagraph 1.3.1 of ACI 301 to change the following titles to read (wherever they occur in ACI 301):

ACI 301	Change to Read
Architect/Engineer	FERMCO
Owner	FERMCO

B. American Society for Testing and Materials (ASTM):

1.	ASTM A48-Rev. A-93	Standard Specification for Gray Iron Castings (AASHTO M105).
2.	ASTM A185-Rev. A-90	Standard Specification for Steel Welded Wire Fabric, Plain, for Concrete Reinforcement (AASHTO M55).
3.	ASTM A615-Rev. B-92	Deformed and Plain Billet-Steel Bars for Concrete Reinforcement.
4.	ASTM C31-91	Standard Practice for Making and Curing Concrete Test Specimens in the Field.
5.	ASTM C39-86	Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens.
6.	ASTM C94-Rev. A-92	Standard Specification for Ready Mixed Concrete.
7.	ASTM C143-Rev. A-90	Standard Test Method for Slump of Hydraulic Cement Concrete.
8.	ASTM C231-Rev. B-91	Standard Test Method for Air Content of Freshly Mixed Concrete by the Pressure Method.
9.	ASTM C920-87	Elastomeric Joint Sealants.
10.	ASTM D1248-84	Standard Specification for Polyethylene Plastics Molding and Extrusion Materials.
11.	ASTM D1751-83	Preformed Expansion Joint Filler for Concrete Paving and Structural (Non-Extruding and Resilient Bituminous Types).

12.	ASTM D1777-64	Standard Test Method for Measuring Thickness of Textile Materials.
13.	ASTM D2321-89	Standard Practice for Underground Installation of Thermoplastic Pipe for Sewers and Other Gravity Flow Applications.
14.	ASTM D3776-85	Standard Test Method for Mass per Unit Area (Weight) of Woven Fabric.
15.	ASTM D3786-87	Standard Test Method for Hydraulic Bursting Strength of Knitted Goods and Nonwoven Fabrics-Diaphragm Bursting Strength Tester Method.
16.	ASTM D4491-92	Standard Test Method for Water Permeability of Geotextiles by Permissivity.
17.	ASTM D4533-91	Standard Test Method for Trapezoid Tearing Strength of Geotextiles.
18.	ASTM D4632-91	Standard Test Method for Grab Breaking Load and Elongation of Textiles.
19.	ASTM D4751-87	Standard Test Method for Determining Apparent Opening Size of a Geotextile.
20.	ASTM D4833-88	Standard Test Method for Index Puncture Resistance of Geotextiles, Geomembranes, and Related Products.
21.	ASTM F405-93	Standard Specification for Corrugated Polyethylene (PE) Tubing and Fittings.

C. State of Ohio, Department of Transportation, Construction and Material Specifications, January 1, 1995 (ODOT). Except as supplemented or otherwise modified herein and/or shown on the construction drawings, the entire work under this section shall be in compliance with the provisions of ODOT.

D. Occupational Safety and Health Administration (OSHA):
1. 29 CFR 1910.1200 Hazard Communication Standard.

E. American Association of State Highway and Transportation Officials (AASHTO):
1. AASHTO M36-90 Standard Specification for Corrugated Steel Pipe, Metallic-Coated, for Sewers and Drains.

1.5 SUBMITTALS

A. Project Record Documents: Accurately record as-built location and invert elevations of catch basins, headwalls, outfall pads, and ditch runs.

B. Product Data: Concrete mix designs, including documentation of aggregate sources and most recent sieve analysis within the past year.

C. Concrete Supplier: Name and address of the transit-mix concrete supplier. Supply typical batch ticket and history per ASTM C94.

D. Placement Records: Records of time, dates, and locations of concrete placing operations upon completion of work.

E. Test Reports: Test reports for all tests required under Field Quality Control.

F. Submit manufacturer's certification that materials supplied meet or exceed the requirements specified.

G. Material Safety Data Sheet (MSDS): MSDSs shall be submitted to FERMCO Industrial Hygiene (IH) for any chemical compound or material used on the project. MSDSs shall be submitted at least 2 to 3 weeks in advance to FERMCO IH for review prior to the chemical compound or material arriving on site. The listing of hazardous chemicals/materials present, labeling of containers, and employee training and protective

measure programs shall be in accordance with 29 CFR 1910.1200.

H. Submit shop drawings of precast catch basin, frame, and grate.

I. Prior to the placement of debris into containers, the Subcontractor shall submit a detailed waste handling plan for approval by FERMCO and FERMCO Quality Assurance.

J. Submit manufacturer's name and technical data for High-Density Polyethylene (HDPE) pipe.

1.6 QUALITY ASSURANCE

Not used.

1.7 DELIVERY, STORAGE, AND HANDLING

Not used.

PART 2 PRODUCTS

2.1 MATERIALS

A. Non-woven, geotechnical fabric similar to Trevira™ No. 1125 as per the following table:

MINIMUM PHYSICAL PROPERTIES (Minimum Average Roll Values)			
Property	**Test Method**	**Units**	**Mat'l**
Unit Weight	ASTM D3776	oz./yd.^{2}	7.1
Grab Tensile	ASTM D4632	lbs.	210
Grab Elongation	ASTM D4632	percent	60
Mullen Burst	ASTM D3786	psi	360
Puncture	ASTM D4833	lbs.	95
Trapezoid Tear	ASTM D4533	lbs.	75
Apparent Opening Size	ASTM D4751	US Sieve Number	70
Permissivity	ASTM D4491	gal/min/ft^2/ sec^{-1}	110 1.47
Permeability	ASTM D4491	cm/sec	0.35
Thickness	ASTM D1777	mils	95

B. Concrete Materials:

1. All cast-in place concrete to be ODOT Class C concrete (average compressive strength at 28 days of 4,000 psi).
2. All precast concrete shall meet the requirements of ODOT 706.13 with 6 ±2 percent air void content in the hardened concrete.

C. Stone shall meet the requirements of ODOT 601.07, Type C dumped rock fill.

D. Catch Basin Frame and Grate:

1. Frame and grate to be gray iron manufactured from iron conforming to ASTM A48, Class 30.
2. Total weight shall be a minimum of 185 pounds.

E. Corrugated HDPE: Smooth interior, corrugated high-density polyethylene pipe and fittings shall be made of polyethylene compounds that meet or exceed the requirements of Type III, Category 4 or 5, Grade P33 or P34, Class C per ASTM D1248 and ASTM F405.

F. Concrete Accessories

1. Joint Sealer: Elastomeric joint sealant conforming to ASTM C920; Type S or Type M, Grade P, Class 25.
   a. Acceptable products and suppliers (or equal):
      1) Sikadur 51 SL, by Sika Corp.
      2) Sonolastic SL-1, by Sonneborn Building Products.
2. Slab Edge Joint Filler: ASTM D1751, premolded asphaltic board, 1/2-inch thick.

G. Reinforcement Materials

1. Reinforcing Steel: ASTM A615, 60 ksi yield grade; deformed billet steel bars; plain finish.
2. Welded Steel Wire Fabric: ASTM A185 plain type, flat sheets, plain finish.
3. Tie Wire: Minimum 16-gage, annealed type wire.
4. Chairs, Bolsters, Bar Supports, Spacers: Sized and shaped for strength and support of reinforcement during concrete placement conditions.
5. Fabrication: Fabricate concrete reinforcing in accordance with ACI SP-66 and Chapters 7 and 12 of ACI 318.

H. Corrugated Metal Pipe

1. Corrugated metal storm pipe shall be in accordance with AASHTO M36 and ODOT 707. Corrugated metal drain pipe shall be galvanized, of the size and type specified on the drawings.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify that excavations are ready to receive work.

B. Subcontractor shall verify the ability of the existing storm drain to convey runoff downstream of the proposed catch basin. This flow test is to be done prior to constructing the catch basin. Materials used in the flow test shall be non-hazardous and used according to the MSDS and manufacturer's recommendations. They

should not be visible when they enter the FEMP stormwater retention basin.

3.2 PREPARATION

A. Hand trim excavations. Correct over-excavation according to the requirements of Section 02200 of this specification package.

3.3 ERECTION/INSTALLATION/APPLICATION

A. General

1. All riprap outfall protection shall be installed on filter fabric as shown on the drawings.
2. If rock is encountered, the excavation shall be carried no less than 6 inches and no more than 12 inches below the bottom of the concrete. Approved compacted material shall be used to backfill from rock excavation prior to installation.
3. All compacted backfill shall be inorganic material, free of rock or gravel over 3 inches in greatest dimension, and free of other objectionable substances which will prevent satisfactory compaction. Backfill compaction shall conform to the requirements of Section 02200. Puddling of backfill will not be allowed.
4. See Section 02200 for the frequency of samples.
5. Excavation shall conform to Section 02200.

B. Installation of Catch Basins and Manholes

1. Subject to approval of FERMCO, the Subcontractor is to adjust dimensions of the catch basin to meet field conditions and the proposed finish surface grades.
2. Include actual invert in and out, frame elevation and horizontal location as part of the as-built survey.

C. Installation of HDPE Pipe and Corrugated Metal Pipe

1. The pipe and fittings shall be free of foreign inclusions and visible defects. The ends of the pipe shall be cut squarely and cleanly so as not

to adversely affect joining. Pipe shall be flush with headwalls.

2. All pipe shall be laid as shown in the drawings.
3. Joints for HDPE pipe shall be made with split couplings, corrugated to engage the pipe corrugations, and shall engage a minimum of four corrugations, two on each side of the pipe joint. A neoprene gasket shall be utilized with the coupling to provide a soil-tight joint. Installation shall be in accordance with ASTM D2321 or as specified by FERMCO.
4. Joints for corrugated metal pipe shall be made with corrugated galvanized steel coupling bands in accordance with AASHTO M36.

3.4 FIELD QUALITY ASSURANCE

A. Inspection: After the Subcontractor has performed the inspections, and prior to testing and backfill, the Subcontractor shall notify FERMCO as noted in Paragraph B.

1. Inspection shall include checking for proper alignment and location of all catch basins and ditches.
2. Stone apron must be free of debris, dirt, sand, silt, or other foreign matter.
3. All inspections shall have a report filed with FERMCO within 1 week after the test.
4. Backfill compaction quality assurance shall conform to Article 3.4, Section 02200.

B. Testing: The Subcontractor shall pay for and provide for services of an independent testing agency, and provide all testing reports to FERMCO immediately upon availability to the Subcontractor. The Subcontractor shall notify FERMCO of testing/inspection activities at least 24 hours prior to the start of all tests or inspections. The agency shall collect field samples for testing, shall perform field tests, and shall perform laboratory tests on the specimens. Concrete testing shall be performed in accordance with Chapter 16 of ACI 301 for each 50 cubic yards, or fraction thereof, of each mix design placed in any 1 day.

1. Slump Tests: ASTM C143. One sample for each strength test.
2. Air Content Tests: ASTM C231. One sample for each strength test.
3. Test Cylinders: ASTM C31. One set of three cylinders for above quantities.
4. Compressive Strength: ASTM C39. One specimen tested at 7 days and two specimens tested at 28 days.

3.5 CLEANING

Not used.

3.6 PROTECTION

A. The Subcontractor shall provide maintenance as necessary to limit sediment discharges from the affected construction areas so that there is no decrease in the area's stormwater quality.

END OF SECTION

SECTION 02733
PUMP STATION

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Installation of Stormwater Pump Station.

1.2 RELATED SECTIONS

A. Section 01010 - General Requirements.

B. Section 02207 - Aggregate Materials.

C. Section 02222 - Excavating.

D. Section 02223 - Backfilling.

1.3 REFERENCE DRAWINGS

See Section 01011 for the Schedule of Drawings.

1.4 REFERENCES

A. American Society for Testing and Materials (ASTM):

1. ASTM D698-78 — Standard Test Methods for Moisture-Density Relations of Soils and Soil-Aggregate Mixtures, Using 5.5 lb (2.49 Kg) Rammer and 12 inch (304.8 mm) Drop.
2. ASTM D2922-81 — Standard Test Methods for Density of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth).
3. ASTM D3017-88 — Standard Test Methods for Water Content of Soil and Rock in Place by Nuclear Methods (Shallow Depth).

1.5 SYSTEM DESCRIPTION

A. Regulatory Requirements:
   1. Conform to applicable code for materials and installation of the work of this section.

B. Field Measurements:
   1. Verify that field measurements and elevations are as indicated on construction drawings.

C. Coordination:
   1. Coordinate work under provisions of Division 1.

D. Installer Qualifications: Not less than 2 years experience installing sewerage pump stations.

1.6 SUBMITTALS

A. Submit under provisions of Section 01010.

B. Product Data: Provide data indicating system components, pump station, and accessories.

C. Manufacturer's Installation Instructions: Indicate special procedures required to install products specified.

D. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.

E. Project Record Documents:
   1. Submit documents under provisions of Division 1.
   2. Record location of pipe runs, connections, cleanouts, and invert elevations.
   3. Identify and describe unexpected variations to subsoil conditions or discovery of uncharted utilities.

1.7 QUALITY ASSURANCE

Not used.

1.8 DELIVERY, STORAGE, AND HANDLING

Not used.

1.9 PROJECT CONDITIONS

Not used.

1.10 SEQUENCING AND SCHEDULING

Not used.

1.11 WARRANTY

Not used.

1.12 MAINTENANCE

Not used.

PART 2 PRODUCTS

2.1 MANUFACTURERS

Not used.

2.2 EQUIPMENT

Not used.

2.3 MATERIALS

A. Pump Station: Stormwater management pond.

2.4 ACCESSORIES

A. Fittings: Same material as pipe, molded or formed to suit pipe size and end design, in required tee, bends, elbows, cleanouts, reducers, traps, and other configurations required.

2.5 FABRICATION

Not used.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify that excavation base is ready to receive work and that excavations, dimensions, and elevations are as indicated on construction drawings.

3.2 PREPARATION

A. Hand-trim excavations to required elevations. Correct overexcavation with lean concrete.

B. Remove large stones or other hard matter which could damage pipe or impede consistent backfilling or compaction.

3.3 ERECTION/INSTALLATION/APPLICATION

Not used.

3.4 FIELD QUALITY ASSURANCE

A. Field inspection and testing will be performed under provisions of Division 1.

B. Request inspection prior to and immediately after placing bedding.

C. Compaction testing will be performed in accordance with ASTM D698, ASTM D2922, and ASTM D3017.

D. If tests indicate that work does not meet specified requirements, remove work, replace, and retest at no cost to Owner.

3.5 ADJUSTING

Not used.

3.6 **CLEANING**

Not used.

3.7 **DEMONSTRATION**

Not used.

3.8 **PROTECTION**

A. Protect finished installation under provisions of Division 1.

B. Protect pipe and aggregate cover from damage or displacement until backfilling operation is in progress.

3.9 **SCHEDULE**

Not used.

END OF SECTION

SECTION 02831
CHAIN LINK FENCES

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Fence framework, fabric, and accessories.

B. Excavation for post bases; concrete foundation for posts and center drop for gates.

C. Specification applies to fence repair needed as a result of Subcontractor's construction or demolition activities.

1.2 RELATED SECTIONS

A. Section 01010 - General Requirements.

B. Section 02200 - Earthwork.

C. Section 16170 - Grounding and Bonding.

1.3 REFERENCE DRAWINGS

A. See Section 01011 for the Schedule of Drawings.

1.4 REFERENCES

A. American Society for Testing and Materials (ASTM):

1. ASTM A121-86 — Standard Specification for Zinc-Coated (Galvanized) Steel Barbed Wire.
2. ASTM A123-89a — Standard Specification for Zinc (Hot Dip Galvanized) Coatings on Iron and Steel Products.
3. ASTM A153-82 — Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware.

4.	ASTM A392-91	Standard Specification for Zinc-Coated Steel Chain-Link Fence Fabric.
5.	ASTM A570-92	Standard Specification for Hot-Rolled Carbon Steel Sheet and Strip - Structural Quality.
6.	ASTM C94-Rev. A-92	Standard Specification for Ready-mixed Concrete.

1.5 SYSTEM DESCRIPTION

A. Fence Height: 7 feet nominal with barbed wire 1 foot high on extension arms as indicated on drawings.

B. Line Post Spacing: At intervals not exceeding 10 feet.

1.6 QUALITY ASSURANCE

A. Qualifications:
1. Manufacturer: Company specializing in manufacturing the products specified in this section with minimum 3 years documented experience.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Material shall be stored at a location directed by FERMCO.

PART 2 PRODUCTS

2.1 MATERIALS

A. Framing (Steel): ASTM A570; hot rolled steel strip, cold formed to pipe configuration, longitudinally welded construction, minimum yield strength of 50 ksi.

B. Fabric Wire (Steel): ASTM A392 zinc-coated, 9-gage wire fabric.

C. Barbed Wire: ASTM A121 galvanized steel; 12-gage wire, three strands, four points at 5 inches on center.

D. Concrete: ASTM C94; normal Portland cement, 3,000 psi strength at 28 days, 3-inch slump; 1-1/2 inch nominal sized coarse aggregate as specified in Section 03001.

E. Components:
1. Corner and Terminal Posts: 2-7/8 inch, outside diameter.
2. Top and Brace Rail: 1-5/8 inch, outside diameter, plain end, sleeve coupled.
3. Fabric: 2-inch diamond mesh interwoven wire, 9 gage thick, top selvage twisted tight, bottom selvage knuckle end closed.
4. Tension Wire: 6-gage galvanized steel, single strand.
5. Tie Wire: 6-gage galvanized steel wire.

2.2 ACCESSORIES

A. Caps: Cast steel galvanized; sized to post diameter, set screw retainer.

B. Fittings: Sleeves, bands, clips, rail ends, tension bars, fasteners and fittings; galvanized steel.

C. Extension Arms: Cast steel galvanized, to accommodate three strands of barbed wire, single arm, sloped to 45 degrees up from horizontal.

D. Finishes:
1. Components and Fabric: Galvanized to ASTM A123; 2.0 ounces/square feet coating.
2. Hardware: Galvanized to ASTM A153, 2.0 ounces/square feet coating.
3. Accessories: Same finish as framing.

PART 3 EXECUTION

3.1 ERECTION/INSTALLATION/APPLICATION

A. Install framework, fabric, accessories, and gates in accordance with the manufacturer's instructions.

B. Set all posts plumb in concrete footings with top of footing 2 inches above finish grade. Slope top of concrete for water runoff.

C. All post footing depth below finish grade 3 feet, 6 inches.

D. Brace corner post to adjacent line post with horizontal center brace rail and diagonal truss rods. Install brace rail, one bay from end.

E. Provide top rail through line post tops and splice with 6-inch long rail sleeves.

F. Stretch fabric between terminal posts or at intervals of 100 feet maximum, whichever is less, as per manufacturer's recommendations.

G. Position bottom of fabric 2 inches above finished grade.

H. Fasten fabric to top rail, line posts, braces, and bottom tension wire with tie wire at maximum 15 inches on centers.

I. Attach fabric to end and corner posts with tension bars and tension bar clips.

J. Install bottom tension wire stretched taut between terminal posts, as per manufacturer's recommendations.

K. Install support arms sloped outward and attach barbed wire; tension and secure.

3.2 ADJUSTING

A. Maximum Variation From Plumb: 1/4 inch.

B. Maximum Offset From True Position: 1 inch.

END OF SECTION

SECTION 02900
SOIL PREPARATION AND SEEDING

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Seed and mulch to stabilize disturbed areas.

B. Maintenance of seeded areas until final acceptance of contract work.

1.2 RELATED SECTIONS

A. Section 01010 - General Requirements.

B. Section 02110 - Site Clearing.

C. Section 02200 - Earthwork.

D. Section 02720 - Site Drainage.

1.3 REFERENCE DRAWINGS

A. See Section 01011 for the Schedule of Drawings.

1.4 REFERENCES

A. State of Ohio, Department of Transportation (ODOT), Construction and Material Specifications, January 1, 1995.

1.	ODOT 207	Temporary Soil Erosion and Sediment Control.
2.	ODOT 659	Seeding and Mulching.
3.	ODOT 659.02	Agricultural Liming Materials.
4.	ODOT 659.06	Mulching Material.
5.	ODOT 659.08	Fertilizing and Liming.
6.	ODOT 670	Erosion Protection.

1.5 SUBMITTALS

A. Provide submittals as required by Section 01010.

B. Maintenance Data: Submit maintenance instructions for seeded areas including:
   1. Grass Seed: Types, application, cutting method, and maximum grass height.
   2. Soil Nutrients: Types, frequency, and recommended coverage.
   3. Soil Conditioners: Type and recommended coverage.

C. Certificates: Provide written certification from supplier of seed to state that the seed delivered to the project complies with the following:
   1. Seed varieties and mixture comply with requirements of the specifications.
   2. Purity and germination rate comply with the requirements of the specifications.

D. Product Data:
   1. Filter fabric catalog data and sample.
   2. Mulch for seeding.

1.6 GENERAL

A. Except as supplemented or otherwise modified herein and/or shown on the construction drawings, the entire work under this section shall be in compliance with the provisions of ODOT Items 659 and 670.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Deliver grass seed mixture in original, sealed containers. Seed in damaged packaging will not be accepted. Containers shall show:
   1. Names and percentage of each seed variety.
   2. Year of production, percentage of purity, minimum germination rate, and date of packaging.
   3. Net weight.

B. Deliver plant nutrients and soil conditioners in waterproof bags showing weight, chemical analysis, and name of manufacturer.

C. Store materials in a dry area, free from wetting and physical damage.

1.8 MAINTENANCE

A. Seed Areas:
1. Mowing: Prior to acceptance, the Subcontractor shall be responsible for mowing all grass to a height of 3 inches when the grass has reached a height of 5 inches. Seeded areas shall be cut at least three times, none of which shall be closer than 10 days apart.
2. Apply plant nutrients as required in recommendations of agricultural authority such as the Soil Conservation Service.
3. Water to prevent grass and soil from drying out.
4. Immediately re-seed areas that show bare spots. Fill in washed-out areas with topsoil and re-seed.

B. Removal of Sedimentation Accumulation:
1. Remove accumulated sediments when sediment is greater than one-half the height of the control measure, and at project completion.

PART 2 PRODUCTS

2.1 MATERIALS

A. Seed
1. Seed Mixture: Permanent seeding
   a. Forty percent Kentucky Bluegrass (POA Pratensis).
   b. Forty percent Kentucky Fescue (Festuca Rubra).
   c. Twenty percent Annual Ryegrass (Lolium Multiflorum).
2. Mixture shall be clean, guaranteed 95 percent pure, and have a minimum germination rate of 85 percent within 1 year of test.

B. Soil Conditioners

1. Lime:

a. Lime shall meet the requirements of ODOT Item 659.02.

b. Agricultural ground limestone, with a minimum total neutralizing power (TNP) of 90 percent, at least 40 percent passing a No. 100 sieve, and at least 35 percent passing a No. 8 sieve, is considered to be standard grade. This grade is applied at a 100 percent standard application rate of 2,000 pounds per acre subject to the approval of FERMCO. Other grades of agricultural liming materials may be used. Apply substitute material at rates which are dependent on the TNP and sample fineness.

C. Plant Nutrients

1. Fertilizer:

a. Fertilizer shall meet the requirements of ODOT Item 659.08.

b. The standard application of fertilizer shall be at the rate of 20 pounds per 1,000 square feet of 12-12-12. Another analysis, in the same ration, may be used by varying the application rate to produce the same values specified. Either dry or liquid fertilizer may be used and shall be distributed in an even pattern over the specified area, then thoroughly disked, harrowed, or raked into the soil to a depth between 2 and 4 inches.

2.2 ACCESSORIES

A. Mulch:

1. Mulch shall meet the requirements of ODOT Item 659.06.

2. Materials used for mulching shall be straw or hay. They shall be reasonably free of weed seed and such foreign materials as may detract from their effectiveness as a mulch or injure desired plant growth.

PART 3 EXECUTION

3.1 PREPARATION

A. Remove debris, weeds, and undesirable plants and their roots. Remove contaminated subsoil.

B. Repeat cultivation in areas where equipment used for hauling and spreading of topsoil has compacted subsoil.

3.2 ERECTION/INSTALLATION/APPLICATION

A. Application of Soil Conditioners:
1. Apply lime conditioners at the rate specified in Article 2.1, Paragraph B, Subparagraph 1.b., or as determined by soil test.
2. Mix thoroughly into the top 2 inches of the topsoil.

B. Application of Plant Nutrients:
1. Apply fertilizer at the rate specified in Article 2.1, Paragraph C, Subparagraph 1.b.
2. Apply after smooth raking of topsoil, and prior to roller compaction.
3. Mix thoroughly into upper 2 inches of topsoil.
4. Lightly water to aid the distribution of fertilizer.

C. Seeding:
1. When applying seed with a mechanical spreader, apply evenly in two intersecting directions. Rake in lightly. Apply at a minimum rate of 3 pounds per 1,000 square feet.
2. Do not seed areas in excess of that which can be mulched on same day.
3. Apply seed mixture as follows:
   a. All seeding performed between October 15 and March 15 shall be temporary seeding in accordance with ODOT Item 207.
   b. Permanent seeding may be performed at any time with permission of FERMCO.
4. Lightly roll seeded area.

5. Immediately following seeding and compacting, apply mulch.
6. Apply water with a fine spray immediately after each area has been mulched. Saturate soil to approximately 4 inches deep.

3.3 FIELD QUALITY ASSURANCE

A. Subcontractor shall notify FERMCO at least 24 hours prior to date of anticipated inspection.
   1. To qualify for acceptance, an area shall have a good, clean stand of perennial grass.
   2. Coverage shall be at least 95 percent of the area, and no bare spots shall exceed 3 square feet.
   3. Areas that fail to meet requirements of the specifications shall be repaired or re-seeded as necessary to produce an acceptable stand of grass.

B. Excess debris and waste generated as a result of the work shall be containerized by the Subcontractor as described in Part 6, Statement of Work, of the Invitation for Bid.

3.4 PROTECTION

A. Seed Protection:
   1. Apply protection as necessary to retain soil and plant material.
   2. Cover seeded slope area with mulch. Cover ditch lines with matting.
   3. Where slope is steeper than 3 horizontal to 1 vertical, replace mulch with matting.
   4. Mulch:
      a. Mulch seeded area with straw mulch. Spread mulch at a rate of not less than 2 tons per acre.
      b. Apply by hand, by mechanical spreaders, or by blowers.

5. Matting:
   a. Roll matting onto slopes or along ditch lines without stretching or pulling.
   b. Lay matting smoothly on surface, and bury top end of each section in 6-inch-deep excavated topsoil trench.
   c. Provide 12-inch overlap of adjacent rolls.
   d. Rake smooth, level with adjacent soil.
   e. Secure outside edges and overlap with staples at a maximum interval of 36 inches. Intermediate staples shall be spaced at a maximum interval of 5 feet.
   f. Lightly dress slopes with topsoil to ensure close contact between matting and soil.
   g. At sides of ditches, lay matting laps in direction of water flow.

END OF SECTION

E-0163

Preliminary Estimate of Utility Requirements for Proposed Remedial Facilities for OU1 Remediation

Operable Unit 1
Project Order 145

October 1995
Revision C

Environmental Remedial Action Project
Fernald Environmental Management Project
Fernald, Ohio
FERMCO Subcontract No. 2-21487

PARSONS

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Cincinnati, Ohio 45246

000698

Preliminary Estimate of Utility Requirements for Proposed Remedial Facilities for OU1 Remediation

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LIST OF ACRONYMS AND ABBREVIATIONS

BSL	Biodenitrification Surge Lagoon
CFC	Certified for Construction
cfm	cubic feet per minute
FEMP	Fernald Environmental Management Project
gpm	gallons per minute
hp	horsepower
kVA	kilovolt ampere
kW	kilowatt
NPDES	National Pollutant Discharge Elimination System
OU	Operable Unit
scfm	standard cubic feet per minute
V	volt
WAC	Waste Acceptance Criteria

Preliminary Estimate of Utility Requirements for Proposed Remedial Facilities for OU1 Remediation

For general information, the following rough estimates of utility requirements have been prepared for the proposed Operable Unit 1 (OU1) remediation facilities. These estimates will be updated periodically as new information is developed.

However, this information will be used in the design of the utility extensions planned with the Certified for Construction (CFC) Site Improvements Package (expected to be issued in February 1996). Those extensions run from their tie-in point to an interface point(s) at the boundary of the new remedial facilities. Because of the preliminary level of information currently available, the extensions will be conservatively designed.

If information for a particular utility(ies) is inadequate to include it with the early February 1996 CFC package, that utility(s) extension will be included with the later, and primary, CFC package for all remaining remedial facilities.

1.0 BASIS OF ESTIMATE

The basis for these rough estimates is the conceptual level design for the remedial facilities, as shown and described by the following design documents:

1) Site Plan (Rev. B, October 1995)
2) Process Flow Diagrams (Rev. A, October 1995)
3) General Arrangement Drawings (Rev. B, October 1995)
4) Process Description (Rev. C, October 1995)
5) Design Criteria Document (Rev. 0, October 1995)

An allowance for additional utility requirements for potential future process expansion (adding a second dryer) and processing enhancements (such as product densification) is also included. Where appropriate, utilities estimates are increased by approximately 25 percent to allow for potential process enhancements.

2.0 ESTIMATE QUALIFICATION

The utility estimates are based on very preliminary data/low level of detail and are refined as design of the OU1 remedial facilities progresses. Estimates of the amount of waste drying (and hence, natural gas requirements) and water recovery from the waste (for transfer to the FEMP wastewater treatment system) are dependent on waste moisture content. These data are subject to confirmation when all Dewatering

and Excavation Evaluation Program testing is complete. Estimates of use for other utilities will be revised as engineering progresses.

3.0 UTILITIES IDENTIFIED FOR THE OU1 REMEDIAL FACILITIES

The following utilities and transfers of wastewater flows are required to support the OU1 remedial facilities:

1) Electrical power

2) Treated (process) water

3) Fire protection water

4) Natural gas

5) Plant air (not expected to be tied to the Fernald Environmental Management Project [FEMP] air system)

6) Pit dewatering effluent (storm and waste drainage water pumped to the Clearwell)

7) Process-related waste drainage and drying water (wastewater - pumped to the Biodenitrification Surge Lagoon)

8) Facility area stormwater (potentially contaminated water - pumped to the Biodenitrification Surge Lagoon)

No lavatories or change areas are included in the immediate area of the remedial waste processing facilities, so potable water supply and a sanitary sewer to the waste processing facilities are not included. Note: A new changeout facility with restrooms and showers to support construction and operation of the remedial facilities has recently been completed. That changeout facility and other support trailers are located north of the lime sludge ponds and are shown on the Site Plan (Sketch SK-G-03936).

Required eyewash, drinking water stations, and emergency showers in the waste processing facilities area are supplied by bottled or other stored water supply. If it is later determined that stored water supplies cannot be used to meet the water needs, a potable water supply line would be extended to the waste processing facilities.

4.0 ROUGH ESTIMATES OF UTILITY REQUIREMENTS

4.1 Electrical Power

Anticipated motor load (primarily from shredding, drying, off-gas and air handling requirements) for the remedial facilities is conservatively estimated at 800 horsepower (HP). Allowing for a future second dryer and off-gas treatment system and other project expansion, future total loads are estimated at 1100 HP. A unit substation, rated 1500/2000 kVA, 13.2 kV - 480 V will serve the initial installation. Should the second dryer and other features be added, another unit substation of the same ratings is required. These loads can be served from feeders F4B and F1B available for tapping at manhole 246 (assuming that the OU4 Fernald Residues Vitrification Plant is not served from these feeders). A 500 kW, 480 V, three phase standby diesel generator is anticipated for each of the initial and future installations.

4.2 Treated Process Water

Treated water, obtained from the existing FEMP system, is required for the following uses:

1) Debris washing at pitside
2) Debris washing in the waste preparation area and blending and loadout area
3) Truck washing in the waste preparation area
4) Dust control at various locations in the waste preparation and waste loadout area
5) Spray tower makeup water
6) Scrubber makeup water
7) Cooled and chilled makeup water
8) Railcar exterior decontamination washdown
9) General cleanup (washing) at various locations in the waste processing area

Cooled and chilled water makeup is estimated at less than 50 gallons per minute (gpm) based on very preliminary calculation. All dust control, washing, and decontamination are intermittent, low-flow streams. The other process-related water needs are continuous, but also low flow, so overall treated water needs are minimal. Assuming that these uses (other than cooled and chilled water makeup) average 5 gpm each, and assuming the unlikely event that they occur simultaneously, the total demand is approximately 90 gpm. Doubling this to allow for possible later expansion results in approximately 200 gpm maximum demand. Whenever possible, recovered water and recycling are used to meet part of this need.

4.3 Fire Protection Water

A fire water loop is extended around the full facilities with hydrants placed at 400-foot maximum intervals. A worst case of two buildings, ordinary Group 2 occupancy hazard with 0.15 gpm per square foot per 4,000 square feet sprinkler density/group, and 250 gpm per inside hose stream, is assumed. These requirements result in an estimated water demand of approximately 2,500 gpm for fire protection purposes.

4.4 Natural Gas

Current information indicates the maximum practical drying capacity for an indirect rotary dryer is approximately 4.2 tons of water evaporated per hour. At this maximum drying rate approximately 400 standard cubic feet per minute (scfm) of natural gas is required. This estimate is based on the METSIM™ calculation for drying Pit 6 waste. Gas flow is shown on PFD Sketch SK-F-03911. Allowing for two dryers and including a small contingency increases the natural gas requirement to approximately 1,000 scfm.

Space heating and other heating needs are very minimal (there is minimal enclosed building area) and easily met through the contingency allowance.

4.5 Plant Air

This system is included to meet miscellaneous needs, such as in the off-gas control system, and for maintenance needs. Installing a dedicated air compressor(s) is more practical than tying to the FEMP air system. For rough estimating purposes, three 10 cubic feet per minute (cfm) supplies at 100 pounds per square inch for a total of 30 cfm can be assumed to meet these minimal needs.

Additional needs for compressed air may include process-related, pneumatically operated pumps, valves, and instruments. If these potential needs are identified during detailed design, the compressed air requirement will increase.

4.6 Wastewater

Wastewater generated by the OU1 remediation activities is treated at the FEMP wastewater treatment system prior to discharge to the Great Miami River via manhole 176B. The FEMP National Pollutant Discharge Elimination System (NPDES) permit governs the discharge from the FEMP wastewater treatment system. The Biodenitrification Surge Lagoon is the receiving basin for any wastewater sent to the FEMP wastewater treatment system from OU1.

OU1 wastewater streams include the following:

1) Waste pit surface water currently on Pits 5, 6, and the Clearwell

2) Water associated with the waste pit excavation including stormwater and water that drains from the waste

3) Process related wastewater from the new remedial facilities

4) Decontamination water

5) Stormwater associated with the new process area

Wastewaters originating from the waste pit area (including stormwater) initially pass to the Clearwell before transfer to the Biodenitrification Surge Lagoon. All other wastewater goes directly to the Biodenitrification Surge Lagoon.

Total flow for these wastewaters is estimated at a peak of 560 gpm for a 24-hour period and 130 gpm for a 1 month average.

Additional description of these wastewater streams, their disposition and the individual flow rates is presented in the Process Description.

On site Rail
Improvements

Design of On-Site Rail Improvements

Pursuant to the Final Remedial Design Work Plan for Remedial Actions at Operable Unit 1, this section of the Site Improvement Plan:

1) Describes the on-site rail improvements.

2) Includes a layout drawing showing the rail upgrades and the construction needed to support on-site operations.

3) Describes the logistics associated with receiving, loading, storing and moving of full and empty cars.

Prepared by

The Fernald Environmental Restoration Management Corporation
Under Contract No. DE-AC05-92OR21972
with the United States Department of Energy

Design of On-Site Rail Improvements

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3-3 Operating Schedule for 3 x 40-Car Unit Trains (8-Day Cycle) at Minimum Supportable Production Rate of 5.0 Cars (450 Tons) Per Day

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LIST OF ACRONYMS AND ABBREVIATIONS

DOE	United States Department of Energy
FEMP	Fernald Environmental Management Project
ft	feet
OU	Operable Unit
RPDF	Representative Permitted Disposal Facility
QA	Quality Assurance

SECTION 1

FEMP RAILCAR AND TRACKAGE REQUIREMENTS

1.1 Purpose

Pursuant to the Remedial Design Work Plan for Remedial Actions at Operable Unit 1 (OU1), this document provides:

1) The layout drawing showing the rail upgrades and the construction to support on-site operations.

2) A description of the logistics associated with receiving, loading, storing, and moving full and empty gondola railcars to support the OU1 production operation.

Although this is a deliverable requirement of the Site Improvement Plan, it is also appended to the Transportation and Disposal Plan to facilitate review.

1.2 Current FEMP Rail Facilities

From Figure 1-1, FEMP railcars travel north along a 24-mile Branch Line to Cottage Grove, Indiana in order to access CSXT Transportation, Inc.'s (CSXT's) Main Line rail system. The Branch Line is owned by CSXT, which provides rail service to the FEMP. CSXT's inactive Shandon Yard, directly northwest of the FEMP, is the origination point of the CSXT spur which serves the FEMP. The track is constructed from heavy-duty rail. After entering DOE-owned property, the track becomes the Main FEMP Spur and continues east across an unfenced access corridor. After crossing Paddys Run Road, DOE's track successively enters: (1) the contiguous portion of the FEMP property, and (2) the fenced, access-restricted, FEMP Controlled Area. The Main FEMP Spur continues into the former process area where it divides into two light-duty rail parallel tracks (FEMP Tracks 1 and 2), with crossovers. The east and west sections of these tracks are in the Contaminated Area; the center has been downposted to a Controlled Area.

These tracks support five unused light-duty FEMP yard spurs, which are in uncertain condition. In addition, the radius of curvature of these tracks is too severe to support substantial rail traffic. These tracks are in the area to be remediated by Operable Unit 3, and their future viability is unknown.

However, FEMP Track 12 (which originates from Track 1, and curves around the west side of the former process area and extends south) is constructed of heavy-duty rail, and appears to be in excellent condition.

Heavy-duty rail weighs about 131 pounds per linear yard and handles the weight of OU1's loaded gondola cars. However, Tracks 1 and 2 are constructed with 80 pound per yard light-duty rail. A contact at the

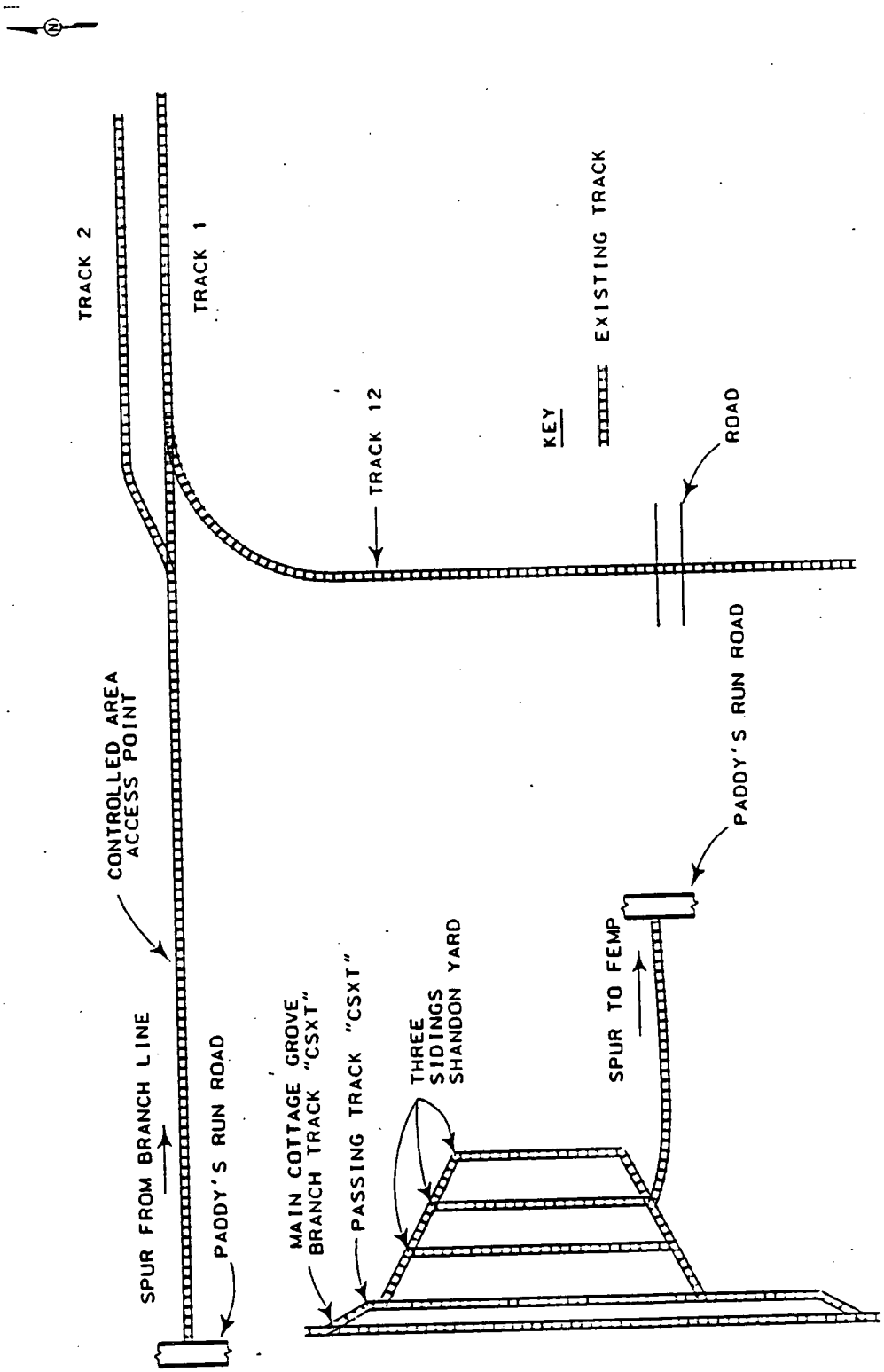


Figure 1-1 - FEMP Site Showing Existing Trackage

US Department of Transportation's Volpe National Transportation Systems Center indicates that 80 pounds per yard rail is unacceptable for loaded cars (Hay ___). This does not preclude use of Tracks 1 and 2 for storage of empty cars.

1.3 Spatial and Traffic Constraints

To comply with commitments to the public, CSXT's Shandon Yard is not used in any manner. As a result of environmental and locational considerations, the only areas available at the FEMP for the construction of new track at the FEMP are parallel to, and:

1) South of Track 1 - Construction of the FEMP Railyard, for storage of filled and empty cars, in this area requires the permanent blockage of "B" Street.

2) East and west of Track 12 - The existing grade crossing of Track 12, between the Low and High Nitrate Tanks, becomes part of the FEMP's primary waste haul road. OU3 assumes the responsibility to construct the roadbed and the warning devices necessary to cross OU1's track structure. It is preferable to have no new tracks crossing the road.

The area south of Track 1 is selected for construction of the FEMP Railyard.

1.4 Design and Operational Constraints

This section presents the design basis for the additional FEMP trackage required for loading and storage of railcars. After completion of the on-site rail upgrade illustrated by Figure 1-2, the FEMP rail system can be described as follows:

1) The FEMP has sufficient track to:
   (1) Store all of the railcars on-site in the event that operations are temporarily stopped
   (2) Start unit train operations with a full inventory of stored cars (i.e., not be "carbound")

2) Under normal production operations, the FEMP originates and receives unit trains using on-site trackage in a timely manner.
   (1) Due to public input:
      a) The maximum time that railcars are on the section of the Main FEMP Spur outside of the Controlled Area is about 36 hours.

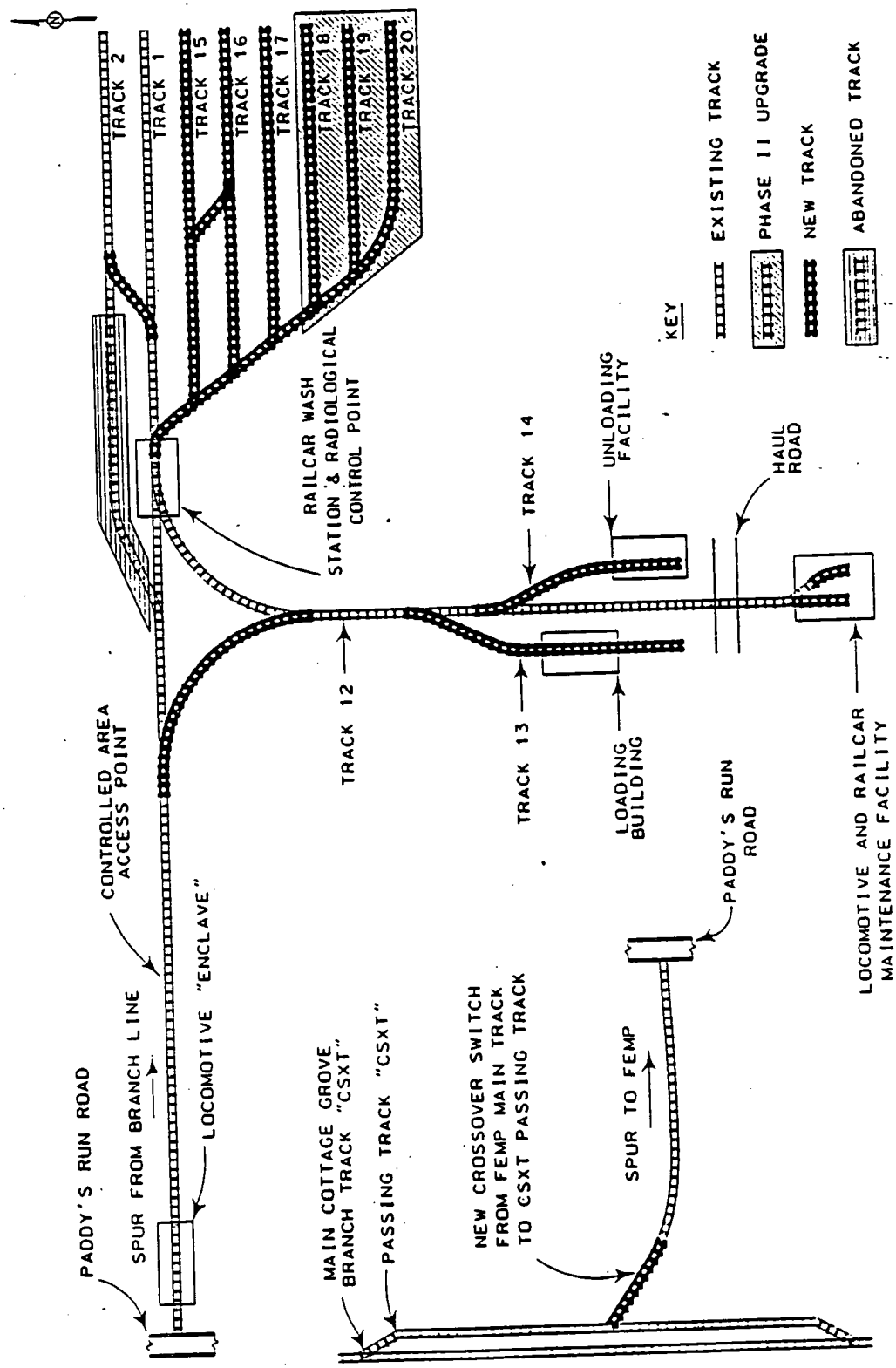


Figure 1-2 - Proposed FEMP Rail Facilities

b) CSXT does not use its Branch Line trackage, in the vicinity of the FEMP, for switching operations in order to deliver and remove unit trains of empty and filled cars on the same day. Therefore, empty cars arrive at least one day after a unit train of filled cars has departed. This involves "deadhead" (i.e., without cars) CSXT locomotive traffic along the Branch Line.

The FEMP achieves these mandates by using a "wye"[1] to allow a small locomotive to rapidly transfer railcars from the FEMP Railyard tracks to the Main FEMP Spur and vice-versa. The wye includes the new curve, connecting the main FEMP Spur and Track 12 and the existing curve.

3) From the preceding section:
   (1) Existing Tracks 1 and 2 are dedicated for empty cars.
   (2) All new track is constructed from heavy-duty rail.

4) New parallel tracks (Numbers 15 et.seq.), adjacent to and south of, Track 1, serve to accumulate loaded cars. These tracks are constructed in two phases in order to accommodate the:
   (1) Start of production in FY 1998 (Tracks 15, 16 and 17), and
   (2) Anticipated production increase in FY 2001 (Tracks 18, 19 and 20).

5) The FEMP railcar loading facility is served by a new spur, Track 13, accessed by a switch at the north end of existing Track 12, immediately south of the new wye. Track 13 is west of, and parallel to, Track 12, and is long enough to allow three cars to project out of either the north or south end of the loading building.

6) A similar track (Number 14), tentatively located on the east side of Track 12 is used in the event that it is necessary to unload railcars. This need arises if a loaded car is rejected by FEMP or Representative Permitted Disposal Facility (RPDF) Quality Assurance (QA). As currently configured, Track 14 is accessed by a switch south of the one for Track 13.

7) The new FEMP track is constructed in accordance with the following guidelines:
   (1) New switches are limited to those absolutely necessary.
   (2) Crossovers, between the railcar storage tracks, are not recommended as operation becomes more complicated, and the potential for derailments increases.

The first step in the design process is to determine the number of required railcars. Then, track needs to support the planned operation are determined. Although operational details in this paper reflect initial planning and are subject to change, the trackage layout is sufficiently flexible to accommodate the needs

[1] A triangular track system with three curved legs and three switches.

of OU1. However, this document does not address possible rail transportation requirements of other FEMP operable units, and revisions may be necessary if any of these needs are defined.

1.4.1 Density

For purposes of this plan, the as-loaded density of the material is 80 pounds per cubic foot.

1.4.2 Railcars

Due to commitments made in public meetings, railcars are fitted with hard covers which are only removed to install liners and load the cars.

The United States Department of Energy (DOE) Fernald Field Office has informally accepted FERMCO's suggestion that standard, medium-wall height gondola cars be acquired. Depending upon the manufacturer, these cars will have interior box dimensions of 52½ feet length, by 9½ feet width, by 5½ feet height (FERMCO 1995). An average one-foot freeboard is the minimum achievable by a production loading operation. As the wall of the recommended car type is one-foot higher than that of common low-wall units, about 90 tons (2240 cubic feet) of material can be loaded.

The coupler-to-coupler 57-foot length of the recommended gondola cars is the primary factor in determining track needs for railcar storage at the FEMP. Shorter "high-wall" gondola cars require less FEMP track, but their internal wall supports prevent compliance with the commitment that the railcars be lined.

1.4.3 Minimum Number of Railcars per Unit Train

CSXT, the originating rail, requires that a unit train's "consist"[2] be at least 40 cars. In addition, pursuant to the requirements of 49 CFR 174.85, a spacer car is necessary to limit exposure to the train crews. The rails require that the spacer car be loaded to prevent it from derailing. Thus, an inert cargo will have to be obtained for spacer cars.

1.4.4 Maximum Number of Railcars per Unit Train

The length of the train is limited by the FEMP's track for originating trains. As the Shandon Yard is not available, the trains must be made up along the Main FEMP Spur up to the point-of-switch for Track 2, as currently configured. Thus, allowing space for access of two CSXT line-haul locomotives and a spacer car, a maximum of about 53-gondola railcars can be dispatched by the FEMP at one time.

---

[2] Number and/or type of cars comprising a freight train.

1.4.5 Production Rate

This subsection is based upon the anticipated production rates between FY 1998 through FY 2004. The corresponding average daily railcar production rates (275 operating days per fiscal year) are tabulated in Table 1-1.

Table 1-1 - Anticipated Daily Railcar Production

Fiscal Year	1998	1999	2000	2001	2002	2003	2004
Average Railcars Produced per Day (275 Operating Days per Year):	2.2	3.2	3.0	6.0	6.3	6.2	6.7
Maximum Railcars per Unit Train:	42	45	42	48	50	50	53
Days to Produce Unit Train:	19	14	14	8	8	8	8

From this table, the rationale for the recommended rail design is as follows:

1) The 6.7 cars per day generation rate in FY 2004 is considered as the upper limit as this high production level only exists for one year. No contingency will be added for more production, as additional funding is not expected to be received.

2) The "base load" railcar generation rate is the three cars per day forecasted in FY 2000. Sufficient additional railcars will be obtained to afford production flexibility in response to possible short-notice funding increases which allow the plant to operate at a higher rate and/or more than 275 days per year.

3) The railcars should be procured, by lease or purchase, in two phases to accommodate the increased production rate at the start of FY 2001. Similarly, the rail infrastructure should be completely designed for both phases. However, construction of the second phase should be delayed until the purchase decision for the second batch of railcars.

4) As noted in Subsection 1.6.2.1, varying the number of railcars per unit train prevents production increases (up about 25 per cent of the baseload) from impacting the overall unit train schedule. Significant production fluctuations will necessitate revision of the unit train cycle and/or number.

1.5 Scheduling

1.5.1 Analytical Hold Periods

Two days are scheduled for completion of preliminary quality assurance testing of the material loaded into railcars. An additional four days are necessary to receive analytical data for the estimated 10 percent of cars which may fail the preliminary tests.

1.5.2 Rail Transit Time

CSXT quotes a unit train round trip transit time of 11 days for the representative RPDF (Johnson, 1994).

1.5.3 RPDF Turn-Around Time

A 4-day cycle (Day 6 through Day 9 of the aggregate 15 day off-site time) affords time for: (1) waste acceptance, (2) unloading, and (3) train make-up. FEMP Scheduling must insure that two unit trains are not at the RPDF at the same time.

1.5.4 FEMP Turn-Around Time

One day is provided for the unit train to be assembled at the FEMP, and another day is afforded for break-down of the unit train of returned empty cars. Furthermore, as noted in Subsection 1.4, the public opposes unit trains arriving and departing on the same day.

1.6 Operation of Multiple Unit Trains

1.6.1 Production Start-Up

As noted in Table 1-2, prior to the release of approved loaded cars, the following reserves must be filled:

1) Two days of railcar production are loaded and certified as "quality assured" at the start of the third working day to provide a production reserve. This affords spare cars in the event that:
   (1) The last batches of cars to be included in the out-bound unit train are rejected by quality assurance.
   (2) CSXT refuses to accept a car due to a maintenance problem.

2) The third and fourth days of production satisfy the holding requirements for initial QA testing.

3) A reserve of empty cars is maintained to accommodate 10 percent of four days' production that may fail the initial QA tests. The need for this reserve will be periodically reviewed during the course of the project.

When the production reserve is drawn down, it must be replenished by increasing daily production. A reserve must be maintained when the unit trains are at, or near, the 40-car minimum; the reserve is not mandatory when longer trains are shipped.

1.6.2 Unit Train Operations

1.6.2.1 Operating Flexibility

FERMCO has established that rail options involving DOE-owned/leased cars and unit trains offer increased safety and security over use of the rails' regularly scheduled freight service in which cars:

1) Sit unattended on sidings waiting for next train

2) Are switched from one train to another in various yards while transiting to and from the RPDF

3) Are scattered across the country, and subject to unauthorized appropriation to other service in the event of local car shortages

Table 1-2 - Unit Train "Consist" and Trackage Requirements

Fiscal Years:	**1999 and 2000**		**2001, 2002, 2003 and 2004**	
Planning Basis For Railcar Utilization	**Minimum Rate with 130 Cars**	**Maximum Rate with 130 Cars**	**Minimum Rate with 190 Cars**	**Maximum Rate with 190 Cars**
Production Rate, Cars/Day:	3.0[3]	3.8	5.00	6.7[4]
Unit Trains:	2	2	3	3
Cars/Unit Train with Pit Material:	42	53	40	53
Total Unit Train Cars for Pit Material:	84	106	120	159
Maximum Working Reserve Cars:	12	12	10	12
Production Reserve Cars (2-days):	6	0	10	0
1st Analytical Reserve Cars (2-days):	6	8	10	13
2nd Analytical Reserve Cars (10%; 4-days):	1	2	2	3
Production Surge Spare Cars:	19	0	35	0
FEMP Spacer Cars:	2	2	3	3
Total Number of Railcars Needed:	**130**	**130**	**190**	**190**
Total Feet of Storage Track Required:	**7,426**		**10,854**	
Storage track needed if the following tracks are used: Tracks 1/2 (3,200'):	4,226		7,654	
Tracks 1/2 and Track 12 (1,250'):	2,976		6,404	

[3] Production rate for FY 2000.

[4] Production rate for FY 2004, the last year of the project.

In addition, unit train service reduces the project cost due to:

1) A discount afforded to this type of traffic by the rails
2) Faster transit time which maximizes utilization of railcars

The primary disadvantages, from an operating perspective, are that:

1) Scheduling problems "ripple" through the transportation system. The ripple effect may increase over time and distance from the source, particularly with multiple unit trains.

2) Production surges must be accommodated.

These problems may be addressed by varying the trains': (1) scheduling and/or (2) consist. The first method involves constantly changing the schedule for unit train departures. CSXT shows a willingness to be somewhat flexible in this matter, but requires a one-week advance notice of schedule changes. The recommended solution is to establish a unit train operating schedule for the lowest anticipated production rate and respond to surges by increasing the number of cars. As noted in Subsection 1.7, the FEMP's rail system is designed such that 53-car unit trains could be originated.

1.6.3 Total Number of Railcars Required

Table 1-2 summarizes railcar and track requirements for various production scenarios.

As noted in Subsection 1.4.5, the FY 2000 production rate is a minimum rate case, and accommodation would be necessary for production surges. The FY 2004 production is considered as an upper "cap." Table 1-2 is the basis for recommending that railcars be procured in two phases:

1) Phase I: Lease/purchase 130 railcars (valued at $7.2 million on the basis of a unit cost of $55,000 [FERMCO 1995]) for delivery in the first quarter of FY 1998.

2) Phase II: If funding materializes to support a substantial production increase, lease/purchase an additional 60 cars to be received in the last quarter of 2000.

Cost reduction efforts include:

1) Performing a lease versus purchase analysis for new cars

2) Preparing a solicitation to determine the availability of a uniform fleet of used railcars in good condition

1.7 FEMP Storage Track Requirements

The installation of new storage sidings (Tracks 15 *et.seq.*) is subject to the constraint that the FEMP have sufficient track to store all railcars in the event that operations were to be suspended due to:

1) Funding problems
2) Seasonal weather disruptions

In addition, car storage on the Main FEMP Spur is impractical, as this would block the FEMP's ability to originate unit trains upon resumption of production.

Sidings derived from, and parallel to Track 1, are configured as a "ladder track" - a series of switches which provide access to several parallel dead-end yard tracks. If all of these stub tracks terminate at a common boundary, such as the on-site cell, each successive stub will be shorter than the previous one. For Number 8 turnouts:

1) The offset distance between the points of switch for successive spurs is 112 feet.

2) The closest point of approach of a railcar on a spur to the point of switch is 112 feet, due to offset requirements to eliminate interferences between railcars on adjacent tracks. Furthermore, the usable length is further reduced by a 50-foot minimum buffer space at the end of the track.

On the basis of Table 1-2, Table 1-3 presents the FEMP's FY 2004 storage track needs if the 4,450 feet of track afforded by existing Tracks 1, 2, and 12 are used.

Table 1-3 - Proposed Minimum New FEMP Spur Tracks for FY 2004 Production Rate
(Car Storage on Tracks 1, 2 and 12)

Track No.	Spur Total Length, Feet	Usable Trackage, Feet	Additional Required Footage
			6,404
15	1,650	1,488	4,916
16	1,538	1,376	3,540
17	1,426	1,264	2,276
18	1,314	1,152	1,124
19	1,202	1,040	84
20	1,090	928	0

In view of funding uncertainties, this is an excessive amount of storage track to construct at one time.

Accordingly, it is recommended that the FEMP embark on a two-phase program to procure railcars and install the required track as follows:

1) Phase I - FY 1998 through FY 2000 production.

2) Phase II - FY 2001 through FY 2004 output.

Table 1-4 presents the trackage requirements for Phase I if Tracks 1, 2 and 12 are used.

Table 1-4 - Proposed New Phase I FEMP Spur Tracks for FY 1998-2000 Production Rate
(Car Storage on Tracks 1, 2, and 12)

Track No.	Spur Total Length, Feet	Usable Trackage, Feet	Additional Required Footage
			2,976
15	1,650	1,488	1,488
16	1,538	1,376	112
17	1,426	1,264	0

Tracks 15 and 16 almost satisfy the minimum FEMP railcar needs. Track 17 is needed for storage of cars held for analytical clearance. The origination of 53-car unit trains will require a crossover, as discussed in Subsection 3.2.3.1.

In addition to the above-noted track, Phase I also involves:

1) Inspection of the Main FEMP Spur and the FEMP trestle (upgrading, if necessary)
2) Inspection, upgrading, and east extension, of Tracks 1 and 2
3) Construction of the new curve to connect the Main FEMP Spur with Track 12
4) Construction of Tracks 13 and 14
5) "Upfront cost" (to be credited) for rebuilding CSXT Shandon Yard switches
6) Construction of support facilities noted in Section 2

Cost reduction efforts focus on availability/procurement of:

1) Heavy-duty "relayer" rail, at favorable pricing, from CSXT's former Shandon Yard

2) Rail from the abandoned southern section of Track 12 for the construction of the new curve-in from the Main FEMP Spur to the north end of Track 12

3) The car bumpers, at the ends of abandoned FEMP stub spurs, for "recycling"

SECTION 2

SUPPORT FACILITIES

2.1 Loading Building

This building and the following facilities are not included in this program as they are considered to comprise the processing plant "package" to be designed by PARSONS:

1) Railcar mover

2) Railcar scale

3) Computer and software for automated shipping document preparation

4) Railcar washing and spent fluid management

5) Radiological monitoring and analytical equipment for determining railcar:
   (1) Total fixed and removable contamination
   (2) Removable contamination

6) Dust control

2.2 Railcar Unloading

This area is supported by Track 14. The facility affords access for equipment to remove material from a railcar and load the waste into a container or truck for return to the OU1 processing area. The entire working area, including the track, is hard surfaced. No other provisions are included.

2.3 Radiological Control Point and Final Car Wash

This structure, slightly longer than one railcar, is similar to the enclosure over the main vehicular access point to the FEMP Controlled Area. No provisions are included in the scope of this work package for laboratory facilities involving radiological detection/counting instrumentation.

If time-consuming tests are required, prior to the release of the loaded railcars, the radiological personnel will have to "field perform" the required monitoring/sampling of cars on Tracks 15 and 16.

The railcar wash station is a simple facility, exposed to the elements, and allows for optional spraying of railcar undercarriage, sides and cover as a "courtesy" wash. Water is collected in a diked area underneath the tracks. Additional handling of the liquid is beyond the scope of this package.

The suggested location for this multiple-use facility is Track 1, just to the east of the northeast wye switch.

Cars are moved slowly through the structure by locomotive.

2.4 Locomotive and Railcar Maintenance Building

A three-bay building is constructed with two adjacent bays having parallel tracks along their entire length. This structure houses the FEMP locomotive(s) and affords simple maintenance services (e.g., lubrication as opposed to engine overhauls). In addition, space is available for scheduled contract-maintenance of the leased gondola railcars. A primary function of the facility is repairing railcar covers. To accomplish this, a railcar with a "bad order" cover is spotted in the center bay. The cover is removed by an overhead crane and placed on a dolly in the adjacent non-rail bay for work or transport outside the building. The new cover is moved from temporary laydown on the tracks of the other bay and placed on the car. This procedure may also be used to successively move covers, stacked on flat cars used for shipping from the vendor's plant, onto DOE's gondola cars.

The building includes an overhead crane of appropriate capacity for the locomotive, a fueling facility, and a heated trailer with telephone and toilet facilities. Tools and other "shop" provisions are excluded from this package. An outside paved yard, with a 2-ton capacity simple overhead crane, stores covers and additional components. The crane traverses three stored covers, the dolly area outside the bay, and a laydown area for a cover removed from a car.

2.5 Fencing

The scope of this project includes:

1) Chain link fencing around:
   (1) Both sides of the Main FEMP spur from the Controlled Area out to Paddys Run Road.
   (2) A 200-foot[5] CSXT locomotive "enclave," just east of Paddys Run Road, with sliding gates at each end. This area isolates CSXT's equipment and crew from the site. It has a small shelter for FEMP security personnel awaiting the arrival/departure of trains. The function of this facility is discussed in Subsections 3.2.3.1 and 3.2.3.2.

[5] Length to be verified during detailed design.

2) Radiological control fencing around Tracks 1, 2 15, 16, 17 and the balance of the Main FEMP Spur.

SECTION 3

LOGISTICS

3.1 Unit Train Management During Production Operations

With respect to train origination, the number of cars released from QA must equal a pre-determined "average" number of cars per day. A uniform production rate is not necessary, but the number of cars generated each day must be an integer.

The illustrative basis for this discussion is Figure 3-1, which depicts the operating cycle from point of start-up (after all of the analytical and production car reserves have been established) for the FY 2000 production rate of 3 cars per day. Under this scenario, which is considered to be the Base Load Case for track design purposes, 14 days are required to generate each of two minimum length unit trains (i.e., 42 cars). The following daily schedule for railcar management, based on a selected starting point on Day 15, complements the schedule for railcar movements described in Subsection 3.2.3.1.

1) Days 15 - 27: QA releases cars designated for Train 2.

2) Day 28: QA releases last cars assigned to Train 2 which is made up on this day along the Main FEMP Spur.

3) Day 29: Train 2 departs and the first set of cars allocated to Train 1 is released by QA. The first three cars from the Working Reserve are loaded and placed into analytical hold.

4) Day 30: Three more empty cars from the Working Reserve are loaded. QA releases cars, filled 2 days previously, which are assigned to Train 1.

5) Day 31: Three more Working Reserve railcars are filled. QA releases cars loaded 2 days previously, which are assigned to Train 1. Train 1 arrives and is broken down. At the end of the day, Working Reserve cars are replenished from Train 1 cars.

6) Day 32: Three cars are approved by QA and join the nine cars released on Days 29 through 31, assigned to Train 1.

STATUS AT DAY END

DAY	CARS FROM QA/QC	TRAIN 1	TRAIN 2	TRAIN 3	CAR SOURCE TRAIN	CAR SOURCE "WORKING" RESERVE	TOTAL QA/QC CARS	EMPTY "WORKING" RESERVE CARS
0	0	ARRIVE			0			
1	3	3 3			3	0	0	9
2	3	3 6			3	0	0	9
3	3	3 9			3	0	0	9
4	3	3 12			3	0	0	9
5	3	3 15			3	0	0	9
6	3	3 18			3	0	0	9
7	3	3 21			3	0	0	9
8	3	3 24			3	0	0	9
9	3	3 27			3	0	0	9
10	3	3 30			3	0	0	9
11	3	3 33			3	0	0	9
12	3	3 36			3	0	0	9
13	3	3 39			3	0	0	9
14	3	3 42	ARRIVE		3	0	0	9
15	3	LEAVE	3 3		3	0	0	9
16	3	1	3 6		3	0	0	9
17	3	2	3 9		3	0	0	9
18	3	3	3 12		3	0	0	9
19	3	4	3 15		3	0	0	9
20	3	5	3 18		3	0	0	9
21	3		3 21		3	0	0	9
22	3		3 24		3	0	0	9
23	3		3 27		3	0	0	9
24	3		3 30		3	0	0	9
25	3	10	3 33		3	0	0	9
26	3	11	3 36		3	0	0	9
27	3	12	3 39		3	0	0	9
28	3	13	3 42		3	0	0	9
29	3	14	LEAVE		0	3	3	6
30	3	15	1		0	3	6	3
31	3	ARRIVE	2		0	3	9	0
32	3	12 12	3		12	0	0	9
33	3	3 15	4		3	0	0	9
34	3	3 18	5		3	0	0	9
35	3	3 21			3	0	0	9
36	3	3 24			3	0	0	9
37	3	3 27			3	0	0	9
38	3	3 30			3	0	0	9
39	3	3 33	10		3	0	0	9
40	3	3 36	11		3	0	0	9
41	3	3 39	12		3	0	0	9
42	3	3 42	13		3	0	0	9
43	3	LEAVE	14		0	3	3	6
44	3	1	15		0	3	6	3
45	3	2	ARRIVE		0	3	9	0
46	3	3	12 12		12	0	0	9
47	3	4	3 15		3	0	0	9
48	3	5	3 18		3	0	0	9
49	3		3 21		3	0	0	9
50	3		3 24		3	0	0	9
51	3		3 27		3	0	0	9
52	3		3 30		3	0	0	9
53	3	10	3 33		3	0	0	9
54	3	11	3 36		3	0	0	9
55	3	12	3 39		3	0	0	9
56	3	13	3 42		3	0	0	9
57	3	14	LEAVE		0	3	3	6
58	3	15	1		0	3	6	3

Dark shading indicates days when trains are in transit; solid shading shows days at PCDF.

Figure 3-1 - Operating Schedule for 2 x 42-Car Unit Trains (14-Day Cycle) at Minimum Supportable Production Rate of 3.0 Cars (270 Tons) per Day

7) Day 42: Train 1 is made up on the Main FEMP Spur using previously released assigned cars and three provided by QA that day. Three empty cars from the Working Reserve are loaded. QA releases cars filled 2 days previously which are assigned to Train 1.

8) Day 43: Train 1 departs and the Working Reserve is "tapped" as a source of cars to be loaded. Three cars are released from QA and assigned to Train 2.

Usually, a repeatable cycle is developed after all of the trains have made one trip. However, a review of Figures 3-3 and 3-4, shows that the train is at the RPDF for 5 days, rather than the minimum of 4 days. This avoids having the first train leave on the same day that the second arrives and is the basis for the "staggered unit concept" in which time elapses between the departure of one unit train and the arrival of the next. This is mandated because the Shandon Yard cannot be used for train origination.

Using the same unit train cycle, Figure 3-2 shows that production surges up to 26 per cent (3.8 cars per day) can be accommodated by increasing the cars in the train up to a maximum of 53. For this scenario, an additional nine to 12 cars are required as a working reserve to accommodate the loading of three to four cars per day during the 3-day intervals between unit trains.

Similarly, Figures 3-3 and 3-4 illustrate the operation of three unit trains, operating on an 8-day cycle. Increasing the number of cars per train from 40 to 53, provides the means to support the maximum production rate of 6.74 cars per day in FY 2004.

3.2 FEMP Track Utilization

3.2.1 On-Site Storage of 130 Railcars

This subsection presents the plan for storing all of the railcars on the site during Phase I if operations are temporarily halted.

The method for putting all FEMP cars into storage is for the site locomotive to pull/push successive strings of inbound cars onto:

1) Existing Tracks 1 and 2
2) New Tracks 15 through 17

Track 17 will be used in lieu of Track 12. The locomotive then proceeds into the new maintenance structure at the south end of Track 12.

STATUS AT DAY END

DAY	CARS FROM QA/QC	TRAIN 1	TRAIN 2	TRAIN 3	CAR SOURCE TRAIN	CAR SOURCE "WORKING" RESERVE	TOTAL QA/QC CARS	EMPTY "WORKING" RESERVE CARS
0	0	ARRIVE			0			
1	3	3 3			3	0	0	9
2	3	3 6			3	0	0	9
3	3	3 9			3	0	0	9
4	4	4 13			4	0	0	9
5	4	4 17			4	0	0	9
6	4	4 21			4	0	0	9
7	4	4 25			4	0	0	9
8	4	4 29			4	0	0	9
9	4	4 33			4	0	0	9
10	4	4 37			4	0	0	9
11	4	4 41			4	0	0	9
12	4	4 45			4	0	0	9
13	4	4 49			4	0	0	9
14	4	4 53	ARRIVE		4	0	0	9
15	3	LEAVE	3 3		3	0	0	9
16	3	1	3 6		3	0	0	9
17	3	2	3 9		3	0	0	9
18	4	3	4 13		4	0	0	9
19	4	4	4 17		4	0	0	9
20	4	5	4 21		4	0	0	9
21	4		4 25		4	0	0	9
22	4		4 29		4	0	0	9
23	4		4 33		4	0	0	9
24	4		4 37		4	0	0	9
25	4	10	4 41		4	0	0	9
26	4	11	4 45		4	0	0	9
27	4	12	4 49		4	0	0	9
28	4	13	4 53		4	0	0	9
29	3	14	LEAVE		0	3	3	6
30	3	15	1		0	3	6	3
31	3	ARRIVE	2		0	3	9	0
32	4	13 13	3		13	0	0	9
33	4	4 17	4		4	0	0	9
34	4	4 21	5		4	0	0	9
35	4	4 25			4	0	0	9
36	4	4 29			4	0	0	9
37	4	4 33			4	0	0	9
38	4	4 37			4	0	0	9
39	4	4 41	10		4	0	0	9
40	4	4 45	11		4	0	0	9
41	4	4 49	12		4	0	0	9
42	4	4 53	13		4	0	0	9
43	3	LEAVE	14		0	3	3	6
44	3	1	15		0	3	6	3
45	3	2	ARRIVE		0	3	9	0
46	4	3	13 13		13	0	0	9
47	4	4	4 17		4	0	0	9
48	4	5	4 21		4	0	0	9
49	4		4 25		4	0	0	9
50	4		4 29		4	0	0	9
51	4		4 33		4	0	0	9
52	4		4 37		4	0	0	9
53	4	10	4 41		4	0	0	9
54	4	11	4 45		4	0	0	9
55	4	12	4 49		4	0	0	9
56	4	13	4 53		4	0	0	9
57	3	14	LEAVE		0	3	3	6
58	3	15	1		0	3	6	3

Dark shading indicates days when trains are in transit; solid shading shows days at PCDF.

Figure 3-2 - Operating Schedule for 2 x 53-Car Unit Trains (14-Day Cycle) at Maximum Supportable Production Rate of 3.78 Cars Per Day

STATUS AT DAY END

DAY	CARS FROM QA/QC	TRAIN 1	TRAIN 2	TRAIN 3	CAR SOURCE TRAIN	CAR SOURCE "WORKING" RESERVE	TOTAL QA/QC CARS	EMPTY "WORKING" RESERVE CARS
0	0	ARRIVE			0			
1	5	5 5			5	0	0	10
2	5	5 10			5	0	0	10
3	5	5 15			5	0	0	10
4	5	5 20			5	0	0	10
5	5	5 25			5	0	0	10
6	5	5 30			5	0	0	10
7	5	5 35			5	0	0	10
8	5	5 40	ARRIVE		5	0	0	10
9	5	LEAVE	5 5		5	0	0	10
10	5	1	5 10		5	0	0	10
11	5	2	5 15		5	0	0	10
12	5	3	5 20		5	0	0	10
13	5	4	5 25		5	0	0	10
14	5	5	5 30		5	0	0	10
15	5		5 35		5	0	0	10
16	5		5 40	ARRIVE	5	0	0	10
17	5		LEAVE	5 5	5	0	0	10
18	5		1	5 10	5	0	0	10
19	5		2	5 15	5	0	0	10
20	5	11	3	5 20	5	0	0	10
21	5	12	4	5 25	5	0	0	10
22	5	13	5	5 30	5	0	0	10
23	5	14		5 35	5	0	0	10
24	5	15		5 40	5	0	0	10
25	5	16		LEAVE	0	5	5	5
26	5	ARRIVE		1	0	5	10	0
27	5	15 15		2	15	0	0	10
28	5	5 20	11	3	5	0	0	10
29	5	5 25	12	4	5	0	0	10
30	5	5 30	13	5	5	0	0	10
31	5	5 35	14		5	0	0	10
32	5	5 40	15		5	0	0	10
33	5	LEAVE	16		0	5	5	5
34	5	1	ARRIVE		0	5	10	0
35	5	2	15 15		15	0	0	10
36	5	3	5 20	11	5	0	0	10
37	5	4	5 25	12	5	0	0	10
38	5	5	5 30	13	5	0	0	10
39	5		5 35	14	5	0	0	10
40	5		5 40	15	5	0	0	10
41	5		LEAVE	16	0	5	5	5
42	5		1	ARRIVE	0	5	10	0
43	5		2	15 15	15	0	0	10
44	5	11	3	5 20	5	0	0	10
45	5	12	4	5 25	5	0	0	10
46	5	13	5	5 30	5	0	0	10
47	5	14		5 35	5	0	0	10
48	5	15		5 40	5	0	0	10
49	5	16		LEAVE	0	5	5	5
50	5	ARRIVE		1	0	5	10	0
51	5	15 15		2	15	0	0	10
52	5	5 20	11	3	5	0	0	10
53	5	5 25	12	4	5	0	0	10
54	5	5 30	13	5	5	0	0	10
55	5	5 35	14		5	0	0	10
56	5	5 40	15		5	0	0	10
57	5	LEAVE	16		0	5	5	5
58	5	1	ARRIVE		0	5	10	0

Dark shading indicates days when trains are in transit; solid shading shows days at PCDF.

Figure 3-3 - Operating Schedule for 3 x 40-Car Unit Trains (8-Day Cycle) at Minimum Supportable Production Rate of 5.0 Cars (450 Tons) Per Day

STATUS AT DAY END

DAY	CARS FROM QA/QC	TRAIN 1	TRAIN 2	TRAIN 3	CAR SOURCE TRAIN	CAR SOURCE "WORKING" RESERVE	TOTAL QA/QC CARS	EMPTY "WORKING" RESERVE CARS
0	0	ARRIVE			0			
1	6	6 6			6	0	0	12
2	6	6 12			6	0	0	12
3	6	6 18			6	0	0	12
4	7	7 25			7	0	0	12
5	7	7 32			7	0	0	12
6	7	7 39			7	0	0	12
7	7	7 46			7	0	0	12
8	7	7 53	ARRIVE		7	0	0	12
9	6	LEAVE	6 6		6	0	0	12
10	6	1	6 12		6	0	0	12
11	6	2	6 18		6	0	0	12
12	7	3	7 25		7	0	0	12
13	7	4	7 32		7	0	0	12
14	7	5	7 39		7	0	0	12
15	7		7 46		7	0	0	12
16	7		7 53	ARRIVE	7	0	0	12
17	6		LEAVE	6 6	6	0	0	12
18	6		1	6 12	6	0	0	12
19	6		2	6 18	6	0	0	12
20	7	11	3	7 25	7	0	0	12
21	7	12	4	7 32	7	0	0	12
22	7	13	5	7 39	7	0	0	12
23	7	14		7 46	7	0	0	12
24	7	15		7 53	7	0	0	12
25	6	16		LEAVE	0	6	6	6
26	6	ARRIVE		1	0	6	12	0
27	6	18 18		2	18	0	0	12
28	7	7 25	11	3	7	0	0	12
29	7	7 32	12	4	7	0	0	12
30	7	7 39	13	5	7	0	0	12
31	7	7 46	14		7	0	0	12
32	7	7 53	15		7	0	0	12
33	6	LEAVE	16		0	6	6	6
34	6	1	ARRIVE		0	6	12	0
35	6	2	18 18		18	0	0	12
36	7	3	7 25	11	7	0	0	12
37	7	4	7 32	12	7	0	0	12
38	7	5	7 39	13	7	0	0	12
39	7		7 46	14	7	0	0	12
40	7		7 53	15	7	0	0	12
41	6		LEAVE	16	0	6	6	6
42	6		1	ARRIVE	0	6	12	0
43	6		2	18 18	18	0	0	12
44	7	11	3	7 25	7	0	0	12
45	7	12	4	7 32	7	0	0	12
46	7	13	5	7 39	7	0	0	12
47	7	14		7 46	7	0	0	12
48	7	15		7 53	7	0	0	12
49	6	16		LEAVE	0	6	6	6
50	6	ARRIVE		1	0	6	12	0
51	6	18 18		2	18	0	0	12
52	7	7 25	11	3	7	0	0	12
53	7	7 32	12	4	7	0	0	12
54	7	7 39	13	5	7	0	0	12
55	7	7 46	14		7	0	0	12
56	7	7 53	15		7	0	0	12
57	6	LEAVE	16		0	6	6	6
58	6	1	ARRIVE		0	6	12	0

Dark shading indicates days when trains are in transit; solid shading shows days at PCDF.

Figure 3-4 - Operating Schedule for 3 x 53-Car Unit Trains (8-Day Cycle) at Maximum Supportable Production Rate of 6.7 Cars Per Day

3.2.2 Start-Up of Production

The loading cycle involves removing stored cars from Tracks 16, 15 and 17 in succession. After filling, the first day's production is pushed out to the limits of the FEMP Controlled Area. More cars are added over time. Before the motive capacity of the locomotive is exceeded, the string of cars is pushed out to the east limit of the enclave near Paddys Run road, where it awaits the departure of the first unit train. Then the storage tracks for filled cars (Numbers 15 and 16) should be sufficiently cleared of empty cars so that loaded cars can be accepted. As the number of cars on site decreases, the production and analytical reserves are established, and a regular unit train schedule is developed to match the production rate.

3.2.3 FEMP Track Logistics During Production Operations

This subsection conceptualizes possible FEMP yard operations for accomplishing these railcar movements in order to ensure that the track design will serve its purpose. Modest refinements of the design may be expected. The on-site operations involve the cycling of empty cars from Tracks 1 and 2, to:

1) Track 13 for loading
2) Track 17 for analytical hold
3) Track 14 for unloading, if necessary
4) Tracks 15 and 16 for storage

During the make-up of a unit train, the FEMP locomotive moves cars from Tracks 15/16 to the Main FEMP Spur for pickup by CSXT's locomotives.

This subsection is based upon Figures 3-1 and 3-2 which depict the upgraded FEMP track system and the southern portion of the former Shandon Yard. CSXT traffic on the Fernald-Cottage Grove Branch Line travels along the main Branch Line which is the westernmost track. About ¾ mile north of the FEMP Spur, somewhat south of New Haven Road, CSXT's Passing Track is accessed by a switch (the North Branch Line Switch). The Passing Track is immediately east of the main line. About ½ mile south of the FEMP Spur, the Passing Track rejoins the Main Branch Line at a switch (the South Branch Line Switch). The balance of the parallel tracks is the unused Shandon Yard. After removal of the Shandon yard, the western end of CSXT's spur will be connected directly to the Passing Track. The involved switch will be referred to as "the Spur Switch."

A wye, which enables a switching locomotive to turn cars around by a series of movements (similar to the "K-turn" used by automobiles), is constructed using the following as the legs:

1) Existing curve from the Main FEMP Spur to Track 12 (the East Leg)
2) New curve between the Main FEMP Spur and Track 12 (the West Leg)
3) Main FEMP Spur (the Top Leg)

The following switches are referenced:

1) The Northeast Switch accessing Tracks 1, 2, 15, 16 and 17
2) The Northwest Switch leading to the Main FEMP Spur
3) The South Wye Switch on Track 12

3.2.3.1 Train Origination at the FEMP

This description of the operational scenario for train make-up involves the following steps for a production rate of three cars per day:

Day 27

The selected starting point for this example is Day 27 as shown by Figure 3-3:

1) At the start of the day's operation, three cars are pulled out of Tracks 1 or 2, and travel west through the car wash and the radiological check point. Either, or both, of the facilities are activated if necessary. The cars continue west across the Top Leg past the Northwest Switch and onto the Main FEMP Spur. The locomotive reverses direction and shoves the cars south along the West Leg to Track 12, and then onto Track 13 for loading. The loading operation is detailed later in this subsection.

2) About 10 QA-approved cars (the estimated maximum number of loaded cars that the FEMP locomotive can move), followed by an empty spacer car, are pulled out of Track 16. They move through the car wash and radiological control point for a pre-departure check. The locomotive pulls the cars south, along the East Leg, onto Track 12. After the South Wye Switch is cleared, the cars are pushed north, across the West Leg, and onto the Main FEMP Spur. The cars stop immediately east of the fence currently delineating the Controlled Area.

3) Near the end of the loading shift, the cars on the Main FEMP Spur are pushed out to just east of the locomotive enclave at the west end of the spur.

4) At the end of the loading shift, decontamination and radiological checking of the three cars ("spotted" at the start of the day in Step 1) continues in the Loading Building.

Day 28

5) The first priority of each day's rail operations is to remove the radiologically-surveyed three cars from Track 13, and pull them north along the West Leg onto the Main FEMP Spur. After all cars clear the Northwest Switch, the cars are shoved east across the Top Leg and onto Track 17 to begin the analytical hold period.

6) Step 1 from Day 27 is repeated to position and load the next set of three cars on Track 13.

7) CSXT is contacted by 8:00 a.m. to provide the standard 24-hour advance notice that a unit train shipment will be ready. This notice confirms the 7-day notice provided earlier.

8) Three empty cars removed from Tracks 1 or 2 are pre-positioned at the south end of Track 12. Except for a maximum of 19 spare cars for production surges needed for unit trains longer than 42 cars (refer to Table 1-2), Tracks 1 and 2 are essentially empty of cars.

9) The combined capacity of Tracks 15 and 16 is about 50 filled cars. During the balance of the shift, successive strings of about ten cars are pulled west out of Tracks 15 and 16. For reasons addressed later, Track 16 is cleared of cars before Track 15. In route to the East Leg, each string passes through the car wash and radiological survey point. After clearing the South Wye Switch, the locomotive pushes the cars north, along the West Leg and onto the Main FEMP spur. Each string is pushed out to, and coupled with, the cars staged east of the locomotive enclave. After the train is completed using the cars released that day from QA, FEMP personnel perform a preliminary inspection of brakes, etc.

10) If the departing unit train substantially exceeds 42 cars, it will block the wye, and the last string of cars cannot be placed as detailed in Step 9. It is then necessary for:
    (1) Track 16 to be cleared of cars, and
    (2) The locomotive to:
        (a) Pull the last 10 cars remaining on Track 15 to its west end so that they clear the crossover between Tracks 15 and 16.
        (b) Travel east on Track 16, past the crossover switch. Upon reversing direction, the locomotive moves northwest onto Track 15.
        (c) Push the last string of cars west onto the Top Leg of the wye. After the string passes the Northeast Switch and is coupled with the rest of the cars, the locomotive reverses direction.
        (d) After clearing the Northeast Switch, the locomotive changes direction, and moves south on the East Leg to Track 12.

Day 29 (Shipment)

11) Step 5 from Day 28 cannot be executed as there may not be sufficient room on the Main FEMP Spur, west of the Northwest Switch, for the string of three radiologically-surveyed cars to be removed from Track 13. Instead, the cars are pulled north across the East Leg of the wye onto Track 16, where the cars are temporarily spotted after clearing the switch accessing Track 16. The locomotive proceeds east. After clearing the crossover switch on Track 16, the locomotive reverses, crosses over to Track 15, moves east, and then south along the East Leg to return to the south end of Track 12. The three cars, pre-positioned via Step 8 from Day 28, are then pulled north. After clearing the Track 13 switch, the cars are pushed south into the loading building.

12) About one to two hours after transmitting a position notification at the Cottage Grove Yard, CSXT's locomotives arrive on the FEMP spur, stopping just west of Paddys Run Road.

13) The west sliding gate of the FEMP enclave is opened by Security personnel who then stop traffic on the road. CSXT's locomotives cross over Paddys Run Road and enter the enclave. The west gate is closed, the east sliding gate is opened, and the locomotives proceed a few feet east into the FEMP area in order to couple with the string of loaded outbound cars. The CSXT crew is provided with shipping papers for the train. This operation should only require a few minutes, and CSXT's crew remains in the locomotive.

14) The west gate is opened, automotive traffic is blocked, and CSXT's locomotives pull the unit train of filled cars across Paddys Run Road and north onto the passing track where the CSXT crew performs the brake and safety inspection. CSXT accepts the unit train and departs. The 15-day off-site cycle commences on Day 30. FEMP Security personnel close all gates and retire.

3.2.3.2 Receipt of Empty Cars

Continuing with the example, empty cars are received at the FEMP as follows:

Day 30 (1 Day Prior to receipt)

15) A 24-hour advance notice of the cars' arrival is obtained on the basis of car tracking information, and/or receipt of notice from CSXT. This completes the 15-day off-site cycle.

Day 31 (Receipt of Inbound Cars)

16) One hour after FEMP's receipt of telephoned advance notice of the train's imminent arrival, CSXT's locomotives pull 42 cars south from the Main Branch Line, onto the passing track via the North Branch Line Switch, and stop immediately north of the Spur Switch accessing the Main

FEMP Spur where they are met by FEMP Security personnel. The cars are uncoupled and temporarily "staged" on the Passing Track, under supervision of FEMP Security.

17) This step, and Steps 18, 19, and 20, allow CSXT's locomotives to "runaround" the empty cars. CSXT's locomotives proceed south on the Passing Track, and stop just north of the South Branch Line Switch, which is then manipulated.

18) CSXT's locomotives traverse the switch, and move south onto the Main Branch Line. The South Branch Line Switch is positioned to access the Main Branch Line.

19) CSXT's locomotives move north on the Main Branch Line and just clear the North Branch Line Switch.

20) The locomotives cross the switch, move south onto the Passing Track, and couple with the string of empty cars.

21) The empties are shoved onto the Main FEMP Spur and into the site as described in Steps 13 and 14 from Day 29. The cars are uncoupled just east of the locomotive enclave.

22) CSXT's locomotives move out to the passing track and depart.

23) Strings of 10 to 20 empty cars are pulled east on the Main FEMP Spur by the FEMP locomotive, and south onto Track 12.

24) The cars are pushed north and then east onto Tracks 1 and 2.

3.2.3.3 Loading

Loading operations commence after Step 1 from Day 27 is completed.

<u>Each Day</u>

25) The FEMP locomotive moves empty cars onto Track 13 until they can be attached to the car mover serving the Loading Building.

26) The car mover pulls the string of cars through the building until all cars, except the north car, extend south of the Loading Building.

27) During the day, the cars are loaded and pulled north of the loading building.

28) At the conclusion of each day's operation, Step 4 and Step 5 from Day 28 are initiated.

At some time each day, the QA-approved cars are moved from the analytical hold track to Tracks 15 and 16.

SECTION 4

REFERENCES

(FERMCO 1995) Fernald Environmental Restoration Management Corporation, July 31, 1995. "OU1 Transportation Mode Options Analysis - Direct Rail Shipment from the FEMP to a Permitted Commercial Disposal Facility Versus Intermodal Transfer."

(Hay) Hay, W., "Assessment of Ability of 80 Pound Rail Section to Withstand Loads from a 100-ton Hopper Car." *Railroad Engineering:* pp 496.

(Johnson 1994) Johnson, R., July 6, 1994 letter from CSX Transportation, Inc.

Off-site Rail Improvements

Off-Site Rail Upgrades

Prepared by

The Fernald Environmental Restoration Management Corporation
Under Contract No. DE-AC05-92OR21972
with the United States Department of Energy

LETTER REPORT

Off-Site Rail Upgrades

In support of the OU1 remediation efforts, it has been determined that there are various off-site rail improvements which shall be implemented before any OU1 wastes can be shipped by rail from the FEMP. The nature of the improvements, the need for the improvements, and a path forward are provided in the following subsections. The focus of these improvements is the CSX Transportation, Inc. (CSXT) Branch Line between the FEMP and Cottage Grove, Indiana, which is depicted on Figure 1.

1.0 Track Conditions

Through various interactions with the public, numerous concerns surfaced concerning the condition of the rail tracks along the Branch Line. Specifically, concerns were identified for conditions such as track blockages, tracks in bad shape (including loose spikes), blocked and/or washed out culverts, vegetation along the track, drainage problems threatening the structural integrity of the track, etc.

It is the responsibility of the rail to ensure compliance with Federal Railroad Administration regulations and that the tracks and related structures used by the trains are in good repair. It is also the responsibility of the rail to maintain safe and sufficient crossings where a street, lane, public road, or highway crosses the railway track. DOE does not have enforcement authority over the rail. However, DOE will require the rail to document its compliance with regulations and laws prior to shipment, and will require, upon request, that the rail document its ongoing compliance. In this way, DOE will be satisfied that the tracks and surrounding structures are in a condition suitable to support safe shipping of OU1 wastes before shipping commences.

2.0 Shandon Yard

This switch yard parallels CSXT's Branch Line at the junction of the FEMP spur. Shandon Yard will not be used as a staging area for unit trains.

Planned improvements to this yard are limited to the construction of a switch connecting the FEMP spur directly to the CSXT Branch Line to facilitate the movement of railcars into and out of the FEMP.

3.0 Bridges/Trestles

Based on information provided by CSXT, trains *en route* from the FEMP to Cottage Grove will cross five bridges/trestles of varying ages, and of wood or wood/steel construction. These structures have

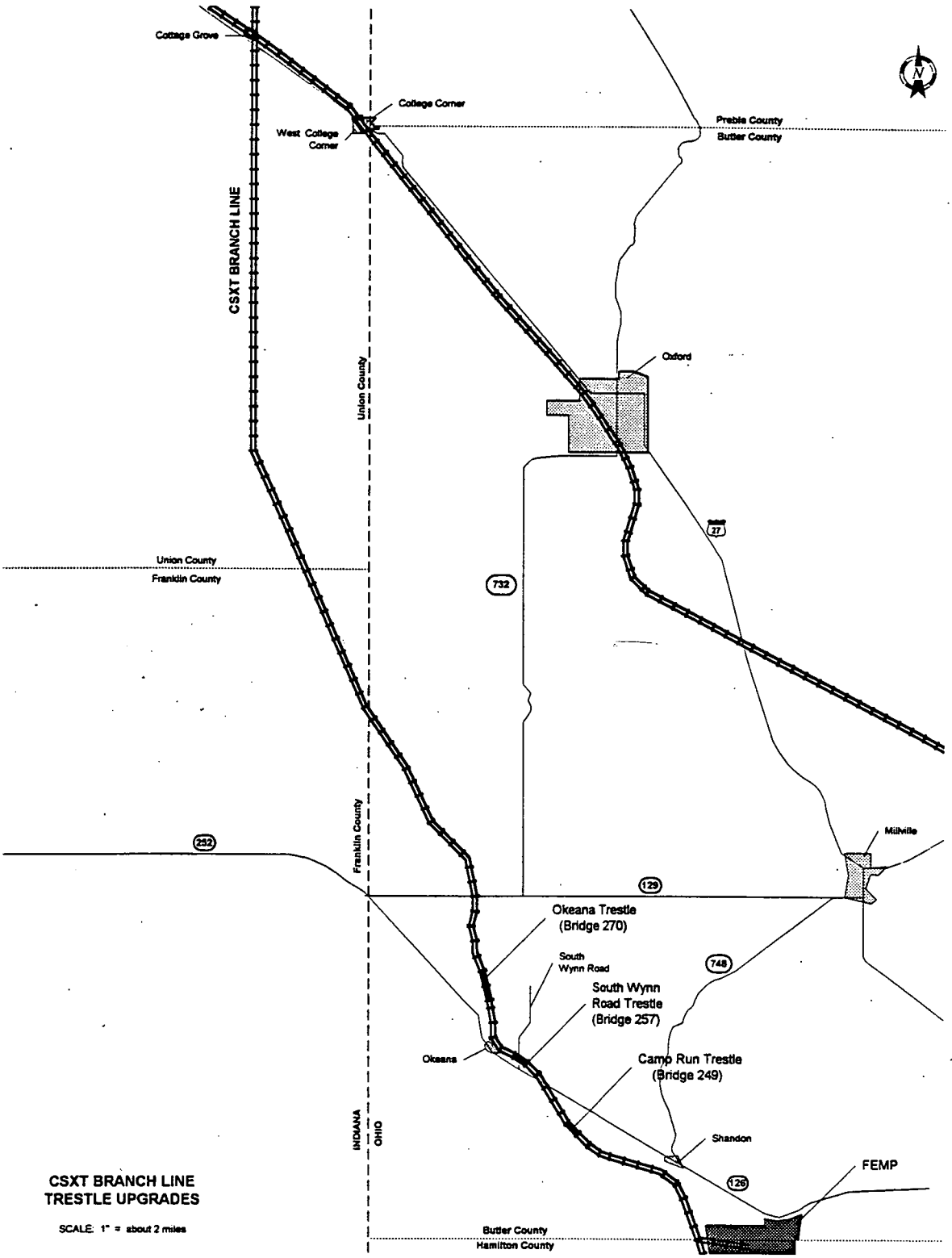


Figure 1 - CSXT's Branch Line from the FEMP to Cottage Grove, IN

received substantial maintenance since the time of construction and, reportedly, are adequate for current rail traffic. The bridges/trestles are routinely inspected for:

1) Track condition
2) Superstructure
3) Substructure
4) Waterway obstructions (if applicable)

CSXT has advised the FEMP that the use of the Branch Line to safely support the proposed, additional train traffic which will be new to this Branch Line, will require that three of the bridges/trestles on the Branch Line be strengthened. Specifically, although suitable for current traffic levels, CSXT has advised the FEMP that these three bridges/trestles would have to be upgraded prior to the commencement of rail traffic associated with this project. The three bridges/trestles, as they have been identified by CSXT (including their respective bridge numbers) are identified below and shown on Figure 1:

1) Camp Run (Bridge #249)
2) South Wynn Road (Bridge #257)
3) Bucks Run and road (Bridge #270), also known as the Okeana Trestle

The structure of primary concern is the 846 foot long and 65 foot high "Okeana Trestle" of which 646 linear feet is timber construction, as shown in Figure 2. Generally, the upgrade of the "Okeana Trestle consists of the replacement of the 646 feet of timber trestle with an open timber deck steel girder superstructure. The substructure will consist of steel pile bents or steel towers supported by concrete footings with piling.

Upgrades to the other two bridges/trestles are expected to be minor.

Specifics relative to the upgrades of all three of the bridges/trestles will be defined by CSXT and/or its subcontractor through the design and subsequently implemented by CSXT and/or its subcontractor. Any upgrades will reflect nominal disruption of the current rail traffic.

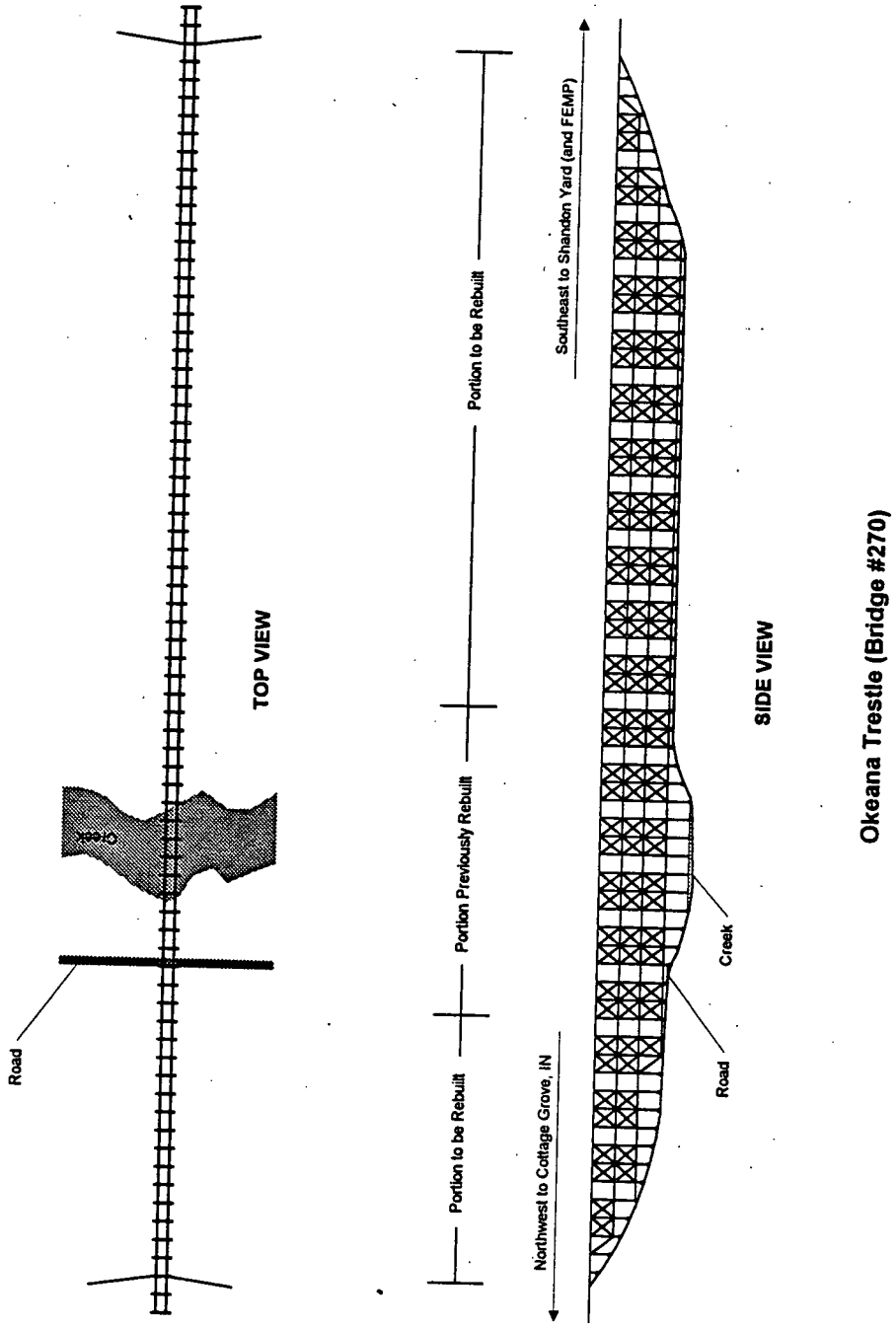


Figure 2 - Figure of the Okeana Trestle (Bridge #270)

CONSTRUCTION SCHEDULE

Construction Schedule for Proposed Remedial Facilities for OU1 Remediation

Prepared by

The Fernald Environmental Restoration Management Corporation
Under Contract No. DE-AC05-92OR21972
with the United States Department of Energy

Construction Schedule

1.0 SUMMARY

The schedule for construction of the remedial facilities for Operable Unit 1 (OU1) is based on the engineering concepts incorporated into the Preliminary Design Package as identified in the Remedial Design Work Plan (RDWP) for OU1.

Key features of the Construction Schedule are the following:

1) The Construction Schedule presented herein is consistent with the FEMP's "10-Year" Plan. The 10-Year Plan is an integrated overall plan for the FEMP with the goal to complete the remediation within a ten-year period commencing in FY 1996 and ending in FY 2005. Consistent with the 10-Year Plan is a projected completion date for the remediation of Operable Unit 1 by the second quarter of FY 2005. The Construction Schedule shows that Operable Unit 1 expects to initiate offsite shipment of waste by July 1998.

   As the remedial design and operational planning progresses, DOE will formally identify a proposed start date for the processing and shipment of waste in the Remedial Action Work Plan (RAWP). Pursuant to the approved RDWP, the RAWP is scheduled to be submitted to the EPA on October 22, 1996.

2) The schedule shows the plan for the design, procurement and construction of the first phase of remediation facilities for OU1 featuring waste drying at a nominal capacity of 22 tons per hour. Waste processing capacity may be supplemented later after initial operating experience is analyzed and decisions made as to the advisability and need for expanded capacity. The 10-Year Plan envisions the need for increased capacity via operation of a second dryer in FY 2001, although the need for this will be established after initial operations are evaluated. The design provides space for installation of additional capacity however, the activities required to install the additional capacity are not shown on this Construction Schedule.

3) The Construction Schedule shows all of the construction elements required to initiate operation of the OU1 remediation facility. The schedule shows:
   (1) Off-site upgrade of the FEMP to Cottage Grove branch rail line
   (2) On-site (rail) infrastructure development associated with the storage, maintenance, and logistics of railcar management
   (3) Construction of the treatment facilities (dryer, shredder, material handling facilities, etc.)
   (4) Site preparation activities

4) The schedule illustrates that OU1 will be meeting the requirement of Section 120(e)(2) of Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) for commencing substantial continuous, onsite physical remedial action not later than 15 months after signing the Record of Decision (ROD) i.e., by June 1, 1996. Pertinent to that demonstration, and as presented in the RDWP and as illustrated on the Construction Schedule are the following:

(1) Construction of site preparation facilities is scheduled to commence in April 1996. These activities prepare the way for the installation of equipment and foundations needed for the plant and for the expansion of the onsite rail.

(2) Award of contracts for major equipment acquisition, including the dryer, the shredder, off-gas treatment system and the material handling equipment. Contract award for the equipment is scheduled for April 1996.

Additional activities which will occur during the 15-month post-ROD period are:

(1) Design and construction of the upgrades and repairs to the bridges and trestles along the FEMP to Cottage Grove branch line. Award for the design portion of this work is anticipated in October 1995.

(2) Construction of support facilities (parking areas, administrative offices, change-out and break-out facilities) to be utilized first by the construction forces building the plant facilities and then by the operating personnel. The construction of these structures was completed in September 1995; they are now operational.

2.0 BRIEF SYNOPSIS OF THE CONSTRUCTION SCHEDULE FOR OU1

The project may be divided into four distinct construction actions: (1) The repair and refurbishment of the Branch rail line extending from the FEMP to Cottage Grove, IN; (2) site preparation activities; (3) the expansion of the on-site rail based infrastructure; and, (4) the installation of the processing plant.

Illustrated on the schedule are the design activities required to prepare the Certified for Construction (CFC) bid package(s). A CFC package is the technical basis for the construction contractor, who will be installing and erecting the equipment comprising plant and related facilities, to bid and ultimately enter into contract with DOE (and its onsite contractor) for construction of the plant. There are four CFC packages shown on the Construction Schedule. A CFC package is required for:

(1) Construction of the processing plant

(2) Performing site preparation activities

(3) Installing the on-site trackage after the site preparation activities have readied the rail bed areas, and,

(4) Construction of the Branch Line trestle and bridge improvements, i.e. the required offsite rail upgrades

While each of the CFC packages is important to the overall success of the project, the critical path of the Construction Schedule passes through the design activities leading to the issue of the CFC package for the processing plant. Developing and awarding this package requires that the Title II (detailed) design be complete. Completion of the Title II design in turn requires integration of drawings and related equipment-specific engineering data for major equipment items, such as the shredder, the dryer, the off-gas system, the buildings, and the (major) material handling equipment into the design of the balance of the processing plant. Early procurement of this equipment is critical to the success of the project. The CFC package for the processing plant then provides complete installation details for equipment, plant services and utilities.

The acquisition of the major equipment required for construction of the processing plant therefore occurs in two steps. First, the engineering data and shop drawings are acquired so that the Title II design of the processing plant and the CFC package can be completed and then the authorization to fabricate the equipment is issued consistent with the funding allocations of the 10-Year Plan.

Once the CFC package for the processing plant is prepared, a procurement action to bring a construction firm into contract is undertaken. According to the Construction Schedule, award of this contract is shown to take place in February 1997.

While the Title II Design is being finalized, notification is provided to the vendors of the equipment to commence fabrication. Most of the equipment required for this construction requires a relatively long lead time before delivery can occur. For example, for the dryer, inquiries with vendors indicate that probable fabrication and delivery times range from 8 to 10 months. As is shown on the Construction Schedule, the fabrication and delivery of the major equipment is shown to coincide with the arrival on site of the selected construction contractor, fully mobilized ready to install the required foundations to set the equipment.

For the site preparation action the engineering is expected to be completed in February 1996, with the issue of a CFC package. Construction (field activities) are scheduled to commence in April 1996. The site preparation activities are precursor actions required both for the establishment of the site grade and utility interconnection required for the processing plant, and for the expansion of the onsite tracks. Funding to support site preparation has been allocated to OU1 in FY96.

To accommodate the expansion of the on-site rail facilities, a CFC package is scheduled for issue in May 1996. The services of a specialty contractor to lay the trackage will be procured. Installation is planned to commence in October 1996. Funding to support this activity has been allocated to OU1 (per the 10-Year Plan) in FY97.

The final construction action presented on the schedule concerns the off-site improvements on the FEMP to Cottage Grove branch rail line. This placement to CSX Transportation involves contract award for the engineering design for the upgrades in October 1995 followed by construction of the upgrades in August 1996. Funding for the offsite rail engineering and construction action has been provided in FY96.

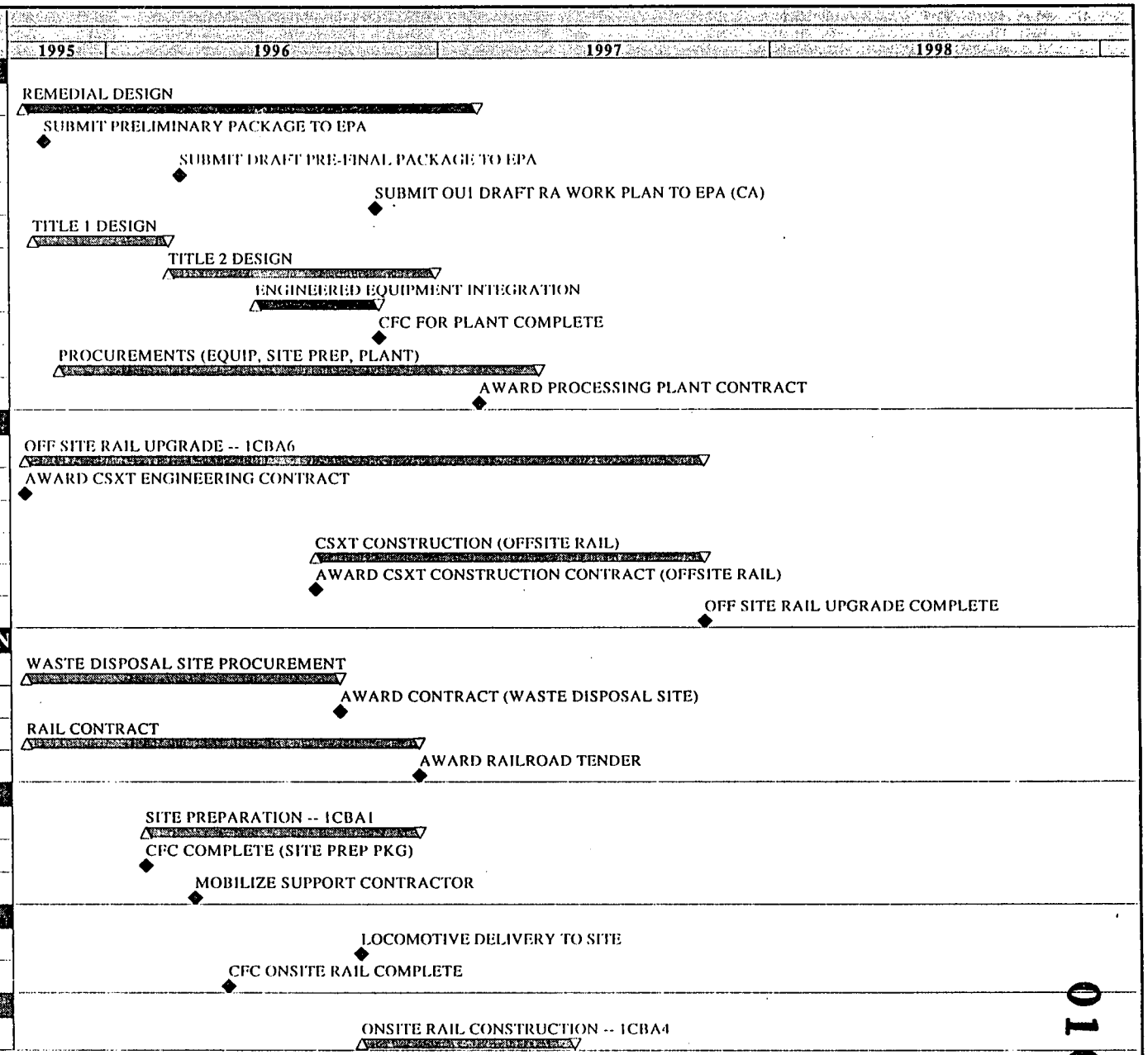
Additional actions involving contracting with a Permitted Commercial Disposal Site for the offsite disposal of the OU1 waste, forming a tender (or contract) arrangement with a railroad for transporting the waste offsite; acquiring, either through lease or purchase, gondola type rail cars; purchasing or leasing of rail car covers; and, purchasing of liners all occur during the same time frame, but are not on the critical path.

As can be seen from the construction schedule the anticipated date for operational startup is July 1998. As noted above the Remedial Action Work Plan for OU1 will formally identify the proposed operational startup date.

3.0 ASSUMPTIONS

1) The 10-Year Plan is based overall on the provision to the FEMP of approximately $256 Million in FY 1996 and $276 million, unescalated 1995 dollars thereafter (through FY 2005).

Activity ID	Early Start	Early Finish
REMEDIAL DESIGN		
1CAA453000	02OCT95	11FEB97
1CAA453020		24OCT95
1CAA453050		21MAR96
1CAA300002		22OCT96
1CAA453075	11OCT95	07MAR96
1CAA453098	08MAR96	26DEC96
1CAA453111	11JUN96	24OCT96
1CAA453140		24OCT96
1CAA454000	08NOV95	18APR97
1CAA454550		11FEB97
OFFSITE RAIL UPGRADE		
1CBA600000	02OCT95	16OCT97
1CBA600150	02OCT95*	
1CBA600181		24SEP93
1CBA600250	14AUG96	16OCT97
1CBA600300	14AUG96	
1CBA600600		16OCT97
REMEDIAL ACTION IMPLEMENTATION		
1DEA100100	02OCT95	09SEP96
1DEA100195		09SEP96
1DEA100200	02OCT95	05DEC96
1DEA100240		05DEC96
SITE PREP		
1CBA100000	08FEB96	04DEC96
1CBA100445		07FEB96
1CBA100500		01APR96
RAIL UPGRADE DESIGN		
1CAA803799	01OCT96	
1CAA803812		07MAY96
ONSITE RAIL CONSTRUCTION		
1CBA400000	01OCT96	22MAY97



Sheet 1 of 2

OU1 Waste Pit Remediation Baseline Schedule (Page 1 of 2)

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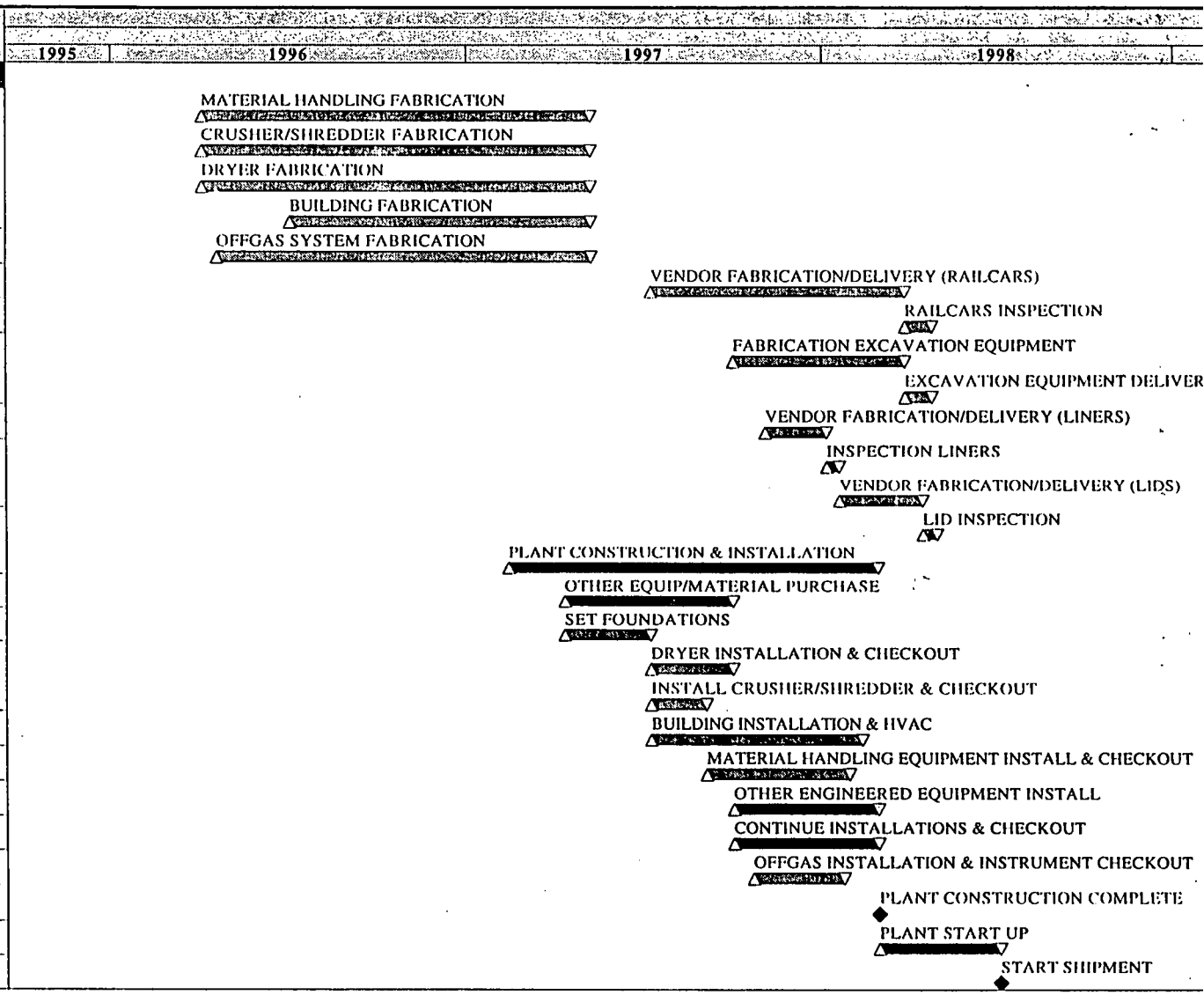
OU-1\PO-145\CONSCHED

000750

OU1 Waste Pit Remediation Baseline Schedule (Page 2 of 2)

Activity ID	Early Start	Early Finish
PLANT CONSTRUCTION		
1CBA204800	03APR96	08MAY97
1CBA204900	03APR96	08MAY97
1CBA204600	03APR96	08MAY97
1CBA205080	03JUL96	08MAY97
1CBA204700	18APR96	08MAY97
1CBA205105	08JUL97	26MAR98
1CBA205110	27MAR98	24APR98
1CBA204570	01OCT97	26MAR98
1CBA204575	27MAR98	24APR98
1CBA205305	03NOV97	05JAN98
1CBA205310	06JAN98	19JAN98
1CBA205205	19JAN98	14APR98
1CBA205210	15APR98	28APR98
1CBA202051	12FEB97	26FEB98
1CBA200010	10APR97	30SEP97
1CBA204000	10APR97	07JUL97
1CBA205500	08JUL97	30SEP97
1CBA207000	08JUL97	02SEP97
1CBA207175	08JUL97	11FEB98
1CBA207100	03SEP97	28JAN98
1CBA207150	01OCT97	26FEB98
1CBA207200	01OCT97	26FEB98
1CBA206500	22OCT97	21JAN98
1CBA208000		26FEB98
1CBA208100	27FEB98	01JUL98
1CBA208500		01JUL98



Project Start	01JAN90	Early Bar
Project Finish	08MAY15	Progress Bar
Data Date	27SEP95	Critical Activity
Plot Date	20OCT95	

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Sheet 2 of 2

OU1 / ADS 46-B2 WASTE PITS
REMEDIAL ACTION PROJECT SCHEDULE
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10/23/95, 7:22am, Rev. No.: A

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Operable Unit 1 Remedial Design
Preliminary Design Package II

Fernald Environmental Management Project
Fernald, Ohio
Fernald Area Office

October 1995

United States Department of Energy

000751

Department of Energy
Fernald Environmental Management Project
P. O. Box 398705
Cincinnati, Ohio 45239-8705
(513) 648-3155

OCT 23 1995

DOE-0084-96

Mr. James A. Saric, Remedial Project Director
U.S. Environmental Protection Agency
Region V - 5HRE-8J
77 W. Jackson Boulevard
Chicago, Illinois 60604-3590

Mr. Tom Schneider, Project Manager
Ohio Environmental Protection Agency
401 East 5th Street
Dayton, Ohio 45402-2911

Dear Mr. Saric and Mr. Schneider:

OPERABLE UNIT 1 SUBMITTAL OF DRAFT PRELIMINARY ENGINEERING PACKAGE

Reference: Letter, J. Reising to J. Saric and T. Schneider, "Integrated Remedial Planning," dated October 12, 1995.

In accordance with the approved Remedial Design Work Plan (RDWP) for Operable Unit 1 (OU1), this letter transmits the Draft Preliminary Engineering Design for review and comment. The submittal contains the following seven elements identified in the approved RDWP for OU1:

- Plant Facilities Design Criteria Document;
- Plant Facilities Engineering Description;
- Equipment Specifications;
- Site Improvement Plan;
- Construction Schedule;
- Excavation Plan; and
- Transportation and Disposal Plan.

Recycled and Recyclable

The RDWP for OU1 also called for the submittal of a Site Restoration Plan. However, in accordance with agreements and understandings concerning the Integration of Remedial Actions at the Department of Energy, Fernald Area Office (DOE-FN), (Ref 1), an overall Site Restoration Plan will be submitted pursuant to the design process presented in the forthcoming Operable Unit 5 (OU5) RDWP.

The DOE-FN is continuing its ongoing work to refine and complete this design. The EPA comments will be addressed in a Comments Response Document (CRD) and incorporated as appropriate into the Pre-Final Design submittal scheduled for March 21, 1996.

If you have any questions or comments, please contact Dave Lojek at (513) 648-3127.

Sincerely,

Johnny Reising

FN:Hall

Johnny W. Reising
Fernald Remedial Action
Project Manager

Enclosure: As Stated

cc w/enc:

K. H. Chaney, EM-423/GTN
B. Skokan, EM-423/GTN
G. Jablonowski, USEPA-V, 5HRE-8J
Manager, TSPP/DERR, OEPA-Columbus
F. Bell, ATSDR
D. S. Ward, GeoTrans
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T. Hagen, FERMCO/65-2
AR Coordinator, FERMCO

cc w/o enc:

C. Little, FERMCO
M. Yates, FERMCO

Operable Unit 1 Remedial Design Preliminary Design Package II

Fernald Environmental Management Project
Fernald, Ohio
Fernald Area Office

October 1995

United States Department of Energy

EXCAVATION PLAN

Waste Excavation Plan for the Operable Unit 1 Remediation System Design

Operable Unit 1
Project Order 145

October 1995
Revision C

Environmental Remedial Action Project
Fernald Environmental Management Project
Fernald, Ohio
FERMCO Subcontract No. 2-21487

PARSONS

25 Merchant Street
Springdale, Ohio, 45246

Waste Excavation Plan for the Operable Unit 1 Remediation System Design

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LIST OF ACRONYMS AND ABBREVIATIONS

ALTER	Accelerated Life Testing and Environmental Research
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CPT	Core Penetrometer Test
CRU.	CERCLA/RCRA Unit
DAC	Derived Air Concentration
DEEP	Dewatering and Excavation Evaluation Program
EPDM	Ethylene Propylene Diene Monomer
FID	Flame Ionization Detector
FEMP	Fernald Environmental Management Project
MDD	Maximum Dry Density
mrem	millirem
OPDF	On Property Disposal Facility
OMC	Optimum Moisture Content
OU	Operable Unit
PID	Photoionization Detector
PSMS	Pit Stormwater Management System
RCRA	Resource Conservation and Recovery Act
RI/FS	Remedial Investigation/Feasibility Study
SPT	Standard Penetration Test
tph	tons per hour
WAC	Waste Acceptance Criteria
VOC	Volatile Organic Compound

SECTION 1

INTRODUCTION

This report reviews the excavation method and presents the waste excavation plan proposed for Operable Unit 1 (OU1). OU1 consists of six waste pits, a Burn Pit, and a Clearwell. The six waste storage pits constructed at the Fernald Environmental Management Project (FEMP) are referred to as "wet" or "dry" pits, depending on the state of the material at the time it was placed in the pit. A pit that received slurries is classified as a "wet" pit, while a pit that received dry solids is classified as a "dry" pit. Waste Pits 1, 2, 4, and Burn Pit are "dry" pits; Waste Pits 3, 5, and 6 are "wet" pits.

1.1 Excavation Methods

The review focuses on a top and bottom excavation method wherein one set of equipment is located on top of the pit cap to strip the cap and waste, and a second operation simultaneously completes waste removal from the pit bottom. Equipment operations are not planned or anticipated to occur on pit wastes. Operations will be from on top pit caps, on the pit bottoms, on existing berms or on constructed ramps.

For the preferred top and bottom approach, a number of contingency measures are presented that respond to or accommodate unexpected waste or stability conditions. Also, various aspects of the operation, such as the most efficient equipment types are presented to optimize the overall approach.

1.2 Review Methodology

The waste excavation plan is a review and conceptualization of the top and bottom excavation approach. The review uses data from Pits 3 and 5 since these pits are the deepest and have the most difficult wastes to excavate and handle. Excavation in Pits 1, 2, 4, and in the Burn Pit will be similar to Pit 3. Excavation in Pit 6 and Clearwell will be similar to that of Pit 5.

Both Pit 3 and Pit 5 (and possibly most of the other pits) are expected to contain some flowable wastes. However, for better efficiency in subsequent water removal steps, mechanical excavation is preferred and is the planned excavation method. (If there are any wastes that cannot be excavated mechanically, hydraulic excavation is retained as a contingency method. For waste volumes that need to be hydraulically excavated, pumping will be done without the addition of slurrying water.) Therefore, mechanical excavation is the focus of this study. To the extent possible (and the most cost effective), water removal is maximized in the pit area either prior to and/or in conjunction with the waste excavation. Pit 4 has been identified as a hazardous waste management unit. This is not expected to change the basic excavation methodology presented in this plan.

1.3 Status with Respect to DEEP Information

Based on the Dewatering and Excavation Evaluation Program (DEEP) information available thus far on the waste strengths, a review of the top and bottom excavation method has been made. Review and analysis of (partial results) waste strength test data from Pits 1, 2, and 3 indicates that the excavation faces will maintain minimum slopes of approximately 3H:1V without the need or further benefit of dewatering. The remaining waste strength tests, dewatering results, and the final DEEP test (which includes excavating ramps through the pit caps and into the wastes in Pits 1 and 3) is expected to provide suitable data for the final and complete acceptability of the top and bottom approach excavation method.

The most current DEEP information, data, and status is presented in the accompanying DEEP report, "Preliminary Technical Summary of DEEP Test Data, Rev A," (PARSONS 1995a).

1.4 Waste Pit Descriptions

This section provides a general description of the configuration and origin of the contents of each of the waste pits. Narratives for this section were obtained from the OU1 Waste Pit Content Study Report (Rev. 0, PARSONS 1993). The purpose of this section is to provide basic information about the construction and operation of Waste Pits 1 through 6, the Clearwell, and the Burn Pit. For additional detail, reference the above mentioned report. See Sketch SK-G-03936 at the end of this section for a plan view of the waste pits and the proposed waste processing facilities.

1.4.1 Waste Pit 1

The waste pit footprint is oval, and the pit is approximately 165 feet wide by 350 feet long by 29 feet deep. The bottom of Waste Pit 1 slopes approximately 1 foot from the east to the west side. Four feet of low permeability materials was placed in the southeast corner of Waste Pit 1. A sump area, lined with approximately 6 feet of low permeability material, was constructed in the southwest corner of Waste Pit 1. A trench that is 11-12 feet wide and 10 feet deep was excavated around the bottom of the waste pit and backfilled with low permeability material. The low permeability material used in the construction of Waste Pit 1 was obtained from excavating clay from the area which would later become the Burn Pit.

The majority of the materials placed in Waste Pit 1 were dry solids including neutralized waste filter cakes, production plant sump cakes, depleted slag (magnesium fluoride), scrap graphite, contaminated brick, and sump liquor. The following materials were routinely dumped into Waste Pits 1, 2, or 3: trailer cake from Plant 8, neutralized filtrate from uranyl ammonium phosphate cake from Plant 8 (including sump liquor), General Sump slurry from the Ore Refinery (including neutralized raffinates), broken graphite molds from Plant 5, chemical feed sump residues from the Water and Boiler Plants, hand cleaned and moistened residues by the residue crew, and cooling water from heat treating operations in Plant 6. The feed sump residues from the Water and Boiler Plants and cooling water from the heat treating operation were disposed of using a tank truck. The hand cleaned and monitored residues were

disposed of with the use of a truck. Rainwater from the pipe trench in the K-65 area was pumped into the south end of Waste Pit 1 through an existing pump. Waste acid filter cake from Plant 8, depleted C-liner from the Storage Pad and Plant 5, and sump cake from Plant 7 were disposed of in Waste Pit 1.

1.4.2 Waste Pit 2

The Waste Pit 2 footprint resembles a six-sided polygon, and the pit is approximately 190 feet wide by 270 feet long by 23 feet deep. In the southern portion of the waste pit, a small, spring fed pond existed with a typical water elevation of approximately 574 feet. The pond was drained and the pit was constructed by excavating a basin into the existing native clay. At the north end of the pit, trees, stumps, and roots were removed from the bottom of the pit and the area was backfilled with clay to construct an impervious pit. The pit was lined with a compacted, on-site native clay layer. The pit bottom and interior side slopes were lined with 4.5 feet of low permeability material. The low permeability material used in the construction of Waste Pit 2 was obtained by excavating material from the location of the future Burn Pit.

Waste Pit 2 was primarily used as a dry pit, but some wet materials were placed in the pit before Waste Pit 3 was constructed. Waste Pit 2 was filled with semi-liquid, filter cakes, sump liquor, and other aqueous liquids. Waste Pit 2 received dry solids mainly consisting of neutralized waste filter cakes from the production plants, depleted slag, scrap graphite, contaminated brick, and sump liquor.

1.4.3 Waste Pit 3

The pit resembles an irregular oval and is approximately 450 feet wide by 720 feet long by 42 feet deep. Waste Pit 3 was constructed by excavating into an existing low permeability material to an approximate elevation of 548 feet. The west berm was constructed approximately 20 feet above the 1958 ground surface. The north side of Waste Pit 3 had no berm. The east side was formed from the west sides of Waste Pits 1 and 2. The sides of Waste Pit 3 were constructed with a 1.5H:1V interior slope and lined with 12 inches of clay. Some of the excavated soil was used to form the west wall of the pit. Layers of 6- to 8-inches were placed on the sides and compacted with a sheepsfoot roller. A natural layer of low permeability material forms the bottom of the pit. Additional clay material was not placed in the bottom of the pit. Spoil areas for the construction of Waste Pit 3 were located due north of the pit and west of the pit; topsoil was placed further north of the pit. The spoil area due north was graded to an approximate elevation of 575 feet.

From 1959 to 1968, Waste Pit 3 was operated as a wet pit for use as a settling basin. Waste Pit 3 was divided into three sections. In August 1959, only one third had been designated for use. This portion of Waste Pit 3 was designated to receive slurries from the Ore Refinery and the Recovery Plant. Material was not to be dumped here until Waste Pit 2 was filled. The majority of the wet material Waste Pit 3 received was lime-neutralized radioactive raffinate concentrate from Plant 8 and the General Sump. The neutralized waste slurry was received through an inlet pipe at the north end of the pit. The solids settled

in the pit, while the supernatant liquid flowed through weirs at the south end of the pit into the Clearwell. Contaminated rainwater from the Burn Pit area was pumped into the north end of Waste Pit 3 with the use of a portable pump. The slurries from the Ore Refinery (Plant 2/3) and the Recovery Plant were pumped to Waste Pit 3. The solids settled out while the clear liquid passed over a weir to the Clearwell. In the late 1960s, an area was dug in the north end of the pit and wooden pallets were placed in this area and then crushed with the bulldozer.

1.4.4 Waste Pit 4

The footprint of Waste pit 4 resembles a trapezoid, and the pit is approximately 380 feet wide by 310 feet long by 32 feet deep. Waste Pit 4 was constructed with interior side slopes of 2H:1V. Waste Pit 4 was lined with 1 to 2 feet of low permeability material.

Depleted uranium residues, low grade thorium residues, contaminated ceramics, and general refuse were discarded without treatment into Waste Pit 4. The depleted uranium residues (0.142 - 0.40 percent U-235) were either not suitable for remelt or it was not economically feasible to recover the uranium. Thorium residues were placed in the pit when it was not economically feasible to reprocess the residues. The ceramics were from production electric furnaces. From 1975 until 1984 the majority of the filter cakes from Plant 8, resulting from the filtration of neutralized raffinates and sludges accumulated in the General Sump tanks, and recycled slurries from Waste Pit 5 were classified as dry waste and deposited into Waste Pit 4. Waste Pit 4 also received process residues, trailer cakes, slurries, raffinates, graphite, non-combustible trash, and asbestos. Waste Pit 4 received construction rubble, crucibles, and contaminated asbestos. Trash, cans, drums, graphite, graphite crucible molds (13 inches in diameter and 3 feet tall), solid abrasive materials, uranium metal, magnesium fluoride, concrete, ceramics, drummed residues of uranium materials, pyrophoric chips and fines, concrete, thorium, and asbestos were deposited in Waste Pit 4. At least 100 drums were deposited on the west side of Waste Pit 4. From 1980 to 1983 barium chloride was disposed of in Waste Pit 4. Between May 1981 and April 1983 Waste Pit 4 received approximately 23,500 pounds of low-level radioactive waste containing barium chloride heat treatment salt.

1.4.5 Waste Pit 5

The footprint of Waste Pit 5 is rectangular, and the pit is approximately 820 feet long by 240 feet wide by 30 feet deep. The pit extends about 15 feet above the original grade on the south side and 14 to 20 feet above grade on the north side. The pit was lined with a 60-mil thick Royal-Seal ethylene propylene diene monomer (EPDM) Elastomeric Membrane. Seepage was encountered during excavation of the pit. The areas where seepage occurred were over excavated and filled with clay prior to installing the liner.

The bottom elevation of Waste Pit 5 is 560 feet at the east side and 558.5 feet at the west side. Waste Pit 5 was constructed with interior side slopes of 2.5H:1V. The top of the waste elevation is approximately 588 feet. Hence, the maximum depth of waste is approximately 30 feet deep.

Waste Pit 5 was placed in service on October 21, 1968. Liquid wastes from all of the plants were pretreated and then sent to the General Sump. At the General Sump, thorium wastes were co-precipitated with barium carbonate and aluminum sulfate to reduce the activity of the Ra-228, and then pumped to Waste Pit 5. Uranium wastes were treated at the General Sump with CaO to adjust the pH to obtain a maximum precipitation of the radioactive material, and then pumped to Waste Pit 5. Until 1984 sludges which settled in the General Sump were sampled and, if the total content of radioactive materials was within pre-set allowable discard limits, the sludges were sent to Waste Pit 5. All of the liquid waste entered Waste Pit 5 through a pipe in the eastern end of the basin. The uranium and thorium containing solids settled out and remained in the pit while the supernatant liquor overflowed through an effluent tower in the southwest end of the pit where it subsequently flowed to the Clearwell. Waste Pit 5 also received neutralized raffinate settled solids, slag leach slurry, sump slurries, and lime sludge from Plant 2/3 and Plant 8.

1.4.6 Waste Pit 6

Waste Pit 6 is square with each side approximately 210 feet long. It is approximately 24 feet deep. Waste Pit 6 was constructed in the same manner as Waste Pit 5 and was also lined with a 60-mil EPDM liner. The bottom elevation of Waste Pit 6 is 560 feet, and the elevation of the top of the waste is approximately 580 feet. Therefore, the depth of the waste material is approximately 20 feet.

Waste Pit 6 received non-coarse, non-pyrophoric solid wastes including depleted slag, green salt, filter cakes, and process residues. Excess rainwater that collected in Waste Pit 6 was pumped to Waste Pit 5 and then discharged to the Clearwell. Material was bulldozed or clam-shelled into the waste pit. Depleted sump filter cake from all of the plants, fine depleted slags, decladding "blue" water, and heat treated quench water were deposited into Waste Pit 6.

1.4.7 Burn Pit

The Burn Pit was used to burn materials such as laboratory chemicals, combustible materials (including pyrophoric and reactive chemicals), oils, and low-level contaminated combustible material. The Burn Pit was also used to burn cafeteria debris, cans, napkins, and skids when the Sewage Treatment Plant incinerator was inoperable.

1.4.8 Clearwell

The footprint of the Clearwell resembles a trapezoid, and the pit is approximately 200 feet long by 180 feet wide by 27 feet deep. The east, west, and south side of the Clearwell were constructed with a

1.5H:1V interior slope; while the north side was constructed with a 2H:1V interior slope. All of the sides were lined with 12 inches of clay.

The west berm was constructed approximately 20 feet above the 1958 ground surface. The north side is adjacent to the south side of Waste Pit 3. The east side was formed from the west side of Waste Pit 1.

The Clearwell was constructed by excavating into an existing low permeability material to an approximate elevation of 548 feet. Additional clay material was not placed in the bottom of the Clearwell. There is approximately 11 feet of decant solid waste in the bottom of the Clearwell.

The Clearwell received surface water runoff from all of the pits and liquid from Waste Pits 3 and 5. The Clearwell was used as the final settling basing before water discharged to the Great Miami River.

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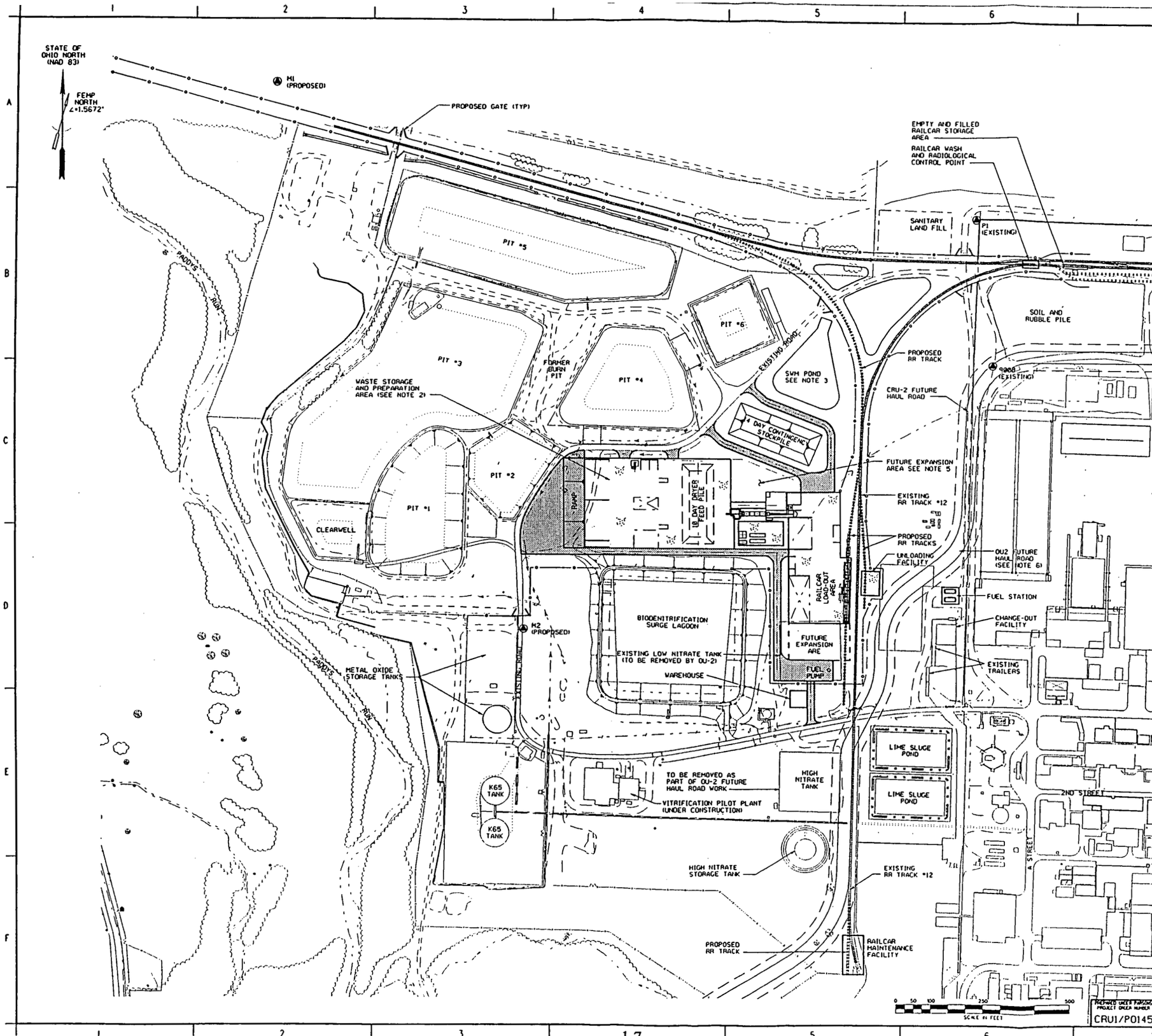

NOTES

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1. EXISTING CONDITIONS SHOWN ON THIS DRAWING WERE PREPARED FROM FEMP SITE PROVIDED DATA FROM THE DOCUMENTS LISTED BELOW.

   EXISTING SITE DATA SOURCE (IN PLANT FILES)
   FEMP 1992 FLYOVER SURVEY
   FEMP CONTRACTOR PROJECT DESIGN DOCUMENTS

2. FOR DETAILED EQUIPMENT LAYOUT, SEE MATERIAL HANDLING SKETCHES SK-M-03917, SK-M-03919 AND SK-M-03921.

3. STORMWATER MANAGEMENT (SWM) POND SIZED TO MANAGE THE 25-YEAR, 24 HOUR STORM, WITH A 100-YEAR STORM EMERGENCY OVERFLOW TO PADDYS RUN. SEE CONCEPTUAL UTILITY PLAN, SK-G-03666.

4. 14 DAY CONTINGENCY STOCKPILE TO BE OPEN SIDED ROOF COVERED.

5. IF ADDITIONAL FUTURE EXPANSION AREA IS REQUIRED, 14 DAY CONTINGENCY STOCKPILE AND THE ACCESS ROAD JUST SOUTH OF THE STOCKPILE WILL BE REMOVED.

6. COORDINATION OF OU2 HAUL ROAD CONSTRUCTION AND UNLOADING RAILROAD SPUR IS REQUIRED.

LEGEND

EXISTING		PROPOSED
	ROAD/PAVEMENT	
	RAILROAD	
	STRUCTURE	
	FENCE	
	SURVEY MONUMENT	
	CONCRETE PAD	

REF DWG NO.	DRAWING TITLE
SK-M-03917	FEED PREPARATION AREA
SK-M-03919	DRYING FACILITY
SK-M-03921	BLENDING AND RAIL LOADOUT FACILITY
SK-G-03666	CONCEPTUAL UTILITY PLAN

PRELIMINARY
NOT FOR CONSTRUCTION

REV. NO.	ISSUE OF REVISION PURPOSE - DESCRIPTION	AE	FERNCO	DATE
B	ISSUED FOR CONCEPTUAL DESIGN (CLIENT COMMENTS INCORPORATED)			
A	ISSUED FOR CONCEPTUAL DESIGN			

INITIALS AND 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
OU1 REMEDIATION SYSTEM DESIGN

DRAWING TITLE
CIVIL
CONCEPTUAL SITE PLAN

DRAWN BY	DATE	LEAD ENGINEER	DATE	CHECKED BY	DATE
Y. AFSHAR	9-22-95			K. GERARD	9-25-95
PLANT/BLDG NO		FLOOR		SCALE 1"=100'	CLASS
SUBMITTED FOR APPROVAL		FERNCO			

000766

AE DOE PROJECT NO.	DATE	FERNCO PROJECT NO.	DATE	DRAWING INDEX CODE NO.	SHEET NO.	REV. NO
		VBS I.I.I.I.I.3.I 00-90701		SK-G-03936	0001	B

PREPARED UNDER PARSONS PROJECT ORDER NUMBER CRU1/PO145

10/19/95, 2:23pm, Rev. No.: C

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OU-1\PO-145\EX-EVAL

SECTION 2

CRITERIA AND ASSUMPTIONS

2.1 Criteria

The following criteria were considered in the evaluation.

1) Operator Safety - Variation in waste composition and soil conditions make excavation operations less predictable. Personnel and equipment maintain a safe distance from excavated slopes in the pit cap and pit bottom.

2) Segregation - To process waste in an orderly fashion, segregation of waste types (i.e., debris, excessively wet material, drier materials) start at the excavation.

3) Stormwater - Existing perimeter stormwater controls are kept intact. Runon into excavation areas is minimized to reduce the volume of water sent to treatment. Stormwater and water freely draining from the waste in the excavations is collected. Suspended solids are removed. Additional methods of pretreatment could be necessary and are being investigated. Storm and wastewater are transferred to the Clearwell. From the Clearwell, water is transferred to the Biodenitrification Surge Lagoon and then conveyed to the FEMP wastewater treatment system for final treatment prior to discharge.

   Note: Stormwater associated with the 11 acres for the new processing facilities will be handled separately.

4) Process - The excavation process is designed to provide a steady stream of waste that is readily adaptable to variable drying and mixing rates. The drier the excavated material, the better the efficiency of operation.

5) Reclamation - The pits are remediated in a logical sequence that permits phased reclamation to natural drainage.

6) Infiltration - Infiltration of contaminated water from the waste to surrounding soils is minimized.

7) Airborne Emissions - The release of fugitive dust is minimized.

2.2 Assumptions

During the evaluation of the top and bottom excavation approach, the following assumptions are made. Various ongoing programs (i.e., DEEP) will determine the validity of some of these assumptions.

1) Many of the waste types particularly those encountered in Pits 3 and 5 have very low strengths and high moisture contents. It is assumed that the waste has sufficient strength to maintain a workable and stable slope and that pit caps can support excavation equipment. Initial DEEP strength data indicate undewatered wastes have adequate strength to maintain workable excavation slopes. Remaining DEEP geotechnical lab data will provide the final information for estimation of stable slope configuration. However, recommendations for slope adjustments in the field are to be made at the discretion of a qualified and competent field geotechnical engineer.

2) The potential for gas and particulate airborne emissions at the pits is assumed to exist. It is also assumed that these emissions are manageable and controllable to acceptable levels with readily available measures. Additional study during future stages of plan development will determine the validity of these assumptions.

3) It is assumed that blending (for material characteristics) of waste, as a part of the excavation operations, commences at the excavation.

4) Equipment support system control for the operator (such as air supplied enclosed cab) and/or personal protective equipment requirements are assumed to be the same at the top and at the bottom of the pits.

5) The FEMP wastewater treatment system is assumed to be able to handle the quantity of storm and wastewater from the OU1 construction area and operating facility. (The quantity of water will be determined during detail design). Temporary storage of storm and wastewater may be required and will be based on the 25-year, 24-hour storm. Waste Pit area storm and wastewater is managed separately from storm and wastewater in the waste processing area. Both streams ultimately enter the Biodenitrification Surge Lagoon for treatment by the FEMP wastewater treatment system.

SECTION 3

PIT EXCAVATION SEQUENCE

The proposed excavation sequence is as follows: Waste Pits 1, 3, 2, and 4; the Burn Pit; Waste Pits 6 and 5; and the Clearwell (see Figure 3-1). Overlapping or simultaneous excavation of various pits provides the necessary waste mixing from a radiological and moisture control standpoint. Once opened, each waste area is excavated and reclaimed as soon as is practical.

1) Waste Pits 1 and 3 are excavated simultaneously. This is the logical area to initiate the excavation. The heterogenous nature of Pit 3's waste provides an initial representative process stream to the dryer. This allows for a realistic assessment of the facility's performance and can determine future needs or facility deficiencies at an early phase in the remediation. Pit 3 is adjacent to Paddys Run and permits an orderly sequence for reclamation. Waste Pit 1 provides an area to egress into Pit 3's bottom. Hence, the pits are excavated as a unit so that reclamation grading can direct uncontaminated runoff toward the natural drainage at Paddys Run (see Drawing 91X-5900-G-00133) and Subsection 5.2.1 for additional detail.

2) During progress of Pits 1 and 3 operation and excavation, Pit 2 becomes accessible and is available for excavation. Material in Pit 2 is mixed with Pit 1 and 3 waste to meet the WAC requirements. The majority of Pit 2 is excavated from the top. A limited amount of waste will be removed from bottom operations. Access into the bottom of Pit 2 is obtained through the common berm from the bottom of Pit 3.

3) Pit 4 is excavated next. Pit 4 excavation must precede the Burn Pit excavation to maintain berm stability. The Burn Pit's limits and confines are unknown; however, they are very close to those of Pit 4. It is, therefore, important to excavate Pit 4 first and not risk breaching its berm in searching for the Burn Pit's boundary. In this way the Burn Pit's excavation is free to follow a definable site. Pit 4 waste also requires mixing to meet WAC requirements. Pit 3 and Burn Pit waste is available for this. The 6 foot earthen cap on Pit 4 also provides drier material for blending with wet pit wastes.

4) Waste Pit 6 is excavated after the Burn Pit followed by completion of Waste Pit 5 excavation. Excavation within Waste Pit 5 commences early in the operation (the dashed line in Figure 3-1), but is not completed until the other areas have been reclaimed. Pit 5's surface face is cut to allow water to drain from the waste. The wastewater is conveyed by sump and pump to the Pit 5 effluent tower. Waste Pit 5's operation is extended to permit maximum wastewater drainage before excavation. Also, as quantities of drier waste (including pit caps and underlying pit soils) become available, they are mixed with the Pit 5 wastes to keep production levels of waste product high while processing the very wet materials in Pit 5. See Drawing 91X-5900-G-00154 and Subsection 5.2.2 for additional detail.

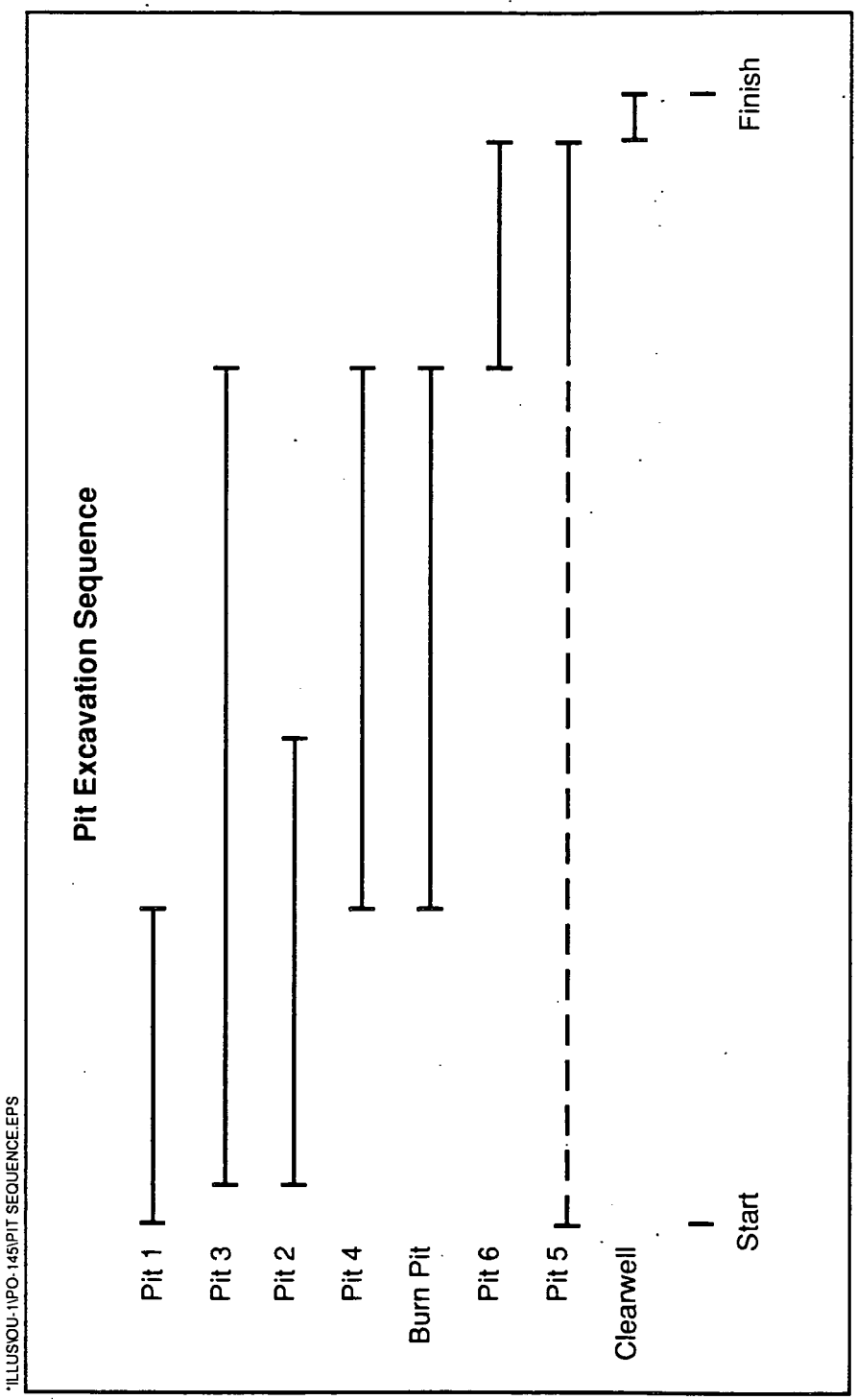

Figure 3-1 - Pit Excavation Sequence

5) The Clearwell is used as part of the stormwater management plan throughout the project; therefore, its reclamation is last. The Clearwell is hydraulically pumped periodically to remove accumulated sediments.

Actual excavation rates (and hence, time frames) for completing each pit are tied to the capacity of the waste processing facilities and, in particular, the dryer. See Table 3-1 for in situ waste volumes. The volumes of contaminated liner and soils below the pits are unknown. The basis for CERCLA/RCRA Unit 1's (CRU1's) estimated treatment volume assumes liners and 1.5 feet of soils below go to the off site disposal facility, and an additional 1.5 feet below this go to the on property disposal facility. It is assumed for this estimate that the remaining soils meet the final remediation levels. The observational approach will be used to guide the excavation and establish the actual depths and resultant material volumes.

Table 3-1 - Waste Pit Volumes[1]

Pit	Waste Volume[2] (yd^3)	Cover Volume (yd^3)	1.5 Feet Below[3] Waste (yd^3)	1.5 - 3.0 Feet Below[4] Waste (yd^3)	Total
1	66,700	1,700	5,200	5,200	78,800
2	33,200	4,200	2,600	2,600	42,600
3	213,800	93,700	13,700	13,700	334,900
4	58,200	14,600	4,700	4,700	82,200
5	97,900	NA	9,600	9,600	117,100
6	9,600	NA	1,900	1,900	13,400
Burn Pit	30,300	NA	2,200	2,200	34,700
Clearwell	4,300	NA	1,900	1,900	8,100
Total	514,000	114,200	41,800	41,800	711,800

(1) Per CRU1 Waste Pit Data dated September 18, 1995.
(2) Includes waste and low permeability soils serving as pit liners.
(3) Approximate volume to be disposed of with the waste at the permitted commercial disposal facility.
(4) Approximate volume to be disposed of at the OPDF.

Excavation rates are designed to meet this demand (over one shift) and be readily adaptable to increased rates if the treatment capacity is later increased. Provisions are made for stockpiling dry cap material

in the waste pit area and for a 14-day waste stockpile at the facility. This will provide flexibility in management of overall waste processing activities.

Once soil remediation progresses to the point where the contamination levels of the remaining soils are below the final remediation levels identified in Table A-2 of Appendix A, reclamation of the pits begins. Although specifics of these reclamation activities are developed as part of the OU5 design process, it is anticipated that any existing berms that meet the final remediation levels are used as backfill to minimize the use of borrow materials from other areas. It is assumed that the berm areas contain some areas of contamination. Accordingly, prior to use of the berm areas for reclamation, these areas (and other surface soil areas within the OU1 boundary) will need to be excavated until the remaining soils are below the final remediation levels identified in Table A-2 (obtained from the OU1 and OU5 RODs).

The final reclamation plan for the waste pit area is an integral part of the overall FEMP site reclamation plan developed as a part of the OU5 design. This excavation plan only covers interim grading for free release of storm runoff to follow a general westerly flow to Paddys Run over a vegetated cover.

SECTION 4

MATERIAL CHARACTERISTICS

As part of the ongoing DEEP Program and previous geotechnical investigations at OU1, geotechnical data are collected to provide for engineering assessment of excavation techniques best suited to remediation objectives. The following DEEP program activities are currently ongoing or interim and available data has been incorporated into this evaluation:

1) Physical properties laboratory test results from Pits 1, 2, and 3 waste materials, including consolidated, undrained triaxial shear strength tests, unit weight, moisture content, other index properties, and compaction test results.

2) Physical properties laboratory test results from Pits 5 and 6 waste materials including undrained triaxial shear strength tests one-dimensional consolidation tests, unit weight, moisture content, other index properties, and compaction test results.

3) Wet excavation/slurry test data, including compaction and bearing tests.

4) Dry excavation test data and evaluation.

An interim DEEP report (PARSONS 1995a) is included as part of this preliminary design package. The interim report contains DEEP data available thus far, and once finalized will provide the basis for geotechnical design. Remaining data are expected to be received in late November 1995.

4.1 Waste/Soil Characteristics for Excavation and Handling

This section provides a general description of the waste materials found in the OU1 waste pits, primarily in terms of soil material classifications. The data were primarily obtained from the OU1 Remedial Investigation/Feasibility Study (RI/FS) and University of Cincinnati Accelerated Life Testing and Environmental Research (ALTER) testing of materials obtained from small diameter samplers (split-spoon and Shelby Tube), and bulk archived sample material from auger boring and grab sampling.

The mixed waste in clay lined pits at the FEMP is, in general, a fine grained physically soil-like material. Typically each waste pit is heterogeneous, and often stratified. In general, the mixed waste in the pits is similar in its grain size distribution. It is composed predominantly of silt size particles. Moisture contents and limits, however, vary widely indicating that the contributing factors to plasticity and moisture holding capacity are not similar between pits. It has been found that the properties of the waste in several of the pits are affected by amorphous materials (ALTER 1994).

The pits, especially the covered pits, also contain debris of various sizes. Various debris, including large pieces of concrete rubble, coarse gravel, planks of lumber, sheet metal, metal bands, and metal wire, were encountered during DEEP wet trenching with a track hoe at various locations at Pits 1, 2, and 3.

The subsections below provides a general description of waste materials from each pit. These descriptions are generally based on data from four reports:

1) *Characterization Investigation Study, Geotechnical Evaluation of Waste Pit Material Properties, and Boring Logs* (WESTON 1988)

2) *Final Remedial Investigation Report for Operable Unit 1* (DOE 1994a)

3) *Cooperative Remedy Screenings Program*, Final Report (ALTER 1994)

4) *CRU1 Dewatering, Excavation Evaluation Program Waste Pits 1, 2, 3*, Interim Report (ALTER 1995)

The descriptions below for Pits 1, 2, and 3 have been updated to include data from the interim ALTER Report. The DEEP report in this preliminary design package summarizes data from these and ongoing laboratory testing.

4.1.1 Waste Pit 1

In general, Pit 1 waste materials behave like nonplastic silts (ML) with little cohesion and low dry strength. Some coarse grained silty sand (SM) (with nonplastic silts) is also present. The moisture contents range from about 16 to 48 percent (by dry weight).

Petroleum odor was observed for some Pit 1 samples. This indicates petroleum products may have an impact, aiding in its nonplastic nature and causing dried Pit 1 waste to repel water (ALTER 1994).

A composite sample of nonplastic silt was formed from low water content, nonplastic materials (NP1) from Waste Pits 1 and 4. A standard compaction test of the NP1 material resulted in an optimum moisture content (OMC) of 13.4 percent and maximum dry density (MDD) of 116 pcf, which compares to values for ordinary soils. A direct shear test of the remolded NP 1 material resulted in a consolidated drained friction angle (ϕ_d) of 40 degrees at 96 percent MDD, which is slightly less than that expected for dense sand (ALTER 1994).

From four unit weight tests of undisturbed DEEP Shelby Tube samples; wet unit weight ranged from 108.5 to 138.1 pcf; and the corresponding dry unit weight range from 74.9 to 115.4 pcf (ALTER 1995).

4.1.2 Waste Pit 2

In general, Pit 2 waste materials range in behavior from nonplastic silts and sands (silt with sand, sandy silt, silty sand) to highly plastic silts (elastic silt, elastic silt with sand, sandy elastic silt). Some lean clays and clayey sands with gravel are also present. Moisture contents range from about 17 percent (lean clay with sand) to 320 percent (nonplastic silt with sand). Moisture content of the elastic silt materials ranges from about 70 to 230 percent (on a dry weight basis).

A composite sample of elastic silt (MH2) was formed to represent MH material with lower liquid and plastic limits (typical of Pits 2 and 3). The material for this composite sample came from Pits 2 and 3. A standard compaction test resulted in an OMC of 35.4 percent and MDD of 77.8 pcf. This density is low for MH soils. A remolded, unconfined compressive strength test of the MH2 material at 96 percent MDD and +2 percent OMC, resulted in an undrained cohesion (c_u) of 1468 psf with a brittle failure mode. A direct shear test of the remolded MH2 material resulted in ϕ_{cd} of 29 degrees at 97 percent MDD (ALTER 1994).

From three unit weight tests of undisturbed DEEP Shelby Tube samples; wet unit weight ranges from 90.0 to 131.2 pcf; and the corresponding dry unit weight ranged from 42.9 to 105.7 pcf (ALTER 1995).

4.1.3 Waste Pit 3

In general, Pit 3 waste materials range in behavior from low plasticity and nonplastic silts and sands (silt with sand, sandy silt and silty sand) to highly plastic silt (sandy elastic silt, elastic silt with sand). Some lean clays are also present. Moisture contents range from about 25 percent (silt with sand) to 197 percent (dry weight basis). Moisture content of the sandy elastic silt material ranges from about 55 to 197 percent.

From four unit weight tests of undisturbed DEEP Shelby Tube samples, wet unit weight ranged from 75.7 to 129.7 pcf; and the corresponding dry unit weights ranged from 25.5 to 110.0 pcf (ALTER 1995).

In-place strength of Pit 3 waste from the DEEP Cone Penetrometer Test (CPT) probes and Standard Penetration Test (SPT) tests indicates very low strengths over much of the pit area (below the cap materials). Low strengths are expected to result in waste collapse at quite low natural slopes, which may present safety concerns and excavation inefficiencies due to flat slopes. Based on the relative values from interim DEEP results of three consolidated undrained triaxial shear strength tests had the following results: undrained friction angle, ϕ_u ranged from 15 to 23 degrees with cohesion intercept of 1 to 0.7 psi; drained friction angle ranged from 32 to 33 degrees, with no cohesion (ALTER 1995). Existing data indicates that the moisture content for much of the waste (in situ conditions) is above the liquid limit, indicating the material could behave like a fluid.

4.1.4 Waste Pit 4

Based on ALTER data (ALTER 1994) and RI/FS data, in general, Pit 4 waste materials range in behavior from nonplastic silts (silt, silt with sand, and sandy silt) to lean and silty clays (lean clay with sand, sandy lean clay, and sandy silty clay). Moisture contents range from about 10 percent (sandy lean clay) to 62 percent (sandy silty clay) (dry weight basis).

4.1.5 Waste Pit 5

Based on ALTER data (ALTER 1994), in general, Pit 5 waste material behaves as a high-plasticity elastic silt. The pit also contains some nonplastic silt. In general, the moisture content of the waste material in Pit 5 is the highest of the OU1 waste material tested. Moisture content of the elastic silt material ranges from about 161 to 620 percent. The moisture content of the nonplastic silt material was about 109 to 115 percent (dry weight basis).

Based on preliminary DEEP data, waste materials appear to be low density with extremely high moisture contents that do not tend to be free-draining.

4.1.6 Waste Pit 6

Based on ALTER data (ALTER 1994), in general, Pit 6 waste material behaves as a nonplastic to low plasticity silt (silt, sandy silt, silt with sand, and silty sand). The pit also contains some high plasticity elastic silt. Moisture content of Pit 6 materials range from about 27 percent (silt with sand) to 425 percent (nonplastic silt) (dry weight basis). Based on preliminary DEEP data, waste materials appear to be free draining.

4.1.7 Burn Pit

Based on RI/FS and ALTER data (ALTER 1994), in general, Burn Pit waste material ranges in behavior from a low plasticity silt (sandy silt) to a silty sand. Some lean clay with sand is also present. Moisture content of Burn Pit waste materials range from about 25 percent (lean clay with sand) to 43 percent (silty sand) (dry weight basis).

4.1.8 Clearwell

Based on ALTER data (ALTER 1994), in general, the waste in the Clearwell contains materials behaving as high- plasticity silts (sandy elastic silt, elastic silt with sand), silty sand, and sandy lean clay. The water contents of these materials range from about 35 percent (sandy lean clay) to 72 percent (sandy elastic silt) (dry weight basis).

4.2 Potential Waste Dewatering

Based on preliminary review of DEEP wet trenching activities in Pits 1, 2, and 3, groundwater may be present as free standing or pore water in the waste materials and perched at the cap/waste interface, both of which may present problems during excavation. Perched groundwater may also be encountered at the excavation face at the pit perimeters.

DEEP dewatering tests using wells have been conducted in Waste Pits 1 and 3 to evaluate the effectiveness of this technique to increase the strength and bearing capacity of wet pit materials prior to excavation. Also, trenching and ramping in Pits 1 and 3 is being conducted to evaluate excavation methods, waste stability and strength, and waste seepage. Thus far, based on available waste strength data, stability analysis shows that safe and maintainable slopes are possible without dewatering. Also, flows obtained from the dewatering test wells were very low (1-2 gpm); hence their use for waste dewatering is not recommended.

However, since maximum waste drainage is an objective, other dewatering techniques such as using wick drains, compression through surcharging (or preloading) the surface, gravity drainage through trenching, French drains, or other interceptor drains and sumps may be considered. These techniques and their application will be further developed in the final design phase.

SECTION 5

OPERATION SEQUENCE

5.1 Water Management

A key element of maintaining a workable site and reducing waste migration is water management. Wastewater is removed for treatment and stormwater is restricted to the extent possible from contacting waste. Wastewater is considered either the water currently within the waste or stormwater that has been allowed to come in contact with exposed waste. Retention, collection, and removal of water draining from the waste is expected to be difficult.

The existing Pit Stormwater Management System (PSMS), including the Clearwell, continues to be used throughout the excavation. The PSMS consists of routing stormwater and wastewater to the Clearwell and Building 18N (the Special Products Plant), then to the Biodenitrification Surge Lagoon and, finally, to treatment at the FEMP wastewater treatment system. However, due to the denuded state created by the excavation, selected water management features will probably need to be built, improved, and maintained. Approximately 15 to 20 tons/acre/year of sediment from the denuded surfaces could enter the water management system. Additional water management work includes temporary stormwater diversion berms, construction dewatering, treatment pools, and well dewatering (if feasible). Water management practices are maintained so that the water treatment facilities are not overloaded.

Temporary diversion berms are constructed before excavation begins so that stormwater is intercepted before entering uncovered waste areas. These berms are installed, removed, and relocated, as necessary, as excavation progresses. See Drawing No. 91K-5900-G-00133 for concept.

Construction dewatering is accomplished using sumps and pumps. Sump location and number is field determined. The sumps and wells are pumped into the PSMS.

It is important that the sediment is controlled so that the water treatment facilities are not overloaded. Temporary settling pools with liners with other sediment control measures (e.g., flocculate, polishers, etc.) will potentially be used to reduce solids loading. Baffles are helpful by increasing detention time, allowing more suspended solids to settle. The settling pools' purpose is twofold. First, they reduce the frequency with which the Clearwell requires maintenance and removal of the settled soils, and second, they reduce the solids entering the wastewater treatment facilities (Biodenitrification Surge Lagoon and, subsequently, the FEMP wastewater treatment system).

5.2 Excavation Approach

The excavation approach for Waste Pit 3 is described in Subsection 5.2.1 to illustrate the general excavation approach for most of the other waste areas except Pit 5, Pit 6, and the Clearwell. Pit 5 is expected to be the wettest waste area; therefore, additional waste drainage measures are warranted. As described in Subsection 5.2.2 Pit 6 excavation is similar to that of Pit 5, as is the final excavation of the Clearwell wastes.

In general, lightweight, low-ground-pressure equipment is used to excavate from on top of the cap to a safe, maximum possible depth with safe side slopes. This initial operation strips 15 to 20 feet (more, if possible) of the cap and waste, and is staged to move ahead of the second operation, taking place from the bottom of the pit (the bottom of the waste). Low points are graded in the pit to create sumps for wastewater collection. Caution is warranted near the bottom of the waste so that sumps are not excavated into the top of the Great Miami Aquifer. Excavated dry materials are segregated and transferred to the process area.

Equipment for the second operation (at the pit bottom) includes a long reach excavator working in conjunction with a track loader or similar front-loading equipment. Articulated dump trucks (approximate 20 ton capacity) haul the waste to the processing area.

The excavation operations allow for separate handling and transfer for drier wastes and soils and also for debris encountered in the pits. The drier materials are mixed with the wetter waste to improve handleability. Debris management starts with initial excavation and is more fully described in Appendix A and the overall Process Description (PARSONS 1995b).

During excavation of dry materials, water sprays are used to minimize escape of fugitive radioactive contaminants to the atmosphere. These dry materials are excavated and transferred separately to the waste processing area. Dry waste, such as cap and contaminated berm material, is excavated on an as needed basis and is used for blending with wet waste.

Exposed areas, other than the working face, that are not reclaimed in a timely manner are covered with spray membranes, herculite plastic, or other suitable protection to reduce erosion and waste migration. These and other stormwater control measures are maintained throughout the excavation.

5.2.1 Waste Pit 3

As discussed above, the 40 foot deep excavation of Pit 3 uses a top and bottom approach that operates from stable edges (i.e., cover, bottom, or berms). An approximately 15 to 20 foot depth of material is removed from the top. The remaining waste is excavated from the bottom. A benched working face, is used throughout the operations to maintain a safe separation between top and bottom excavations and

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to minimize slope heights. Slopes are to maintain a 3H:1V minimum steepness. Access to the bottom of Pit 3 is obtained through Pit 1. The sequence for this entry occurs as follows:

1) Excavate waste at south and west sides of Pit 1 to approximate bottom elevation 562. Maintain stable slopes, at least 2H:1V. The stability of stable slopes in this area needs to be determined. Maintain 3H:1V slope at east side of Clearwell (Phase 1 on drawing 91X-5900-G-00133).

2) Remove top 15 to 20 feet of waste from Pit 3 at its southeast corner. Maintain a 20-foot clearance from top of dike at Clearwell. These first two operations expose the pit berm shared by Pits 1 and 3. The actual location and configuration of this berm must be known prior to ramp construction and subsequent entry into the bottom of both pits (Phase 2 on drawing 91X-5900-G-00133).

3) Construct a cut and fill ramp in the south berm of Pit 1 to the bottom at approximately elevation 562. Ramp grades are flexible but should be kept uniform and should not exceed 8 percent. Construct a road into the Pit 1 bottom liner to the edge of the common Pit 1-3 berm. Simultaneously excavate the top 20 feet of the common berm at the point of planned entry into Pit 3. Point of planned entry needs to be established at a reasonable distance (approximately 120 feet) north of the Clearwell to permit construction of slopes and road without endangering Clearwell. All roads are established through berms or pit bottoms and not in wastes (Phase 3 on drawing 91X-5900-G-00133).

4) Excavate through the bottom portion of the Pit 1-3 common berm to begin operations from bottom of Pit 3 at approximately elevation 548 (Phase 4 on drawing 91X-5900-G-00133).

See Drawing 91X-5900-G-00133 for the plan view of the above sequence. See drawing 91X-5900-G-00133 for section of Pit 1 ramp construction and Pit 3 benched excavation.

The areas need to be maintained and drained. Roads are crowned or pitched. Sufficient space is provided for ditches and sumps. Road surfaces consist of at least a layer of geotextile and gravel. Consideration should be given to wood Uni-Mats™ at locations with more difficult soil conditions or high traffic areas.

The waste conditions are quite varied and will be unpredictable. Operations will need to maintain stable slopes and setback distances. See Subsection 5.6 for further discussion.

5.2.2 Waste Pit 5

In addition to the foot or more of water over the waste, Waste Pit 5 is reported as having a significant amount of liquid waste. Therefore, this pit is opened early and remains open for an extended period to allow drainage. The waste at the pit's southern boundary is trenched first. The open face is expected

to release wastewater. This wastewater is conveyed to the Clearwell via an existing effluent tower and pipe. Sump pumps and pipe will be used to keep trenched excavations dry and to convey wastewater to the effluent tower. After the pit has drained as much as is practical, waste excavation is anticipated to follow similarly to the other areas. Approximately 11,000 cubic yards of berm material needs to be excavated to provide a work area so that the backhoe can reach to the bottom of Waste Pit 5. See Drawing 91X-5900-G-00154 for plan and Drawing 91X-5900-G-00134 for accompanying sections.

The sequence for waste excavation is planned as follows:

1) Widen the Pit 5 berm from 10 feet to 20 feet to permit access for excavation equipment. See Section A on Drawing 91X-5900-G-00134 for detail.

2) Excavate waste around perimeter of pit from berm using a long reach excavator. Operator needs to exercise caution near 2.5H:1V berm slopes. Water will be drained from top of waste prior to excavation and excavations will be pumped and kept dry as possible throughout construction sequence.

3) Construct a cut and fill ramp and bench at mid-height in existing 2.5H:1V berm slope around pit perimeter. Excavation of waste will occur concurrently with this operation. The integrity and function of the effluent tower needs to be maintained. Hence, bench construction will not occur at this vicinity. The excavator will cast material from the pit to the top berm. A front end loader will be used to load trucks from here. This method of operation will minimize truck traffic on the narrow bench in the berm.

4) At the end of the above operation, a mound of waste will be left in the bottom of Pit 5. The natural repose angle of Pit 5 waste is expected to be low. Hence, the resulting mound will probably be less than 10 feet in height. A ramp will be constructed on the east side of the pit to egress the bottom. Excavation will proceed from this ramp and progress west through the bottom of the pit to complete the waste's removal. It is expected that whatever is left of the Pit 5 EDPM liner will also be removed at this time.

The existing water cover at Pit 5 controls radon release from the pit waste. Additional monitoring and surveillance at the time of dewatering will determine if any radon abatement measures are required for the waste.

5.2.3 Excavation of Soils Underlying the Pits

For this Waste Excavation plan, it is assumed that upper parts of the pit liners and some areas soil below the liners must be treated and disposed of with the pit waste. Visual observation of material characteristics during the excavation operations are initially used to determine when the apparent depth of contamination is reached (i.e., limit of waste). However, following the initial cut, and at some actual

deeper field-determined depth, the contamination lessens to a level at which the soil can be disposed of in the planned on-property disposal facility. This delineation of contamination level and depth (and excavation as necessary) is initially accomplished with the use of real-time field scanning equipment. Additional characterization of the incrementally excavated soil will likely be necessary to assure confidence in meeting the on-property disposal facility Waste Acceptance Criteria (WAC) or designating the soil for off-site disposal.

Similarly, at some greater depth, the soil contamination level will further lessen to the point at which it is below the final soil remediation levels identified for OU1 and OU5 and can therefore be left in place. Cleanup level confirmation sampling and site restoration is determined in a site-wide design package submitted pursuant to the OU5 remedial design process. Additional detail of this soil excavation process as described in the Draft OU5 Record of Decision is presented in Section A4.1 of Appendix A of this plan.

For purposes of preparing this excavation plan, and for developing overall project waste and soils mass balances, assumptions are made for these contaminated soil depths. The first 1.5 feet of soil below the pit liners is assumed to be treated with the waste (and disposed of off-site) and the next 1.5 feet of soil is assumed suitable for disposal in the on-property disposal facility. Below the 3-foot limit, it is assumed the soil is acceptable to be left in place.

5.3 Waste Transport

As described in Subsection 5.2, waste pits are excavated using conventional earth moving equipment such as extended reach hydraulic excavators and front end loaders. Approach ramps are excavated as required for equipment deployment and for transporting waste from the pits. During excavation, large debris is segregated from the waste based on visual observations. Waste along with some debris (that is not visually apparent) is loaded into trucks (all wheel drive articulating rear dumps) for transport to the storage bins located in the waste preparation facility.

Large debris found during excavation is loaded into trucks and transported or possibly moved by skid to a pad at the pit side. Debris segregation and processing is discussed in more detail in Section 2.2 of Process Description and in Appendix A of this report.

All waste and debris is transported by all wheel drive articulating rear dump trucks. As necessitated by field conditions, trucks are covered with tarp during transportation of dry materials to minimize fugitive emissions to the atmosphere.

5.4 Equipment Selection Parameters

Conventional earth moving equipment such as front end loaders, hydraulic excavators, and all wheel drive articulating rear dump trucks are used for excavation and transport of waste and debris. As the

excavation proceeds, excavation conditions change depending on the waste characteristics. The cap material is relatively dry and is easily excavated. However, as the excavation proceeds deeper in some of the pits, liquid waste will be encountered.

Because of the varying conditions in the pits, equipment selection takes into consideration the following parameters.

5.4.1 Debris Excavation

Some of the pits (Pits 1, 2, 4, and the Burnpit) contain waste that has a high solids content. During excavation of these pits (and excavation of some areas of other pits), excavation equipment such as front end loaders and hydraulic excavators is used to excavate and segregate debris from the waste. If waste is deemed to be debris free it is loaded directly into trucks. However, if debris (wood pallets, concrete blocks, structural steel etc.) is encountered, it is segregated before transport to the feed preparation facility.

5.4.2 Low Ground Pressure

In Pits 3, 5, and 6, soft footing conditions will be encountered as excavation proceeds deeper into the pits. In those conditions "swamp equipment," (i.e., equipment with wide tracks suitable for low ground pressure) is employed. The approach ramps, as well as areas being excavated, are lined with Uni-Mats™ (interlocking 8-foot wide, 14-foot long wooden mats), as field conditions warrant, for transport of waste out of the pits by all wheel drive articulating rear dump trucks. Trucks are equipped with flotation tires suitable for low ground pressure operations.

5.4.3 Waste Excavation and Transfer Rates

Pit waste excavation and transfer rates vary depending upon the moisture content of the waste. This is because the dryer has a maximum water evaporation capacity of 4.2 tons per hour (tph). To support dryer operations, excavation rates are lower for the wet pits and higher for the dry pits.

The highest excavation rates will be for Pit 6, because, when dewatered, the contents of Pit 6 yield the maximum dryer throughput. An average of approximately 5,500 tons of waste per week will be excavated for Pit 6. Excavation operations are planned for 5 days per week, 8 hours per day. However, excavating operators and equipment are effective only 6 hours per day. The equipment and operator fleet is, therefore, selected to support an excavation rate of 185 tph. Excavation rates for the other pits are expected to be less.

5.4.4 Excavation Slopes Stability

During excavation of wet pits (Pit 3, the Clearwell, and Pits 5 and 6), operators must take into consideration the possibility of slope failure. Safe distances will be is maintained to minimize difficulties in case of a slump of the excavation face. Long reach hydraulic excavators are used to maintain a safe distance. Front end loaders are then used to load excavated waste into the trucks. Equipment (loaders and trucks) must also maintain adequate setback distances.

5.4.5 Space Limitations

In some of the wet pits space will be limited in the excavation area for equipment operations because of soft footing conditions. Equipment (loaders and trucks) are off-highway types with tight turning radii so they can be maneuvered in a limited space.

5.4.6 Equipment Retrieval Capabilities

There is a possibility of equipment getting stuck in areas where soft footing conditions are encountered. Excavation operations will be planned so that excess equipment is available to pull equipment out of the waste. Trucks, dozers, winches, and steel cables are made available for equipment retrieval. All excavation equipment will have features so that steel cables can be easily attached in case it has to be pulled by a truck or a dozer.

5.4.7 Liquid Waste Retrieval

Some areas of the pits are extremely wet and pumping waste is the only reasonable alternative for waste retrieval. A slewing/luffing crane with long reach is required for deployment of a slurry pump for waste retrieval.

5.4.8 Stormwater Collection

As described earlier, stormwater is collected from excavation areas and pumped to the Clearwell for settling. Also, temporary settling pools are employed prior to pumping the water to the Clearwell. If field conditions dictate, a crane may be required for deployment of the stormwater pumps. In some instances it is possible to manually deploy the pump without a crane. In that case steel cables are attached to the pump for ease of handling.

5.5 Minimization of Aquifer Infiltration

Water that percolates or travels over the waste to the pit bottom could infiltrate to the coarse sands and gravels of the Great Miami Aquifer. Pits 1, 2, 4, 5, and 6 bottoms are located approximately 10 feet above the Great Miami Aquifer materials. The top of the aquifer materials is approximately 547 feet

mean sea level elevation. Water levels in the aquifer are approximately 25 feet lower. If the pits are kept drained, no deep holes are excavated in the pit bottoms, and pit liners maintained intact as much as possible, the potential for infiltration is minimal and manageable. The actual depth and limits of the Burn Pit are not known. Pit 3 and the Clearwell have areas with 1 foot or less of separation between the waste and the Great Miami Aquifer. Some of the aquifer's sands may be contaminated. The extent and depth of contamination is not known, but will be determined during sampling and analysis after waste excavation (see Subsection 1.4).

Construction will take measures to limit and minimize infiltration, especially at Pit 3 and the Clearwell. As mentioned previously, stormwater diversion is important because it lessens the volume of water to handle or possible infiltration into the Great Miami Aquifer. Covering on inactive excavation face areas lessens water contact with waste. The sump and pumps in the bottoms of the excavation are to be kept functional and maintained. A diligent and dedicated effort to remove standing water will be followed. Exposed sand in the pit bottoms presents the most difficult condition. Based on the site and distance from the working face, various techniques can be used, such as:

1) Blend in agricultural lime, cement, or bentonite with sand to form a less permeable surface.

2) Install perforated drain lines to intercept seepage.

3) Geomembranes or sprayed membranes can be applied to pit bottoms that will remain inactive for a long period.

4) Common clayey soil can be placed. Soil may be from above pit caps, to minimize creation of new or additional waste.

Combinations of these techniques (such as combining a geomembrane with a foot of common soil) could prove effective. Use of additives and drains is more effective at or near the working face. Additives, which are especially useful in absorbing free liquids, can be broadcast and tilled in later. Care is to be exercised when using lime or cement, due to their acidic and alkaline natures. Bentonite, while more costly, is a more effective additive.

Additional study in the later stages of design will determine the most cost-effective choices. At this time, sprayed membranes appear attractive from the standpoint of easy application, minimal additional waste, and anticipated effectiveness. However, having a selection of options is probably best suited to the range of conditions that may be encountered.

5.6 Field Conditions

5.6.1 Flexibility of Operations

A wide array of field conditions will be encountered through a multitude of waste types. The waste includes wooden pallets, concrete debris, cinders, clay, sands, wet tailings, sludge, drums, metals, slag, graphite, process wastes, and perched water. Thickness of waste types varies drastically from several feet to 30 feet. Pit 5, Pit 6, and the Clearwell waste is mostly a wet consistent tailing, sludge, or sediment. Pit 1 is mostly non-plastic solids and debris. Pit 3 is the largest and most varied, and is expected to have the most difficult and uncertain conditions. The middle half or more of this pit contains a wet sludge or tailings ranging in thickness from 20 to 30 feet. Recent CPT and SPT test data show this area to have very little strength. Initial results indicate sufficient material strengths for the planned excavation operations. A DEEP test ramp and other forthcoming geotechnical test data will allow estimation of the strengths and at what slopes this material can be stable.

Operations and equipment will adapt to this wide array of wastes. Backhoes are readily adaptable to interchanging attachments. Buckets with "thumb," grapples, and hydraulic hammer attachments are considered standard standby equipment at the site. The majority of the pit wastes were end-dumped or pumped in. Hence, operations occur from pit caps, pit bottoms, and pit berms at reasonable setback distances from all open slopes.

5.6.2 Slope Stability

Waste materials need to be able to hold a stable slope to allow the safe operation of equipment during mechanical excavation. To improve strength and bearing capacity of the material, dewatering techniques using wells, drains, or other methods may be implemented. Dewatering as part of the DEEP, using wells and dry excavation tests, is being conducted in Pits 1 and 3 to evaluate the effectiveness of this technique.

Stable slopes for the different soil and waste material encountered will be determined and adhered to. Guidelines for determining slope stability for the various conditions will be addressed in the design and in the construction work plan. Continual observation is needed due to the multitude of waste types and conditions encountered. Qualified field personnel, knowledgeable about soil analysis and predictable hazards in excavation work, ultimately will determine the safe setback distance and stable slope to maintain. As with any excavation operation, the rules and regulations of OSHA 29 CFR, Part 1926, Subpart P, "Excavations," will be adhered to and followed.

Excavation operations from the cover will consider transitional and rotational slide failures. The cap material is composed mostly of earthen materials at a reasonable moisture and is approximately 10-feet thick at Pit 3. Excavation activities to this depth present only limited problems. Once excavation proceeds deeper than the thickness of the cap, the waste becomes exposed. In the middle of Pit 3, the waste has limited strength. Hence, toe conditions could become unstable, resulting in various degrees

and types of slide failures. Field operations will inspect toe conditions and adjust slopes of excavation, or depth as necessary. Conditions at the top of the slope, such as undercutting that leaves a ledge or tension cracks in the soil, will be monitored. Equipment will not proceed into areas with these features.

Pumping subgrade and other undesirable characteristics associated with soft and wet field conditions are expected in the pit bottoms. Equipment is to operate from an aggregate road with geosynthetics or equivalent platforms to reduce the risk of sinking and tracking waste. Truck traffic and egress from the pit bottoms is not allowed to leave a dedicated and maintained road. Use of wood Uni-Mats™ should be considered on difficult areas (i.e., pumping subgrade).

5.6.3 Airborne Emissions

The waste pit area excavation approach and methods uses conventional soils excavation equipment, similar to many other common earthwork and earth-moving operations. In these operations, dry soil or waste particles become airborne from moving vehicles or operating excavation equipment. As natural wind speeds increase, the dust problem increases. If wind speeds are high enough, they cause particle suspension and dispersion.

A number of dust control/suppression measures are available. Because the wastes exist in a saturated condition, dust control measures are not expected to be required on a normal basis in the waste pit area. Normally the wastes remain wet throughout their excavation and transfer to the waste preparation area.

However, for the waste haul roads, pit areas that are open but inactive, or any areas where dusting becomes or has the potential to be a problem, the following types of dust control measures will be employed.

1) Operating controls, such as truck haul speed limits and truck bed covers, are established by field conditions.

2) Water spraying outside of the pits, using recycle wastewater wherever possible, is used.

3) Chemical binders or moisture attractors are applied. The choice of chemical depends on whether there might be travel on the surface, whether it is an inactive area, and the required time for stabilization.

5.6.4 Special Features

Wastewater from Pit 5 is conveyed to the Clearwell via a 12-inch diameter pipe located along Pit 3's western berm. This pipe system must be relocated before this berm is used as backfill in reclamation.

SECTION 6

MONITORING

This section covers Air and Worker Safety Monitoring that will be conducted during waste pit area excavation operations. Ground and surface water monitoring will be implemented as part of CRU5 monitoring operations.

6.1 Air Monitoring Program

Two existing air emissions monitoring programs support the OU1 remedial action; they are the Fernald Site Environmental Monitoring Program and the Occupational Air Monitoring Program. Both programs will continue to be implemented throughout the OU1 remedial action. In addition to these programs, air monitoring specific to OU1 emissions requirements will also be identified in subsequent more detailed versions of the Excavation Plan and the accompanying equipment specifications will address those requirements. The remedial action deliverables associated with the actual air monitoring operations will be identified in the Remedial Action Work Plan.

Radiological Environmental Monitoring continues under the Fernald Site Environmental Monitoring Program on a weekly basis. Data is collected during the implementation of the remedial action from air monitoring stations located on site (including four environmental air monitors in the vicinity of the waste pits), near the fenceline, and at several locations in nearby communities. The monitoring program has been developed in response to United States Department of Energy Orders 5400.1 and 5400.5 and 10 CFR 835 and is presented in the Fernald Site Environmental Monitoring Plan, PL-1002.

Additional project specific monitoring may be required based on an environmental assessment for supplemental air monitoring conducted during the remediation. Radiological Environmental Monitoring uses computer modeling to derive a maximum release estimate and off-site exposures during OU1 remedial activities at the waste pits. For this modeling and release estimation, natural catastrophes (such as earthquakes) are not considered. If modeling indicates that the maximum off-site inhalation exposure due to excavation and drying of the wastes is at least 0.1 millirem (mrem)/yr., then supplemental environmental ambient air monitoring is required during remedial activities.

Air monitoring is not required if modeling indicates the maximum potential off-site inhalation exposure due to the excavation and drying of the wastes is less than 0.1 mrem/yr. However, monitoring may still be performed during these activities to provide data on the effectiveness of engineering controls or to address public concerns.

Once a decision is made to monitor the remediation activities for OU1, a project specific air monitoring program is developed. The monitoring locations, frequency of filter collection and analysis, specific

analytes, etc. is determined. The following elements are evaluated to develop a project-specific, supplemental air monitoring program:

1) Project specific phases and activities that have the potential for radiological air emissions, and the type of monitoring (continuous versus grab) that should be performed. Continuous sampling is desirable if airborne radionuclide concentrations have the potential to fluctuate widely.

2) The need for pre- and post-project monitoring. This data is necessary for comparing data that is obtained during each project. Such data are also used to verify the effectiveness of control measures.

3) The potential hazard of the materials available for release, considering both the expected quantities and relative radiotoxicities. The review of previously obtained characterization data of radionuclides in a particular component, including ratios to other non-measurable radionuclides, is necessary since the control of radionuclide releases depends on the source available and any treatment system used.

4) The expected dispersion of airborne releases, including predominant wind directions and the degree to which the radionuclides of concern is diluted or reconcentrated in the biosphere. Air monitors generally concentrate downwind of the monitored area, but monitors in all directions are desirable.

5) The length of time required to complete each activity that has the potential to cause fugitive emissions.

6) Representativeness. Measurements should be made at the points/areas at which the data best represent what is being released to uncontrolled areas.

7) Other remedial activities being performed at the same time. More than one project may be occurring simultaneously. Project-specific monitoring with results that can be attributed solely to one project may not be possible.

8) The radionuclides or analytes to be measured. Gross radioactivity measurements will probably be inadequate, except under the following circumstances: when gross radioactivity releases are a small fraction of the off-site Derived Concentration Guide values for "unidentified" mixtures; when ratios of specific radionuclides are sufficiently known (and constant) for which gross activity measurements are truly indicative; and when radionuclide concentrations are so low as to preclude specific nuclide measurements.

9) Accessibility to the air monitoring station for maintenance, filter exchange, and calibration.

In addition to the air monitoring network described here, Radiological Environmental Monitoring is also conducting environmental monitoring and surveillance of radon. This program has been previously documented and discussed in the CRU1 Dewatering, Excavation, Evaluation Program. The radon monitoring program currently has several continuous radon instruments in the waste pit area. Additional monitors may be deemed necessary once project plans have been finalized.

6.2 Occupational Air Monitoring, Chemical (Volatile Organics and Heavy Metals)

Personnel monitoring for workers conducting activities associated with OU1 remedial activities is conducted to access exposure to volatile organic compounds (VOCs) and heavy metals. The VOCs and metals sampled for are based on air monitoring data collected during the DEEP.

The amount of sampling conducted is based on the task being conducted and the potential for exposure. This information is further defined as the remediation design is completed.

For personnel VOC sampling, it is anticipated that personal Photoionization Detector (PID) units with alarming features will be used along with long term sampling equipment.

For personnel heavy metal sampling, it is anticipated the personal sampling pumps with particulate filters will be used.

In addition to the personnel monitoring, area monitoring for VOCs is conducted. The VOCs are monitored using PID, FID, or other direct reading portable equipment and sorbet tubes.

At this time, the use of respiratory protection along with protective coveralls (anti-c's) is anticipated for some workers on a temporary basis. Specific personnel protective equipment requirements will be determined when the excavation plan is completed.

All Radiological Control air sampling that is to be performed during the excavations of the waste pits is intended to supply information to Radiological Engineering and Radiological Assessment (field support) for implementation of worker protection requirements. Radiological surveys (radiation and contamination) are performed to assess conditions in the work areas and are used in conjunction with the air sample data to determine personal protective requirements.

The isotope of concern for the Radiological area that isolates Waste Pits 1-4, the Burn Pit, the Clearwell, and the Pit 5 Contamination Area is Thorium-230. The Derived Air Concentration (DAC) for Th-230 is 3E-12 uCi/ml. The DAC for Radon-222 (in the Uranium-238 decay chain) progeny is 0.33 Working Levels.

6.3 Radiological Control Air Monitoring to be Performed During OU1 Waste Pit Excavations

1) All personnel entering the contamination area that isolates Waste Pits 1-4, the Burn Pit, and the Clearwell are required to wear Personal or Breathing Zone Air Samplers (Lapel Air Samplers). This is required for all thorium areas and the information is used for internal dosimetry purposes.

2) High or low volume general area air sampling (for particulates) is performed at the excavation sites and at the boundaries of the Radiological Areas. This data also aids Radiological Control in determining necessary posting requirements and ensuring proper radiological controls and personal protective measures for work activities.

3) Radon grab sampling is performed in and around the excavation and at the boundaries of Radiological Areas. The samples are taken periodically during excavation to determine radon levels in worker occupied spaces and aids Radiological Control in determining necessary posting requirements and ensuring proper radiological controls and personal protective measures for work activities.

SECTION 7

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Materials Management Plan

APPENDIX A

MATERIALS MANAGEMENT

APPENDIX A

MATERIALS MANAGEMENT

A.1 Introduction

A key aspect of the remediation activities for Operable Unit 1 (OU1) relates to the handling of materials excavated from the pit areas during the remedial action. The purpose of this appendix is to discuss the various forms of materials which can be expected to be generated through the OU1 excavation activities and then discuss how these materials will best be handled, with a focus on special waste handling needs.

For discussion purposes, this appendix presents the OU1 materials management strategy reflective of currently delineated organizational responsibilities. Although responsibilities may change over time, this should have no direct relationship to the concepts presented herein.

A.2 OU1 Waste Streams

Based on process knowledge and excavation activities which have taken place through the Dewatering Excavation and Evaluation Program, various types of materials are expected to be encountered during OU1 excavation activities. These materials can be separated into two categories - OU1 Processable Waste Streams and OU1 Special Case Waste Streams. OU1 Processable Waste Streams reflect various materials which are routinely processed through the OU1 waste processing facilities, while OU1 Special Case Waste Streams reflect wastes which, by their nature, require some special handling. This includes nonprocessable wastes and other special wastes that may be processed in the OU1 remediation facility after pre-treatment, such as size reduction. The materials identified as being a part of each of these waste streams are as follows:

1) <u>OU1 Processable Waste Streams</u> - General sump sludge; neutralized raffinate; magnesium fluoride; water treatment sludge; graphite and ceramics; uranyl ammonium phosphate filtrate; ash; flyash; thorium wastes; and depleted residues, including: contaminated rags, paper, and polyethylene; dust collector bags; scrap salts (high in fluoride), including floor sweepings; contaminated soil, rocks, sand, brick, and ceramics; pit liners; furnace salt (solidified, nonchloride); dust collector residues (high fluoride, pyrophoric); dry crushed slag from furnace pot blowouts; partially oxidized metal (containing no metal-x fire retardant); bad reductions (no derbies); unrecycled slag (ball mill product); dirty prill (magnesium metal, high uranium content); reject UO_3; drum decontamination residues; magnesium oxide and magnesium zirconate from crucible cleanout; sludges (oily, high free metal); sludges (salt, soft, chloride); sludges (nonoily, low or high free metal); wet sump of filter cake (with and without oil); scrap uranium oxide

U_3O_8; chips and turnings; scrap wood/wood pallets; concrete with rebar; personal protective equipment; and solid metal (other than cores) U_3O_8.

2) OU1 Special Case Waste Streams - Intact drums; oversized concrete with rebar; heavy gage metals; derbies; heavy equipment metals; asbestos; and transformers.

This categorization of materials provides the basis for the remainder of the discussions in this appendix. It is not the intent of this appendix to discuss routine materials management activities, but rather to focus the discussion on special handling requirements for OU1 materials. This appendix, therefore, focuses on the OU1 Special Case Waste Streams which, by their definition, require special handling. In addition, this appendix focuses on the handling of soils, which can differ from that of the other OU1 Processable Waste Stream materials depending on the levels of contamination found therein.

Figure A-1 provides a basic flow chart of material handling with respect to the OU1 Special Case Waste Streams. Subsections A.3 and A.4 provide discussion in support of this figure. Subsection A.4 discusses the management of OU1 soils.

A.3 Derbies, Intact Drums, Asbestos, and Transformers

Because of the nature of these materials, or the nature of materials within them, derbies, intact drums, asbestos, and transformers are packaged to prevent possible degradation to the environment (e.g., drums to be overpacked), and transported to the Fernald site's existing and ongoing Waste Management operation where they are handled by others in accordance with existing site procedures for such wastes. This includes such things as the characterization of materials in drums, draining of fluids from transformers, treatment of any wastes from drums, transformers, etc., as necessary, appropriate packaging, and shipment for disposal to Envirocare[1], the United States Department of Energy's Nevada Test Site, etc., as appropriate.

A.4 Oversized Materials

Certain materials identified in Subsection A.2 as waste streams are identified as such primarily because of their size, including oversized concrete with rebar, heavy gage metals, and heavy equipment metals. These "oversized" materials are categorized as such because they are not amenable or readily amendable to processing through the OU1 remediation facilities. This section discusses the options available for handling these "oversized" materials. Consideration first focuses on the ability to send any or all of these

[1] FEMP Waste Management has contracted with Envirocare for this disposal. OU1 has not yet contracted with a permitted commercial disposal facility.

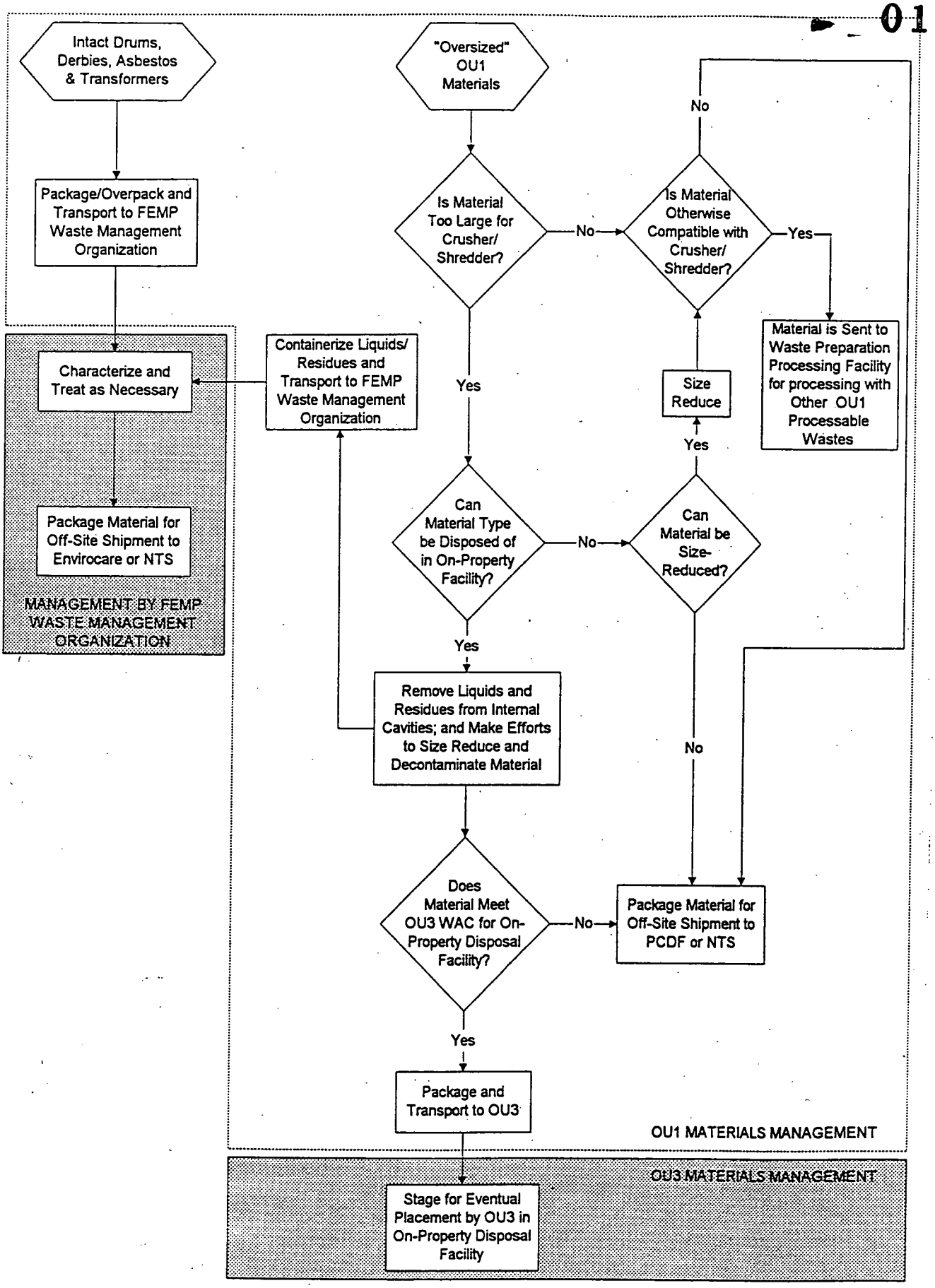

Figure A-1 - Management of OU1 Special Case Waste Streams

materials to OU3 for management, and then discusses the path forward for those materials which are not amenable to the selected alternative for OU3.

A.4.1 Management by OU3

A key component of the selected remedy described in the Record of Decision (ROD) for OU1 is that oversized material amenable to the selected alternative for OU3 would be segregated from OU1 waste, decontaminated, and forwarded to OU3 to be managed as construction rubble. This section will discuss the implementation of this aspect of the OU1 remedy, through first highlighting planned OU3 remediation activities, and then through a discussion of the impact of this on managing "oversized" OU1 materials.

A.4.1.1 OU3 Preferred Alternative for Final Remedial Action

The preferred alternative for OU3, as identified in the September 1995 Draft Proposed Plan for the OU3 Final Remedial Action, consists of selected material treatment, on-property disposal, and off-site disposition. This alternative calls for the treatment of materials, if necessary, to meet waste acceptance criteria (WAC) for the on-property disposal facility. When treatment is not effective or if it would not be cost effective to apply treatment, materials are packaged and transported to an off-site disposal facility. All OU3 materials that remain at the Fernald site following the interim remedial action will be evaluated, based on material type and contaminant levels, to determine the least-cost disposition option.

The results of the WAC development process for OU3 materials, as presented in the September 1995 Draft OU3 Remedial Investigation and Feasibility Study (RI/FS) Report, demonstrate that an allowable mass of Technetium-99 of 105 grams is the only contaminant-specific WAC which will be used to screen materials for on-property disposal. Of the Technetium-99 source term which the OU3 RI/FS has defined as being subject to evaluation (i.e., with a mass of 117 grams), approximately 90 percent is from concrete and 5 percent is from metals (these being the two critical material categories). As detailed in the OU3 RI/FS, the approach being proposed to meet this WAC is through the removal of surface areas of concrete in specified OU3 facilities, resulting in the remaining mass of Technetium-99 for disposal within the on-property disposal facility being 59 grams.

The source term associated with the OU3 metals categories is not reflective of the metals themselves but of materials on the surface of the metals. Specifically, the OU3 RI/FS based its source term development on the assumption that construction metals are non-porous materials and, therefore, would not be contaminated at depth, regardless of the type of metal. However, contaminated metal surfaces (i.e., paint coatings or a contaminated "film" on unpainted surfaces) are expected and would be independent of the metal on which it is found.

A decontamination process will be applied to most OU3 materials during the interim remedial activities. Because the source term estimates discussed above do not assume removal of contaminant sources through

decontamination, any decontamination applied to materials anticipated for on-property disposal reduces contaminant source terms even further. This adds another layer of conservatism in ensuring that groundwater protection criteria is met.

The material categories which have the ability to be placed in the on-property disposal facility, based on their acceptability with respect to meeting the contaminant-specific WAC also, most likely, have size constraints applied to facilitate ease of material handling during placement operations in the on-property disposal facility. Table A-1 (Table G-2 from the OU3 RI/FS) provides size constraints developed to support the OU3 RI/FS for materials with potential for on-property disposal under the proposed alternative for OU3. OU2 design efforts for the on-property facility will establish final size constraints in the waste placement plan.

A.4.1.2 Amenable Oversized Materials

Because of its porous nature, concrete (with rebar) found in the waste pits has a stronger potential for being contaminated through continuous contact with the environment within which it has existed, and is impractical (if even possible) to salvage through treatment for placement in the on-property disposal facility. Accordingly, concrete is not amenable for handling by OU3 in terms of placement in the on-property disposal facility, but requires additional handling as discussed in Subsection A.4.2.

Heavy gage metals encountered during OU1 excavation activities are not expected to have a significant amount of paint on them (this being the element of concern with respect to any Technetium-99 source for these materials), and, therefore, do not have any significant impact on the OU3 source term. Even if painted surfaces are encountered, it is anticipated that decontamination can be easily accomplished. Also, it is assumed that this material can be easily reduced in size, if necessary, to meet the size constraint aspect of the OU3 WAC. Accordingly, heavy gage metals are considered to be amenable to placement in the on-property disposal facility. The same holds true for heavy equipment metals, with the additional provision that all internal cavities need to have residues removed and the cavities subsequently cleaned. If any of these materials cannot be size-reduced to meet the on-property disposal facility WAC, and/or if any paint coatings cannot be removed, and/or if the internal cavities cannot be cleaned, then this material needs to be disposed of off site, as discussed in Subsection A.4.2.

Table A-1 - OU3 Material Size Constraints for On-Property Disposal

RI/FS Material Category	Associated Size Constraints
General for all categories	Any piece ≤ 10' in any dimension Any piece ≤ 1.5' height
A - Accessible Metals	Maximum length = 10' Maximum width = 4' Maximum height (including projections) = 1.5'
B - Inaccessible Metals	Maximum length = 10' Maximum width = 4' Maximum height (including projections) = 1.5' Pipes with diameter ≥ 12" split in half
D - Painted Light Gauge Metals	Maximum length = 10' Maximum width = 4' Maximum height (including projections) = 1.5'
E - Concrete	Maximum length = 6' Maximum width = 4' Maximum height = 1.5'
F - Brick	Maximum length = 6' Maximum width = 4' Maximum height = 1.5'
G - Non-regulated ACM	Maximum length = 8' Maximum width = 4' Maximum height = 1.5' (Bundled stacks)
H - Regulated ACM	Maximum volume/piece = 27 cu ft For Pipes: Maximum length = 10' Maximum width = 4' Maximum height (including projections) = 1.5' Pipes with diameter ≥ 12" split in half

Table A-1 - OU3 Material Size Constraints for On-Property Disposal (Continued)

RI/FS Material Category	Associated Size Constraints
I - Miscellaneous Materials	All miscellaneous materials will be compacted Maximum length = 8' Maximum width = 4' Maximum height = 1.5' Rubber tires cut in half radially

Note: Material categories C (Process Related Metals), F (Brick), and J (Product, Residues and Special Materials) are excluded from potential on-property disposal

Monolithic objects that are not compressible and do not contain interior void space can exceed the maximum size limits on a limited basis.

A.4.1.3 Handling of Oversized Materials for Forwarding to OU3

Heavy gage metals and heavy equipment metals need to be transported to a location where they can be size reduced and decontaminated. If these materials cannot be size reduced to meet the on-property disposed facility WAC and/or cleaned to remove all paint and residues from internal cavities, the material needs to be packaged for off-site shipment as discussed in Subsection A.4.2. Those materials which can be size reduced and decontaminated are packaged in roll-off boxes, or as otherwise directed by OU3, for transport to and storage at a staging area identified by OU3.

A.4.2 Management of Oversized Materials Within OU1

As indicated in Subsection A.4.1.2, concrete with rebar is amenable for placement in the on-property disposal facility. If this material can be further size reduced, however, these materials can be handled by the shredder. Accordingly, these materials are transported to the waste preparation facility, or other area, where attempts are made to size reduce this material to meet the size constraints of the treatment process (primarily dictated by the shredder).

Any OU1 oversized materials which fail to meet the WAC for the on-property disposal facility or which are otherwise incompatible for processing through the OU1 remediation facilities, are transported to a staging area for placement in railcars for shipment to the permitted commercial disposal facility.

A.5 OU1 Soils Management

This section focuses on the extent to which OU1 soils need to be excavated, the disposition of excavated soils, and factors that, therefore, need to be considered relative to soils management.

A.5.1 Final Remediation Levels for Operable Unit 1 Soils

The selected remedy described in the OU1 ROD includes excavation of the surrounding contaminated soils within the OU1 boundary. In support of this, the ROD presents remediation levels established for both surface soils and soils beneath the waste areas, for the OU1 constituents of concern. (These levels are also presented in Tables 3-1 and 3-2 of the OU1 Remedial Design Work Plan.) These levels are protective of human health and the environment, assuming continued Federal ownership of the site as provided in the selected OU1 remedy.

The OU1 ROD states that the OU1 remediation levels discussed above will be re-examined upon finalization of the OU5 remedy decision process. Specifically, where the final remediation level for a constituent established through the OU5 remedy decision process is more restrictive (i.e., lower) than that defined in the OU1 ROD, the final OU5 remediation level will serve as the soil cleanup criteria. Table A-2 presents the OU1 final remediation levels for soils based on a re-examination against the on-property soil remediation levels identified in Table 9-2 of the August 1995 Draft OU5 ROD.

As is evidenced by Table A-2, the OU5 levels are more restrictive in their entirety than the OU1 surface soil levels and, therefore, are used for all OU1 surface soil excavation. The OU5 remediation levels are also used for OU1 subsurface soils, with the following exceptions:

1) OU1 levels established for Technetium-99 for subsurface soils are more restrictive (i.e., lower), in every case, than the OU5 soil remediation level for Technetium-99 and are, therefore, used.

2) The polychlorinated biphenyl (PCB) level established for Waste Pit 1 subsurface soils is used in conjunction with the Aroclor-specific OU5 levels. Specifically, in addition to remediating to the individual levels for Aroclor-1254 and -1260, remediation also proceeds to the extent that the level for all PCBs is below .78 ppm.

Table A-2 includes only the level of 82 ppm for less leachable forms of uranium (i.e., it does not contain the 20 ppm level for the more leachable forms of uranium). The reason for this is that according to the August 1995 Draft OU5 ROD, the more leachable forms of uranium are associated with soils within the former production area beneath the retired processing buildings. For soil exhibiting these less leachable forms of uranium the August 1995 Draft OU5 ROD goes on to state that the selected remedy has adopted an As Low As Reasonably Achievable (ALARA) goal of 50 ppm of total uranium in soil.

Table A-2 - Final Remediation Levels for OU1 Soils[c]

Constituent	Final OU1 Remediation Level	Constituent	Final OU1 Remediation Level
Radionuclides (pCi/g)		**Chemicals (mg/kg) (Cont'd)**	
Cesium-137 + 1d	1.4×10^{0}	Bromomethane	8.2×10^{3}
Neptunium-237 + 1d	3.2×10^{0}	Cadmium	8.2×10^{1}
Lead-210 + 2d	3.8×10^{1}	Carbazole	1.2×10^{1}
Plutonium-238	7.8×10^{1}	Carbon disulfide	5.0×10^{3}
Plutonium-239/240	7.7×10^{1}	Carbon tetrachloride	2.1×10^{0}
Radium-226 + 8d	1.7×10^{0}	Chlordane	1.9×10^{-1}
Radium-228 + 1d	1.8×10^{0}	Chlorobenzene	3.4×10^{2}
Strontium-90 + 1d	1.4×10^{1}	Chloroform	4.5×10^{1}
Technetium-99[a]	3.0×10^{1}	Chromium VI	3.0×10^{2}
Thorium-228 + 7d	1.7×10^{0}	Chrysene	2.0×10^{3}
Thorium-230	2.8×10^{2}	Cobalt	7.4×10^{2}
Thorium-232 + 10d	1.5×10^{0}	Copper	2.2×10^{5}
Uranium, total (ppm)	8.2×10^{1}	Cyanide	1.2×10^{5}
		Dibenzo(a,h)anthracene	2.0×10^{0}
Chemicals (mg/kg)		3,3-Dichlorobenzidine	5.5×10^{-1}
Acetone	4.3×10^{4}	1,2-Dichloroethane	1.6×10^{-1}
Antimony	9.6×10^{1}	1,1-Dichloroethene	4.1×10^{-1}
Aroclor-1254[b]	1.3×10^{-1}	Dieldrin	1.5×10^{-2}
Aroclor-1260[b]	1.3×10^{-1}	Di-n-octylphthalate	1.1×10^{3}
Arsenic	1.2×10^{1}	Ethylbenzene	5.1×10^{3}
Barium	6.8×10^{4}	Fluoride	7.8×10^{4}
Benzene	8.5×10^{2}	Heptachlorodibenzofuran	8.8×10^{-4}
Benzo(a)anthracene	2.0×10^{1}	Heptachlorodibenzo-p-dioxin	8.8×10^{-4}
Benzo(a)pyrene	2.0×10^{0}	Indeno(1,2,3-cd)pyrene	2.0×10^{1}
Benzo(b)fluoranthene	2.0×10^{1}	Lead	4.0×10^{2}
Benzo(k)fluoranthene	2.0×10^{2}	Manganese	4.6×10^{3}
Beryllium	1.5×10^{0}	Mercury	7.5×10^{0}

Table A-2 - Final Remediation Levels for OU1 Soils[c] (Continued)

Constituent	Final OU1 Remediation Level	Constituent	Final OU1 Remediation Level
Bis(2-chloroisopropyl)ether	4.2×10^{2}	Methyl-2-pentanone	2.5×10^{3}
Bis(2-ethylhexyl)phthalate	8.2×10^{2}	Methylene chloride	3.7×10^{1}
Boron	7.4×10^{3}	4-Methylphenol	2.5×10^{2}
Bromodichloromethane	4.0×10^{0}	Molybdenum	2.9×10^{3}
Bromoform	3.1×10^{1}	Nickel	1.5×10^{4}
Chemicals (mg/kg)		**Chemicals (mg/kg) (Cont'd)**	
4-Nitroanaline	1.5×10^{2}	Thallium	9.1×10^{1}
N-nitrosodiphenylamine	5.1×10^{1}	Toluene	1.0×10^{5}
N-nitrosodipropylamine	2.0×10^{-1}	Tributyl phosphate	2.5×10^{2}
Octachlorodibenzofuran	8.8×10^{-3}	1,1,2-Trichloroethane	4.3×10^{0}
Octachlorodibenzo-p-dioxin	8.8×10^{-3}	Trichloroethene	2.5×10^{1}
Pentachlorophenol	2.3×10^{0}	Vanadium	5.1×10^{3}
Selenium	5.4×10^{3}	Vinyl chloride	1.3×10^{-1}
Silver	2.9×10^{4}	Xylenes, total	9.2×10^{5}
Tetrachloroethene	3.6×10^{0}	Zinc	1.2×10^{5}

[a] The soil remediation levels for Technetium-99 for the following OU1 areas (as identified in the OU1 ROD) are more restrictive than the level identified in this table, and will, therefore, serve as the final remediation level for Technetium-99 for the respective area:

Waste Pit 2 Subsurface Soils - 5.5×10^{0} pCi/g
Waste Pit 3 Subsurface Soils - 7.5×10^{-1} pCi/g
Waste Pit 4 Subsurface Soils - 2.6×10^{-1} pCi/g
Waste Pit 5 Subsurface Soils - 1.4×10^{0} pCi/g
Waste Pit 6 Subsurface Soils - 7.3×10^{0} pCi/g
Burn Pit Subsurface Soils - 1.4×10^{1} pCi/g
Clearwell Subsurface Soils - 9.9×10^{0} pCi/g

[b] The PCB level established for Waste Pit 1 subsurface soils will be used in conjunction with these Aroclor-specific levels. Specifically, in addition to remediating to the individual levels for Aroclor-1254 and -1260, remediation will also proceed to the extent that the level for total PCBs is below 0.78 ppm.

[c] Based on integration with Draft OU5 ROD remediation levels

The Fernald site applies available hand-held instrumentation to help guide excavation and assist in identifying any isolated areas of higher contamination to help attain this ALARA goal.

A.5.2 Soils Disposition

Another key component of the selected remedy described in the OU1 ROD is that residual contaminated soils are dispositioned consistent with the selected remedies for contaminated process area soils documented in the August 1995 Draft OU5 ROD. The OU1 ROD further states that any materials not amenable to the OU5 remedy will be disposed as waste materials (i.e., shipped off site). This section addresses this component by first presenting the selected remedy for OU5 with respect to soils remediation, and then discussing how this soils remediation strategy will be implemented in terms of OU1 remediation activities.

A.5.2.1 OU5 Selected Remedy

The selected remedy described in the August 1995 Draft OU5 ROD consists of several key components associated with soil (and sediment) remediation. These components are summarized in this section under the categories of excavation, treatment, and disposal.

There are several key elements of the selected remedy in the August 1995 Draft OU5 ROD which relate to excavation. Specifically, excavation includes verification sampling to establish excavation boundaries, excavation of soils to the extent necessary to attain the final remediation levels, and performance of a certification sampling program following excavation activities to demonstrate that the final remediation levels have been attained.

In terms of the disposal of soils, the two key elements identified in the August 1995 Draft OU5 ROD are the transportation and on-property disposal of excavated material attaining the on-property disposal facility WAC, and the transportation and off-site disposal of excavated material exceeding the on-property disposal facility WAC. As can be seen here, the key to this disposition strategy is the ability to meet the WAC for the on-property disposal facility for OU5 materials. Table A-3 presents the OU5 on-property disposal facility WAC, as identified in Table 9-6 of the August 1995 Draft OU5 ROD.

Table A-3 - Operable Unit 5 On-Property Disposal Facility Waste Acceptance Criteria

Constituent of Concern	Maximum Concentration	Constituent of Concern	Maximum Concentration
Radionuclides (pCi/g)		**Organic (mg/kg) (Cont'd)**	
Neptunium-237	3.12×10^{9}	Heptachlor epoxide[a]	*
Strontium-90	5.67×10^{9}	Hexachlorobutadiene[a]	*
Technetium-99	2.91×10^{1}	Methoxychlor[a]	*
Uranium, total (mg/kg)	1.03×10^{3}	Methylene chloride[a]	*
Organics (mg/kg)		Methyl ethyl ketone[a]	*
Acetone[a]	*	Methyl isobutyl ketone[a]	*
Alpha-chlordane	2.89×10^{0}	4-Nitroaniline	4.42×10^{-2}
Benzene[a]	*	Tetrachloroethene[a]	1.28×10^{2}
Bis(2-chloroisopropyl)ether	2.44×10^{-2}	Toluene[a]	*
Bromodichloromethane	9.03×10^{-1}	Toxaphene[a]	1.06×10^{5}
Carbazole	7.27×10^{4}	1,1,1-Trichloroethane[a]	*
Carbon tetrachloride[a]	*	Trichloroethene[a]	1.28×10^{2}
Chloroethane[a]	3.92×10^{5}	Vinyl chloride	1.51×10^{0}
Chloroform[a]	*	Xylenes[a]	*
Chloromethane[a]	*	**Inorganics (mg/kg)**	
1,1-Dichloroethane	*	Barium[a]	*
1,2-Dichloroethane[a]	*	Boron	1.04×10^{3}
1,1-Dichloroethene[a]	1.14×10^{1}	Chromium VI[a]	*
1,2-Dichloroethene[a]	1.14×10^{1}	Lead[a]	*
Endrin[a]	*	Mercury[a]	5.66×10^{4}
Ethylbenzine[a]	*	Silver[a]	*
Heptachlor[a]	*		

[a] RCRA-based constituent of concern.

* Denotes compounds that will not exceed designated Great Miami Aquifer action level within the 1,000-year performance period, regardless of starting concentration in the disposal facility.

Several of the Resource Conservation and Recovery Act (RCRA) constituents shown in Table A-3, including a number of the RCRA organic solvents, do not have a calculated WAC value because the OU5 modeling simulations show that these constituents do not have the capability to exceed designated Great Miami Aquifer action levels within the 1,000-year simulation period, regardless of the starting concentrations for these constituents in the disposal facility. However, the mass balance approach applied in the modeling does not consider the potential deleterious effect that full-strength solvents can have on the earthen material comprising the disposal facility liners or the underlying native clays. Full strength solvents have been proven to cause shrinking of clays with a resulting potential for increases in clay liner permeability. As a best management practice for these compounds, the Fernald site acknowledges that it cannot place any RCRA Constituents of Concern into the disposal facility at concentrations that are incompatible with the clay liners or the underlying native clays beneath the liners. To track these concentrations during the excavation control surveys, field screening methods will be relied on to identify the soil that is contaminated with RCRA organics. This soil will be segregated for treatment before placement in the on-property disposal facility or shipped for off-site disposal.

In addition, the August 1995 Draft OU5 ROD states that the WAC referred to in this table has been extended to prohibit the receipt of materials exhibiting the characteristics of reactivity, ignitability, or corrosivity (as defined in RCRA Subtitle C). Materials exhibiting these characteristics will be segregated for treatment before placement in the on-property disposal facility or dispositioned off site.

Key elements of the OU5 selected remedy, which relate to the treatment of soils, include the application of cost-effective treatment (e.g., thermal desorption) for soil that exceeds the WAC due to the presence of nonradiological constituents. Additionally, continuation of efforts to examine and apply, where practical, emerging technologies pertaining to treatment of soil and sediment occurs.

A final element of the OU5 selected remedy relates to the implementation of the remedy, and hence, is a focal point of the discussions which follow. Specifically, the August 1995 Draft OU5 ROD states that soil excavation and interim storage will be conducted consistent with the requirements of the United States Environmental Protection Agency (US EPA)-approved Removal Action (RA) 17 Work Plan (Improved Storage of Soil and Debris) until such time as the appropriate OU5 remedial design is approved by the US EPA. The OU5 remedial design deliverable addressing soil management practices during the remedial action will contain the final strategy for excavation and interim storage/staging of contaminated materials originating from OU5. At this point, RA 17 will be terminated, and soil and sediment excavation activities will be conducted in accordance with the approved remedial design plan.

A.5.2.2 Overall OU1 Soils Disposition Strategy

This section discusses how the selected remedy for OU5 soils, as discussed in Subsection A.5.2.1 is implemented in terms of OU1 remediation activities. Specifically, the discussion focuses on the overall concept for OU1 soils management based on the elements discussed above.

As is indicated in Subsection A.5.2.1, until such time as the appropriate OU5 remedial design is approved, soils management is conducted consistent with the requirements of the US EPA-approved RA 17 Work Plan. For purposes of this discussion, it is assumed that Rev. 3 of the RA 17 Work Plan is utilized. Rev. 3 provides a strategy based on approved RODs or anticipated remedies, such as the selected remedy in the August 1995 Draft OU5 ROD. In terms of soils management, one of the goals of Rev. 3 of RA 17 is to minimize the total number of soil staging areas for the Fernald site by providing an integrated implementation strategy (which can be achieved through the application of soil staging criteria). In general, therefore, the following storage/staging strategy are applied to OU1 soils:

1) Soils which meet the WAC for the on-property disposal facility are either transported to a designated central staging area (e.g., prior to the disposal facility being able to accept such materials, or during winter months when the disposal facility may be closed), or transported directly to the disposal facility.

2) Soils which do not meet the WAC for the on-property disposal facility because they contain organic matter in excess volumes are transported to a designated location for treatment until the WAC is met.

3) OU1 soils which do not meet the on-property WAC are dried, as necessary, and disposed of off site.

A.5.2.3 Disposition of OU1 Waste Pit Soil Cover

An exception to the strategy presented in Subsection A.5.2.2, is that the waste pit cover soils are stockpiled during excavation, for possible blending with other OU1 wastes. Processed wastes that are characterized and determined to exceed the WAC of the permitted commercial disposal facility are loaded into railcars and mixed with the cover soil in a proportion determined to meet the permitted commercial disposal facility WAC, thereby minimizing the quantity of wastes requiring shipment and costly disposal at the Nevada Test Site. Any cover soils remaining after remediation of the waste pits are treated and characterized for placement in the on-property disposal facility, maximizing the quantity of waste pit cover soils disposal in the on-property disposal facility.

A.6 Summary

Figure A-2 provides a summary of the various materials management strategies presented in this appendix.

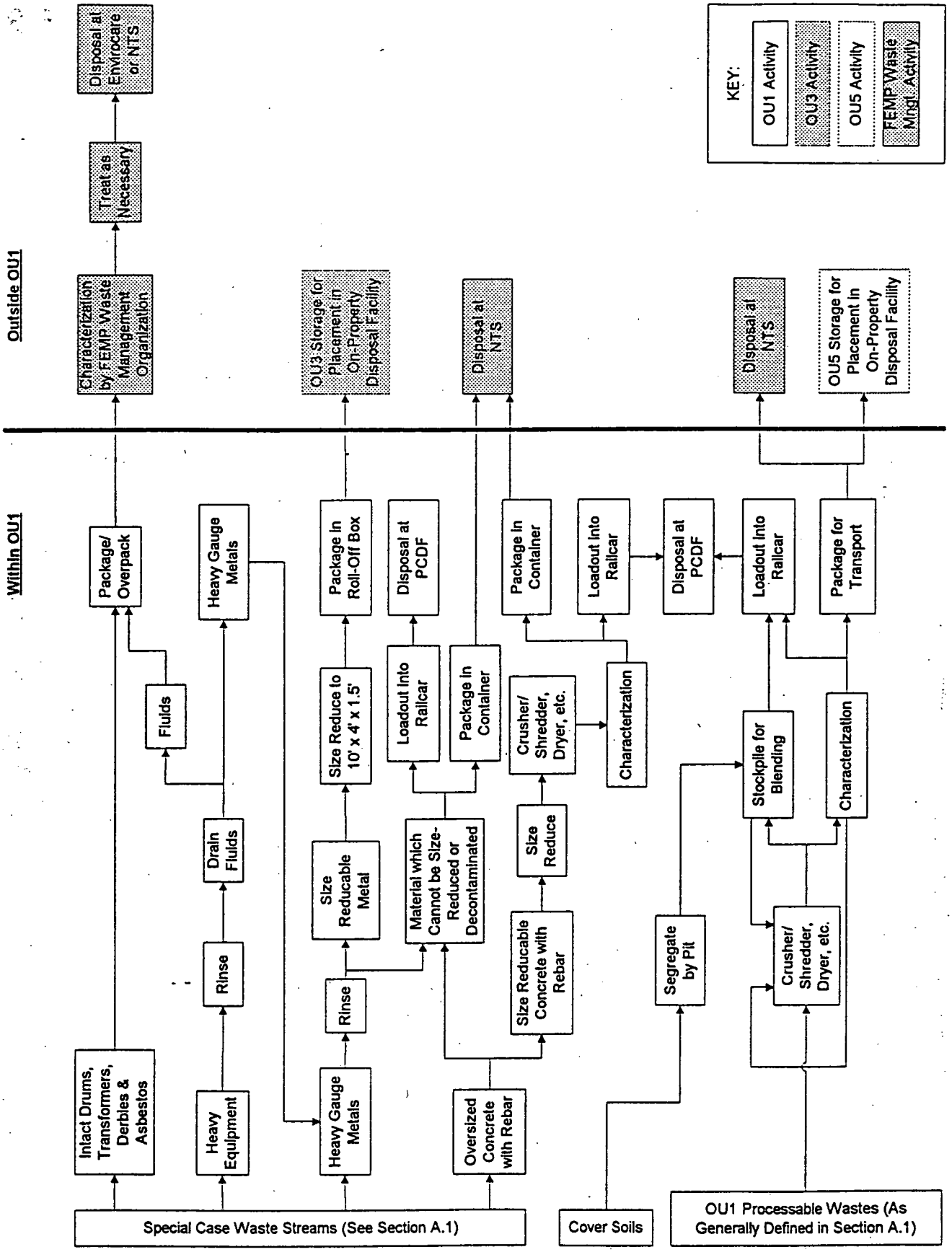

Figure A-2 - OU1 Materials Management

APPENDIX B

CONCEPTUAL DRAWINGS

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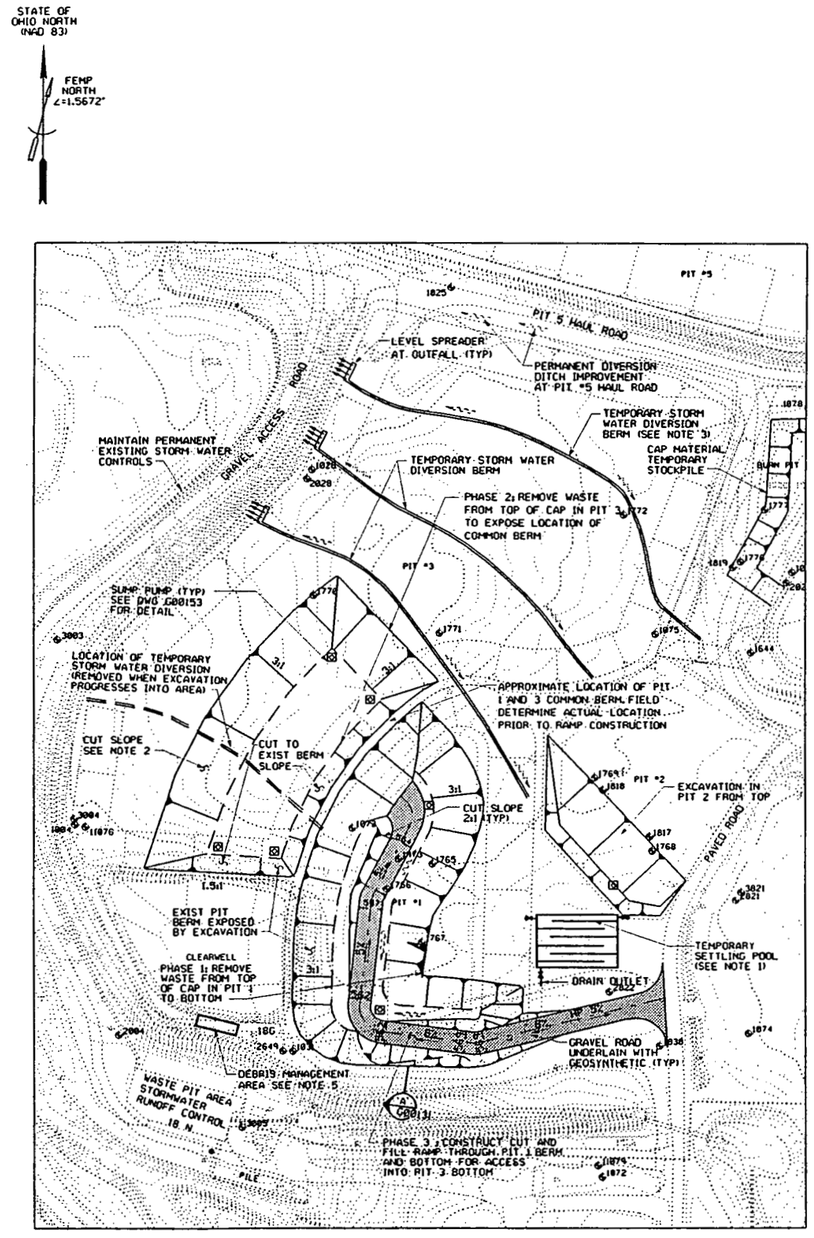
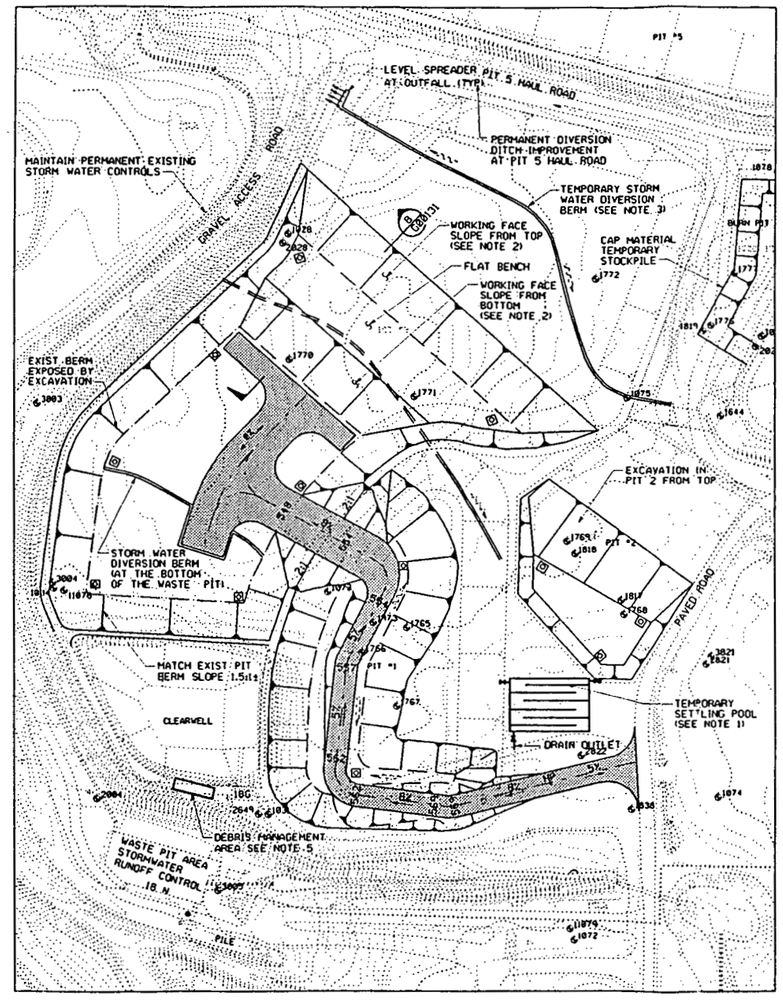


PLAN PHASE 1, 2, & 3



PLAN PHASE 4

NOTES

1. TEMPORARY SETTLING POOL WILL RECEIVE STORM WATER PUMPED FROM PIT BOTTOMS. PRIMARY PURPOSE IS FIRST STAGE SETTLING OF SUSPENDED SOLIDS TO REDUCE LOAD OF SEDIMENT AT CLEARWELL. POOL COULD BE A 3' HIGH FREESTANDING STRUCTURE WITH LINER. BAFFLES ARE OPTIONAL, BUT WOULD INCREASE DETENTION TIME NEEDED TO SETTLE SOLIDS. LOCATION TO BE FIELD DETERMINED AND WILL CHANGE AS EXCAVATION PROGRESSES.
2. 3H:1V SLOPE IS SHOWN. ACTUAL SLOPE ANGLE WILL BE FIELD DETERMINED BY QUALIFIED PERSONNEL BASED ON FIELD CONDITIONS ENCOUNTERED.
3. TEMPORARY STORM WATER DIVERSION BERM TO BE INSTALLED AT START OF CONSTRUCTION AND RELOCATED AS NECESSARY.
4. SUMP PUMP PITS SHALL BE FIELD LOCATED AT EDGE OF MUCK OR WET AREA AND MAINTAINED AS NEEDED.
5. DEBRIS MANAGEMENT AREA IS A CONCRETE PAD WHICH DRAINS TO THE CLEARWELL.

LEGEND

EXISTING		PROPOSED
	CONTOUR	565
	ROAD	
	STRUCTURE	
	FENCE	
1644	MONITORING WELL	
	SLOPE	
	SWALE	
	SUMP PUMP PIT	

REF DWG NO.	DRAWING TITLE
91X-5900-G-00131	PIT 1 AND 3 - EXCAVATION SECTIONS
91X-5900-G-00153	DETAILS

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REV. NO.	ISSUE OR REVISION PURPOSE - DESCRIPTION	A-E INITIALS	FERMCO INITIALS	DATE
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CINCINNATI, OHIO

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WASTE EXCAVATION PLAN

DRAWING TITLE
CIVIL
PIT 1, 2, AND 3 EXCAVATION PLAN

DRAWN BY	DATE	LEAD ENGINEER	DATE	CHECKED BY	DATE
W. LIU	8/22/95			K. GERARD	8/25/95

PLANT/BLDG NO.	FLOOR	SCALE	CLASS
		1"=60'	

SUBMITTED FOR APPROVAL: A-E DATE
FERMCO CRU APPROVAL: NA DATE NA

000811

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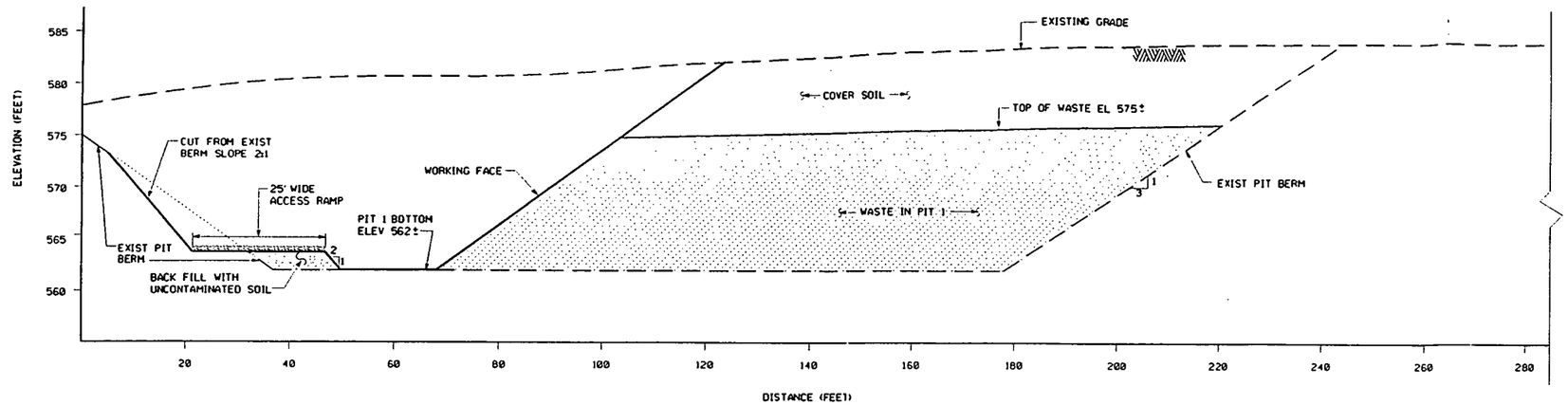

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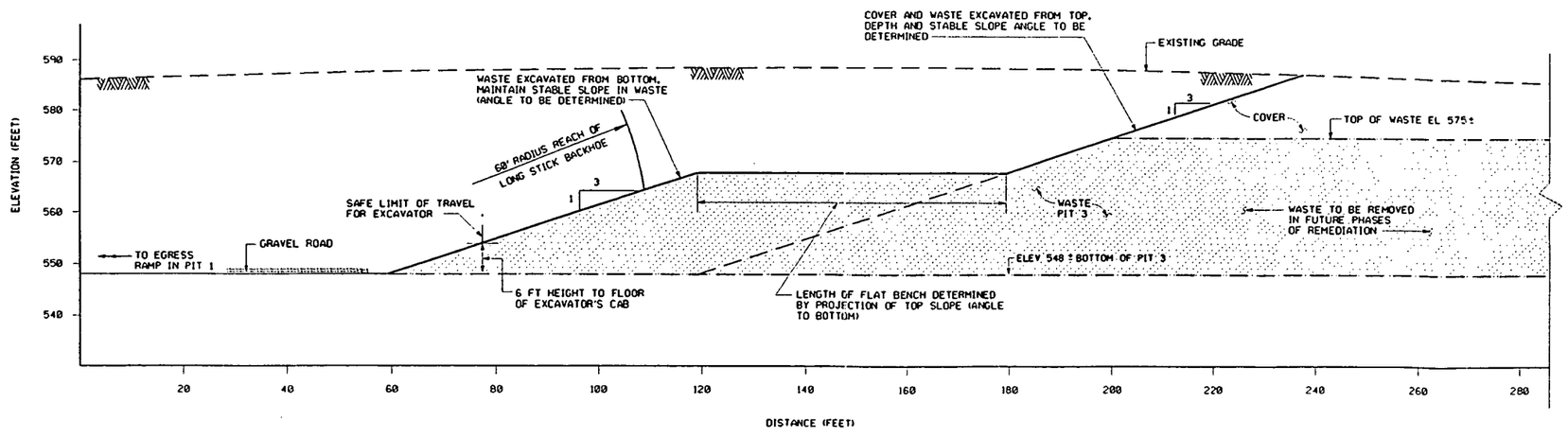

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0163

REF DWG NO.	DRAWING TITLE
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PIT 1 AND 3
EXCAVATION SECTIONS

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SUBMITTED FOR APPROVAL | FERNCO CRU APPROVAL NA 000812

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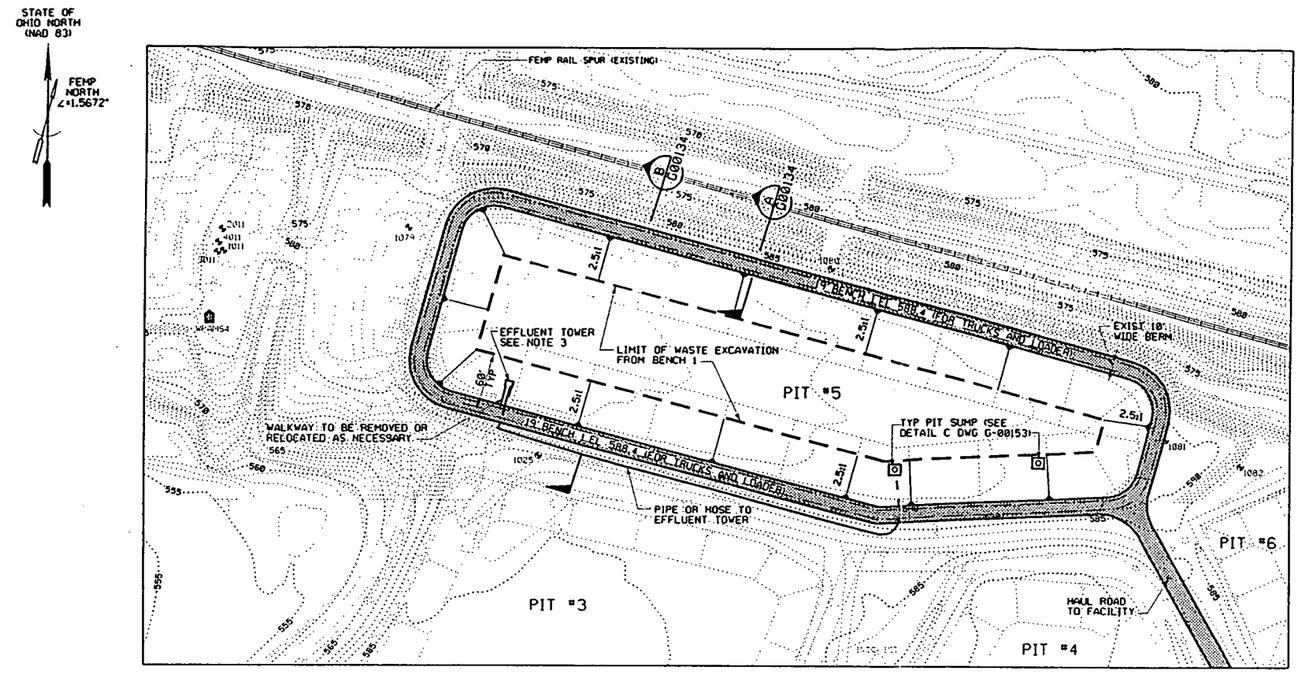

PHASE 1 EXCAVATION PLAN

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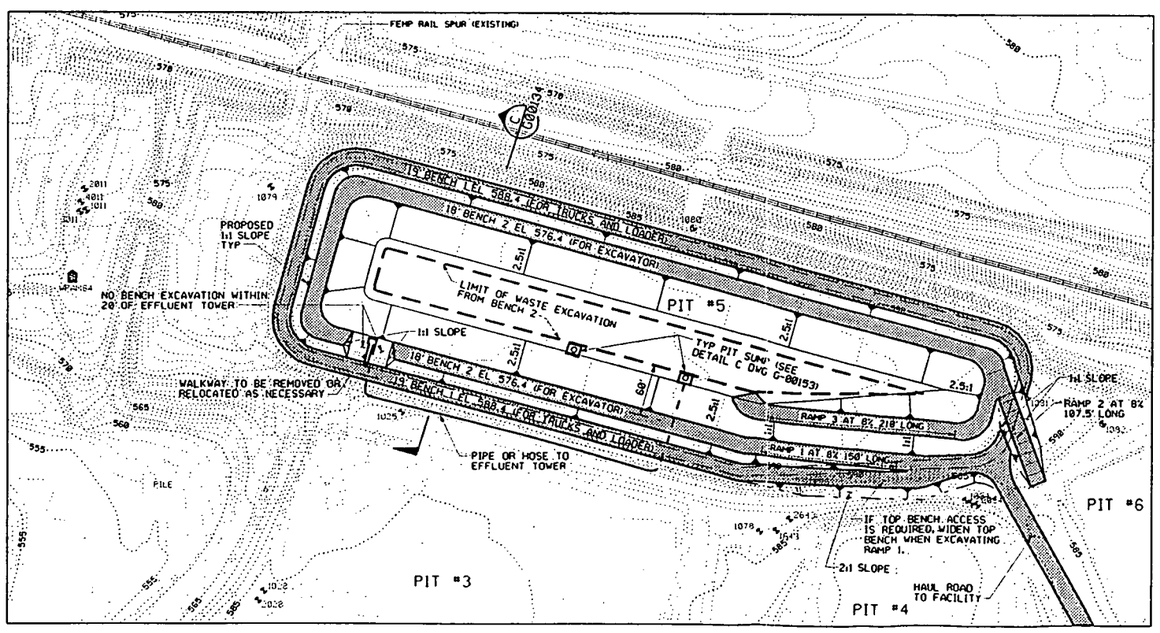

PHASE 2 EXCAVATION PLAN

SCALE : 1"=60'

NOTES

0163

1. EXISTING CONDITIONS SHOWN ON THIS DRAWING WERE PREPARED FROM FEMP SITE PROVIDED DATA FROM THE DOCUMENTS LISTED BELOW.

   EXISTING SITE DATA SOURCE (IN PLANT FILES)
   FEMP CADD GRID/UTILITY DRAWINGS
   FEMP CONTRACTOR PROJECT DESIGN DOCUMENTS

2. DESCRIPTION OF LONG REACH EXCAVATOR OPERATION:

   EXCAVATE EXISTING TOP OF BERM 2.0' DEEP MAKE THE BENCH 1 FROM 10' TO 19' WIDE FOR LONG REACH EXCAVATOR SPACE REQUIRED.

   LONG REACH EXCAVATOR WITH MINIMUM 60' ARM AND 38' DUMPING HEIGHT TO REMOVE WASTE AND LOAD INTO TRUCKS FOR TRANSPORT TO DISPOSAL AREA.

   EXCAVATE 150 FEET RAMP 1 AND 107.5 FEET RAMP 2 AT 8% SLOPE TO THE 18 FEET WIDE BENCH 2 TO ALLOW LONG REACH EXCAVATOR FOR SECOND REMOVAL.

   EXCAVATE 210 FEET RAMP 3 AT 8% SLOPE TO THE BOTTOM OF THE PIT FOR THE FINAL REMOVAL.

   MAINTAIN SPACING OF OPERATION SEQUENCES ALONG THE BENCHES AND RAMPS UNTIL EXCAVATION IS COMPLETED.

3. POND IS TO BE DRAINED AND MAINTAINED IN A DRAINED STATE. POOL LEVEL CONTROLLED AT EFFLUENT TOWER IS TO BE LOWERED TWO FEET BEFORE BERM IS WIDENED AND PROGRESSIVELY LOWERED DURING CONSTRUCTION.

LEGEND

EXISTING		PROPOSED
	CONTOUR	565
	ROAD	
	RAIL ROAD	
	STRUCTURE	
	FENCE	
	MONITORING WELL	
	SLOPE	

REF DWG NO.	DRAWING TITLE
91X-5900-G-00134	PIT 5 EXCAVATION SECTIONS
91X -5900-G-0015	DETAILS

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WASTE EXCAVATION PLAN

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CIVIL
PIT 5
EXCAVATION PLAN

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K. TANG / W. LIU	08/14/95			E. KUBRIN	08/18/95

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		1"=60'	

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A-E DATE	NA NA

000813

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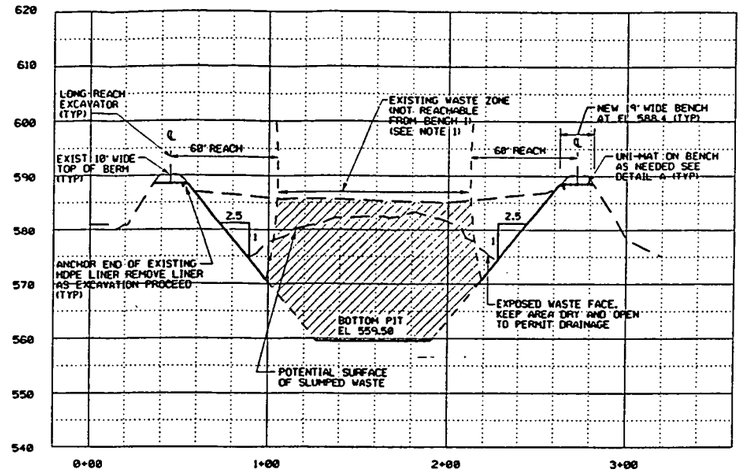

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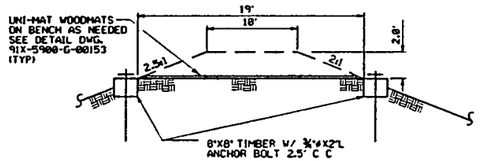
VERT 1" = 10'



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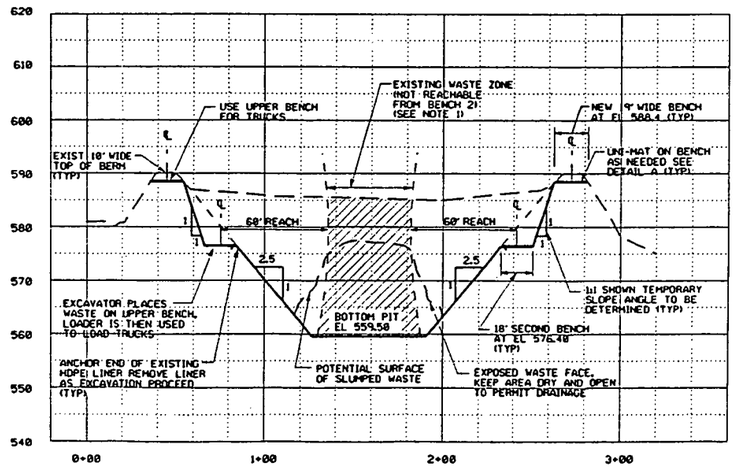

SECTION C REF G00134 G00154
HOR 1" = 30'
VERT 1" = 10'

NOTES

1. WASTE IS EXPECTED TO SLUMP TO A LOWER ANGLE. REPOSE SLOPE ANGLE TO BE DETERMINED.

0163

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91X-5900-G-00154	PIT 5 EXCAVATION PLAN

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WASTE EXCAVATION PLAN

DRAWING TITLE
CIVIL
PIT 5
EXCAVATION SECTIONS

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SUBMITTED FOR APPROVAL | FERNCO CHIEF ENGINEER | DATE | NA

G00814

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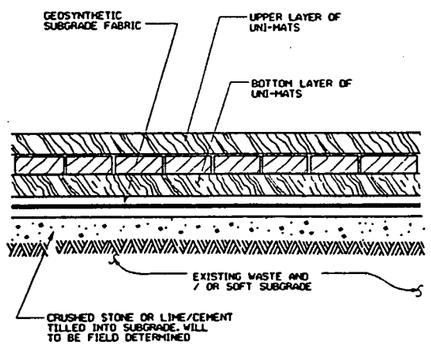

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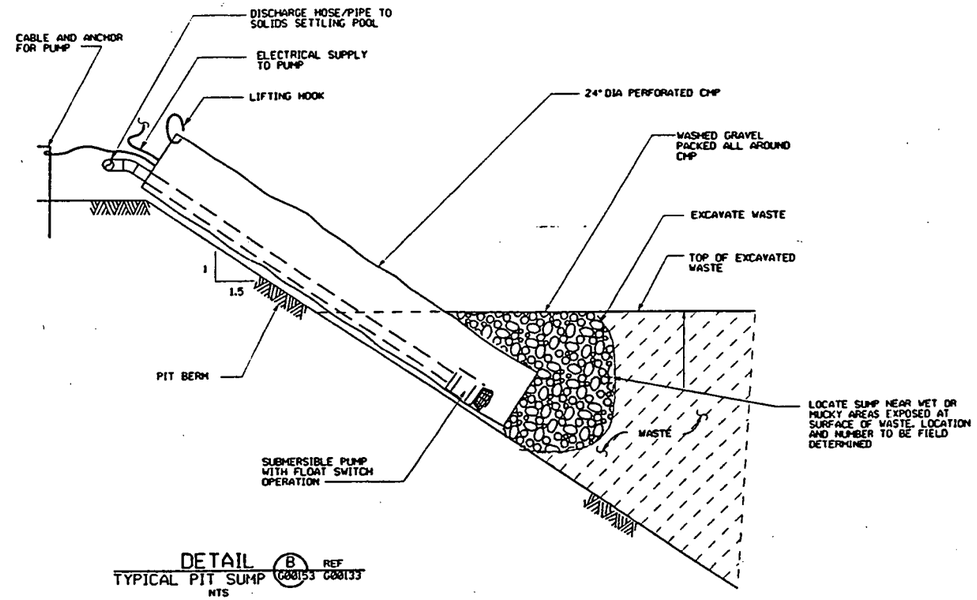

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NOTES

0163

REF DWG NO.	DRAWING TITLE
91X-5900-G-00133	PIT 1 AND 3 EXCAVATION PLAN
91X-5900-G-00154	PIT 5 EXCAVATION PLAN

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WASTE EXCAVATION PLAN

DRAWING TITLE
CIVIL
DETAILS

DRAWN BY	DATE	LEAD ENGINEER	DATE	CHECKED BY	DATE
K. TANG	8/18/-95			D. REED	8/18/95

PLANT/BLDG. NO. | FLOOR | SCALE | CLASS

SUBMITTED FOR APPROVAL | FEMCO OPU APPROVAL NA | NA

A-E DATE | DATE

000815

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CRU1/P0145		WBS 00-90701	91X-5900-G-00153	G0005	B

DEEP DATA REPORT

0163

Preliminary Technical Summary of DEEP Test Data

Operable Unit 1
Project Order 145
October 1995
Revision A
(75% Complete)

Environmental Remedial Action Project
Fernald Environmental Management Project
Fernald, Ohio
FERMCO Subcontract No. 2-21487

PARSONS

Fairfield Executive Center
6120 South Gilmore Road
Fairfield, Ohio 45014

000816

Preliminary Technical Summary of DEEP Test Data

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4-6 Three-Dimensional Block Model Interpretation of Material Types at Waste Pits 1, 2, and 3

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LIST OF ACRONYMS AND ABBREVIATIONS

ALTER	Accelerated Life Testing and Environmental Research
ARA	Applied Research Associates, Inc.
ASTM	American Society for Testing and Materials
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
cm	centimeter
CPT	Cone Penetrometer Test
DEEP	Dewatering and Excavation Evaluation Program
DOE	United States Department of Energy
FEMP	Fernald Environmental Management Project
FERMCO	Fernald Environmental Restoration Management Corporation
ft	foot (feet)
GIS	Geographical Information System
GMA	Great Miami Aquifer
gpm	gallons per minute
MDD	Maximum Dry Density
OMC	Optimum Moisture Content
OU	Operable Unit
pcf	pounds per cubic foot
RCRA	Resource Conservation and Recovery Act
sec	second
SPT	Standard Penetration Test
3-D	three-dimensional

SECTION 1

INTRODUCTION

This document presents preliminary geotechnical interpretations, analyses, and evaluations based on field and geotechnical laboratory data collected in the Operable Unit 1 (OU1) area at the Fernald Environmental Management Project (FEMP) as part of the ongoing Dewatering and Excavation Evaluation Program (DEEP). These geotechnical data include results of slug tests, cone penetrometer tests (CPTs), Standard Penetration Tests (SPTs), visual logging of test borings, wet trenching, and test dewatering at Pits 1, 2, and 3. Geotechnical soil sampling was performed in conjunction with the test borings at Pits 1, 2, and 3. This report summarizes interim results of geotechnical laboratory tests on samples from Pit 1, 2, and 3 test borings completed in October 1994. Pit 5 and 6 results will be included in the final report.

Eight additional test borings were completed in Pits 1, 2, and 3 in August 1995, and a crane-mounted VibraCore sampler collected samples at several locations in Pits 5 and 6. Geotechnical laboratory testing of samples collected during the 1995 field activities is in progress; therefore, data (except preliminary Pit 5 and 6 moisture and density data) are not available. Samples were also collected for geotechnical testing during trenching activities. The results of these tests are also not yet available. When laboratory test results become available and analysis is completed, the results will be summarized and evaluated in the final report. Results from geotechnical testing of samples from Pits 1, 2, 3, 5, and 6 are expected in November 1995. As a final activity of the DEEP, ramp excavation tests are planned at Pits 1 and 3. The results of these tests will also be summarized and evaluated in the final report.

There are numerous reasons for collecting the DEEP data, as can be found in the DEEP DQOs. However, these can be combined into three general purposes:

1) To provide engineering input to an assessment of excavation techniques best suited to remediation objectives

2) To develop a data base for assessing the correlation among CPT, SPT, and laboratory test results as they relate and can be extrapolated to actual physical conditions

3) To provide parameters for waste process design

The data received by PARSONS to date from the DEEP for Pits 1, 2, and 3 were used for preliminary analyses and evaluation of in situ dewatering and mechanical excavation of these pit wastes. The preliminary analyses, described in Section 4, consider the slope stability and bearing capacity of Pit 3

waste material during mechanical excavation. This section also summarizes preliminary evaluation of well or well point systems for use in waste dewatering prior to and during excavation.

Section 3 summarizes index properties, including moisture content, density, and plasticity. These properties provide data that can be used to establish a basis for process design, which includes drying the waste. Index property data from geotechnical testing conducted prior to the DEEP Project are used to supplement the DEEP index properties data base.

Based on the preliminary analyses described in Section 4 and the current design data needs, recommendations for additional testing are provided.

SECTION 2

TESTING PROGRAM

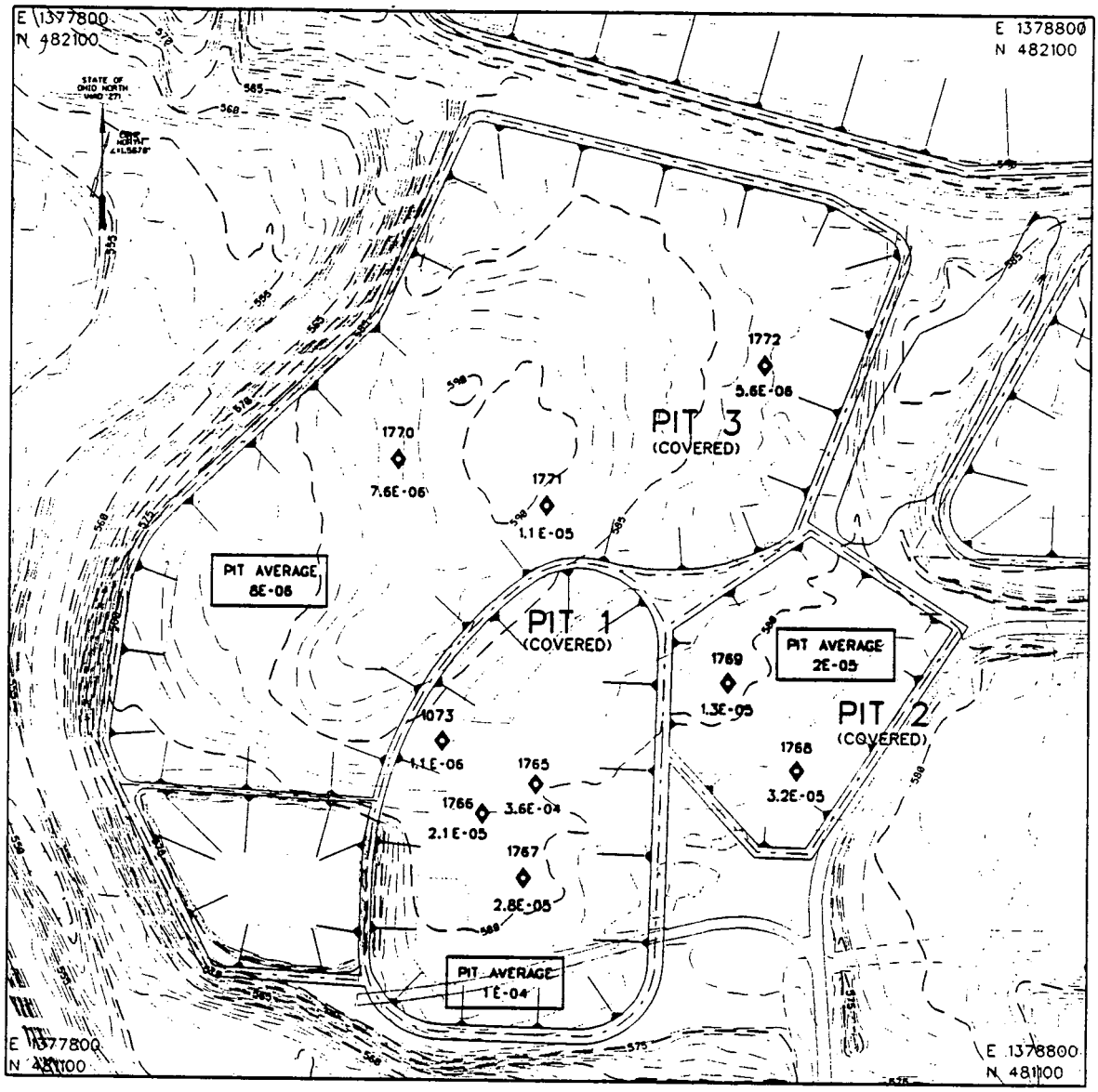
Fernald Environmental Restoration Management Corporation (FERMCO) is conducting a treatability study to evaluate dewatering and mechanical excavation of waste materials in three covered waste pits and two open pits in the OU1 area at the FEMP site. *Operable Unit 1 Dewatering Excavation Evaluation Program Treatability Study Work Plan* (DOE 1994a), prepared and amended by FERMCO Comprehensive Environmental Response, Compensation, and Liability Act/Resource Conservation and Recovery Act (CERCLA/RCRA) Unit 1, describes the objectives and activities of the treatability study. As part of the treatability study, geotechnical data collection activities at Waste Pits 1, 2, 3, 5, and 6 have been conducted and are ongoing. Field slug tests were performed at nine existing monitoring wells in covered Pits 1, 2, and 3. Geotechnical test borings and cone penetrometer tests in Pits 1, 2, and 3 have been completed to provide data regarding physical properties of the waste in existing "wet" conditions. Geotechnical samples taken from the test borings have been transferred to the geotechnical testing laboratory. Interim geotechnical laboratory test results are available for Pits 1, 2, and 3. Trenching was conducted under wet conditions using a tracked excavator at a total of seven locations in Pits 1, 2, and 3. The first phase of test dewatering was performed in Pits 1 and 3.

Ongoing or planned DEEP activities include completion of geotechnical laboratory testing and ramp excavation in Pits 1 and 3. The following subsections summarize the DEEP field activities conducted to date. Section 3 summarizes the interim results of geotechnical laboratory testing.

2.1 Slug Tests

As part of the DEEP, to evaluate dewatering and excavation conditions within Waste Pits 1, 2, and 3, FERMCO performed field slug tests on nine existing monitoring wells located in the waste pits during March and April 1994 (see Figure 2-1), and forwarded the data to PARSONS for analysis (PARSONS 1994). Wells 1073, 1765, 1766, and 1767 are located in Pit 1. It should be noted that, judging from the boring log, Well 1073 appears to have been drilled in the berm of the pit and, therefore, is screened largely in materials not representative of waste materials. Wells 1768 and 1769 are located in Pit 2; wells 1770, 1771, and 1772 are located in Pit 3.

In general, falling head field tests were performed by initially measuring undisturbed water levels by hand, then inserting a slug to perturb the water level and digitally capture water level versus time data as the well water level returned to near initial conditions. Rising head field tests were similarly performed by withdrawing the slug and digitally logging water level recovery.



NOTE: ALL HYDRAULIC CONDUCTIVITIES ARE STATISTICAL MATCH RISING HEAD VALUES.

0 100 200 FT
SCALE

1772 ◆ 5.6E-06 MONITORING WELL SHOWING WELL NUMBER AND HYDRAULIC CONDUCTIVITY IN (cm/sec)

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Figure 2-1 - Slug Test Locations and Results

The objective of this effort was to conduct slug tests in existing wells to develop an approximate sense of the range of hydraulic conductivity values that can be anticipated for pit waste materials in the vicinity of the well screens. Figure 2-1 presents a waste pit area well site map that includes rising head hydraulic conductivities for each well, and conductivity averages for each pit.

From the slug tests, some general observations can be made regarding the permeability characteristics of the wastes. Pit 1 wastes show slightly higher conductivities than Pit 2 wastes, which show slightly higher conductivities than Pit 3 wastes (see Figure 2-1). Although the conductivity ranges vary slightly, it can be concluded that the waste materials in Pits 1 and 2 typically show modal conductivities on the order of 10^{-5} cm/sec, whereas Pit 3 waste materials show conductivities on the order of 10^{-6} cm/sec. No general trends within each pit were noted.

2.2 Cone Penetrometer Testing

Applied Research Associates, Inc. (ARA) conducted a Piezo-electric CPTs at Waste Pits 1, 2, and 3 from August 23, 1994, to September 2, 1994. The tests were conducted with a penetrometer truck having an overall push capacity of 45,000 pounds. Twenty-three CPT probings were conducted at Waste Pits 1, 2, and 3: six at Waste Pit 1, five at Waste Pit 2, and 12 at Waste Pit 3. Figure 2-2 shows the CPT locations. Data from these tests represent existing water conditions.

A penetrometer probe of standard dimensions was used and advanced at a constant rate. Inside the probe, load cells independently measure the vertical resistance against the conical tip and the side friction along the sleeve. Forces are sensed by the load cells and the data are transmitted from the probe assembly via a cable within the push tubes. A pressure transducer located behind the tip in the lower end of the probe measures penetration probe pressure. Typically a set of data is recorded each second, for a minimum resolution of one data point every 0.8 inch. The depth of penetration is measured using a string potentiometer mounted on the push frame.

Electronic data acquisition equipment for the cone penetrometer consists of a computer with a graphics monitor and a rack of eight signal conditioners. Analog signals transmitted from the probe are amplified, filtered, and digitized. The digital data are then read into memory and written to an internal hard disk for future processing. Upon completion of the test, raw data are translated via a soil-specific algorithm and plotted. Floppy disks containing data are brought to ARA for analysis and preparation of reports. Following these tests, PARSONS was also provided copies of the floppy disks. PARSONS developed CPT logs for Waste Pits 1, 2, and 3 from the ARA digital data. Appendix A contains these preliminary CPT logs.

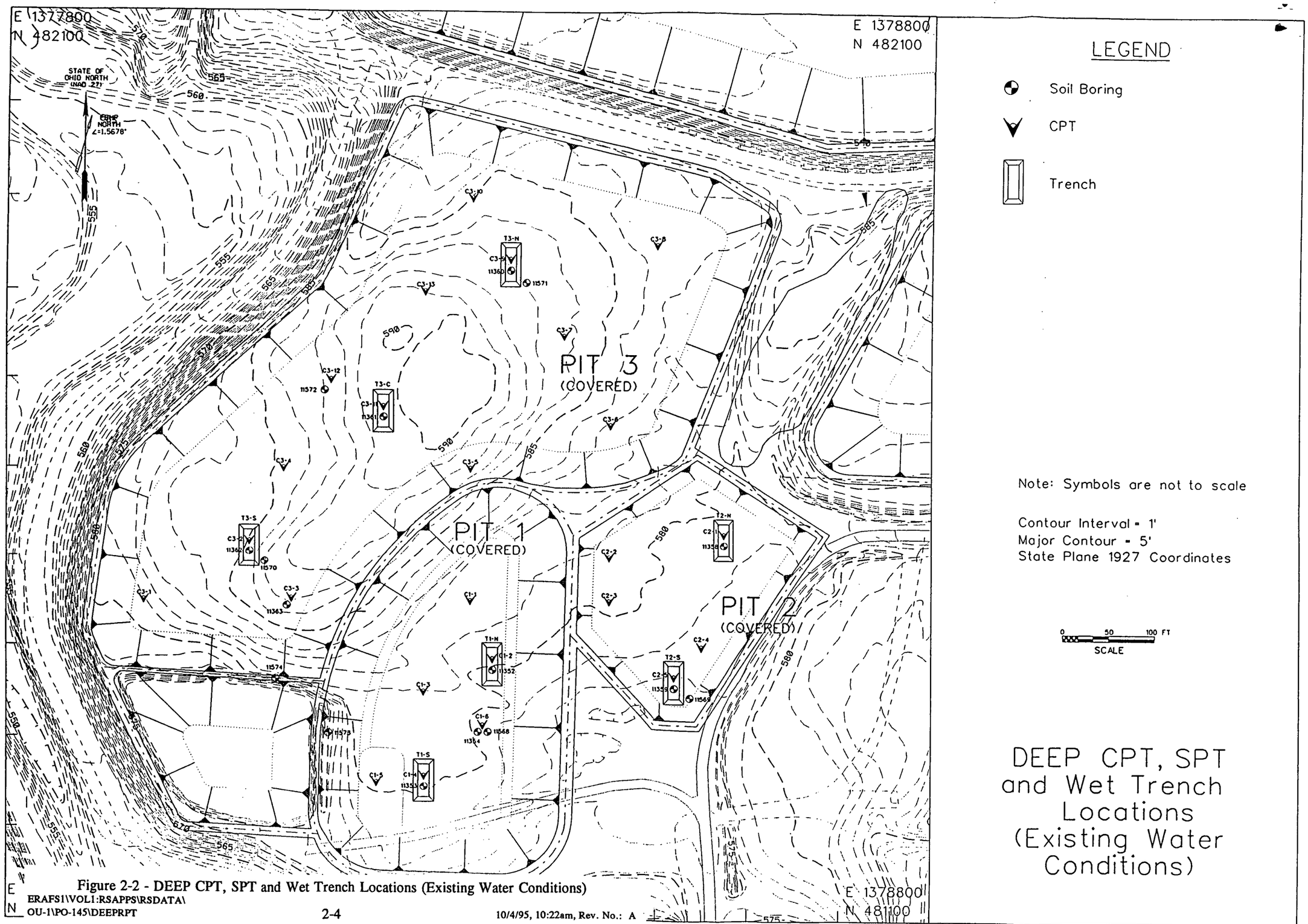

Figure 2-2 - DEEP CPT, SPT and Wet Trench Locations (Existing Water Conditions)

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2.3 Test Borings

SPTs were performed in conjunction with geotechnical sampling at Waste Pits 1, 2, and 3 from October 4 to 11, 1994. Nine borings were completed: three in Waste Pit 1 (11352, 11353 and 11354), two in Waste Pit 2 (11358 and 11359), and four in Waste Pit 3 (11360 through 11363). Figure 2-2 shows the locations of the test borings. Data from these borings represent existing water conditions. Hollow stem auger drilling methods were used to advance the test borings. SPTs (ASTM D 1586) were performed in each test boring at planned depth intervals. A FERMCO field geologist visually logged split-barrel samples. Thin-walled samples (Shelby tubes) (ASTM D 1587) were collected in undisturbed material in advance of the auger at planned depth intervals. Selected geotechnical samples were sent to an on-site geotechnical laboratory for testing. At the completion of sampling, all borings were abandoned with Volclay grout. Interim geotechnical testing results of samples collected from these test borings are available (ALTER 1995).

To provide correlation data for the CPT probes, these nine borings in Waste Pits 1, 2, and 3 were located within about 10 feet of a CPT location. Section 4 contains additional discussion of SPT/CPT correlation.

Seven additional geotechnical test borings were completed at Waste Pits 1, 2 and 3 from August 7 through 16, 1995: one in Pit 1 (11568), one in Pit 2 (11569), three in Pit 3 (11570, 11571, and 11572), and two in the Clearwell berm bordering Pits 1 and 3 (11573 and 11574). Figure 2-2 shows the test boring locations. Boring 11573 did not intercept the clay berm at the anticipated depth and was completed in cover waste material at 16.5 feet. Boring 11574 intercepted the berm at about 15 feet and was completed at 35 feet. Shelby tube sampling was conducted as described above to provide additional samples for strength tests to support slope stability analyses. The test borings in the pits were located near the locations of the borings completed in October 1994 to allow for comparison of test results. Selected geotechnical samples were sent to a geotechnical laboratory for testing; the results of these geotechnical laboratory tests are not yet available.

Appendix B contains draft logs for the test borings from the October 1994 and August 1995 DEEP test borings.

2.4 Wet Trenching

A total of seven wet (not dewatered prior to excavation) trenches have been excavated in Pits 1, 2 and 3 as part of DEEP for the purpose of evaluating conditions of the waste, and to provide information about dewatering and/or excavating a wet waste. A John Deere 690D LC tracked excavator (track hoe) was used to perform test excavations at seven locations at Pits 1, 2 and 3 (see Figure 2-2). FERMCO conducted the trenching from February 1 through March 14, 1995.

The trenches were conducted, using the trackhoe, at seven locations that had a prior CPT sounding and a geotechnical test boring. The excavation site was prepared for spoil piles prior to the excavation. Plastic sheets were placed on the ground surface in the vicinity of the location to collect and direct drainage from the spoil pile back to the trench. A temporary berm around the perimeter of the spoil pile areas was formed using hay bails and plastic sheets. The trench was dug between two spoil pile areas. One spoil pile was for the cover material and the other for the waste. Water tanks (3,000 - 8,000 gallon capacity) at the excavation location collected water that was pumped from the trench with portable dewatering pumps.

Excavation proceeded by creating a rectangular trench about 30 inches wide, 0.79 cy heaped bucket, and 5 feet total. The length of the trenches was about 20 to 25 feet. The long axis of the trench ran along a general north-south line, with the track hoe positioned at the north end of the trench. Excavation was done so the trench wall slope remained as steep as possible, permitting observation of trench sidewall failure. The backhoe achieved its full reach (excavated depth of 15 feet). As the trench wall material collapsed into the trench, it was excavated from the pit and placed on the spoil pile. The final width of the trench at ground surface varied from 5 to 30 feet, depending on the amount of sidewall failure. A field engineer recorded observations during the excavation.

During the trenching, a FERMCO sampling technician collected samples of the waste materials, taken at various depths from each trench, directly from the track hoe bucket, prior to its placement on the spoil pile. Additional material samples were collected from the waste spoil pile prior to backfilling the material into the trench. A 5-gallon plastic bucket of waste material was collected from each trench. The samples were transferred to an on-site geotechnical laboratory for moisture content tests, classification, compaction, and bearing ratio tests. The results of these geotechnical tests are not available. Additionally, waste material from each of the trenches was archived in white steel boxes for future testing by OU1.

FERMCO videotaped excavation operations at each location. The cameraman was positioned above the trench location with a four-wheel drive man-lift.

Appendix C summarizes field observation notes completed by the field engineers during trenching operations.

2.5 Dewatering

B&B Drilling, Inc. performed the first of three phases of a dewatering test program for Pits 1 and 3 from July 27 to August 19, 1995. The primary objective of Phase I was to determine whether groundwater could be extracted from Pit 1 and 3 sludges. If extraction was judged feasible, further objectives were to determine optimum well installation technique and well yield. Phase II of the study is to determine

sludge hydrology, well spacing, and the effect of certain enhancements to well efficiencies. Phase III is to perform pilot-scale dewatering operations in Pits 1 and 3.

Starting on July 27, 1995, a linear array of wells, wellpoints, and instruments were installed in Pit 1 using various combinations of drilling techniques. Figure 2-3 shows a plan view of the array. Both wells had screen and riser diameters of 4 inches, while both wellpoints had screen and riser diameters of 1.5 inches. All wells and wellpoints were screened from 7 to 12 feet of depth. The pore pressure piezometer was screened by a canvas bag over an interval of 10 to 12 feet of depth, and the tensiometer tip was installed at a depth of 6.5 feet. Figure 2-4 shows the precise location of the array within Pit 1.

The well designated as DW1-1 on Figure 2-3 was installed using direct rotary techniques with water only. Well DW2-1 was installed in a similar fashion, except that the borehole was flushed with fresh water after drilling. Wellpoints WP1-1 and WP2-1 were both installed by the jet method, the difference being that WP2-1 was flushed with fresh water after drilling. The Pit 1 array installation was completed on August 8, 1995.

A similar linear array was installed in Pit 3 beginning on August 9, 1995. Figure 2-5 shows that the arrangement of the test array for Pit 3 differs from that of Pit 1 only in the inter-element spacing. Screen and riser diameters were 4 inches and 1.5 inches for the wells and wellpoints, respectively. All wells and wellpoints were screened from 10 to 30 feet of depth except DW1-3, which was screened from 9 to 29 feet. The pore pressure piezometer was screened by a canvas bag over the 27-to-29 foot interval while the tensiometer tip was installed at 9 feet. Figure 2-4 depicts the location of the array within Pit 3.

Both wells were drilled using direct rotary techniques with water only, and both wellpoints were installed by the jet method. Pit 3 array installation was completed on August 14, 1995.

Four preliminary tests for Pit 1 commenced on August 17 and involved, for each of the four wells and wellpoints, 1 hour of pumping followed by measurement of post-pumping recovery. For the two wells, the 1 hour pumping periods consisted of 1/2 hour of pumping under gravity followed by 1/2 hour of pumping with applied vacuum of 23 inches of water. The wellpoints were pumped with vacuum of 20 to 25 inches of water for the entire hour.

Wellpoint WP2-1 demonstrated the highest yield in the preliminary tests (approximately 1.3 gallons per minute (gpm)) and was then pumped for 4 hours, after which recovery was measured. Figure 2-6 shows the time history of well yield during this 4 hour test. The plot shows a fluctuating yield with an average over the 4 hours of 1.15 gpm. Pit 1 testing was completed on August 18, 1995.

PHASE I - TEST WELL AS-BUILT LOCATION PLAN(PIT #1)

NTS

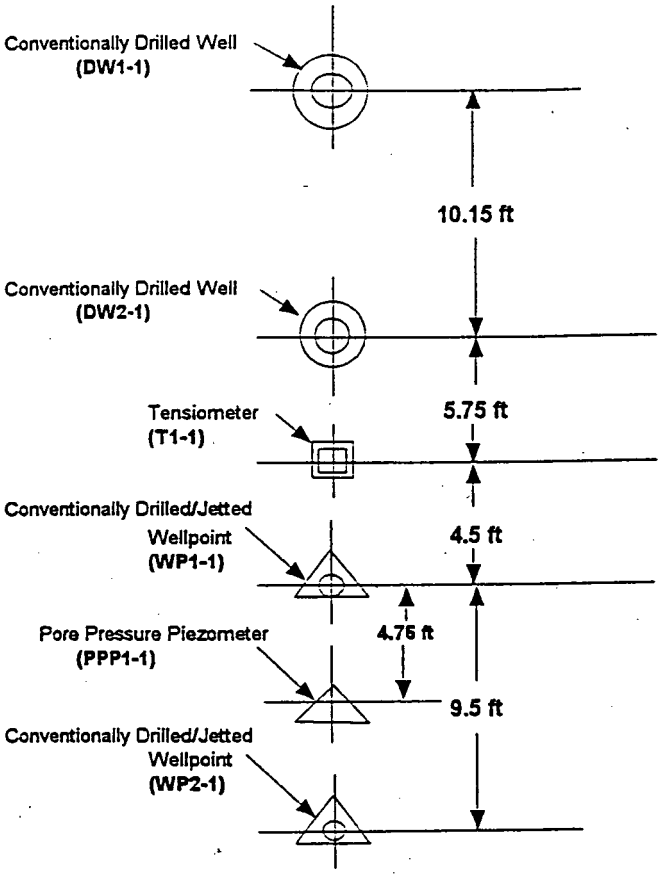
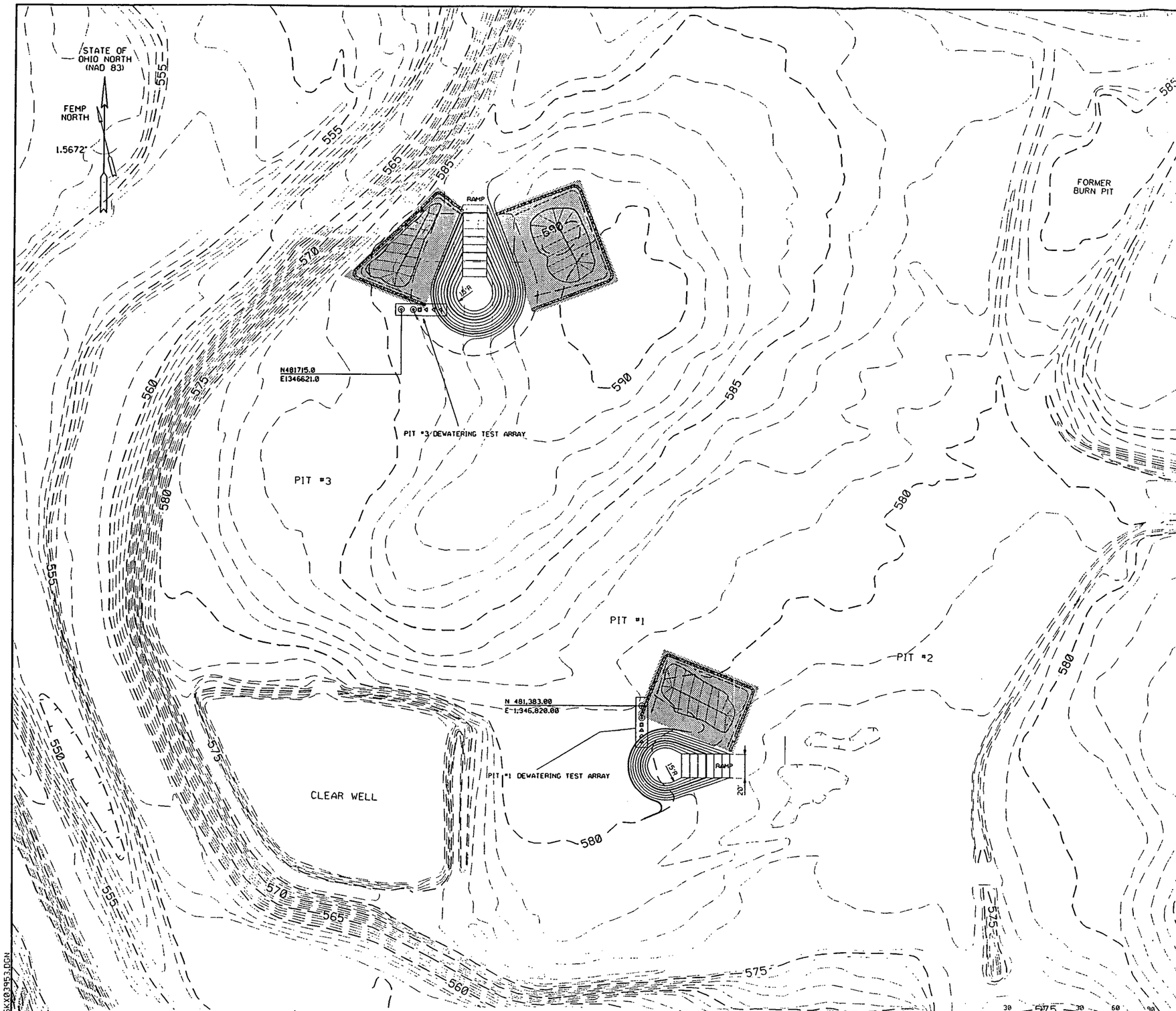


Figure 2-3 - Pit 1 Test Array Plan View



LEGEND

- ◎ CONVENTIONALLY DRILLED WELL
- ◘ TENSIOMETER
- ▲ CONVENTIONALLY DRILLED/JETTED WELLPOINT
- △ PORE PRESSURE PIEZOMETER

FIGURE 2-4
LOCATION MAP
DEWATERING TEST ARRAYS
AND RAMP EXCAVATION
LOCATIONS

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Figure 2-4 - Location Map for Dewatering Test Arrays and Ramp Excavation Locations

PHASE I - TEST WELL AS-BUILT LOCATION PLAN(PIT #3)

NTS

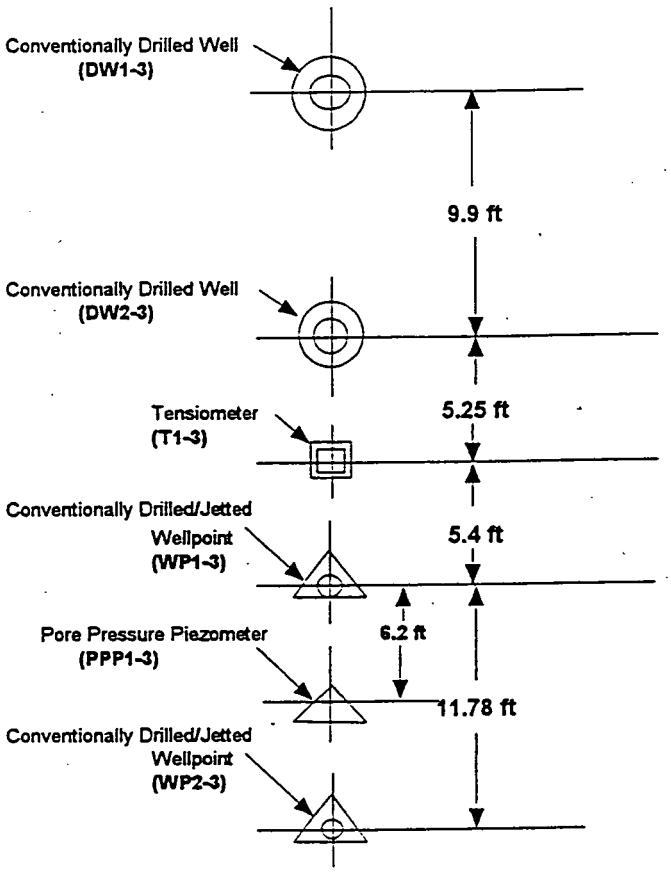

Figure 2-5 - Pit 3 Test Array Plan View

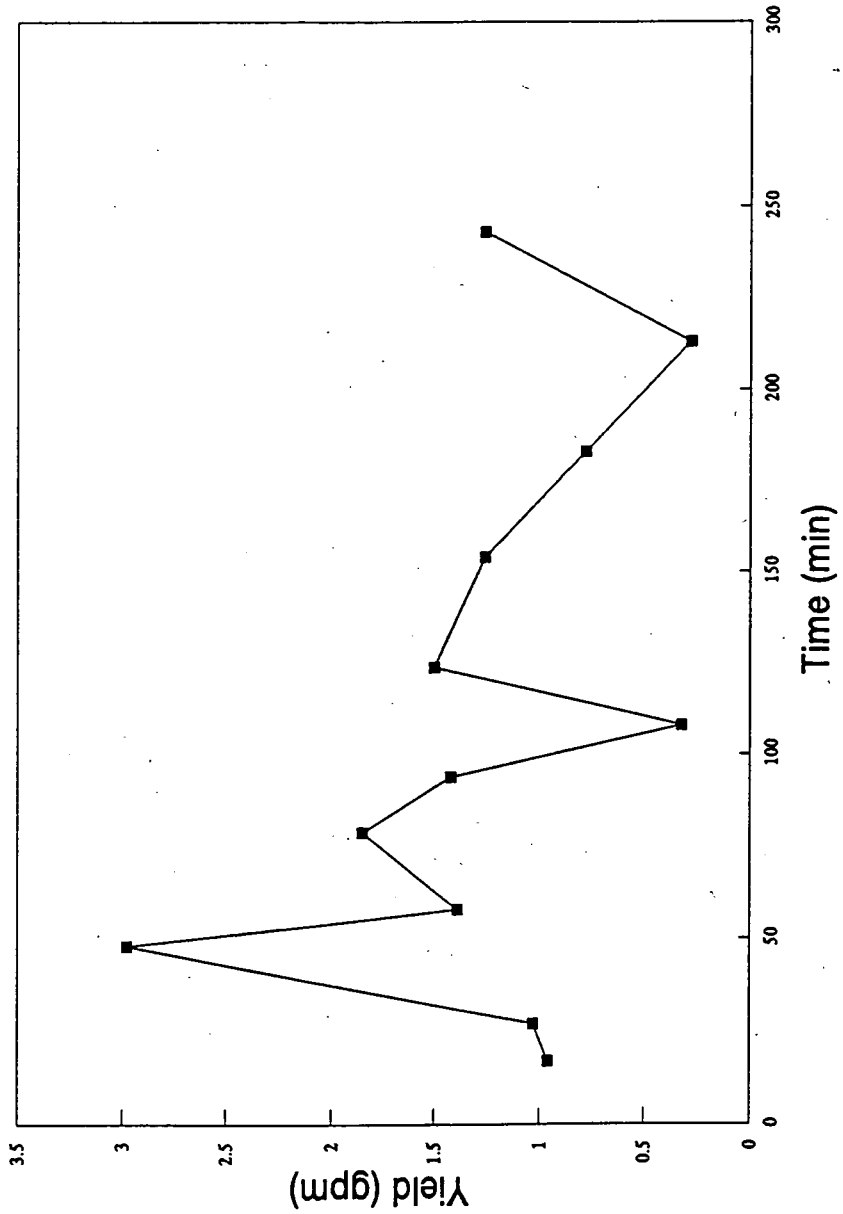

Figure 2-6 - Wellpoint Yield vs. Time for Pit 1, 4-Hour Pump Test

Testing in Pit 3 began on August 18, 1995. The preliminary test procedure for Pit 3 was identical to that for Pit 1. Vacuum for the second 1/2 hour of the well pumping tests was 22 inches of water for DW1-3 and 27 to 28 inches for DW2-3. Vacuum was 24 to 27 inches for WP1-3 and 25 to 26 inches for WP2-3 for the entire hour of pumping.

Well DW2-3, which demonstrated a preliminary test average yield of .4 gpm (.65 gpm with vacuum), was selected for the 4 hour pump test. Figure 2-7 shows the time history of well yield during this 4-hour test. The plot shows an almost monotonically decreasing yield with a final yield of .26 gpm at the end of 4 hours. Pit 3 testing was completed on August 19, 1995.

Appendix D summarizes B&B's findings and recommendations and uses Phase I results to evaluate the impact of dewatering on pit remediation activities and schedules.

2.6 Ramp Excavations

The DEEP test ramps and other geotechnical testing results will allow estimation of strength and the determination of what slope the pit material will remain stable. Allowable bearing capacity of equipment can also be confirmed against calculations which are based on very limited geotechnical testing. Run-in can also be estimated from ramp excavation activities.

Waste Pit 1 will contain an east-west trending ramp with a 15 percent slope (see Figure 2-4). The total depth of the excavation (8 feet) will accommodate a stable ramp, with side slopes of 2H/1V. The bottom of the excavation will be located 572 feet above mean sea level.

Waste Pit 3 will contain a north-south trending ramp with a 15 percent slope (Figure 2-4). The upper 6 feet of the ramp side slopes will have a 2H/1V incline and the lower 6 feet will have side slopes of 2.5H/1V incline. Total depth of the excavation will be to 12 feet with the bottom of the excavation located at 577 feet above mean sea level. Excavation will be accomplished using a track excavator and loader.

Field information will be used to assist in the determination of the most stable slope configurations, the selection of the appropriate excavation equipment and to evaluate a field dewatering approach for free draining of water.

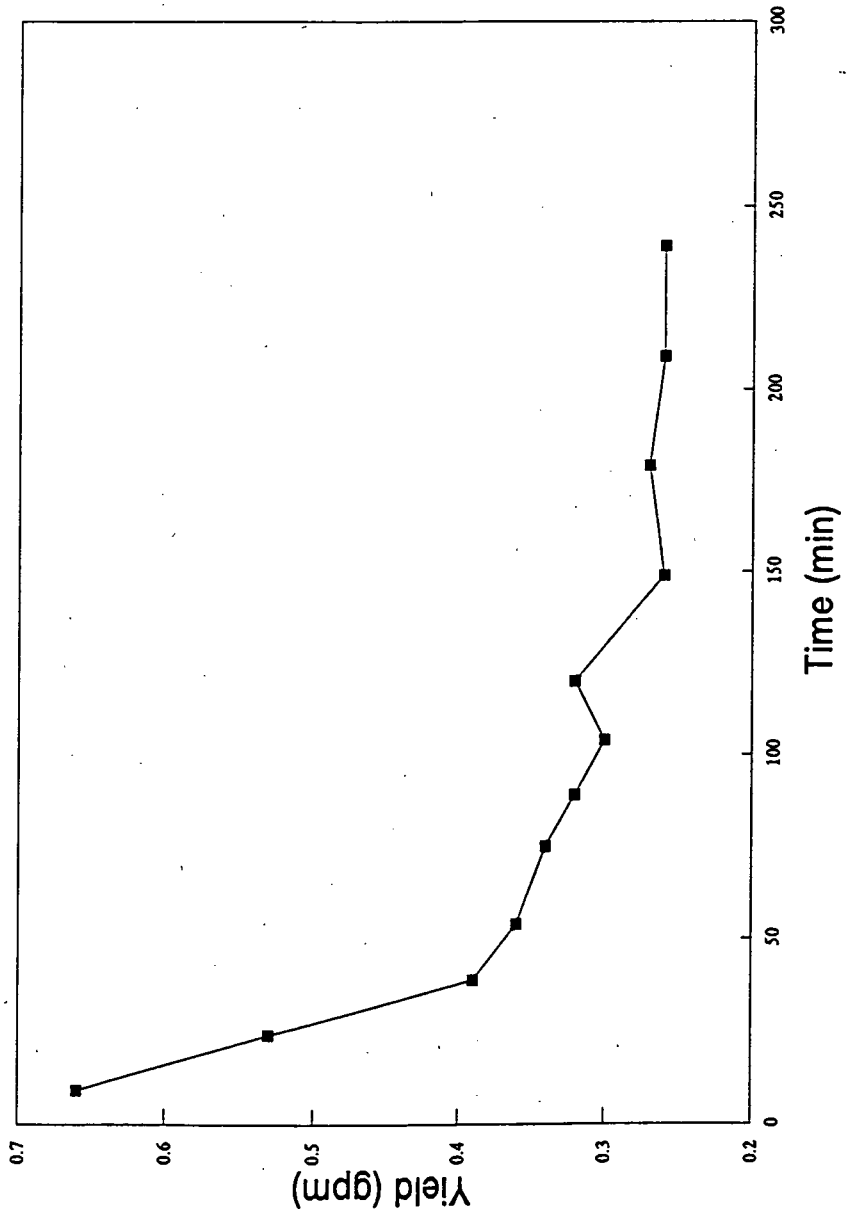

Figure 2-7 - Well Yield vs. Time for Pit 3, 4-Hour Pump Test

SECTION 3

SUMMARY OF LABORATORY TESTING PROGRAM

Selected disturbed samples (from split-barrel samplers) and undisturbed samples (Shelby tube samples) were transferred to the on-site geotechnical laboratory for testing. Interim results of the laboratory testing are available. The testing plan for these samples includes index properties testing and physical properties testing. Index properties testing includes grain size analyses, specific gravity tests, moisture content tests, and Atterberg limits tests. Physical properties testing on waste material from Waste Pits 1, 2, and 3 includes consolidated, undrained triaxial shear strength tests and unit weight data.

3.1 Index Properties

Index properties are reported for OU1 Waste Pits 1, 2, and 3 only. Index properties for the DEEP are reported in *OU1 Dewatering, Excavation Evaluation Program Waste Pits 1, 2, 3,* Interim Report (ALTER 1995). Additional data are reported from the following sources:

1) *Characterization Investigation Study, Geotechnical Evaluation of Waste Pit Material Properties, and Boring Logs* (WESTON 1988)

2) *Final Remedial Investigation Report for Operable Unit 1* (DOE 1994)

3) *Cooperative Remedy Screenings Program,* Final Report (ALTER 1994)

Table 3-1 is a summary of the index properties of materials sampled from Waste Pits 1, 2 and 3. Table 3-1 is organized by the primary Unified Soils Classification System (USCS) group name found in each Waste Pit.

Table 3-2 is a summary of average moisture contents and unit weights for pits 1, 2 and 3 arranged by USCS group name. For Pit 1, the majority of the material sampled was a nonplastic silt (ML(NP)). In Pit 2 the majority of the sampled material was an elastic silt (MH) with some lean clay (CL), clayey sand (SC) and silty sand (SM). In Pit 3 the majority of the sampled material classifies as either an inelastic silt (ML) or an elastic silt (MH) with some lean clay (CL) and silty sand (SM).

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Table 3-1 - Summary of Index Properties

Pit No.	USCS Group Name	Moisture Content (%)	Specific Gravity	Grain Size Analysis				Atterburg Limits			Dry Unit Weight (pcf)	Wet Unit Weight (pcf)
				Gravel (%)	Sand (%)	Silt and Clay (%)	Clay Fraction (%)	LL	PL	PI		
1	ML(NP)	15.9 - 39.1 [20]	2.92 - 3.15	0 - 19	4 - 38	53 - 96	0 - 13	NP	NP	NP	109.4-120.5 [6]	135.7-138.1[6]
	SM	44.8 - 47.3[2]	2.80 - 3.05	2 - 6	49 - 50	46 - 48	4 - 7	42.1 - 67.7	42.5 - 68.2	NP	74.9[1]	108.5[1]
2	CL	16.7 - 38.3[2]	2.72	4 - 8	22 - 26	66 - 74	22	42.3 - 44.1	16.2 - 23.1	19.2 - 27.9	-	-
	MH	31.9 - 231.2[6]	2.59 - 3.02	0 - 20	1 - 40	58 - 99	2 - 22	53.0 - 181.0	32.0 - 1050	10.2 - 72.0	42.9 - 45.6[2]	78.5 - 90.2[2]
	SC	21.4 - 24.1[2]	2.20 - 2.69	18 - 22	32 - 67	15 - 46	8 - 11	24.0 - 33.4	14.0 - 20.3	10.0 - 13.2	105.7[1]	131.2[1]
	SM	32.7 - 35.4[2]	2.65[1]	1 - 25	46 - 55	29 - 44	8	33.1 - 36.0	23.2 - 28.0	8.0 - 9.9	-	112.5[1]
3	CL	18.0 - 36.1[2]	2.69[1]	4 - 6	20 - 25	72 - 74	25	26.3 - 44.1	16.2 - 25.2	10.1 - 18.9	110.0[1]	129.7[1]
	MH	55.1 - 173.6[8]	2.54 - 2.84[5]	0 - 4	15 - 49	50 - 84	3 - 16	52.0 - 119.0	32.0 - 38.0	16.0 - 71.0	-	-
	ML	25.3 102.8[7]	2.45 - 2.96[4]	0 - 7	4 - 46	53 - 96	3 - 23	30.0 - 46.9	24.8 - 33.9	4.6 - 18.7	44.8[1]	75.1 - 90.7[2]
	ML (NP)	44.7 - 63.7[2]	2.20 - 2.39	1 - 2	31 - 56	44 - 67	7 - 8	45.7 - 51.0	53.7 - 57.8	NP	64.3[1]	93.0[1]
	SM	63.7 - 138.7[3]	2.20 - 2.88	0 - 3	48 - 56	43 - 50	6 - 8	73.2 - 116.0	55.0 - 56.2	17.0 - 61.0	-	90.1[1]

Notes: Superscript number in parentheses is the number of samples.

% Gravel: Portion retained on #4 sieve up to 3 inches in diameter.

% Sand: Portion passing #4 sieve but retained on #200 sieve

%Silt and Clay: Portion passing the #200 sieve. Distinction between clay and silt is determined by the hydrometer analysis.

Table 3-2 - Summary of Average Moisture Contents and Unit Weights

Pit Number	USCS Group Name	Average Moisture Content(s)	Average Dry Unit Weight (pcf)	Average Wet Unit Weight (pcf)
1	ML(NP)	23.3(20)	114.1(6)	136.9(6)
	SM	46.1(2	74.9(1)	108.5(1)
2	CL	27.5(2)	ND	ND
	MH	118.5(6)	44.3(2)	86.2(2)
	SC	22.8(2)	105.7(1)	131.2(1)
	SM	34.1(2)	ND	112.5(1)
3	CL	27.1(2)	110.0(1)	129.7(1)
	MH	119.1(8)	ND	ND
	ML	49.3(7)	44.8(1)	82.9(2)
	ML(NP)	64.7(2)	64.3(1)	93.0(1)
	SM	96.6(3)	ND	85.7(2)

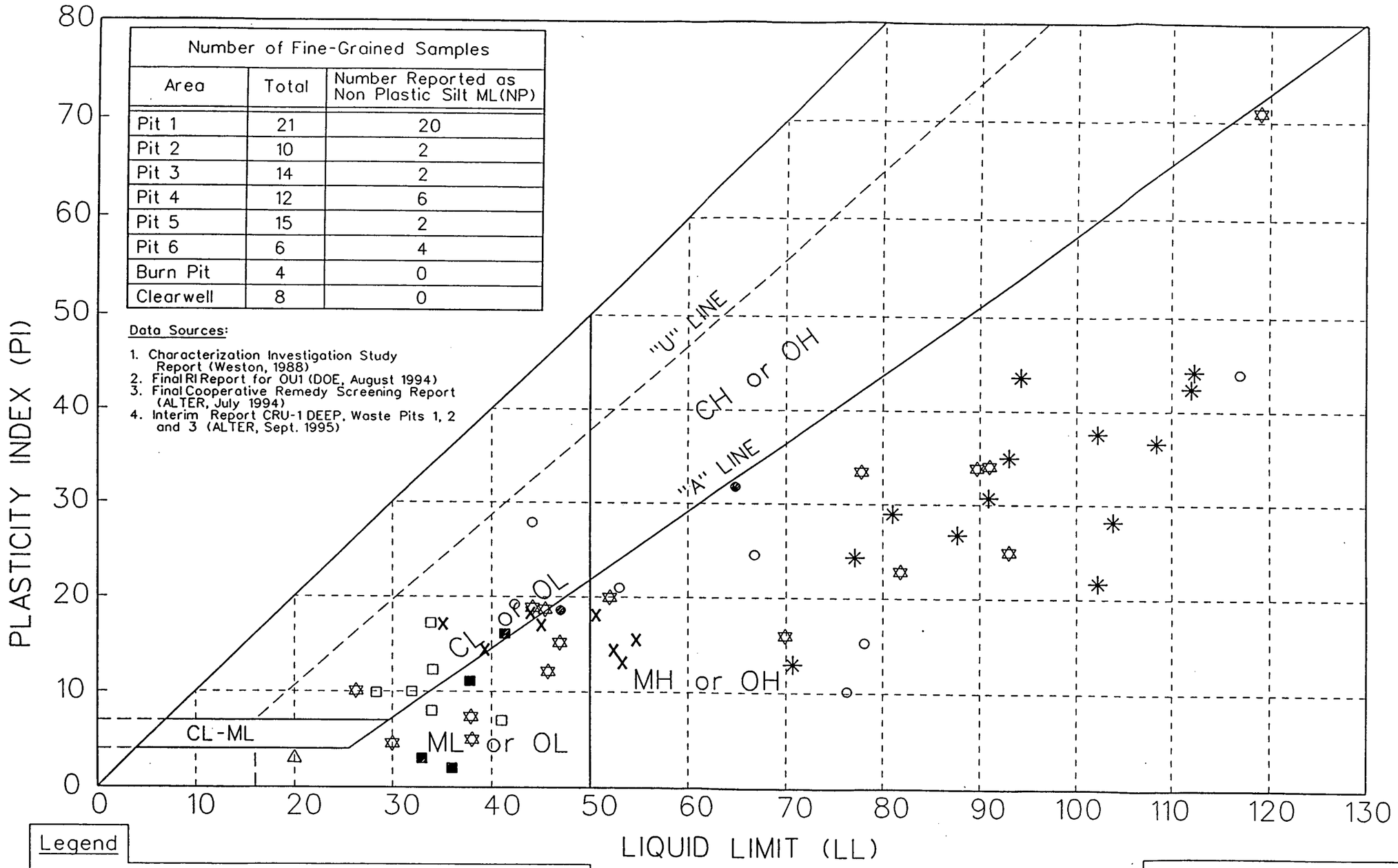
Notes: ND = No data available
Number in parentheses is number of samples average is based upon.

Appendix E includes tables of all the geotechnical properties for OU1 Waste Pits 1 through 6 and statistical information for data from Pits 1, 2 and 3.

As shown in Figure 3-1 and in Appendix E, the materials from Waste Pit 1 are nonplastic silts while the materials from Waste Pits 2 and 3 are low plasticity and high plasticity silts. The material from Pit 1 tends to be much drier and more dense than the materials from Waste Pits 2 and 3.

3.2 Physical Properties (In Situ and Remolded)

The physical properties of Pits 1, 2 and 3 are divided into in situ and remolded physical properties. The in situ physical property source is ALTER 1995, and the remolded physical property source is ALTER 1994.



Number of Fine-Grained Samples		
Area	Total	Number Reported as Non Plastic Silt ML(NP)
Pit 1	21	20
Pit 2	10	2
Pit 3	14	2
Pit 4	12	6
Pit 5	15	2
Pit 6	6	4
Burn Pit	4	0
Clearwell	8	0

Data Sources:

1. Characterization Investigation Study Report (Weston, 1988)
2. Final RI Report for OU1 (DOE, August 1994)
3. Final Cooperative Remedy Screening Report (ALTER, July 1994)
4. Interim Report CRU-1 DEEP, Waste Pits 1, 2 and 3 (ALTER, Sept. 1995)

Legend

- △ Pit 1 Sample
- ○ Pit 2 Sample
- ✡ Pit 3 Sample
- □ Pit 4 Sample
- ✳ Pit 5 Sample
- ● Pit 6 Sample
- ■ Burn Pit Sample
- X Clearwell Sample

Figure 3-1 - Plasticity Chart

Plasticity Chart
OU-1 Waste Pit
Fine-Grained Samples

Source of Plasticity Chart: ASTM D 2487

File: SKX03941.DGN

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The only in situ physical property reported in ALTER 1995 is the consolidated undrained CU triaxial shear results from Waste Pit 3. Table 3-3 summarizes the Waste Pit 3 CU triaxial results. The reported undrained ϕ_u values range between 15° and 23° and undrained cohesion values between 0 and 1.5 psi. The reported drained ϕ_d values range between 32° and 39° and the drained cohesion values were assumed to be zero.

Table 3-3 - Summary of In Situ Physical Properties

Boring Number	Sample Number	Depth Range (ft)	Pit Number	ϕ_u	ϕ_d	c (psi)
11361	400039	21.0 - 22.5	3	23.9°	33.7°	0
11362	400041	19.0 - 20.5	3	15.0°	39.0°	1.5
11362	400042	23.0 - 25.0	3	16.0°	32.9°	0.7

Physical property tests were performed on remolded samples composited from several different sample intervals and combinations of different waste pits. Table 3-4 summarizes the results of the physical property tests performed on the composited samples.

Compared to material from Pits 2 and 3, the waste material from Pit 1 is closer to optimum moisture due to its more free-draining nature. As a result, it is possible for the material in Pit 1 to have in situ densities near maximum dry density, whereas the material from Pits 2 and 3 is too wet to obtain in situ densities near maximum dry density.

Geotechnical laboratory data from the waste pit samples, when available, complete the information necessary to assess the undewatered strength and stability of the materials, and provide a baseline condition against which to evaluate the effects of dewatering on the materials. Additionally, the geotechnical laboratory data are expected to allow for calibration of the CPT data, thus enhancing confidence in extrapolation of expected material properties to areas where only CPT data exist.

These data suggest that the material in Pits 2 and 3 will have to be densified before ramps, roads or other access structures can be built in the pits for removal of the waste material, assuming equipment will sit directly on the waste material. Except for working atop the soil cap, there is no plan to work on the waste.

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Table 3-4 - Summary of Remolded Physical Properties

Sample Group	Source of Material for Composite Sample	Liquid Limit %	Plastic Limit %	Optimum Moisture %	Std. Proctor Max. Dry Density (lb/ft^3)	UCS*		Direct Shear		Permeability* (cm/s)
						q_u (psf)	c_u (psf)	c_{cd} (psi)	ϕ_{cd} (° ∆)	
NP1	Pits 1 and 4	21.3	NP	13.4	116.6	N/A	N/A	0.0	40	4.3×10^{-6}
MH2	Pits 2 and CW	59.8	40.1	35.4	77.8	2936	1468	7.6	2.9	6.6×10^{-8}*
CL	Pits 2 and 3	32.2	23.8	20.1	102.3	2962	1481	2.4	32	2.6×10^{-7}

* at approximately 95 percent standard Proctor maximum dry density

SECTION 4

ANALYSIS AND RESULTS

This section presents preliminary evaluation of Pits 1, 2, and 3 subsurface conditions, and analyses of slope stability and bearing capacity of materials at Pit 3. The results from these analyses are important with respect to evaluating and establishing the appropriate approach to safe mechanical excavation of the materials at OU1. The analyses evaluate conditions in covered Pit 3, which is the largest and deepest, and, potentially, poses the most challenging excavation sequence. Additional similar analyses can be performed for other pits as the geotechnical laboratory data become available. A three-dimensional (3-D) interpretation of CPT data is presented, and preliminary correlations of CPT and SPT data are discussed. A 3-D excavation sequence will be modeled and presented in the final report.

Although results of geotechnical laboratory testing on samples from the test borings are not yet complete, it is worth noting that considerable benefit has already been realized in terms of correlating CPT/SPT data as it relates to necessary design parameters and interpretation of subsurface conditions. By integrating data from the CPT probings with data from the boring logs, it is possible to view the suite of results on a single graphic (see Figure 4-1). This capability greatly enhances understanding of the interactions of the various parameters, and lends confidence to conclusions made from the data. Subsection 4.5 provides a discussion of specific parameters as they relate to one another, to the boring log classifications, and ultimately to laboratory test results.

4.1 Subsurface Conditions (Pits 1, 2 and 3)

The following discussion summarizes findings from the SPT borings drilled in the areas of Waste Pits 1, 2, and 3, and trenching activities.

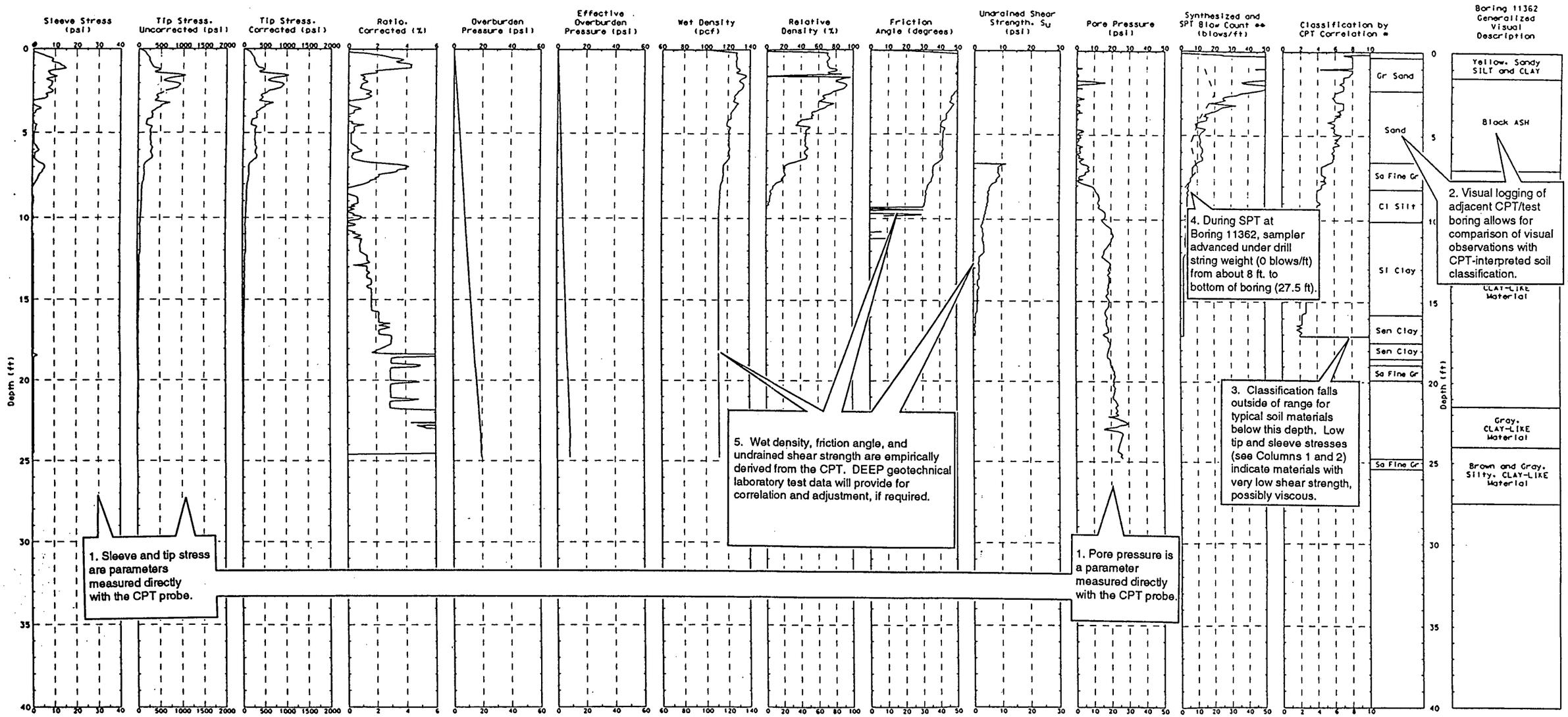
The waste in clay-lined pits at the FEMP is, in general, a fine-grained, physically soil-like material. Typically each waste pit is heterogeneous, and often stratified. In general, the waste in the pits is similar in its grain size distribution. It is composed predominantly of silt size particles. Moisture contents and limits, however, vary widely, indicating that the factors contributing to plasticity and moisture holding capacity are not similar between pits. It has been found that the properties of the waste in several of the pits are affected by amorphous materials (ALTER 1994).

The pits, especially the covered pits, also contain debris of various sizes. Various types of debris were encountered during DEEP wet trenching with a track hoe at various locations in Pits 1, 2, and 3. Debris encountered included large pieces of concrete rubble, coarse gravel, planks of lumber, sheet metal, metal bands, and metal wire.

PIT: 3

CPT ID: C3-2

DATE TEST PERFORMED: 9/1/94



LOCATION			
ID	Coordinates (NAD 1983)		Ground Surface Elevation - feet (NAVD 1927)
	Northing	Easting	
C3-2	481536	1346593	584.8
11362	481546	1346593	584.5

LEGEND

** - - - - - - Standard Penetration Test (SPT) blow count from adjacent boring: 11362

* Classification: 1-Sensitive 2-Peat 3-Clay 4-Silt Mixture 5-Sand Mixture 6-Sand 7-Gravelly Sand 8-Overconsolidated

NOTES

1. Data Source: Applied Research Associates (ARA), Inc. File: S01S402
2. Water table set by ARA at depth: 0 feet
3. Water table setting represents approximate depth and has not been adjusted based on measured water levels.
4. CPT derived density and strength data shown are estimates based on empirical correlation by ARA and have not been adjusted based on laboratory data.
5. Stratigraphy shown in classification by CPT Correlation is from ARA interpretation.

Fernald Environmental Management Project
Dewatering Excavation Evaluation Project (DEEP)

Electric Cone Penetrometer Test Results

CPT ID: C3-2

CAD FILE: P019/SKX03462.DGN

Figure 4-1 - Annotated Log of CPT Data and Adjacent Test Boring Selected Data

Based on preliminary review of DEEP wet trenching activities in Pits 1, 2, and 3, groundwater may be present as freestanding or pore water in the waste materials and perched at the cap/waste interface, which may present problems during excavation. Other sources of perched groundwater may be encountered at the excavation face at the pit perimeters. A detailed description summarizing the field observations from wet trenching in Pits 1, 2, and 3 can be found in Appendix C.

4.1.1 Waste Pit 1

Boring 11352 indicates a stiff to very stiff silt/clay mixture comprising a cap of about 6 inches in thickness. Below a depth of about 5 feet to the total drilled depth of 15.5 feet, the materials become paste-like, wet, and soft. Boring 11353 indicates a cap thickness of about 2 feet that is composed of very stiff, sandy clay. At a depth of about 3 feet, to the total drilled depth of 15.5 feet, the materials become soft, wet, and loose. The upper 10 feet of boring 11354 is composed of very stiff silt/clay mixtures. Below 10 feet, the materials become wet to the total depth of 15.5 feet. General conclusions from observing Pit 1 wet trenching can be found in Subsection 5.6.

4.1.2 Waste Pit 2

Borings 11358 and 11359 indicate about 3 feet of very stiff to hard silty clay that becomes wet and soft below 3 feet to the total drilled depth. See Subsection 5.6 for general conclusions observed from Pit 2 wet trenching.

4.1.3 Waste Pit 3

Borings 11360 and 11361 show approximately 1.5 feet and 2.5 feet, respectively, of loose, silty, clayey sand at the surface. Below that, the materials become generally wet and soft. See Subsection 5.6 regarding general conclusions observed from Pit 3 wet trenching.

Although not considered part of the scope of this preliminary technical summary, for the final evaluation of the data, additional existing borings in Pits 1, 2, and 3 can be considered when evaluating the existing wet conditions. Figure B-1 in Appendix B is a map showing the locations of borings in Pits 1, 2 and 3.

4.2 Stability Analysis

4.2.1 Technical Approach

The stability of the proposed Pit 3 excavation access ramps and subgrade soils was analyzed for the following six unique scenarios:

1) 2.5 Horizontal to 1 Vertical Slope, Undrained Condition
2) 3 Horizontal to 1 Vertical Slope, Undrained Condition
3) 4 Horizontal to 1 Vertical Slope, Undrained Condition
4) 2.5 Horizontal to 1 Vertical Slope, Drained Condition
5) 3 Horizontal to 1 Vertical Slope, Drained Condition
6) 4 Horizontal to 1 Vertical Slope, Drained Condition

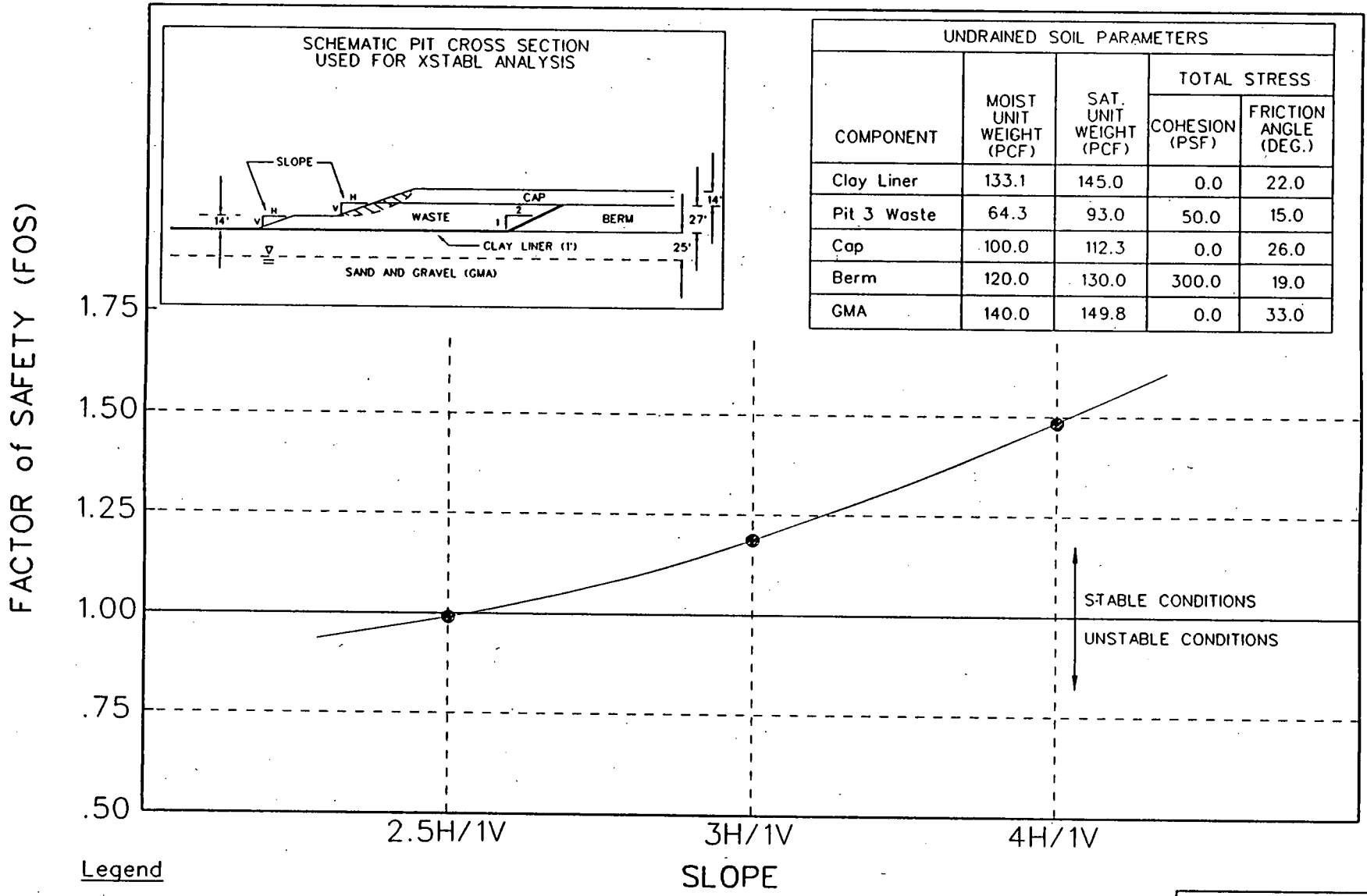
Undrained conditions consider total stress parameters determined for the waste while drained conditions assume effective stress parameters and incorporate a lowered phreatic water surface to account for partial pit dewatering from wells, wick drains, trenching, etc.

The analyses were performed using the XSTABL slope stability computer model, developed by Interactive Software Designs, Moscow, Idaho. This model performs two-dimensional limit equilibrium analyses and incorporates a random surface generator for searching out the critical failure surface for a given slope. All analysis performed assumed static conditions and utilized the Bishop's Simplified Method.

4.2.2 Analysis Cross Section

Each cross section consists of five soil layers including the cap, waste, berm, one foot clay liner, and Great Miami Aquifer. Three distinct geometries are assumed based on slopes of 2.5 to 1, 3 to 1, and 4 to 1. The geometry is determined by descending through the cap and waste at the appropriate slope to a point midway through the waste depth. A horizontal bench extends from this point to a location determined by extending the first ramp to the bottom of the pit and drawing a vertical line to intersect. The second ramp proceeds from this intersection point at the appropriate slope to the bottom of the pit. Figures 4-2 and 4-3 show the safety factors for each slope angle analyzed, and the undrained and drained conditions, respectively. Embankment heights are also shown in these figures.

Both drained and undrained cases incorporate a horizontal phreatic water surface representing the water table at 522.0 ft above mean sea level. However, the drained scenarios assume a second water surface to account for partial dewatering. This surface is bordered by the bottom of the waste, the lower ramp, and the extension of the horizontal bench to the pit berm (See Appendix F).



UNDRAINED SOIL PARAMETERS				
COMPONENT	MOIST UNIT WEIGHT (PCF)	SAT. UNIT WEIGHT (PCF)	TOTAL STRESS	
			COHESION (PSF)	FRICTION ANGLE (DEG.)
Clay Liner	133.1	145.0	0.0	22.0
Pit 3 Waste	64.3	93.0	50.0	15.0
Cap	100.0	112.3	0.0	26.0
Berm	120.0	130.0	300.0	19.0
GMA	140.0	149.8	0.0	33.0

Legend

PHREATIC SURFACE

TYPICAL ZONE OF TRIAL SURFACE WITH THE LOWEST FOS

Notes:

FOS are from simplified Bishop Analysis (circular failure surfaces) using XSTABL

Factor of Safety vs. Slope Angle, Undrained Conditions

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Figure 4-2 - Factor of Safety vs. Slope Angle, Undrained Conditions

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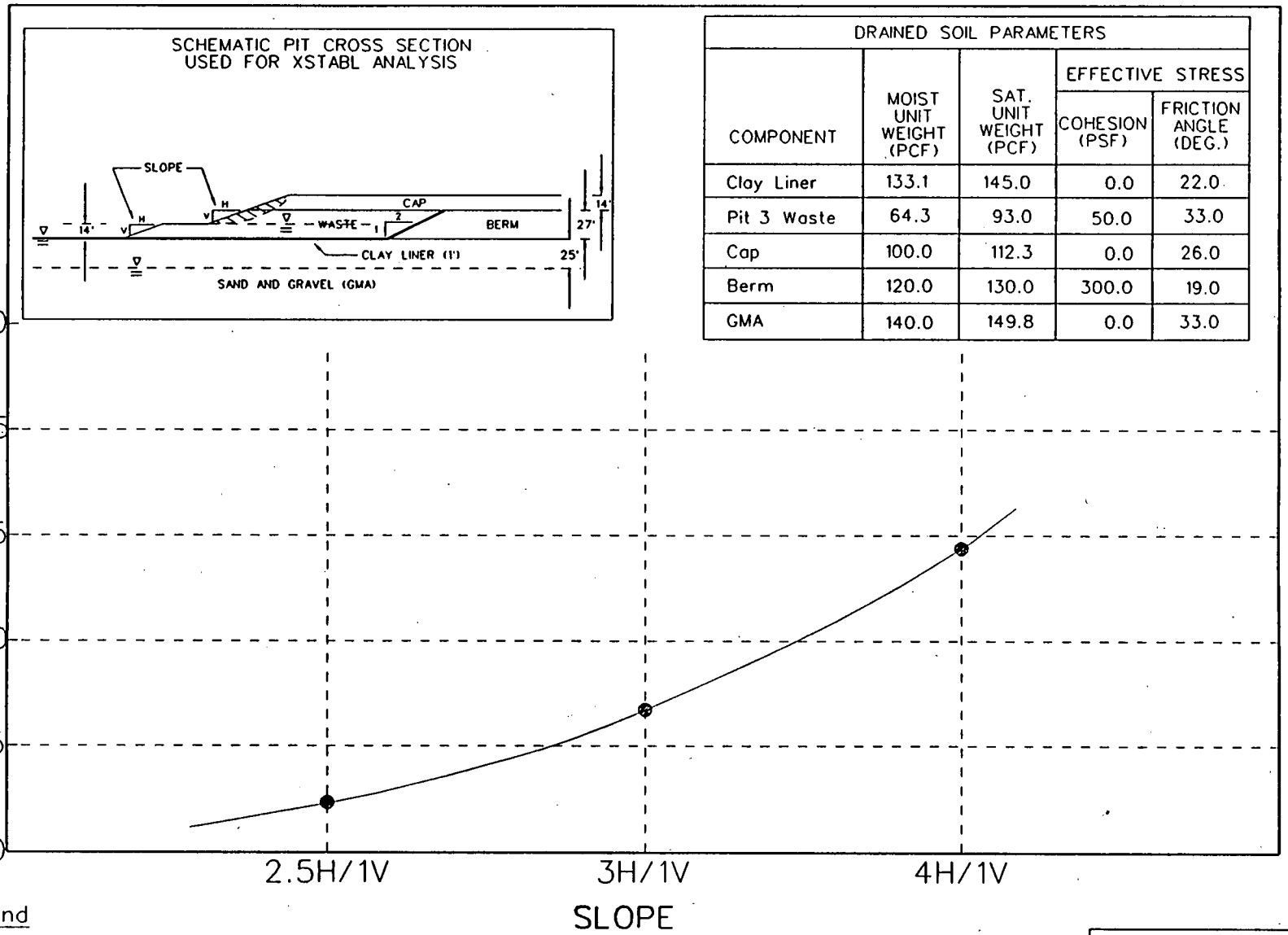

DRAINED SOIL PARAMETERS				
			EFFECTIVE STRESS	
COMPONENT	MOIST UNIT WEIGHT (PCF)	SAT. UNIT WEIGHT (PCF)	COHESION (PSF)	FRICTION ANGLE (DEG.)
Clay Liner	133.1	145.0	0.0	22.0
Pit 3 Waste	64.3	93.0	50.0	33.0
Cap	100.0	112.3	0.0	26.0
Berm	120.0	130.0	300.0	19.0
GMA	140.0	149.8	0.0	33.0

Legend

PHREATIC SURFACE

TYPICAL ZONE OF TRIAL SURFACE WITH THE LOWEST FOS

Notes:

FOS are from simplified Bishop Analysis (circular failure surfaces) using XSTABL

Factor of Safety vs. Slope Angle, Drained Conditions

FILE: /PO154/SKX03948.DGN

Figure 4-3 - Factor of Safety vs. Slope Angle, Drained Conditions

4.2.3 Material Properties

Material properties used for slope stability modeling were based on laboratory results (ALTER 1995), literature values, and engineering judgement. Properties for drained and undrained simulations for each of the five soil layers are summarized in Appendix F.

4.2.4 Results

Table 4-1 summarizes the results of the stability analysis modeling for each of the six cases examined.

Table 4-1 - Summary of Stability Analysis Results, Pit 3

Scenario	Slope	Condition	FOS
1	2.5 to 1	Undrained	0.997
2	3.0 to 1	Undrained	1.187
3	4.0 to 1	Undrained	1.484
4	2.5 to 1	Drained	1.616
5	3.0 to 1	Drained	1.836
6	4.0 to 1	Drained	2.222

In all cases, the most critical failure surface is located on the upper ramp. Any reduction in the height of the embankment will increase the factors of safety.

Data files detailing geometry, soil layer parameters, phreatic water surfaces, and the 10 most critical failure surfaces are provided in Appendix F.

4.3 Bearing Capacity

4.3.1 Bearing Capacity of Track Loaders on Waste Material

Track loaders are the planned equipment to remove the waste material from the OU1 waste pits. As a result, the bearing capacity of the waste material under the load of various track loaders was investigated. The bearing capacity of the waste material was analyzed in the event that equipment would rest on the waste material while excavating adjacent waste material. This is a conservative analysis since the excavation plan calls for working from the capped berms and excavating upward from the ramped entrance into the pit bottom.

Shear strength values, determined using consolidated-undrained triaxial shear tests, from OU1 Waste Pit 3 were used for evaluation of bearing capacity. The undrained ϕ value was 15 degrees, and the undrained cohesion value was 100 degrees psf. The drained ϕ value was 33 degrees, and the drained cohesion value was 0 psf.

The width of the tracks were used for the width of the bearing surface, and the contact length of the tracks with the ground surface were used for the length of the bearing surface. Operating loads and track dimensions of two track loaders, a Caterpillar 931 C Series II and a Caterpillar 953B, were determined using published data from the manufacturer.

Both drained and undrained conditions were evaluated for bearing capacity failure. The existing waste material in Waste Pit 3 has moisture contents between 18 percent and 197 percent with the majority of the measurements being greater than 40 percent. As a result, the majority of the waste material is saturated, and any loading of the material would result in undrained conditions. If the waste material was dewatered before excavation was started, loading could result in drained conditions depending upon the degree of the dewatering.

The drained and undrained factors of safety against bearing failure for both types of track loaders are summarized in Table 4-2. Since the removal of the wastes in the waste pits is a construction activity, a factor of safety against bearing failure between 1.5 and 2.0 is considered adequate. The Caterpillar 931C Series II track loader results in undrained and drained factors of safety of 1.9 and 4.3, respectively. The Caterpillar 953B track loader results in undrained and drained factors of safety of 0.96 and 1.9, respectively. Due to the low factors of safety in both the undrained and drained cases, the Caterpillar 953B track loader is not recommended for the excavation of the waste materials in the OU1 waste pits. The waste materials in the OU1 waste pits should provide adequate bearing capacity to support the Caterpillar 931C Series II track loader or another track loader producing similar load.

Table 4-2 - Summary of Bearing Capacity, Pit 3

Loader/Drainage Case	Track Load (psi)	Ult. Bearing Capacity (psi)	Factor of Safety
931C Undrained	4.8	9.1	1.9
931C Drained	4.8	20.6	4.3
953B Undrained	9.1	8.7	.96
953B Drained	9.1	17.3	1.9

4.4 3-D CPT Data Interpretation

In addition to the graphic log representation, the CPT data can readily be entered into a Geographical Information System (GIS) 3-D model to develop interpretations as presented on Figures 4-4 and 4-5.

Figures 4-4 and 4-5 are developed by PARSONS directly from the ARA digital CPT data. The empirical blow count data for the 12 Waste Pit 3 CPT probings were loaded into the GIS platform, and a 3-D voxel model was used to interpolate and extrapolate the data and create various views. Color Figures 4-4 and 4-5 represent a range of blow count, which, in turn, also represents a range of consistencies for the waste materials. For Waste Pit 3, the consistencies of materials were used as described in Table 4-3.

Table 4-3 - Consistency of Cohesive Soils (see Figures 4-5 and 4-6)

Color	Blow Count	Consistency
Black	0 to 4	very soft to soft
Red	5 to 8	medium stiff
Purple	9 to 15	stiff
Blue	16 to 30	very stiff
Yellow	31 to 50	hard
Green	> 50	very hard

From the graphical presentations for Waste Pit 3, the distribution of the consistencies of the waste pit materials can be visualized and areas with potentially low strength characteristics identified for additional evaluation. Figures 4-4 and 4-5 show that potentially unstable, very soft to soft materials exist below about Elevation 565. Stiffer materials overlay the softer materials. These stiffer materials have a greater thickness at the northern end of Waste Pit 3.

Visual inspection of the side-by-side CPT printouts and of the GIS-generated graphics provides a general picture of the more granular cap materials, which are about 10 to 15 feet in thickness, overlying the fine-grained, clay like, soft waste materials below the cap. More recently, trenching activities under present water conditions (part of the DEEP program) have confirmed much of the engineering data derived from the CPT probings and SPT boring activities.

The GIS system has also proven useful in assessing the relationship of material types among the waste pits. Figure 4-6 is a 3-D depiction of material types in Waste Pit 3 (the biggest block), Waste Pit 2 (the

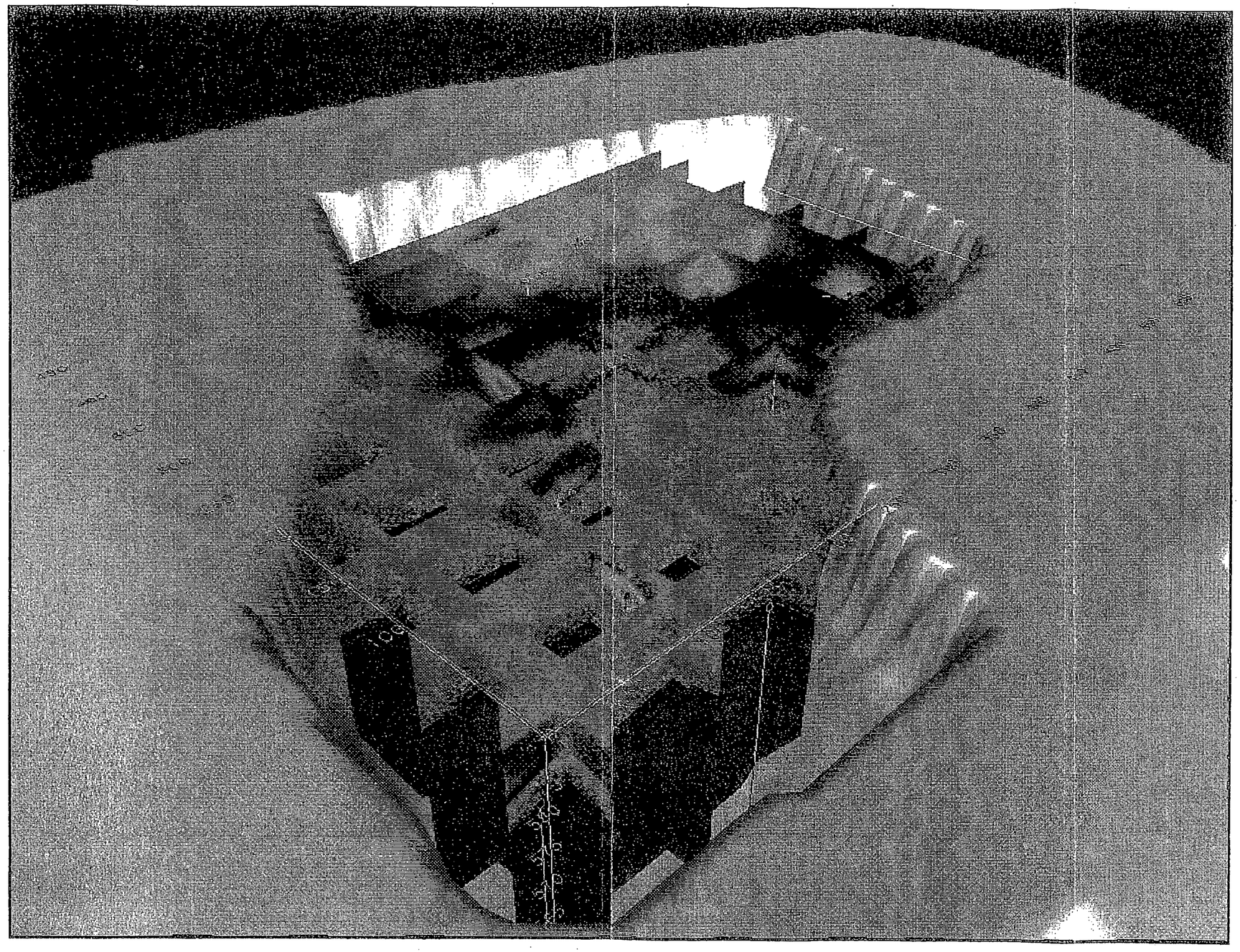

Figure 4-4 - Three-Dimensional Interpretation of Empirical Blow Count Data at Waste Pit 3

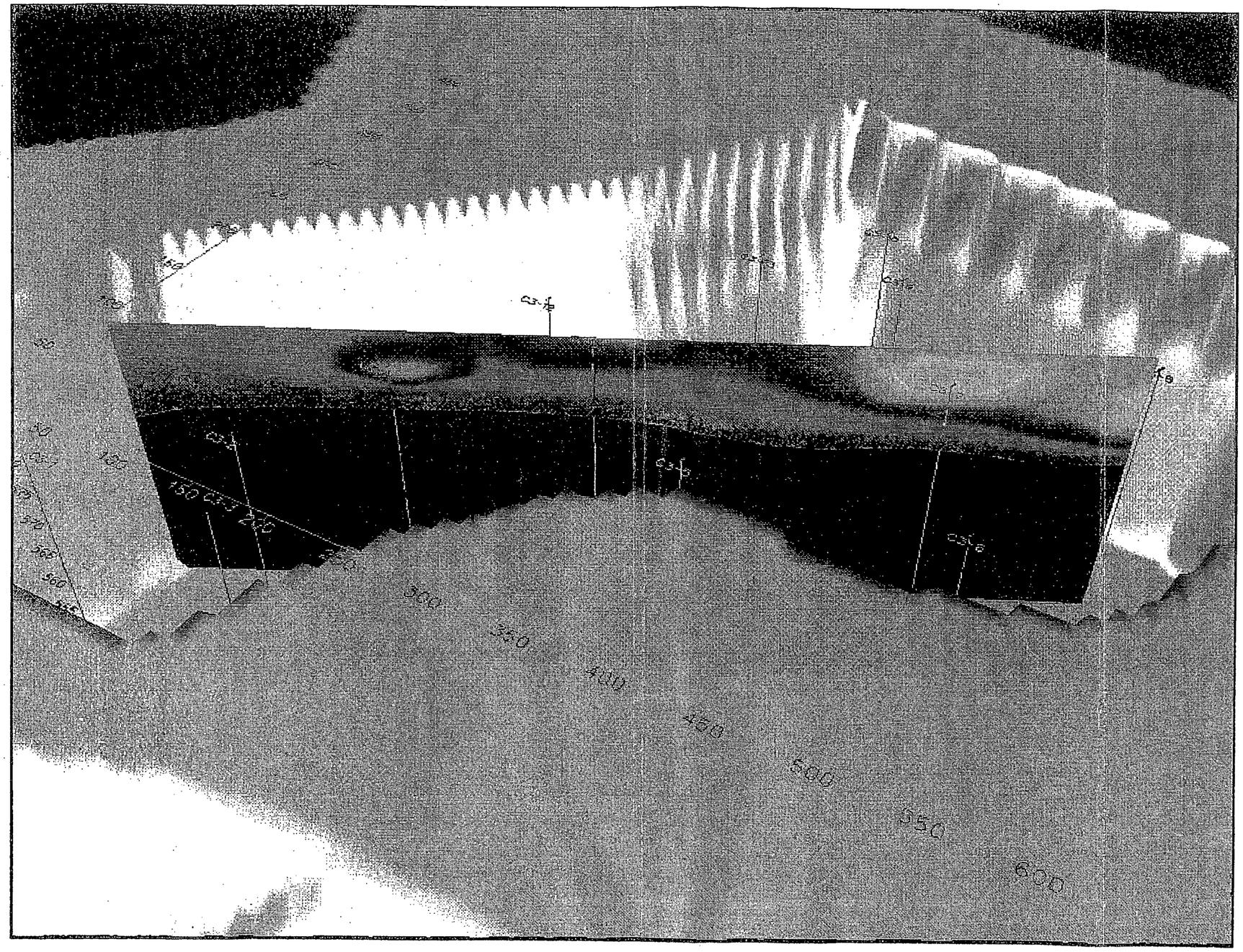

Figure 4-5 - Cross-Section of Three-Dimensional Interpretation of Empirical Blow Count Data at Waste Pit 3

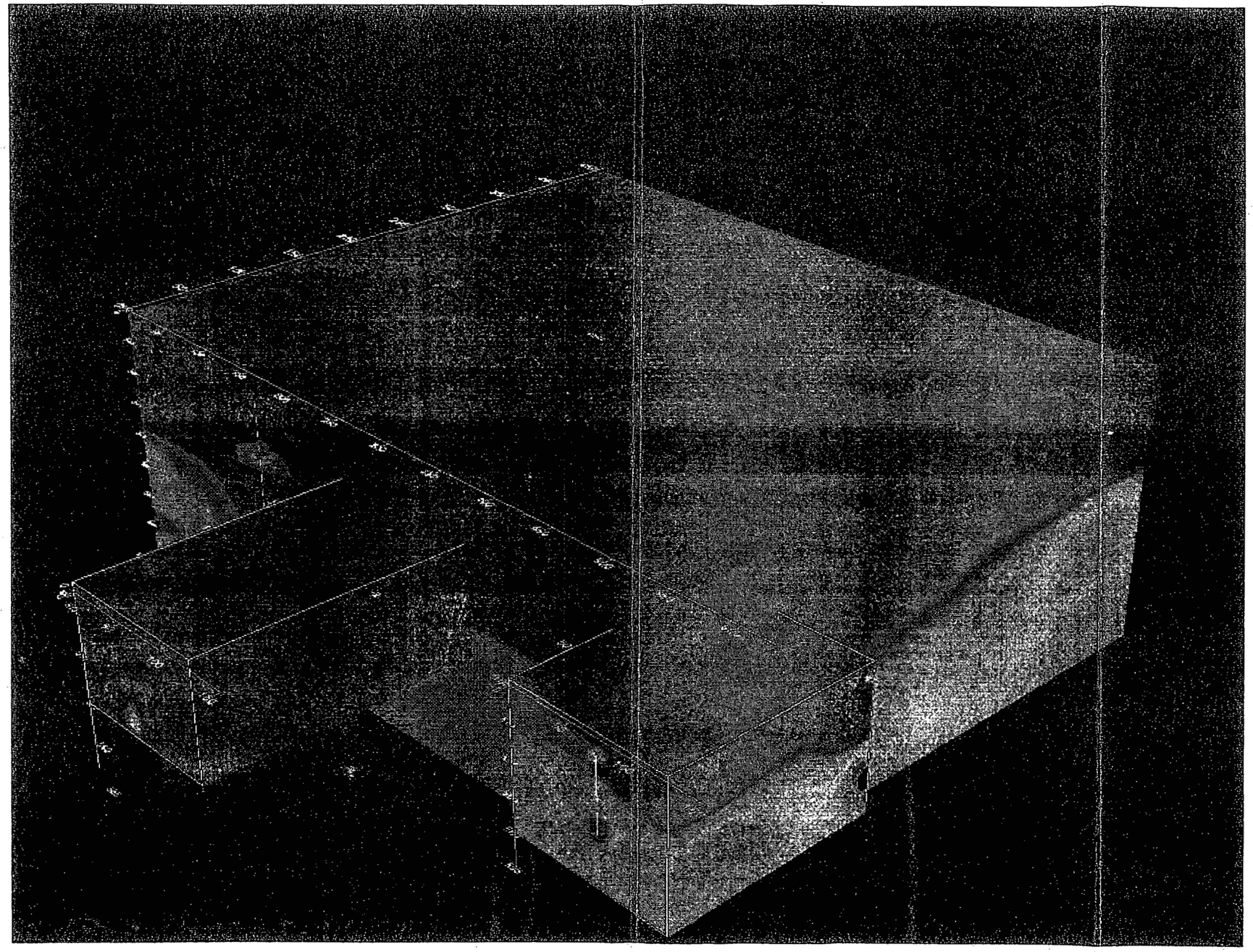

Figure 4-6 - Three-Dimensional Block Model Interpretation of Material Types at Waste Pits 1, 2, and 3

block intercepting the corner of the big block), and Waste Pit 1 (intersecting the side of the big block). The graphic is generalized, taking into account only material type (i.e., CPT empirical classification) and not necessarily the shape or exact geographical orientation of the three pits.

In Figure 4-6, the red to pink and purple-red represents fine-grained, soft deposits (i.e., clay). The green to greenish-blue represents sand/silt mixtures, and the light to dark blue represents coarse-grained materials (sand and gravel). From Figure 4-6 it is readily discerned that Waste Pit 3 is generally similar to Waste Pit 2 in grain-size makeup and distribution, whereas Waste Pit 1 is clearly different from either Waste Pit 2 or Waste Pit 3.

4.5 CPT Correlations

As discussed in Section 2, test borings were conducted adjacent to the CPT probes. The purpose of the adjacent placement of test borings and CPT probes was to allow comparison among CPT data and visual observations, SPT blow counts, and material classifications and physical properties obtained from laboratory tests. This comparison is anticipated to allow a site-specific calibration of the CPT for FEMP materials. Figure 4-1 provides an annotated log showing the CPT data from CPT probe C3-2, SPT blow count data from boring 11362, and a generalized visual description profile from the field geologist's log of boring 11362. Assumptions made for preparation of the CPT logs are indicated in the notes on the log.

The following items correspond to the annotated text blocks on Figure 4-1:

1) The three parameters measured directly with the CPT are sleeve stress, tip stress, and pore pressure. Other CPT data from C3-2 are based on empirical correlations for soils. Site-specific laboratory data from the adjacent test boring will assist in calibrating the CPT for the site-specific material, especially necessary because the majority of the OU1 waste materials are not truly soil materials.

2) The visual logging of adjacent test borings allows comparison/correlation of visual observations with empirical CPT classifications.

3) The empirical CPT classification number sometimes falls outside the range of typical soil materials when CPT data for the waste materials are evaluated using empirical correlations for soils. For C3-2, low tip and sleeve stresses indicate waste material with very low shear strength, possibly viscous.

4) During the SPT at test boring 11362, the sampler advanced under the weight of the drill string alone (i.e., 0 blows per ft). This occurred from a depth of about 8 feet to the bottom of the test

boring (27.5 feet). The empirical blow count from the CPT correlated very closely with the SPT blow count from the test boring.

5) Empirical CPT correlations such as wet density, friction angle, and undrained shear strength require comparison with results of geotechnical laboratory tests. This will allow for adjustment of CPT parameter plots, if required.

SECTION 5

CONCLUSIONS

This section presents preliminary conclusions regarding OU1 Pits 1, 2, and 3 waste material geotechnical characteristics; dewatering and CPT correlations based on the DEEP activities conducted; and geotechnical laboratory test results available as of September 1995.

5.1 Pit 1

In general, Pit 1 waste materials behave like nonplastic silts (ML) with little cohesion and low dry strength. Some coarse-grained silty sand (SM) (with nonplastic silts) is also present. The moisture contents range from about 16 to 48 percent (by dry weight).

Petroleum odor was observed for some Pit 1 samples. This indicates that petroleum products may have an impact, aiding in its nonplastic nature and causing dried Pit 1 waste to repel water (ALTER 1994).

A composite sample of nonplastic silt was formed from low-water-content, nonplastic materials (NP1) from Waste Pits 1 and 4. A standard compaction test of the NP1 material resulted in an optimum moisture content (OMC) of 13.4 percent and a maximum dry density (MDD) OF 116.6 pounds per cubic foot (pcf), which compares to values for ordinary soils. A direct shear test of the remolded NP1 material resulted in a consolidated drained friction angle (ϕ_{cd}) of 40 degrees at 96 percent MDD, which is slightly less than that expected for dense sand (ALTER 1994).

From four unit weight tests of undisturbed DEEP Shelby tube samples, wet unit weight ranged from 108.5 to 138.1 pcf, and the corresponding dry unit weight ranged from 74.9 to 115.4 pcf (ALTER 1995).

5.2 Pit 2

In general, Pit 2 waste materials range in behavior from nonplastic silts and sands (silt with sand, sandy silt, silty sand) to highly plastic silts (elastic silt, elastic silt with sand, sandy elastic silt). Some lean clays and clayey sands with gravel are also present. Moisture contents range from about 17 percent (lean clay with sand) to 320 percent (nonplastic silt with sand). Moisture content of the elastic silt materials ranges from about 70 to 230 percent.

A composite sample of elastic silt (MH2) was formed to represent MH materials with lower liquid and plastic limits (typical of Pits 2 and 3). The material for this composite sample came from Pits 2 and 3. A standard compaction test resulted in an OMC of 35.4 percent and MDD of 77.8 pcf. This density is low for MH soil. A remolded, unconfined compressive strength test at 96 percent MDD and +2 percent

OMC resulted in an undrained cohesion (c_u) of 1,468 psf with a brittle failure mode. A direct shear test of the remolded MH2 material resulted in ϕ_{cd} of 29 degrees at 97 percent MDD (ALTER 1994).

From three unit weight tests of undisturbed DEEP Shelby tube samples, wet unit weight ranged from 90.0 to 131.2 pcf, and the corresponding dry unit weight ranged from 42.9 to 105.7 pcf (ALTER 1995).

5.3 Pit 3

In general, Pit 3 waste materials range in behavior from low plasticity and nonplastic silts and sands (silt with sand, sandy silt and silty sand) to highly plastic silts (sandy elastic silt, elastic silt with sand). Some lean clays are also present. Moisture contents range from about 25 percent (silt with sand) to 197 percent. Moisture content of the sandy elastic silt material ranges from about 55 percent to 197 percent.

From four unit weight tests of undisturbed DEEP Shelby tube samples, wet unit weight ranged from 75 to 129 pcf, and the corresponding dry unit weight ranged from 25 pcf to 110 pcf (ALTER 1995).

In-place strength of Pit 3 waste from the DEEP CPT probes and SPT tests indicates very low strengths over much of the pit area (below the cap materials). Low strengths are expected to result in waste collapse at quite low natural slopes, which may present safety concerns and excavation inefficiencies due to flat slopes. Interim DEEP results of three consolidated, undrained triaxial shear strength tests had the following results: undrained friction angle (ϕ_u) ranged from 15 degrees to 23 degrees with cohesion intercept of 1 psi to 0.7 psi, drained friction angle ranged from 32 degrees to 33 degrees, with a low same cohesion intercept reported (ALTER 1995). In addition, existing data also indicate that the moisture content for much of the waste (in situ conditions) is above the liquid limit, indicating the material could behave like a fluid. To accommodate these conditions, excavation from the top of the capped berm will allow equipment to operate on a firm foundation. Excavating the second bench from the bottom of the pit also allows equipment to operate on a firmer footing.

5.4 Dewatering

DEEP dewatering tests using wells and wellpoints have been conducted in Waste Pits 1 and 3 to evaluate the effectiveness of this technique to increase the strength and bearing capacity of wet pit materials prior to excavation. Trenching or ramping in the pit materials is being conducted to evaluate the degree of success of the excavation program. The results should allow a confirmation of the bearing capacity, angle of repose, and safe, maintainable slopes.

Initial strength test data indicate, however, that dewatering is not required to excavate with reasonable efficiency and safety for the top and bottom excavation approach. If trenching/ramping tests confirm that dewatering is not necessary to achieve safe bearing capacities and slopes, then a major rationale for the use of dewatering is removed.

However, the dewatering testing did indicate that water can be removed from the wastes through the use of wells and wellpoints. Given assumptions regarding sustainable yields and the percentage of total waste volume that can be removed as free water, the number of wells needed to achieve the greatest possible reduction in drying time has been calculated (see Appendix D). With some conceptual planning of a dewatering system, the cost effectiveness of using this number of wells to reduce drying times could be determined. Additional savings from dewatering may result from the potential elimination of a second dryer to meet future increased production levels.

To summarize, it appears that dewatering should not be pursued as a means of enhancing soil strength and stability, but may be of value in reducing processing times. If full-scale dewatering is not found to be cost effective, other dewatering techniques (such as using wick drains, compression through surcharging or preloading the surface, gravity drainage through trenching, French drains, or other interceptor drains and sumps) may be considered.

5.5 CPT Correlations

Inclusion of the laboratory test results will provide a basis for calibration of the CPTs to direct measurements from test borings, providing further confidence and enhancing specific detail.

Application of the integrated CPT/SPT and laboratory test data includes:

1) Providing a baseline to evaluate the effects of dewatering on the specific design parameters of the waste materials in Pits 1, 2, and 3. These parameters include moisture content, shear strength, and density. Moisture content and density data lead directly to determination of solids mass (dry solids weight) in the pits.

2) Allowing efficient data gathering with the CPT in the event that specific data gaps are identified in design.

3) Allowing concise and understandable presentation of a wide range of data to concerned parties.

4) Providing specific data for evaluation of excavation alternatives.

5) Possibly assisting in prioritization of remedial activities.

It is recommended that once the final geotechnical laboratory data are available, these data be provided to the CPT contractor to make adjustments in data files, if required. The CPT logs in Appendix A should also be revised to reflect modifications.

5.6 Wet Trenching

The following conclusions are the results of observation from the wet trenching at Pits 1, 2, and 3:

1) Mechanical excavation of pit wastes to depths of about 15 to 20 feet using a bucket excavator from the ground surface of the covered pits was demonstrated.

2) The waste materials encountered to the depths excavated, behaved like earth materials (i.e. did not flow), and were blocky or granular. Material that exhibited gelatinous behavior was also encountered, especially in Pit 1.

3) The cover material for the waste pits was general fill: clay, flyash, gravel, and other debris and rubble. The cover thickness in Pits 1 and 2 is from 1 to a few feet, and the cover thickness at Pit 3 is from 10 to 12 feet thick.

4) A laminated to stratified, fine-grained waste underlies the cover material in Pits 2 and 3. This material, composed of various layers of plastic and granular materials, is soft, saturated, highly plastic and holds water. Wastes in Pits 2 and 3, which are laminated to stratified, had thin layers of wet, soupy material. The waste material in Pit 1, is soft, saturated, granular and gelatinous.

5) Standing water was encountered at trenches T1-S, T2-N, and T3-N near ground surface. Trenches T1-N, T2-S, T3-C and T3-S did not have standing water. At the trenches with standing water, large amounts of rubble were also encountered in the cover or shallow waste. This relatively porous rubble creates zones of perched water, often found in the cover material. A large amount of lumber was found in Trench T3-N.

6) Trench wall collapse was observed in the noncohesive materials comprising the cover. At the shallow depths excavated, the more cohesive waste material underlying the cap often held vertical slopes when it was wet. The material, however, is soft and gelatins or "pudding like". The ability of the these materials to hold steep working slopes at an appreciable height is doubtful. Laboratory classification tests show the waste material is non plastic to highly plastic silts. As the exposed working face dries, this material exhibits an uncertain behavior.

7) Based on visual observation, angle of repose of the wet waste placed waste piles was generally about 20 to 30 degrees for Pit 2 and 3 wastes. It should be noted that the waste piles were typically no greater than about 8 feet high.

SECTION 6

REFERENCES

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(DOE 1994a) United States Department of Energy, August 1994. *Operable Unit 1, Dewatering Excavation Evaluation Program (DEEP) Treatability Study Work Plan*. Fernald Field Office: DOE.

(DOE 1994b) ----------, August 1994. *Final Remedial Investigation Report for Operable Unit 1*. Fernald Field Office: DOE.

(FERMCO 1995) Fernald Environmental Restoration Management Corporation, September 18, 1995. "Average In Situ Waste Pit Conditions." FERMCO Spreadsheet, Sheet A.

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(PARSONS 1994) PARSONS Environmental Remedial Action Project, August 1994. *Project Order 103, Engineering Technical Support (OU-1), Analysis of Waste Pit Areas Slug Test Data*. Fairfield: PARSONS.

(Weston 1988) Roy F. Weston, Inc., March 1988. *Characterization Investigation Study, Geotechnical Evaluation of Waste Pit Material Properties, and Boring Logs*. Albuquerque: Roy F. Weston. Inc.

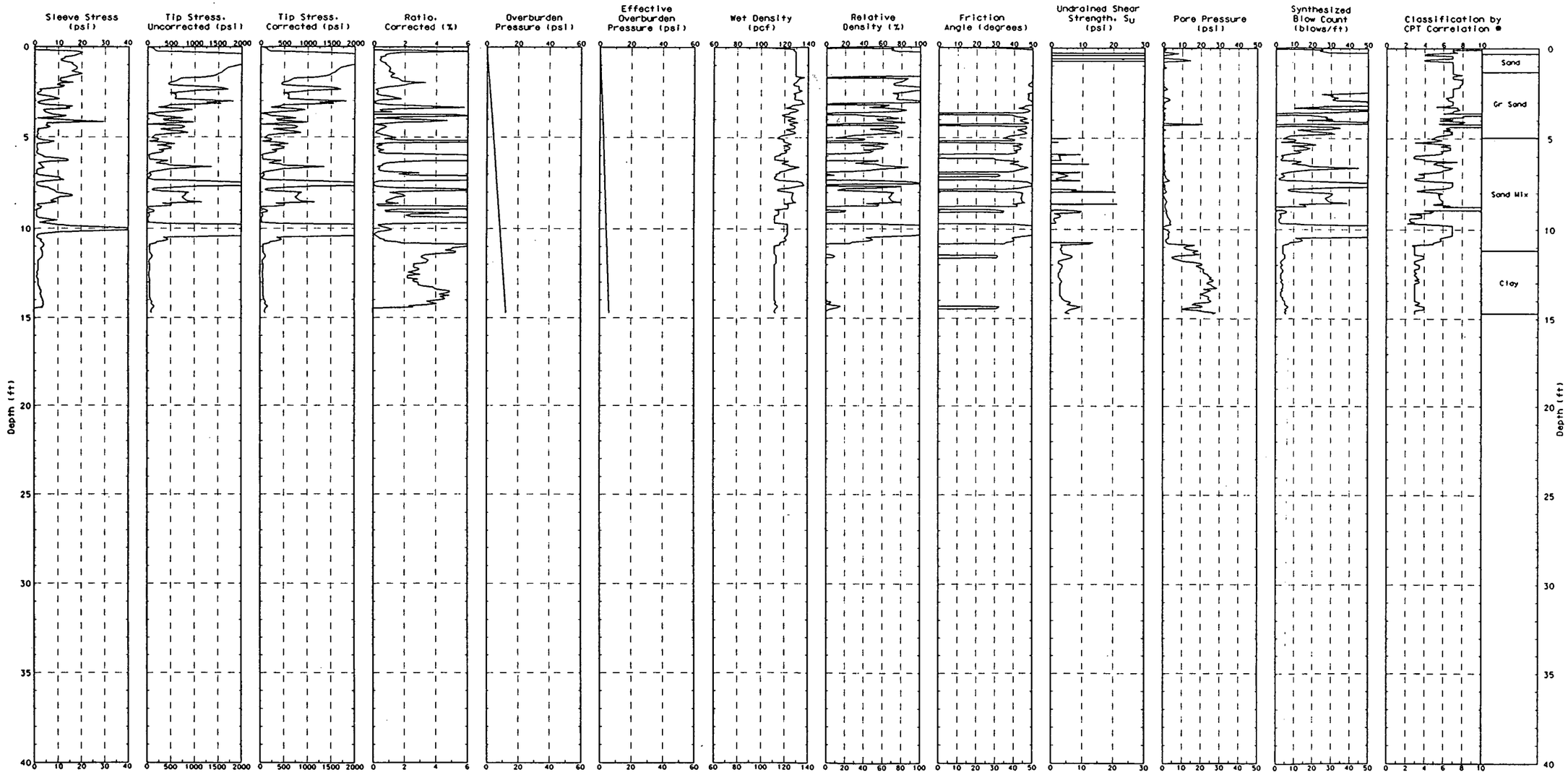
APPENDIX A

PRELIMINARY CPT LOGS

PIT: 1

CPT ID: C1-1

DATE TEST PERFORMED: 8/30/94



LOCATION			
ID	Coordinates (NAD 1983)		Ground Surface Elevation - feet (NAVD 1927)
	Northing	Easting	
C1-1	481480	1346830	581.4

LEGEND

- Classification: 1-Sensitive 2-Peat 3-Clay 4-Silt Mixture 5-Sand Mixture 6-Sand 7-Gravelly Sand 8-Overconsolidated

NOTES

1. Data Source: Applied Research Associates (ARA), Inc. File: S30G404
2. Water table set by ARA at depth: 0 feet
3. Water table setting represents approximate depth and has not been adjusted based on measured water levels.
4. CPT derived density and strength data shown are estimates based on empirical correlation by ARA and have not been adjusted based on laboratory data.
5. Stratigraphy shown in classification by CPT Correlation is from ARA interpretation.

Fernald Environmental Management Project
Dewatering Excavation Evaluation Project (DEEP)

Electric Cone Penetrometer Test Results

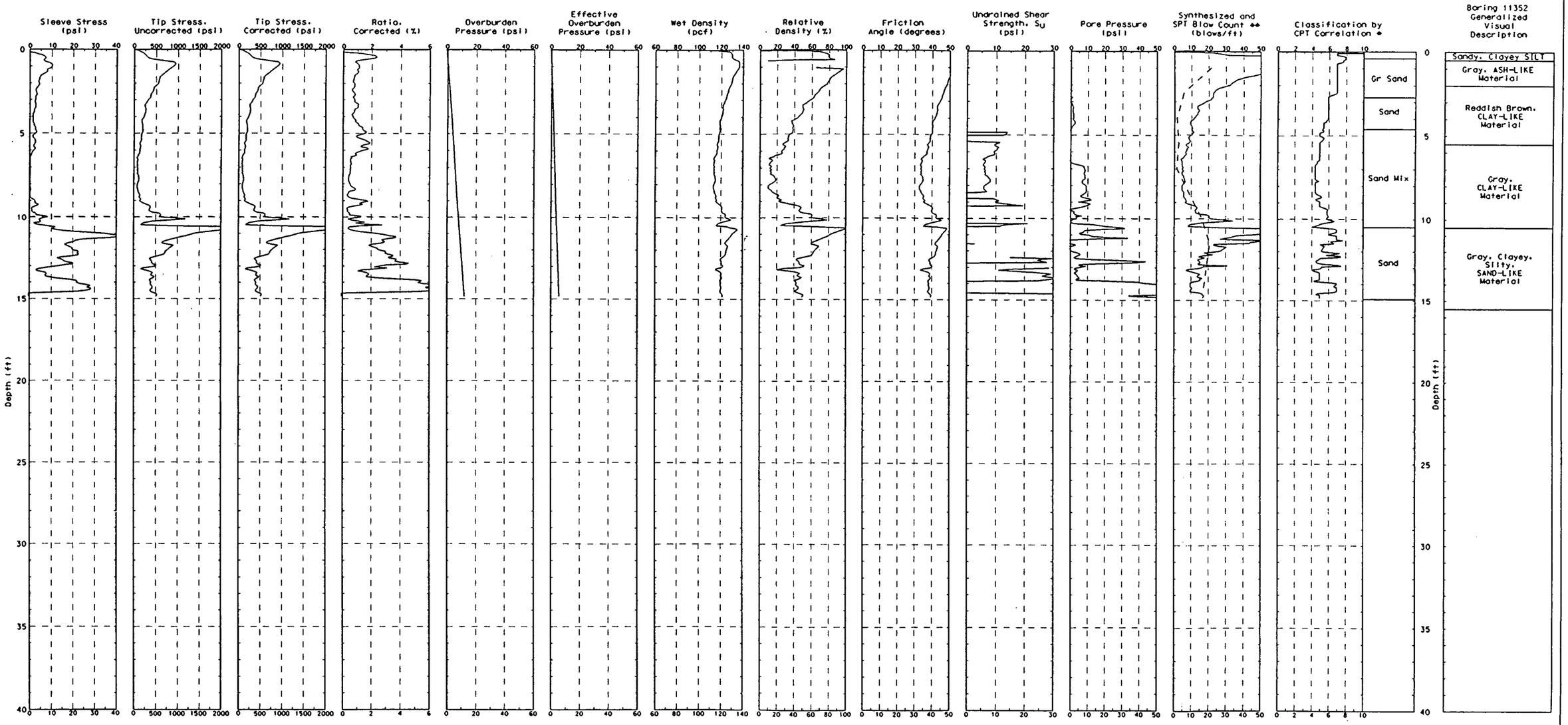
CPT ID: C1-1

CAD FILE: P019/SKX03450.DGN

PIT: 1

CPT ID: C1-2

DATE TEST PERFORMED: 8/30/94



LOCATION			
ID	Coordinates (NAD 1983)		Ground Surface Elevation - feet (NAVD 1927)
	Northing	Easting	
C1-2	481410	1346850	580.1
11352	481405	1346851	579.9

LEGEND

** - - - - - - Standard Penetration Test (SPT) blow count from adjacent boring: 11352

* Classification: 1-Sensitive 2-Peat 3-Clay 4-Silt Mixture 5-Sand Mixture 6-Sand 7-Gravelly Sand 8-Overconsolidated

NOTES

1. Data Source: Applied Research Associates (ARA), Inc. File: S30G405
2. Water table set by ARA at depth: 0 feet
3. Water table setting represents approximate depth and has not been adjusted based on measured water levels.
4. CPT derived density and strength data shown are estimates based on empirical correlation by ARA and have not been adjusted based on laboratory data.
5. Stratigraphy shown in classification by CPT Correlation is from ARA interpretation.

Fernald Environmental Management Project
Dewatering Excavation Evaluation Project (DEEP)

Electric Cone Penetrometer Test Results

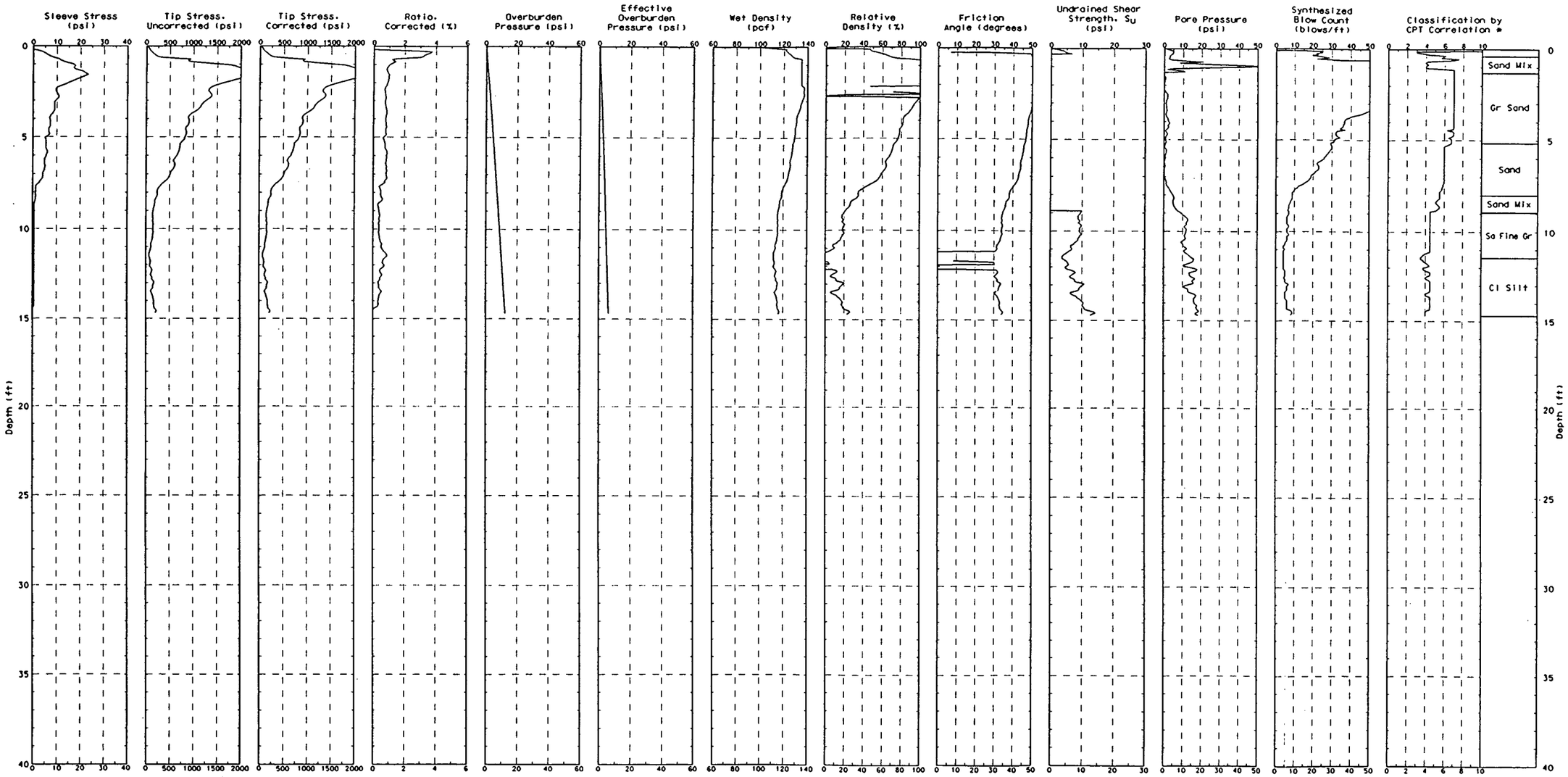
CPT ID: C1-2

CAD FILE: P019/SKX03451.DGN

PIT: 1

CPT ID: C1-3

DATE TEST PERFORMED: 8/31/94



LOCATION			
ID	Coordinates (NAD 1983)		Ground Surface Elevation - feet (NAVD 1927)
	Northing	Easting	
C1-3	481380	1346780	580.6

LEGEND

* Classification: 1-Sensitive 2-Peat 3-Clay 4-Silt Mixture 5-Sand Mixture 6-Sand 7-Gravelly Sand 8-Overconsolidated

NOTES

1. Data Source: Applied Research Associates (ARA). Inc. File: S31G405
2. Water table set by ARA at depth: 0 feet
3. Water table setting represents approximate depth and has not been adjusted based on measured water levels.
4. CPT derived density and strength data shown are estimates based on empirical correlation by ARA and have not been adjusted based on laboratory data.
5. Stratigraphy shown in classification by CPT Correlation is from ARA interpretation.

Fernald Environmental Management Project
Dewatering Excavation Evaluation Project (DEEP)

Electric Cone Penetrometer Test Results

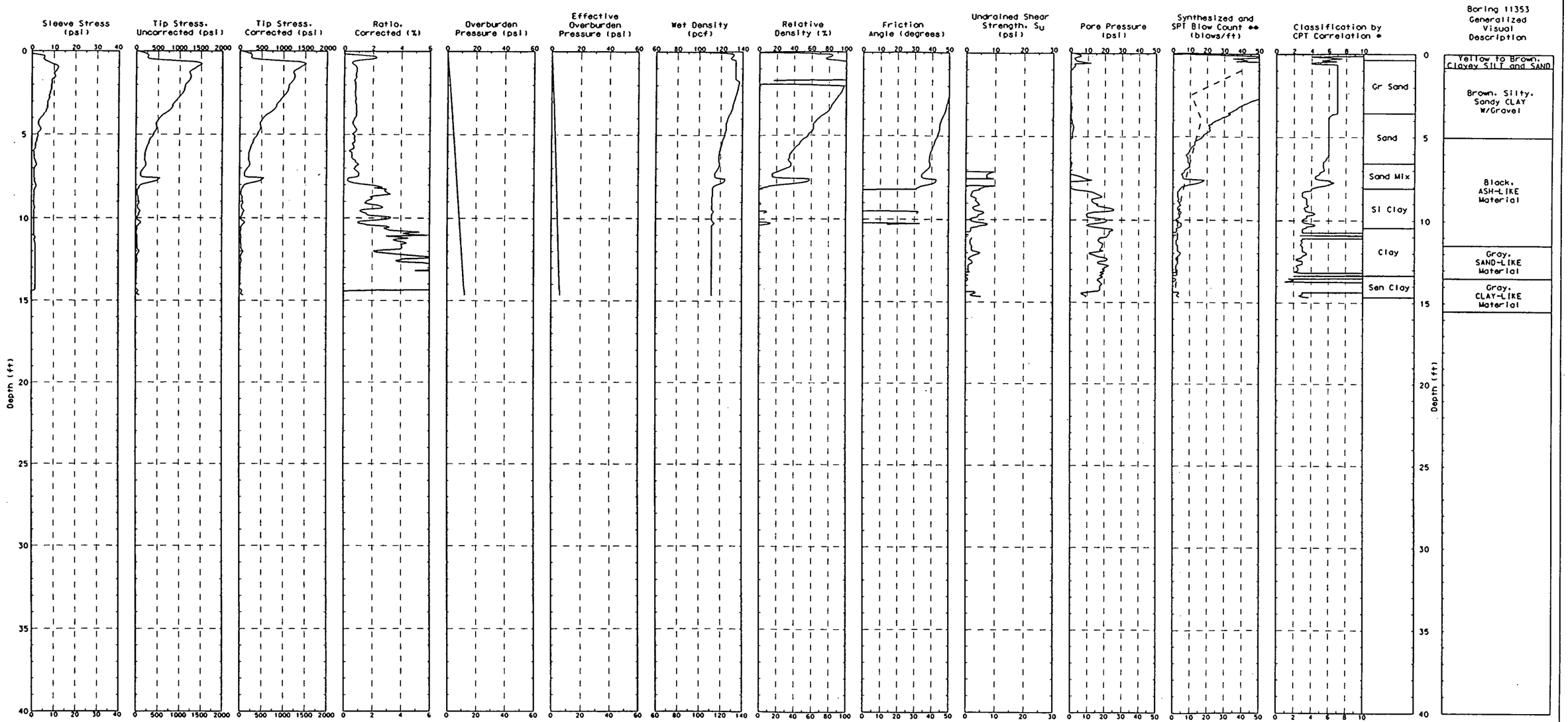
CPT ID: C1-3

CAD FILE: PO19/SKX03452.DGN

PIT: 1

CPT ID: C1-4

DATE TEST PERFORMED: 8/31/94



LOCATION			
ID	Coordinates (NAD 1983)		Ground Surface Elevation - feet (NAVD 1927)
	Northing	Easting	
C1-4	481287	1346780	580.2
11353	481286	1346770	580.2

LEGEND

** - - - - - - Standard Penetration Test (SPT) blow count from adjacent boring: 11353

* Classification: 1-Sensitive 2-Peat 3-Clay 4-Silt Mixture 5-Sand Mixture 6-Sand 7-Gravelly Sand 8-Overconsolidated

NOTES

1. Data Source: Applied Research Associates (ARA), Inc. File: S31G402
2. Water table set by ARA at depth: 0 feet
3. Water table setting represents approximate depth and has not been adjusted based on measured water levels.
4. CPT derived density and strength data shown are estimates based on empirical correlation by ARA and have not been adjusted based on laboratory data.
5. Stratigraphy shown in classification by CPT Correlation is from ARA interpretation.

Fernald Environmental Management Project
Dewatering Excavation Evaluation Project (DEEP)

Electric Cone Penetrometer Test Results

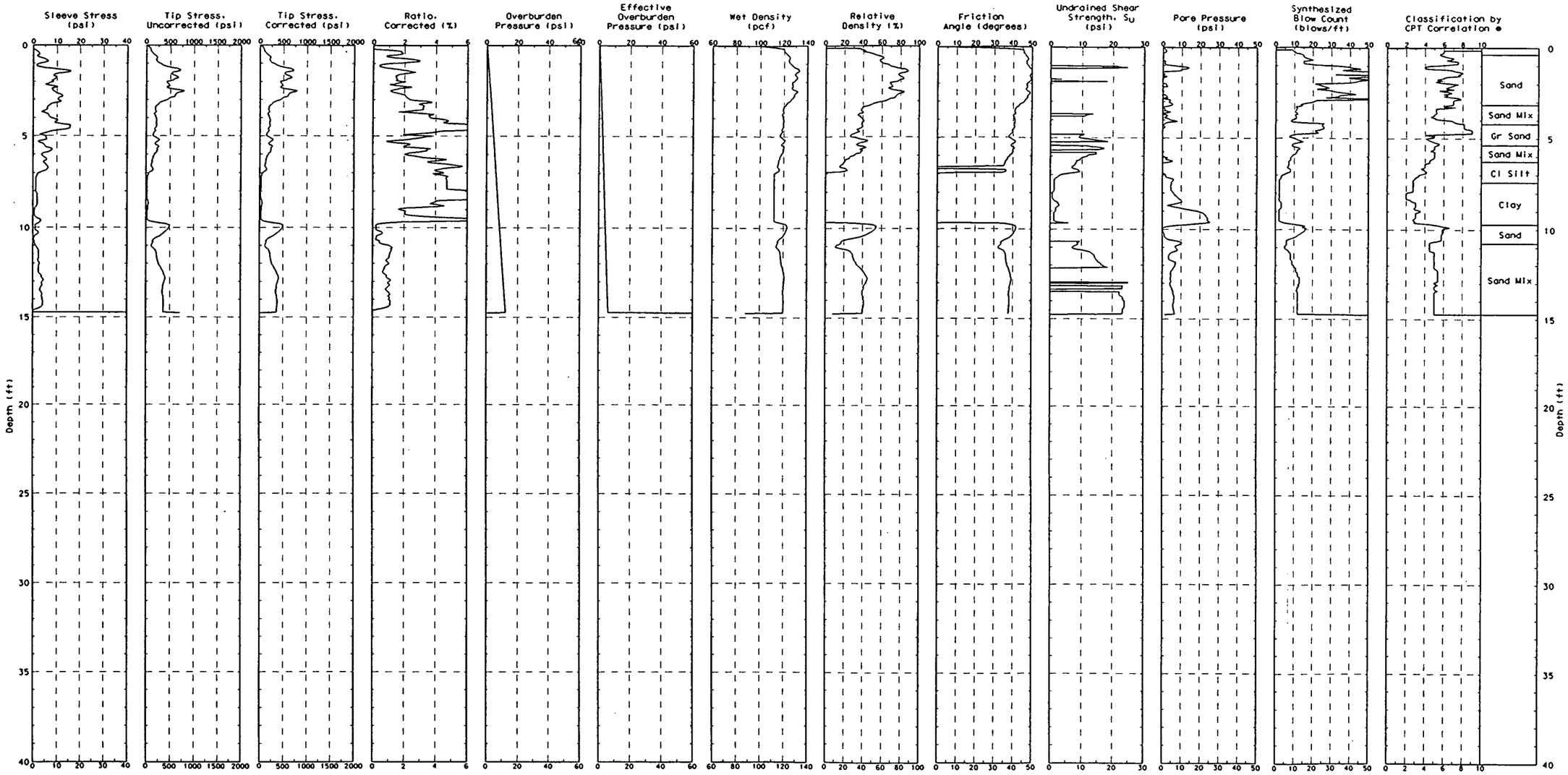
CPT ID: C1-4

CAD FILE: PO19/SKX03453.DGN

PIT: 1

CPT ID: C1-5

DATE TEST PERFORMED: 8/31/94



LOCATION			
ID	Coordinates (NAD 1983)		Ground Surface Elevation - feet (NAVD 1927)
	Northing	Easting	
C1-5	481280	1346730	580.1

LEGEND

* Classification: 1-Sensitive 2-Peat 3-Clay 4-Silt Mixture 5-Sand Mixture 6-Sand 7-Gravelly Sand 8-Overconsolidated

NOTES

1. Data Source: Applied Research Associates (ARA), Inc. File: S31G404
2. Water table set by ARA at depth: 0 feet
3. Water table setting represents approximate depth and has not been adjusted based on measured water levels.
4. CPT derived density and strength data shown are estimates based on empirical correlation by ARA and have not been adjusted based on laboratory data.
5. Stratigraphy shown in classification by CPT Correlation is from ARA interpretation.

Fernald Environmental Management Project
Dewatering Excavation Evaluation Project (DEEP)

Electric Cone Penetrometer Test Results

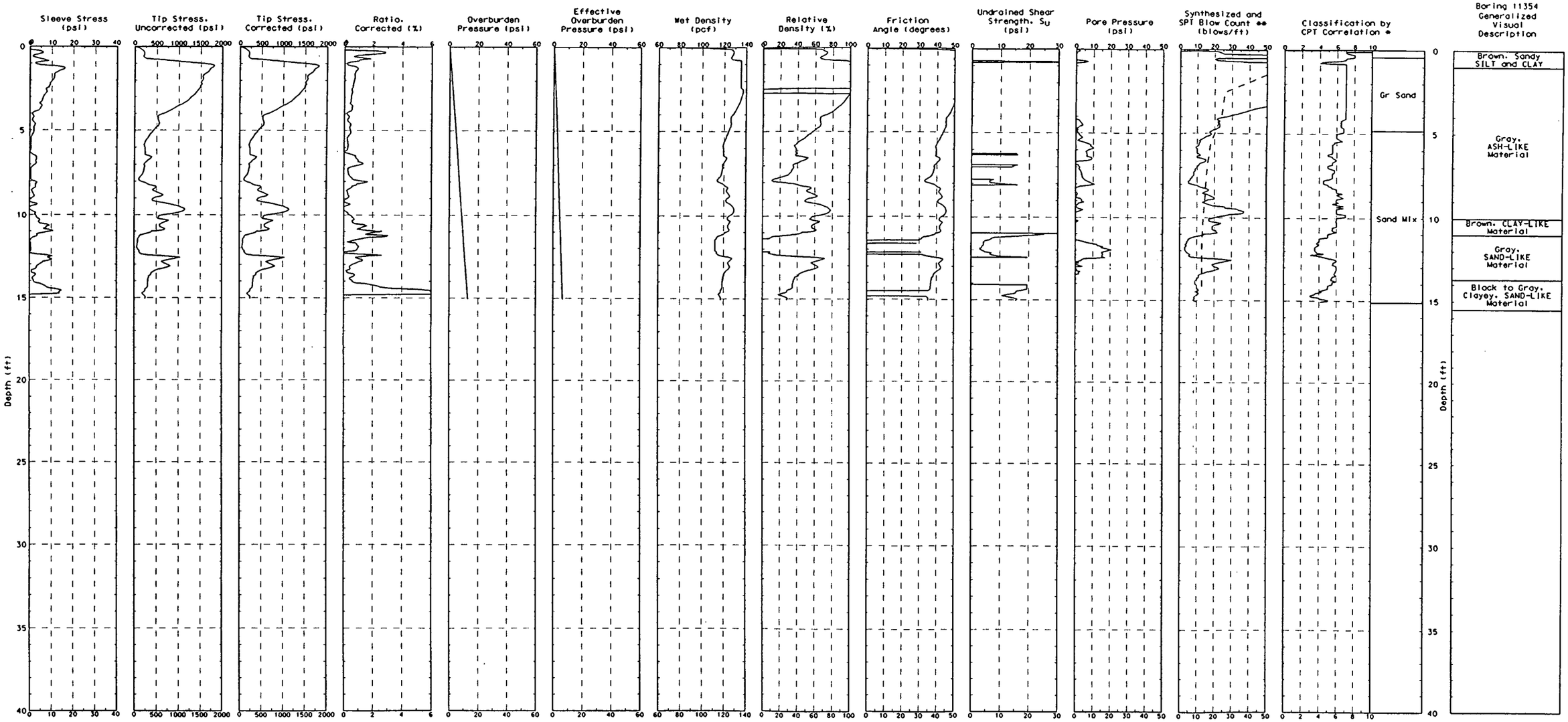
CPT ID: C1-5

CAD FILE: P019/SKX03454.DGN

PIT: 1

CPT ID: C1-6

DATE TEST PERFORMED: 8/31/94



LOCATION			
ID	Coordinates (NAD 1983)		Ground Surface Elevation - feet (NAVD 1927)
	Northing	Easting	
C1-6	481336	1346838	579.6
11354	481336	1346838	579.6

LEGEND

** - - - - - - Standard Penetration Test (SPT) blow count from adjacent boring: 11354

* Classification: 1-Sensitive 2-Peat 3-Clay 4-Silt Mixture 5-Sand Mixture 6-Sand 7-Gravelly Sand 8-Overconsolidated

NOTES

1. Data Source: Applied Research Associates (ARA), Inc. File: S31G403
2. Water table set by ARA at depth: 0 feet
3. Water table setting represents approximate depth and has not been adjusted based on measured water levels.
4. CPT derived density and strength data shown are estimates based on empirical correlation by ARA and have not been adjusted based on laboratory data.
5. Stratigraphy shown in classification by CPT Correlation is from ARA interpretation.

Fernald Environmental Management Project
Dewatering Excavation Evaluation Project (DEEP)

Electric Cone Penetrometer Test Results

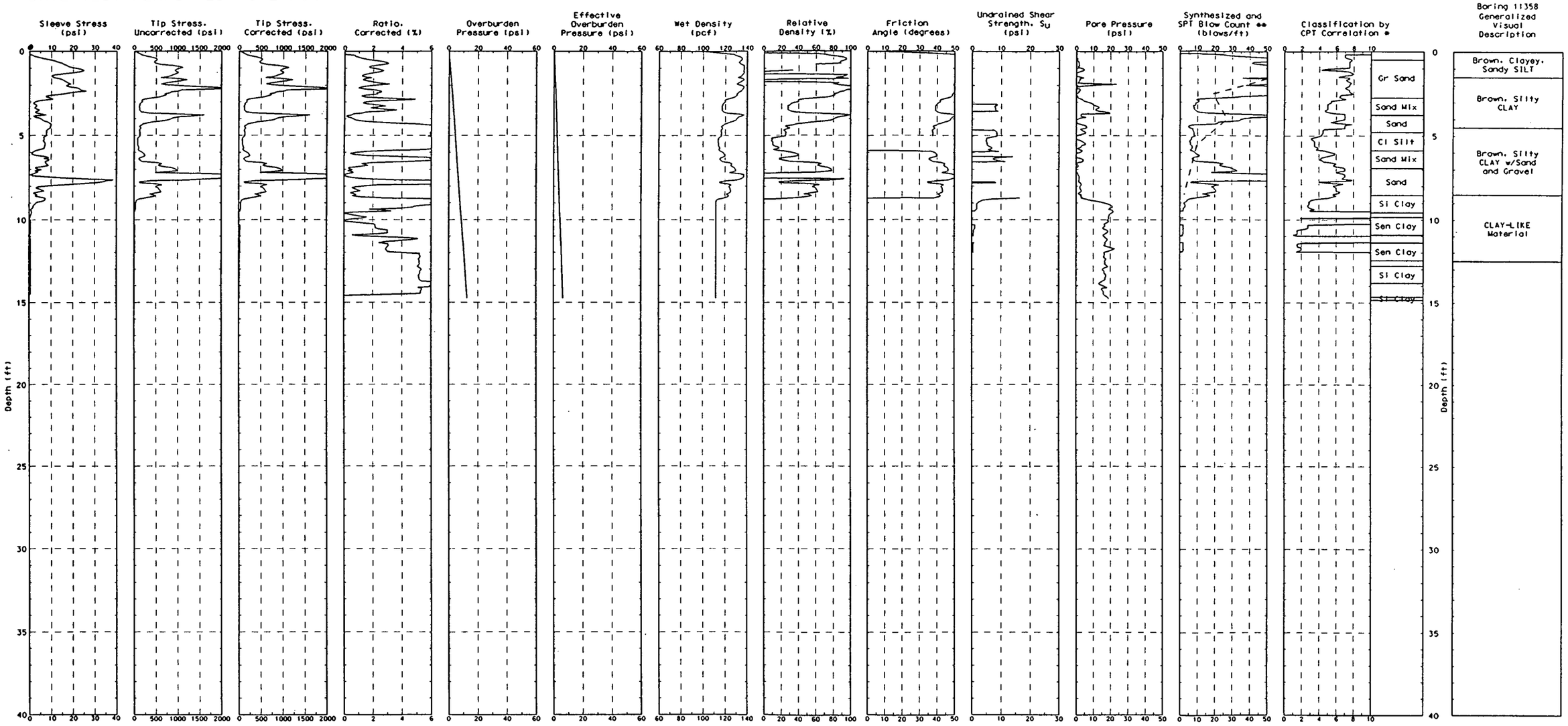
CPT ID: C1-6

CAD FILE: P019/SKX03455.DGN

PIT: 2

CPT ID: C2-1

DATE TEST PERFORMED: 8/24/94



LOCATION			
ID	Coordinates (NAD 1983)		Ground Surface Elevation - feet (NAVD 1927)
	Northing	Easting	
C2-1	481556	1347104	579.4
11358	481551	1347100	579.5

LEGEND

** - - - - - - Standard Penetration Test (SPT) blow count from adjacent boring: 11358

* Classification: 1-Sensitive 2-Peat 3-Clay 4-Silt Mixture 5-Sand Mixture 6-Sand 7-Gravelly Sand 8-Overconsolidated

NOTES

1. Data Source: Applied Research Associates (ARA). Inc. File: S24G401
2. Water table set by ARA at depth: 0 feet
3. Water table setting represents approximate depth and has not been adjusted based on measured water levels.
4. CPT derived density and strength data shown are estimates based on empirical correlation by ARA and have not been adjusted based on laboratory data.
5. Stratigraphy shown in classification by CPT Correlation is from ARA interpretation.

Fernald Environmental Management Project
Dewatering Excavation Evaluation Project (DEEP)

Electric Cone Penetrometer Test Results

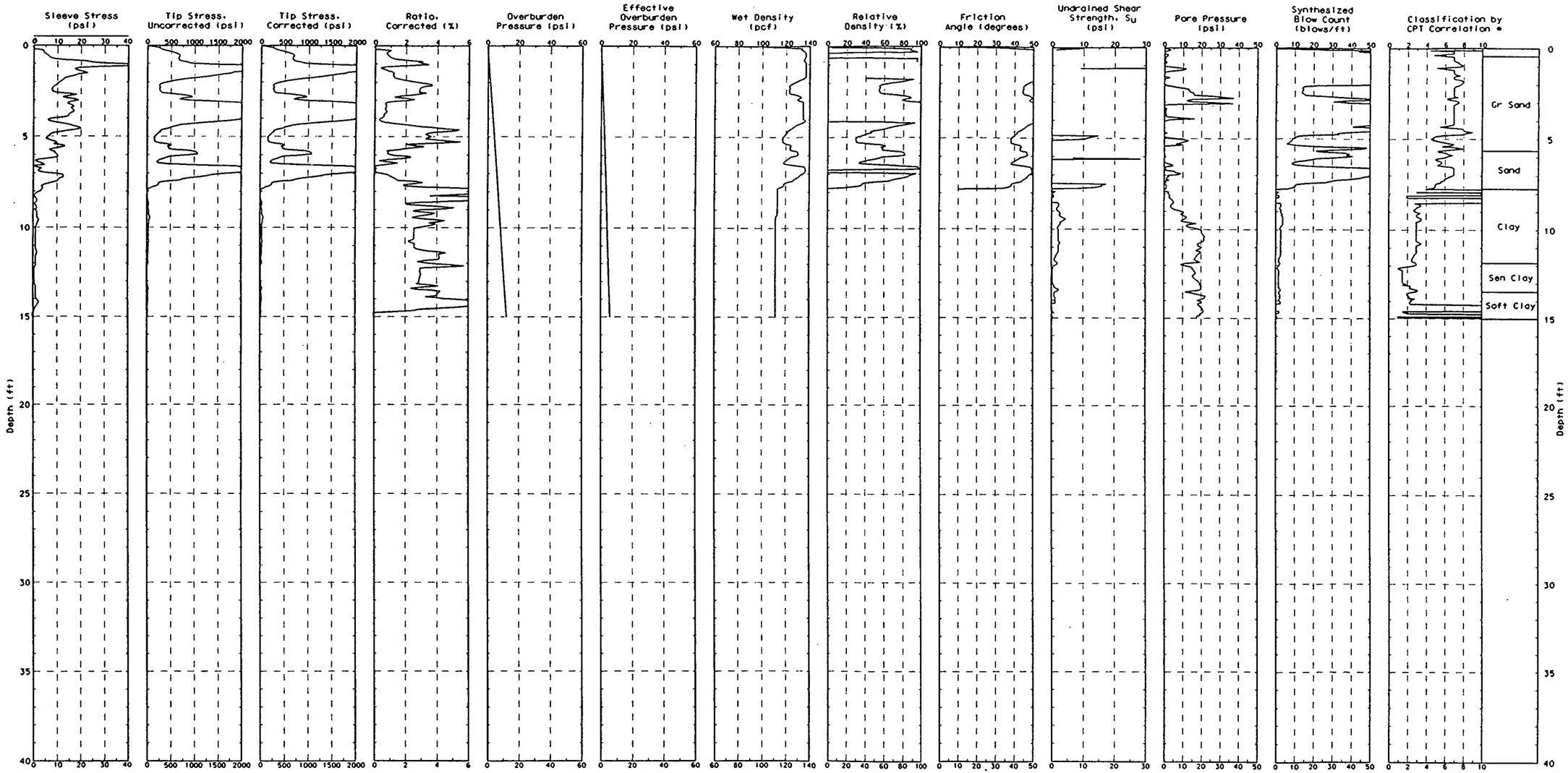
CPT ID: C2-1

CAD FILE: P019/SKX03456.DGN

PIT: 2

CPT ID: C2-2

DATE TEST PERFORMED: 8/24/94



LOCATION			
ID	Coordinates (NAD 1983)		Ground Surface Elevation - feet (NAVD 1927)
	Northing	Easting	
C2-2	481530	1346980	580.8

LEGEND

* Classification: 1-Sensitive 2-Peat 3-Clay 4-Silt Mixture 5-Sand Mixture 6-Sand 7-Gravelly Sand 8-Overconsolidated

NOTES

1. Data Source: Applied Research Associates (ARA), Inc. File: S24G402
2. Water table set by ARA at depth: 0 feet
3. Water table setting represents approximate depth and has not been adjusted based on measured water levels.
4. CPT derived density and strength data shown are estimates based on empirical correlation by ARA and have not been adjusted based on laboratory data.
5. Stratigraphy shown in classification by CPT Correlation is from ARA interpretation.

Fernald Environmental Management Project
Dewatering Excavation Evaluation Project (DEEP)

Electric Cone Penetrometer Test Results

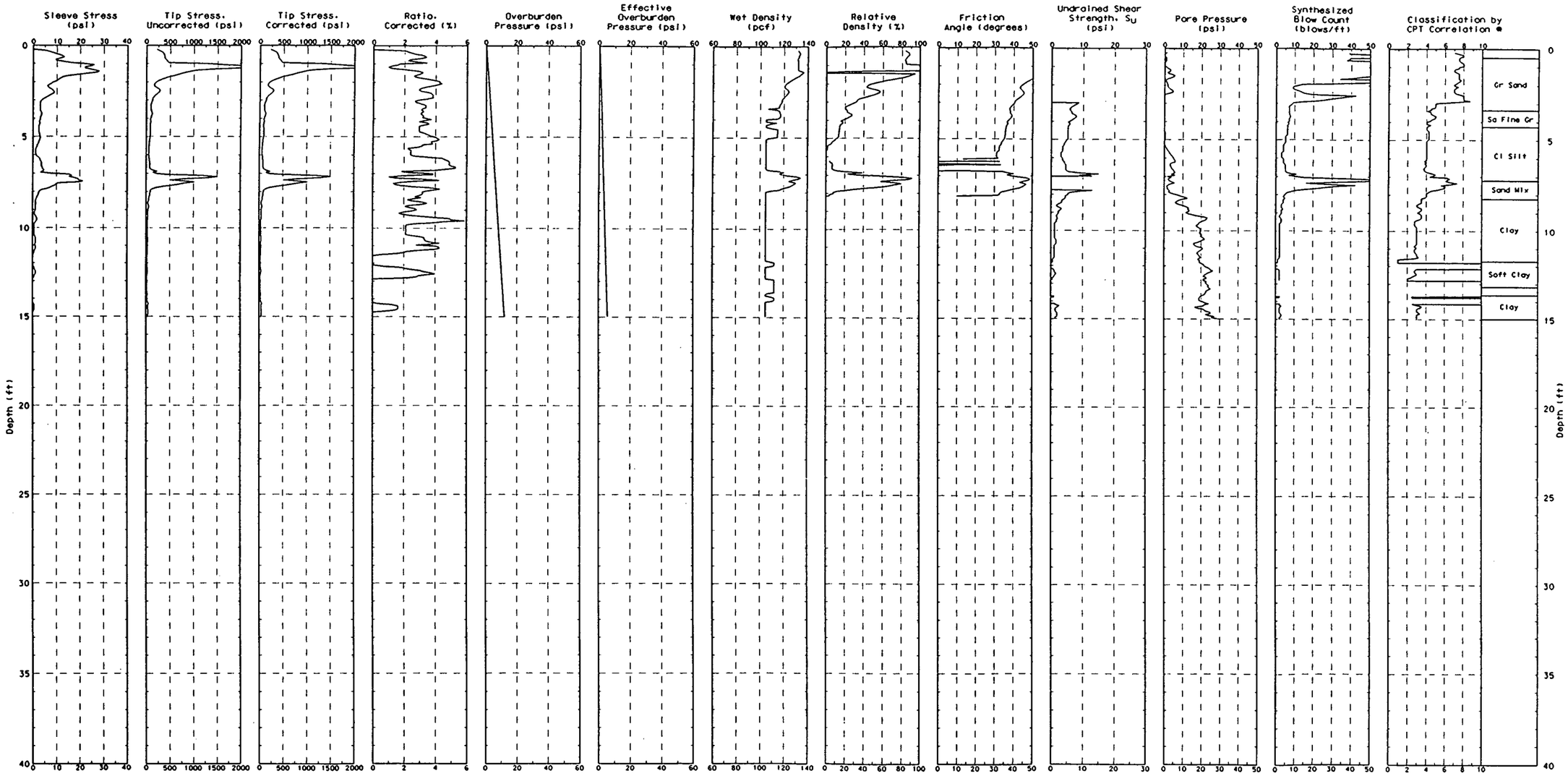
CPT ID: C2-2

CAD FILE: P019/SKX03457.DGN

PIT: 2

CPT ID: C2-3

DATE TEST PERFORMED: 8/24/94



LOCATION			
ID	Coordinates (NAD 1983)		Ground Surface Elevation - feet (NAVD 1927)
	Northing	Easting	
C2-3	481480	1346980	580.1

LEGEND

* Classification: 1-Sensitive 2-Peat 3-Clay 4-Silt Mixture 5-Sand Mixture 6-Sand 7-Gravelly Sand 8-Overconsolidated

NOTES

1. Data Source: Applied Research Associates (ARA), Inc. File: S24G403
2. Water table set by ARA at depth: 0 feet
3. Water table setting represents approximate depth and has not been adjusted based on measured water levels.
4. CPT derived density and strength data shown are estimates based on empirical correlation by ARA and have not been adjusted based on laboratory data.
5. Stratigraphy shown in classification by CPT Correlation is from ARA interpretation.

Fernald Environmental Management Project
Dewatering Excavation Evaluation Project (DEEP)

Electric Cone Penetrometer Test Results

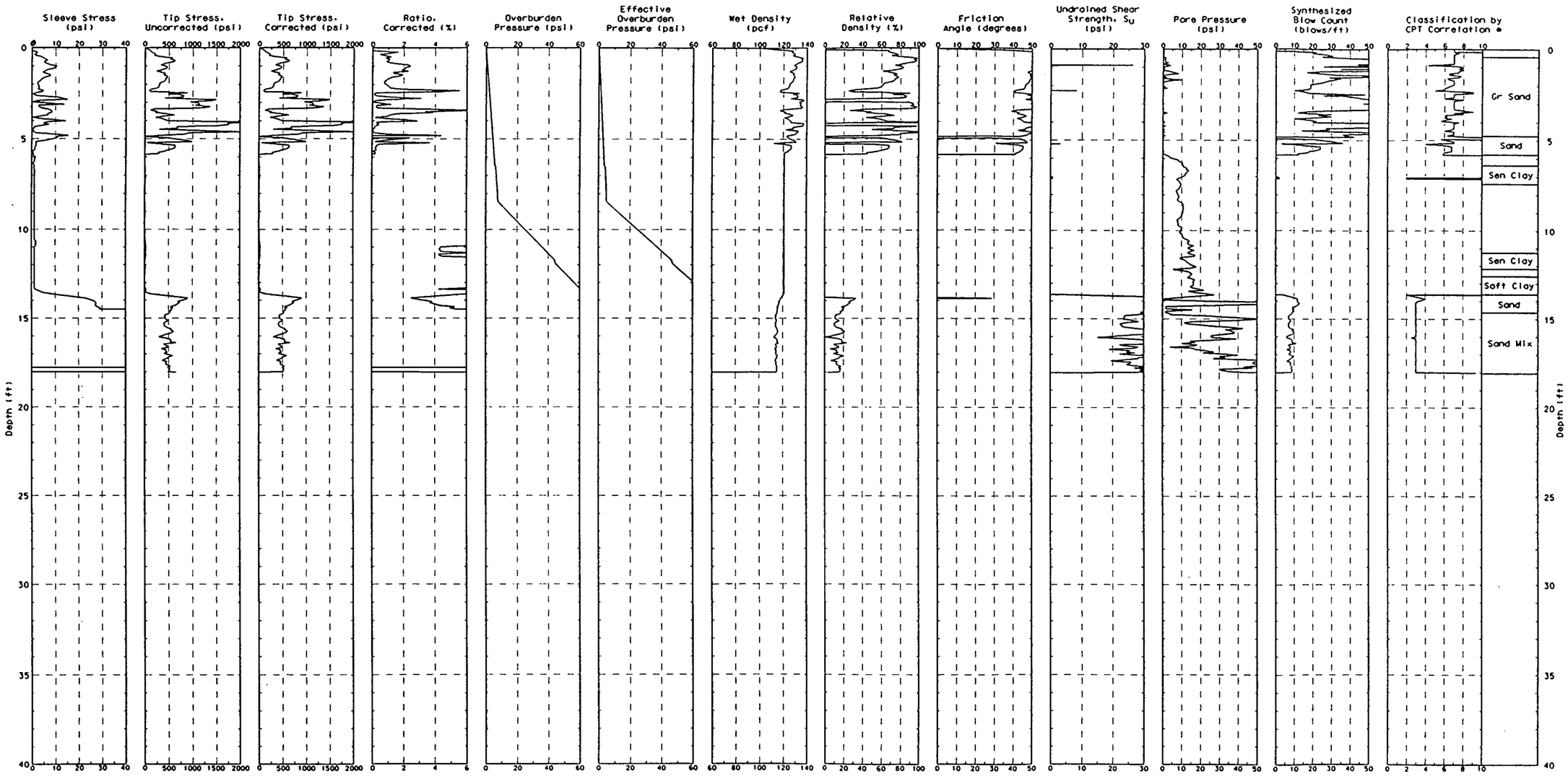
CPT ID: C2-3

CAD FILE: PO19/SKX03458.DGN

PIT: 2

CPT ID: C2-4

DATE TEST PERFORMED: 8/23/94



LOCATION			
ID	Coordinates (NAD 1983)		Ground Surface Elevation - feet (NAVD 1927)
	Northing	Easting	
C2-4	481430	1347080	578.2

LEGEND

- Classification: 1-Sensitive 2-Peat 3-Clay 4-Silt Mixture 5-Sand Mixture 6-Sand 7-Gravelly Sand 8-Overconsolidated

NOTES

1. Data Source: Applied Research Associates (ARA), Inc. File: S23G404
2. Water table set by ARA at depth: 0 feet
3. Water table setting represents approximate depth and has not been adjusted based on measured water levels.
4. CPT derived density and strength data shown are estimates based on empirical correlation by ARA and have not been adjusted based on laboratory data.
5. Stratigraphy shown in classification by CPT Correlation is from ARA interpretation.

Fernald Environmental Management Project
Dewatering Excavation Evaluation Project (DEEP)

Electric Cone Penetrometer Test Results

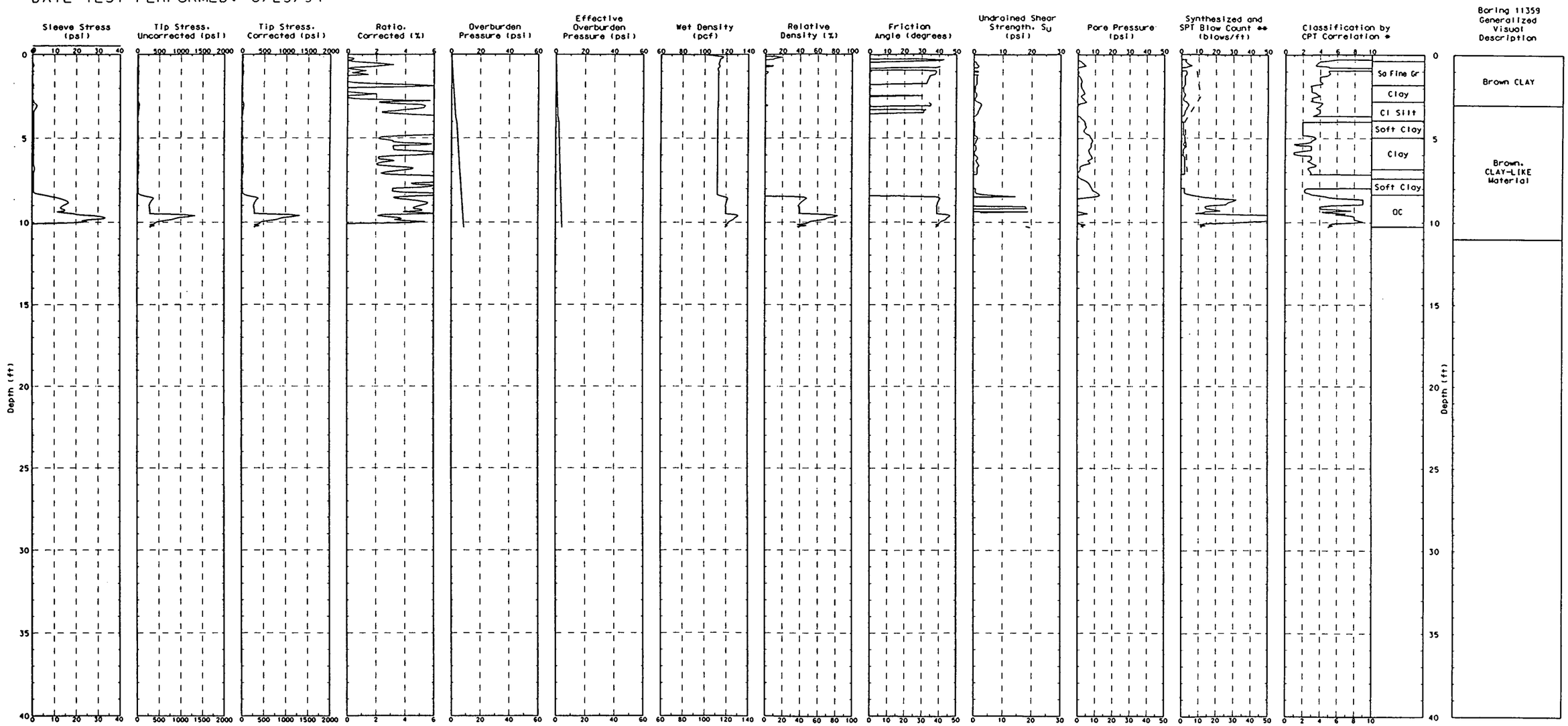
CPT ID: C2-4

CAD FILE: PO19/SKX03459.DGN

PIT: 2

CPT ID: C2-5

DATE TEST PERFORMED: 8/23/94



LOCATION			
ID	Coordinates (NAD 1983)		Ground Surface Elevation - feet (NAVD 1927)
	Northing	Easting	
C2-5	481397	1347050	577.7
11359	481396	1347044	577.7

LEGEND

** - - - - - - Standard Penetration Test (SPT) blow count from adjacent boring: 11359

* Classification: 1-Sensitive 2-Peat 3-Clay 4-Silt Mixture 5-Sand Mixture 6-Sand 7-Gravelly Sand 8-Overconsolidated

NOTES

1. Data Source: Applied Research Associates (ARA), Inc. File: S23G402
2. Water table set by ARA at depth: 0 feet
3. Water table setting represents approximate depth and has not been adjusted based on measured water levels.
4. CPT derived density and strength data shown are estimates based on empirical correlation by ARA and have not been adjusted based on laboratory data.
5. Stratigraphy shown in classification by CPT Correlation is from ARA interpretation.

Fernald Environmental Management Project
Dewatering Excavation Evaluation Project (DEEP)

Electric Cone Penetrometer Test Results

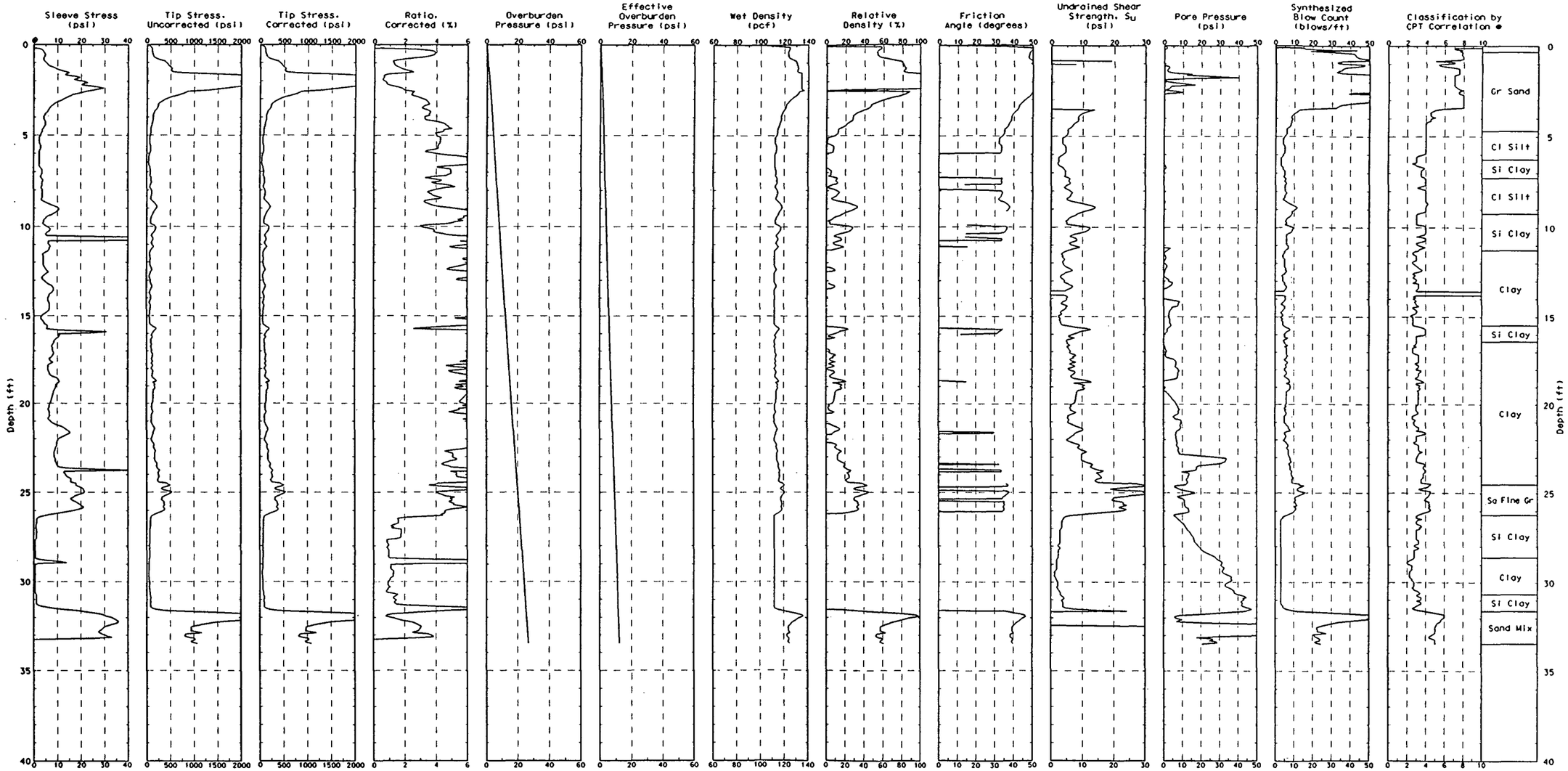
CPT ID: C2-5

CAD FILE: PO19/SKX03460.DGN

PIT: 3

CPT ID: C3-1

DATE TEST PERFORMED: 9/1/94



LOCATION			
ID	Coordinates (NAD 1983)		Ground Surface Elevation - feet (NAVD 1927)
	Northing	Easting	
C3-1	481480	1346480	580.2

LEGEND

* Classification: 1-Sensitive 2-Peat 3-Clay 4-Silt Mixture 5-Sand Mixture 6-Sand 7-Gravelly Sand 8-Overconsolidated

NOTES

1. Data Source: Applied Research Associates (ARA), Inc. File: S01S403
2. Water table set by ARA at depth: 0 feet
3. Water table setting represents approximate depth and has not been adjusted based on measured water levels.
4. CPT derived density and strength data shown are estimates based on empirical correlation by ARA and have not been adjusted based on laboratory data.
5. Stratigraphy shown in classification by CPT Correlation is from ARA interpretation.

Fernald Environmental Management Project
Dewatering Excavation Evaluation Project (DEEP)

Electric Cone Penetrometer Test Results

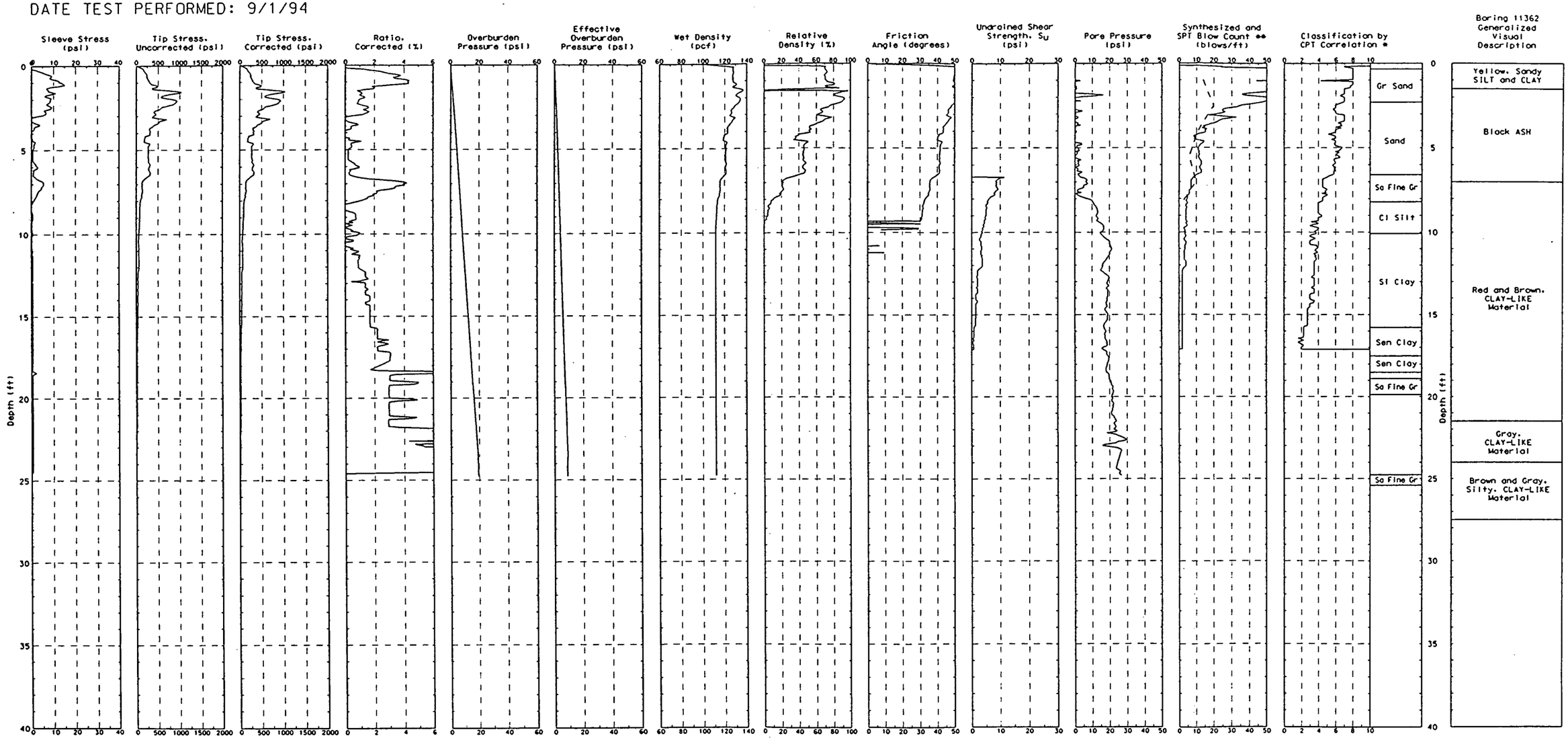
CPT ID: C3-1

CAD FILE: P019/SKX03461.DGN

PIT: 3

CPT ID: C3-2

DATE TEST PERFORMED: 9/1/94



LOCATION			
ID	Coordinates (NAD 1983)		Ground Surface Elevation - feet (NAVD 1927)
	Northing	Easting	
C3-2	481536	1346593	584.8
11362	481546	1346593	584.5

LEGEND

** - - - - - - Standard Penetration Test (SPT) blow count from adjacent boring: 11362

* Classification: 1-Sensitive 2-Peat 3-Clay 4-Silt Mixture 5-Sand Mixture 6-Sand 7-Gravelly Sand 8-Overconsolidated

NOTES

1. Data Source: Applied Research Associates (ARA), Inc. File: S015402
2. Water table set by ARA at depth: 0 feet
3. Water table setting represents approximate depth and has not been adjusted based on measured water levels.
4. CPT derived density and strength data shown are estimates based on empirical correlation by ARA and have not been adjusted based on laboratory data.
5. Stratigraphy shown in classification by CPT Correlation is from ARA interpretation.

Fernald Environmental Management Project
Dewatering Excavation Evaluation Project (DEEP)

Electric Cone Penetrometer Test Results

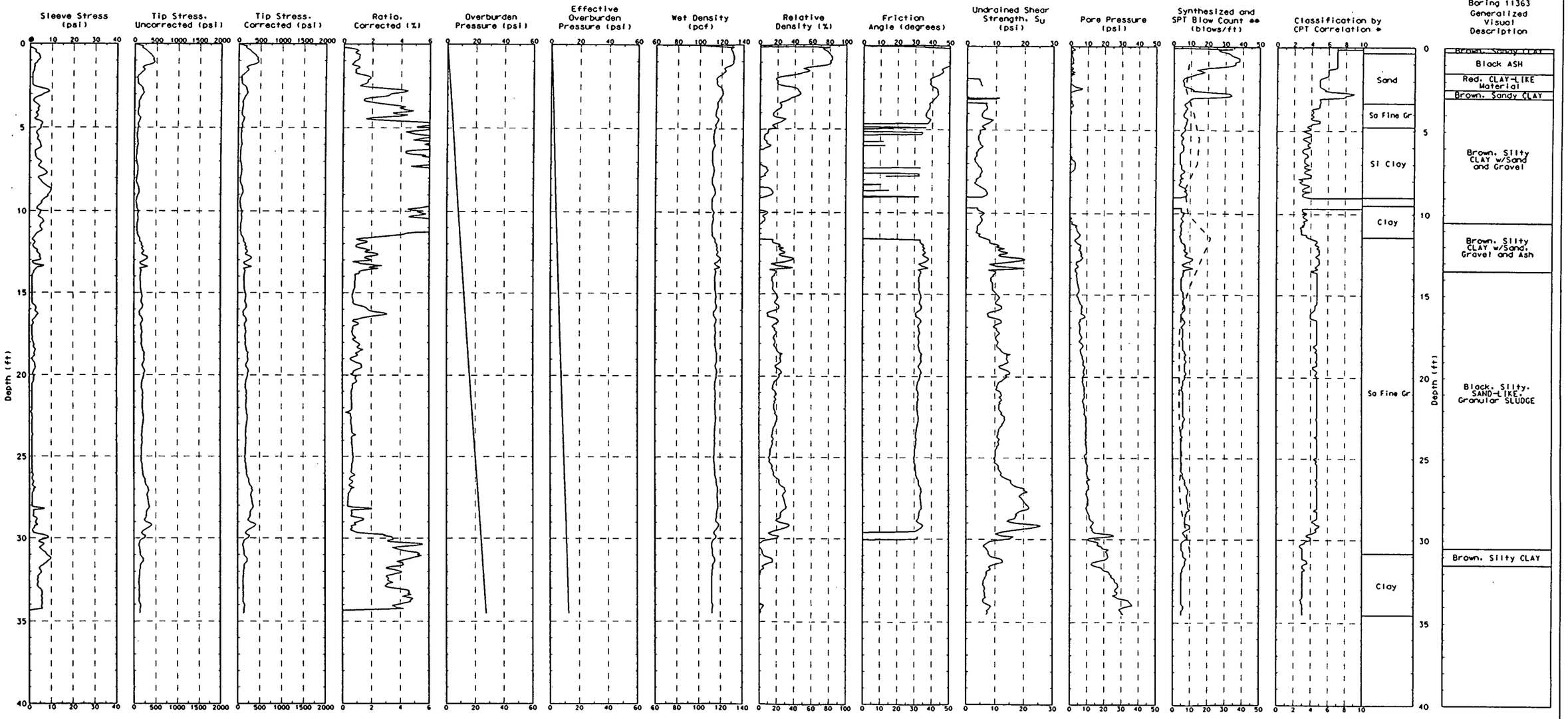
CPT ID: C3-2

CAD FILE: P019/SKX03462.DGN

PIT: 3

CPT ID: C3-3

DATE TEST PERFORMED: 9/1/94



LOCATION			
ID	Coordinates (NAD 1983)		Ground Surface Elevation - feet (NAVD 1927)
	Northing	Easting	
C3-3	481474	1346634	586.0
11363	481474	1346634	586.0

LEGEND

** - - - - - - Standard Penetration Test (SPT) blow count from adjacent boring: 11363

* Classification: 1-Sensitive 2-Peat 3-Clay 4-Silt Mixture 5-Sand Mixture 6-Sand 7-Gravelly Sand 8-Overconsolidated

NOTES

1. Data Source: Applied Research Associates (ARA), Inc. File: S01S401
2. Water table set by ARA at depth: 0 feet
3. Water table setting represents approximate depth and has not been adjusted based on measured water levels.
4. CPT derived density and strength data shown are estimates based on empirical correlation by ARA and have not been adjusted based on laboratory data.
5. Stratigraphy shown in classification by CPT Correlation is from ARA interpretation.

Fernald Environmental Management Project
Dewatering Excavation Evaluation Project (DEEP)

Electric Cone Penetrometer Test Results

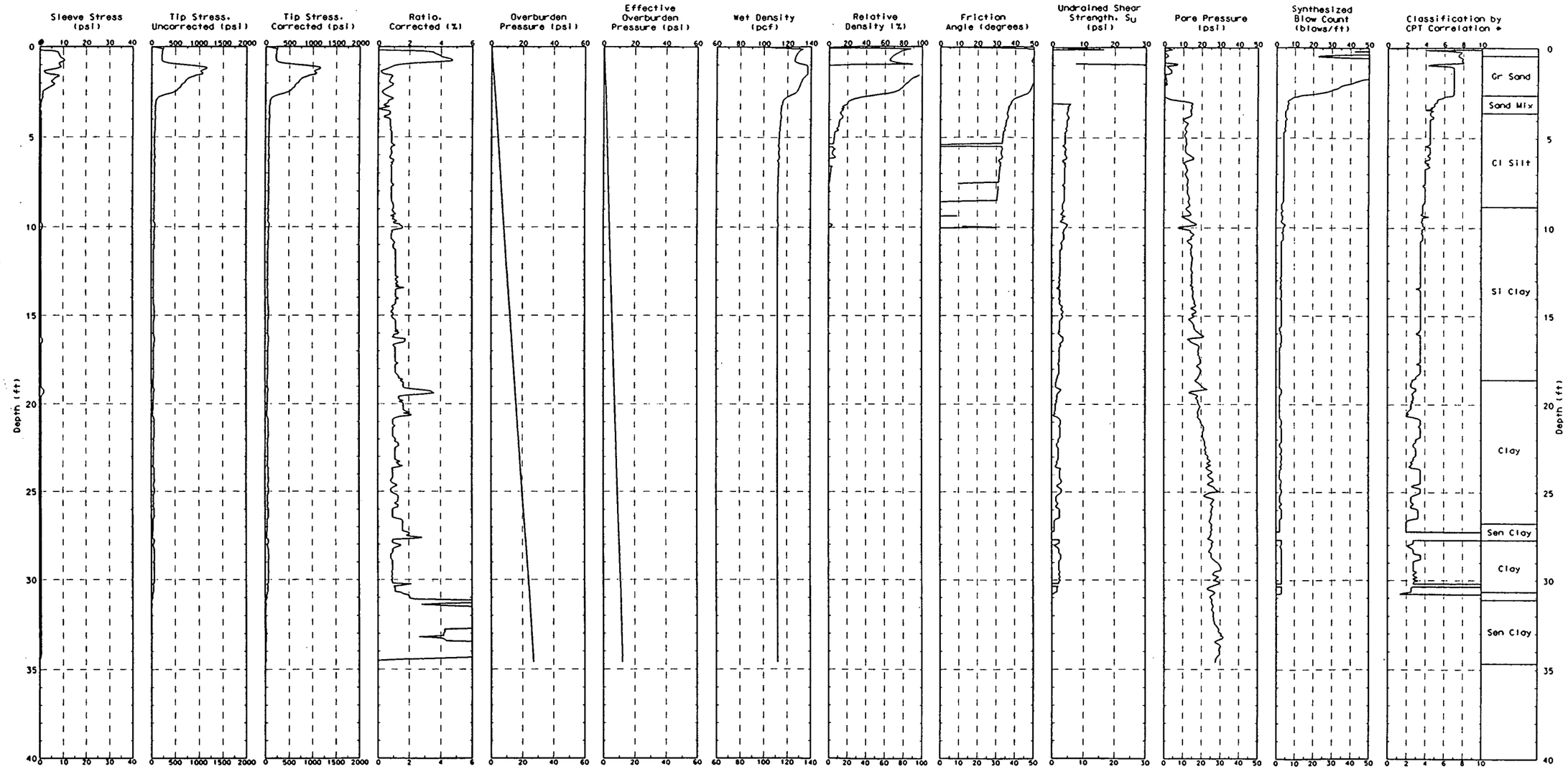
CPT ID: C3-3

CAD FILE: P019/SKX03463.DGN

PIT: 3

CPT ID: C3-4

DATE TEST PERFORMED: 8/25/94



LOCATION			
ID	Coordinates (NAD 1983)		Ground Surface Elevation - feet (NAVD 1927)
	Northing	Easting	
C3-4	481630	1346630	585.1

LEGEND

* Classification: 1-Sensitive 2-Peat 3-Clay 4-Silt Mixture 5-Sand Mixture 6-Sand 7-Gravelly Sand 8-Overconsolidated

NOTES

1. Data Source: Applied Research Associates (ARA), Inc. File: S250401
2. Water table set by ARA at depth: 0 feet
3. Water table setting represents approximate depth and has not been adjusted based on measured water levels.
4. CPT derived density and strength data shown are estimates based on empirical correlation by ARA and have not been adjusted based on laboratory data.
5. Stratigraphy shown in classification by CPT Correlation is from ARA interpretation.

Fernald Environmental Management Project
Dewatering Excavation Evaluation Project (DEEP)

Electric Cone Penetrometer Test Results

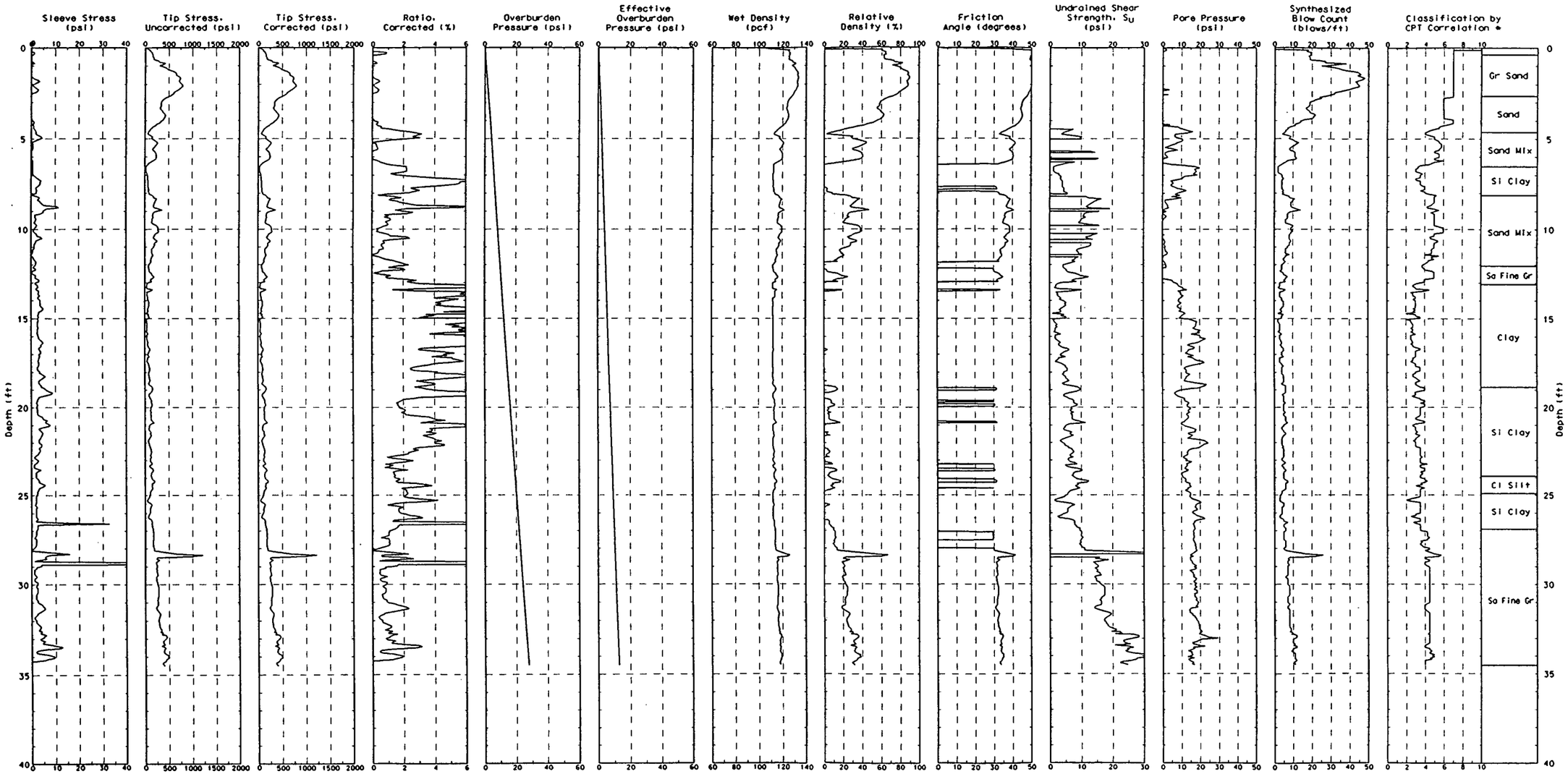
CPT ID: C3-4

CAD FILE: P019/SKX03464.DGN

PIT: 3

CPT ID: C3-5

DATE TEST PERFORMED: 9/1/94



LOCATION			
ID	Coordinates (NAD 1983)		Ground Surface Elevation - feet (NAVD 1927)
	Northing	Easting	
C3-5	481630	1346830	587.5

LEGEND

* Classification: 1-Sensitive 2-Peat 3-Clay 4-Silt Mixture 5-Sand Mixture 6-Sand 7-Gravelly Sand 8-Overconsolidated

NOTES

1. Data Source: Applied Research Associates (ARA), Inc. File: S01S404
2. Water table set by ARA at depth: 0 feet
3. Water table setting represents approximate depth and has not been adjusted based on measured water levels.
4. CPT derived density and strength data shown are estimates based on empirical correlation by ARA and have not been adjusted based on laboratory data.
5. Stratigraphy shown in classification by CPT Correlation is from ARA interpretation.

Fernald Environmental Management Project
Dewatering Excavation Evaluation Project (DEEP)

Electric Cone Penetrometer Test Results

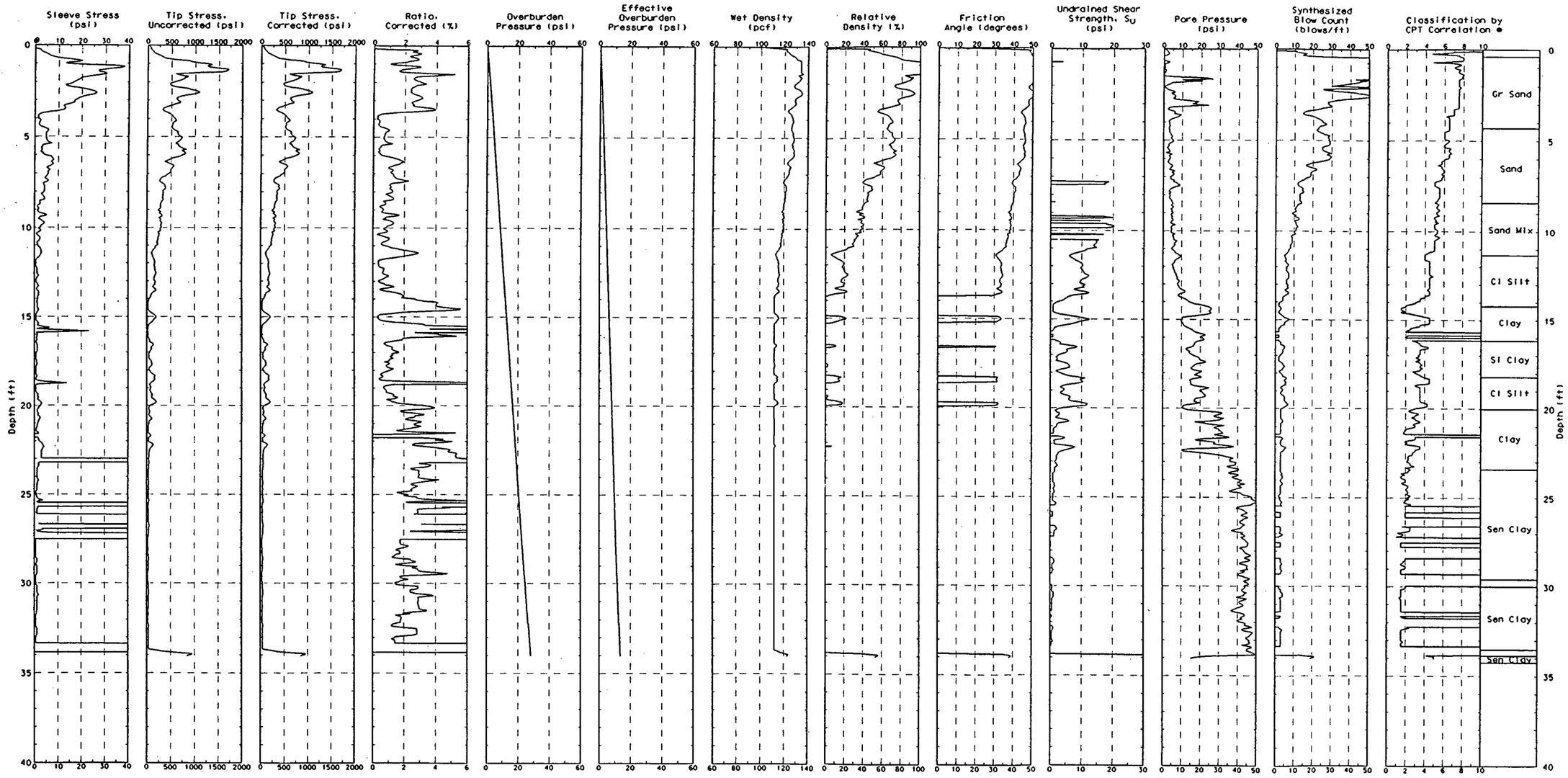
CPT ID: C3-5

CAD FILE: P019/SKX03465.DGN

PIT: 3

CPT ID: C3-6

DATE TEST PERFORMED: 9/1/94



LOCATION			
ID	Coordinates (NAD 1983)		Ground Surface Elevation - feet (NAVD 1927)
	Northing	Easting	
C3-6	481679	1346981	582.6

LEGEND

* Classification: 1-Sensitive 2-Peat 3-Clay 4-Silt Mixture 5-Sand Mixture 6-Sand 7-Gravelly Sand 8-Overconsolidated

NOTES

1. Data Source: Applied Research Associates (ARA), Inc. File: S01S405
2. Water table set by ARA at depth: 0 feet
3. Water table setting represents approximate depth and has not been adjusted based on measured water levels.
4. CPT derived density and strength data shown are estimates based on empirical correlation by ARA and have not been adjusted based on laboratory data.
5. Stratigraphy shown in classification by CPT Correlation is from ARA interpretation.

Fernald Environmental Management Project
Dewatering Excavation Evaluation Project (DEEP)

Electric Cone Penetrometer Test Results

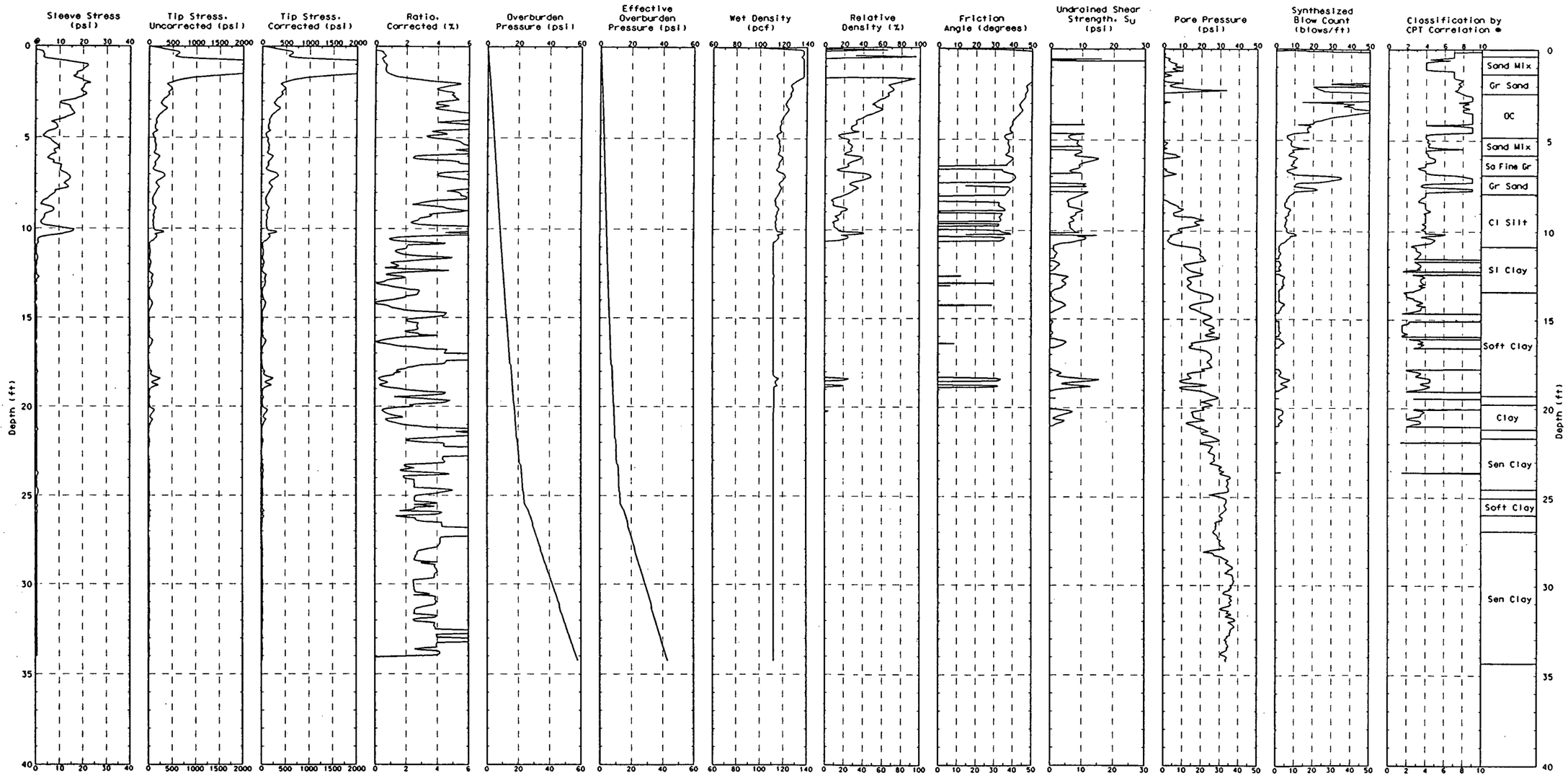
CPT ID: C3-6

CAD FILE: P019/SKX03466.DGN

PIT: 3

CPT ID: C3-7

DATE TEST PERFORMED: 8/26/94



LOCATION			
ID	Coordinates (NAD 1983)		Ground Surface Elevation - feet (NAVD 1927)
	Northing	Easting	
C3-7	481779	1346931	586.1

LEGEND

* Classification: 1-Sensitive 2-Peat 3-Clay 4-Silt Mixture 5-Sand Mixture 6-Sand 7-Gravelly Sand 8-Overconsolidated

NOTES

1. Data Source: Applied Research Associates (ARA), Inc. File: S26G402
2. Water table set by ARA at depth: 0 feet
3. Water table setting represents approximate depth and has not been adjusted based on measured water levels.
4. CPT derived density and strength data shown are estimates based on empirical correlation by ARA and have not been adjusted based on laboratory data.
5. Stratigraphy shown in classification by CPT Correlation is from ARA interpretation.

Fernald Environmental Management Project
Dewatering Excavation Evaluation Project (DEEP)

Electric Cone Penetrometer Test Results

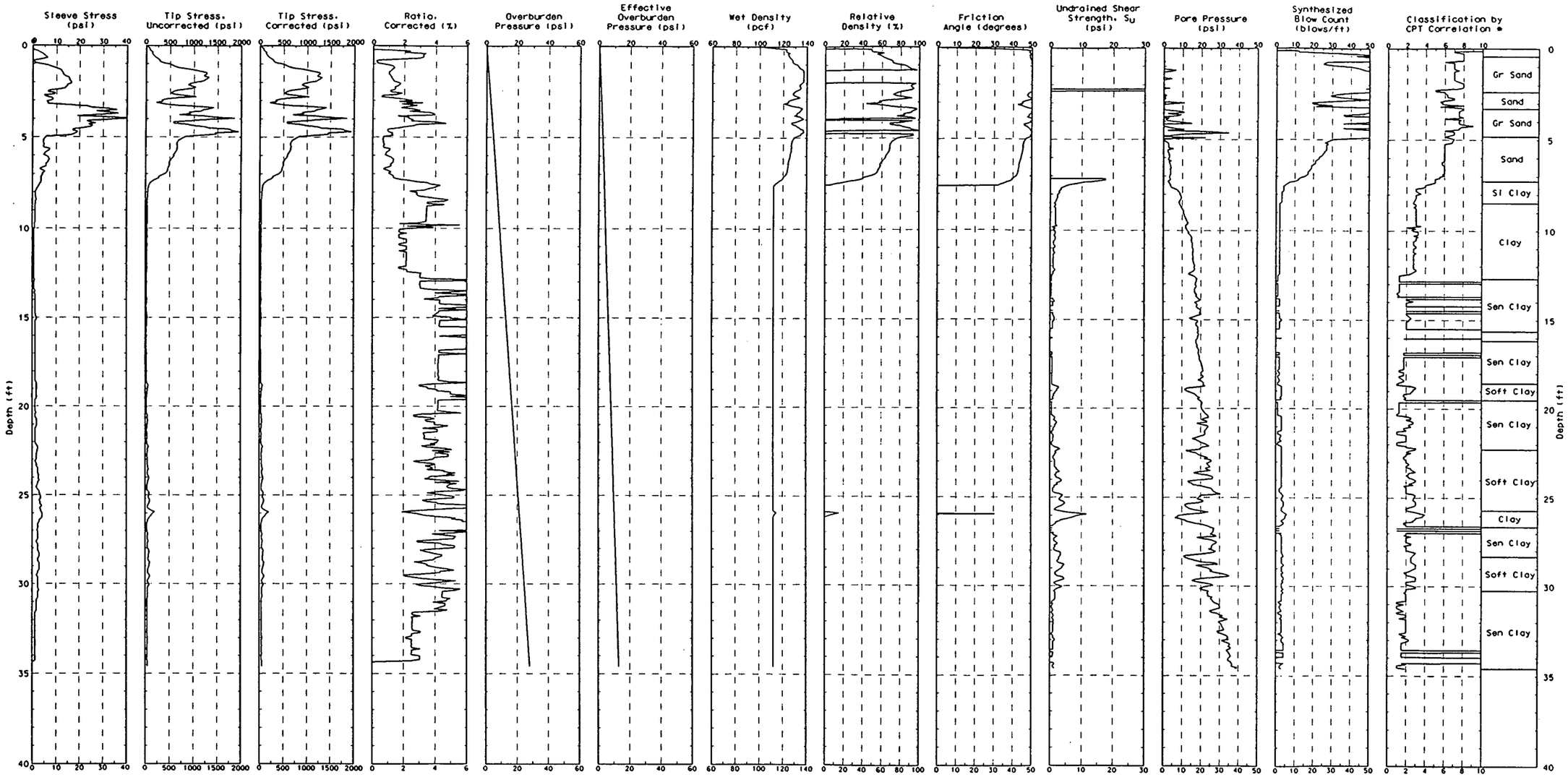
CPT ID: C3-7

CAD FILE: P019/SKX03467.DGN

PIT: 3

CPT ID: C3-8

DATE TEST PERFORMED: 8/30/94



LOCATION			
ID	Coordinates (NAD 1983)		Ground Surface Elevation - feet (NAVD 1927)
	Northing	Easting	
C3-8	481879	1347031	583.3

LEGEND

* Classification: 1-Sensitive 2-Peat 3-Clay 4-Silt Mixture 5-Sand Mixture 6-Sand 7-Gravelly Sand 8-Overconsolidated

NOTES

1. Data Source: Applied Research Associates (ARA), Inc. File: S30G401
2. Water table set by ARA at depth: 0 feet
3. Water table setting represents approximate depth and has not been adjusted based on measured water levels.
4. CPT derived density and strength data shown are estimates based on empirical correlation by ARA and have not been adjusted based on laboratory data.
5. Stratigraphy shown in classification by CPT Correlation is from ARA interpretation.

Fernald Environmental Management Project
Dewatering Excavation Evaluation Project (DEEP)

Electric Cone Penetrometer Test Results

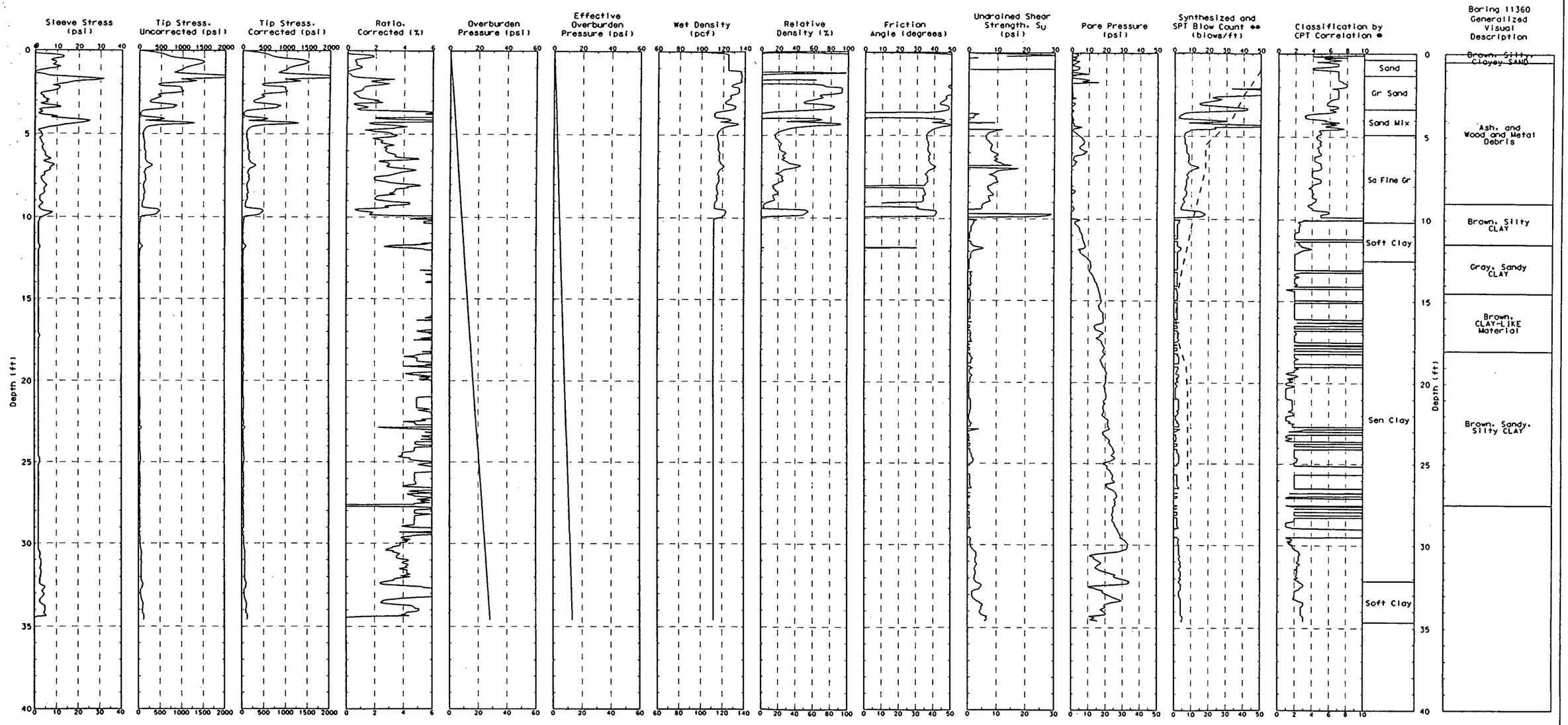
CPT ID: C3-8

CAD FILE: P019/SKX03468.DGN

PIT: 3

CPT ID: C3-9

DATE TEST PERFORMED: 8/26/94



LOCATION			
ID	Coordinates (NAD 1983)		Ground Surface Elevation - feet (NAVD 1927)
	Northing	Easting	
C3-9	481865	1346866	586.9
11360	481867	1346863	586.9

LEGEND

** - - - - - - Standard Penetration Test (SPT) blow count from adjacent boring: 11360

* Classification: 1-Sensitive 2-Peat 3-Clay 4-Silt Mixture 5-Sand Mixture 6-Sand 7-Gravelly Sand 8-Overconsolidated

NOTES

1. Data Source: Applied Research Associates (ARA), Inc. File: S26G401
2. Water table set by ARA at depth: 0 feet
3. Water table setting represents approximate depth and has not been adjusted based on measured water levels.
4. CPT derived density and strength data shown are estimates based on empirical correlation by ARA and have not been adjusted based on laboratory data.
5. Stratigraphy shown in classification by CPT Correlation is from ARA interpretation.

Fernald Environmental Management Project
Dewatering Excavation Evaluation Project (DEEP)

Electric Cone Penetrometer Test Results

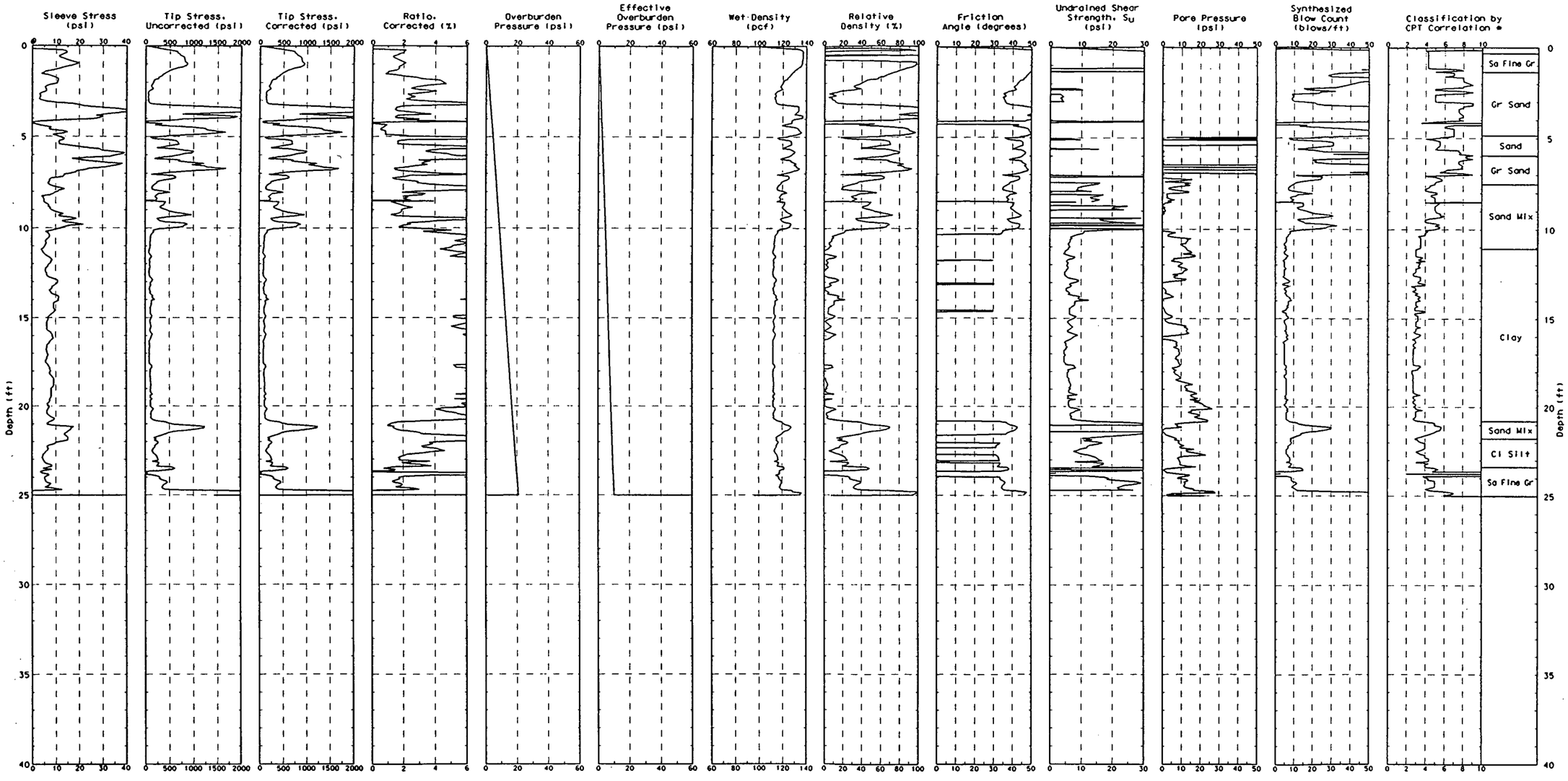
CPT ID: C3-9

CAD FILE: PG19/SKX03469.DGN

PIT: 3

CPT ID: C3-10

DATE TEST PERFORMED: 8/25/94



LOCATION			
ID	Coordinates (NAD 1983)		Ground Surface Elevation - feet (NAVD 1927)
	Northing	Easting	
C3-10	481929	1346831	585.1

LEGEND

* Classification: 1-Sensitive 2-Peat 3-Clay 4-Silt Mixture 5-Sand Mixture 6-Sand 7-Gravelly Sand 8-Overconsolidated

NOTES

1. Data Source: Applied Research Associates (ARA), Inc. File: S25G404
2. Water table set by ARA at depth: 0 feet
3. Water table setting represents approximate depth and has not been adjusted based on measured water levels.
4. CPT derived density and strength data shown are estimates based on empirical correlation by ARA and have not been adjusted based on laboratory data.
5. Stratigraphy shown in classification by CPT Correlation is from ARA interpretation.

Fernald Environmental Management Project
Dewatering Excavation Evaluation Project (DEEP)

Electric Cone Penetrometer Test Results

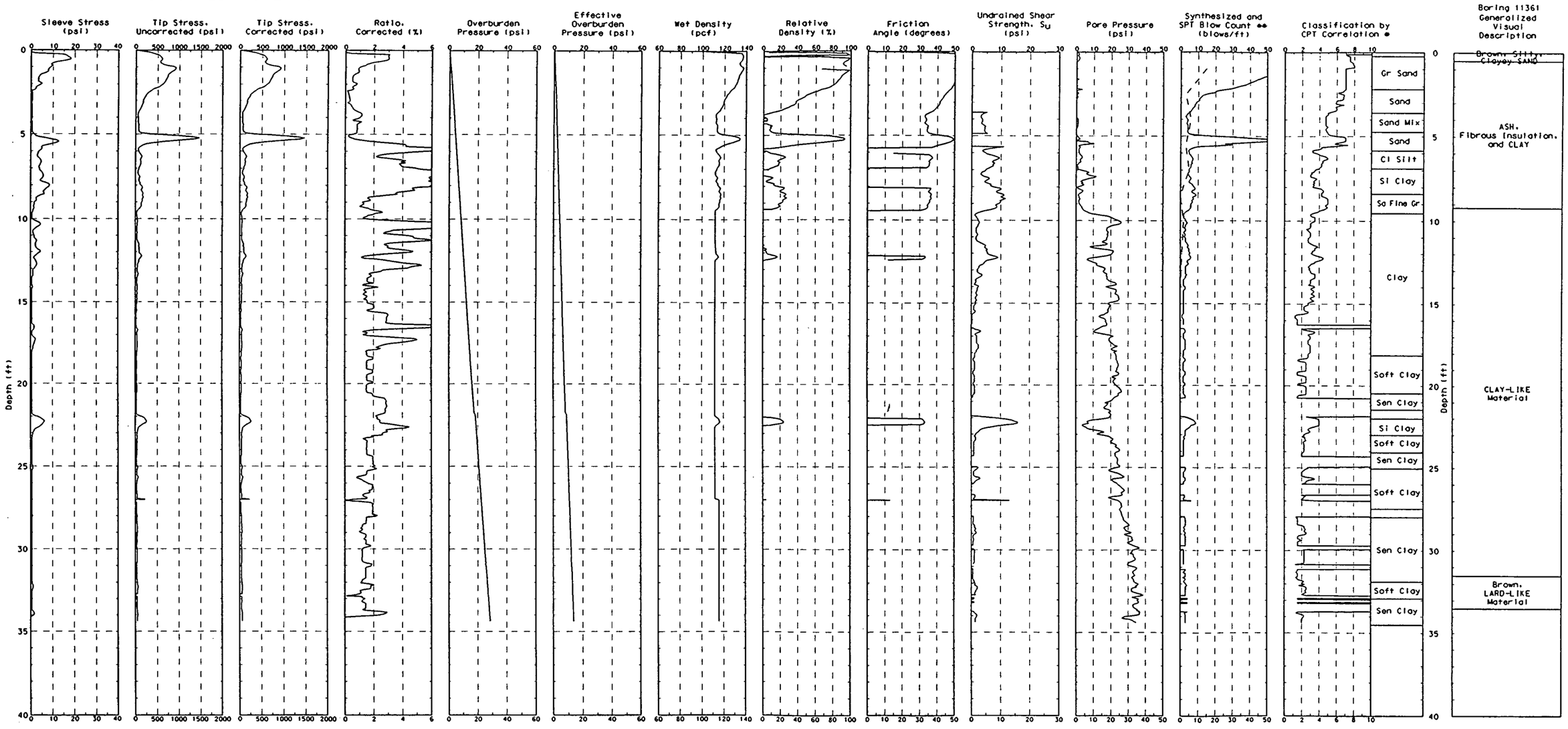
CPT ID: C3-10

CAD FILE: PO19/SKX03470.DGN

PIT: 3

CPT ID: C3-11

DATE TEST PERFORMED: 8/24/94



LOCATION			
ID	Coordinates (NAD 1983)		Ground Surface Elevation - feet (NAVD 1927)
	Northing	Easting	
C3-11	481690	1346737	589.5
11361	481698	1346734	589.5

LEGEND

** - - - - - - Standard Penetration Test (SPT) blow count from adjacent boring: 11361

* Classification: 1-Sensitive 2-Peat 3-Clay 4-Silt Mixture 5-Sand Mixture 6-Sand 7-Gravelly Sand 8-Overconsolidated

NOTES

1. Data Source: Applied Research Associates (ARA), Inc. File: S24G404
2. Water table set by ARA at depth: 0 feet
3. Water table setting represents approximate depth and has not been adjusted based on measured water levels.
4. CPT derived density and strength data shown are estimates based on empirical correlation by ARA and have not been adjusted based on laboratory data.
5. Stratigraphy shown in classification by CPT Correlation is from ARA interpretation.

Fernald Environmental Management Project
Dewatering Excavation Evaluation Project (DEEP)

Electric Cone Penetrometer Test Results

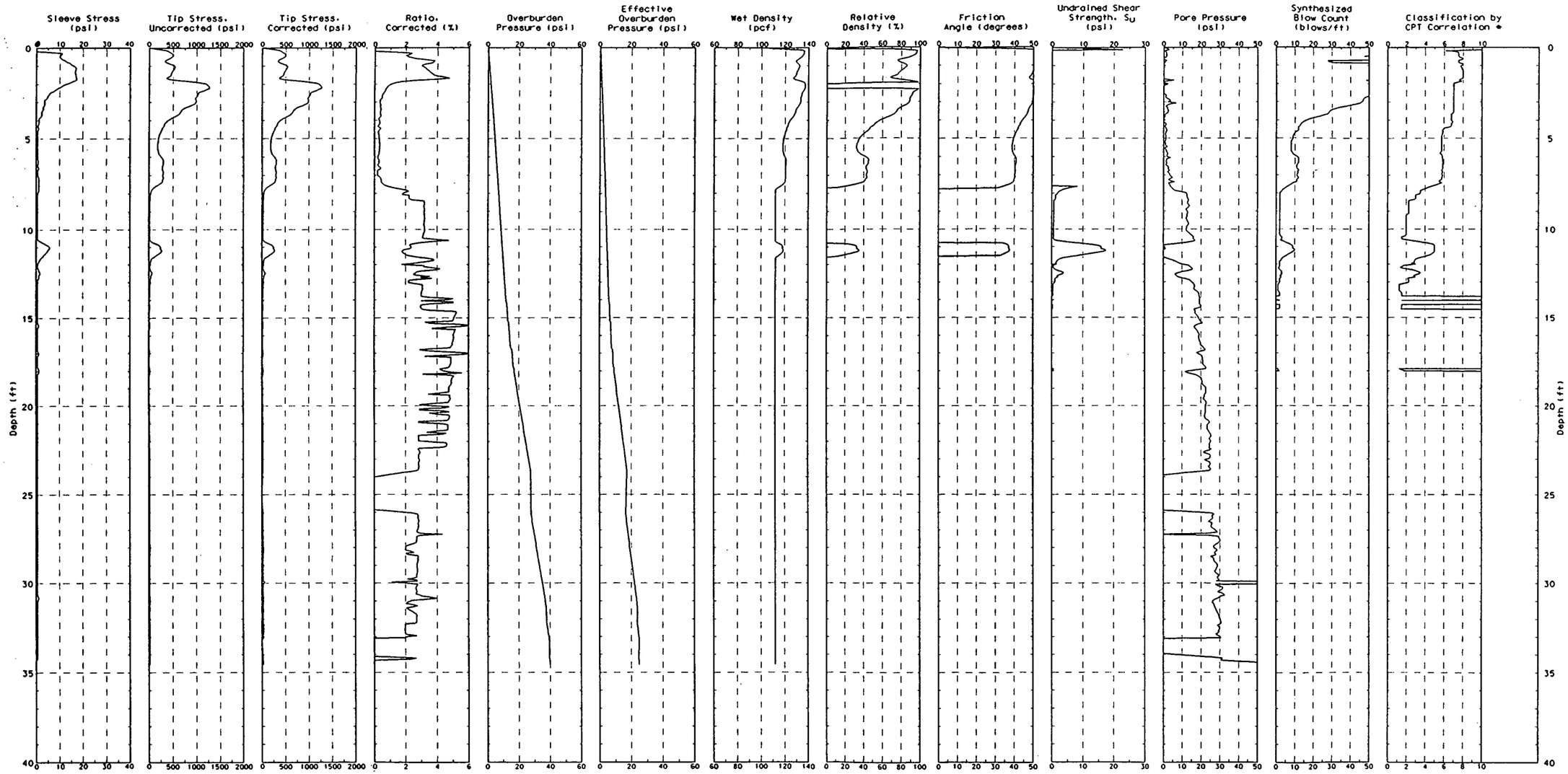
CPT ID: C3-11

CAD FILE: PD19/SKX03471.DGN

PIT: 3

CPT ID: C3-12

DATE TEST PERFORMED: 8/25/94



LOCATION			
ID	Coordinates (NAD 1983)		Ground Surface Elevation - feet (NAVD 1927)
	Northing	Easting	
C3-12	481729	1346681	587.0

LEGEND

* Classification: 1-Sensitive 2-Peat 3-Clay 4-Silt Mixture 5-Sand Mixture 6-Sand 7-Gravelly Sand 8-Overconsolidated

NOTES

1. Data Source: Applied Research Associates (ARA), Inc. File: S25G402
2. Water table set by ARA at depth: 0 feet
3. Water table setting represents approximate depth and has not been adjusted based on measured water levels.
4. CPT derived density and strength data shown are estimates based on empirical correlation by ARA and have not been adjusted based on laboratory data.
5. Stratigraphy shown in classification by CPT Correlation is from ARA Interpretation.

Fernald Environmental Management Project
Dewatering Excavation Evaluation Project (DEEP)

Electric Cone Penetrometer Test Results

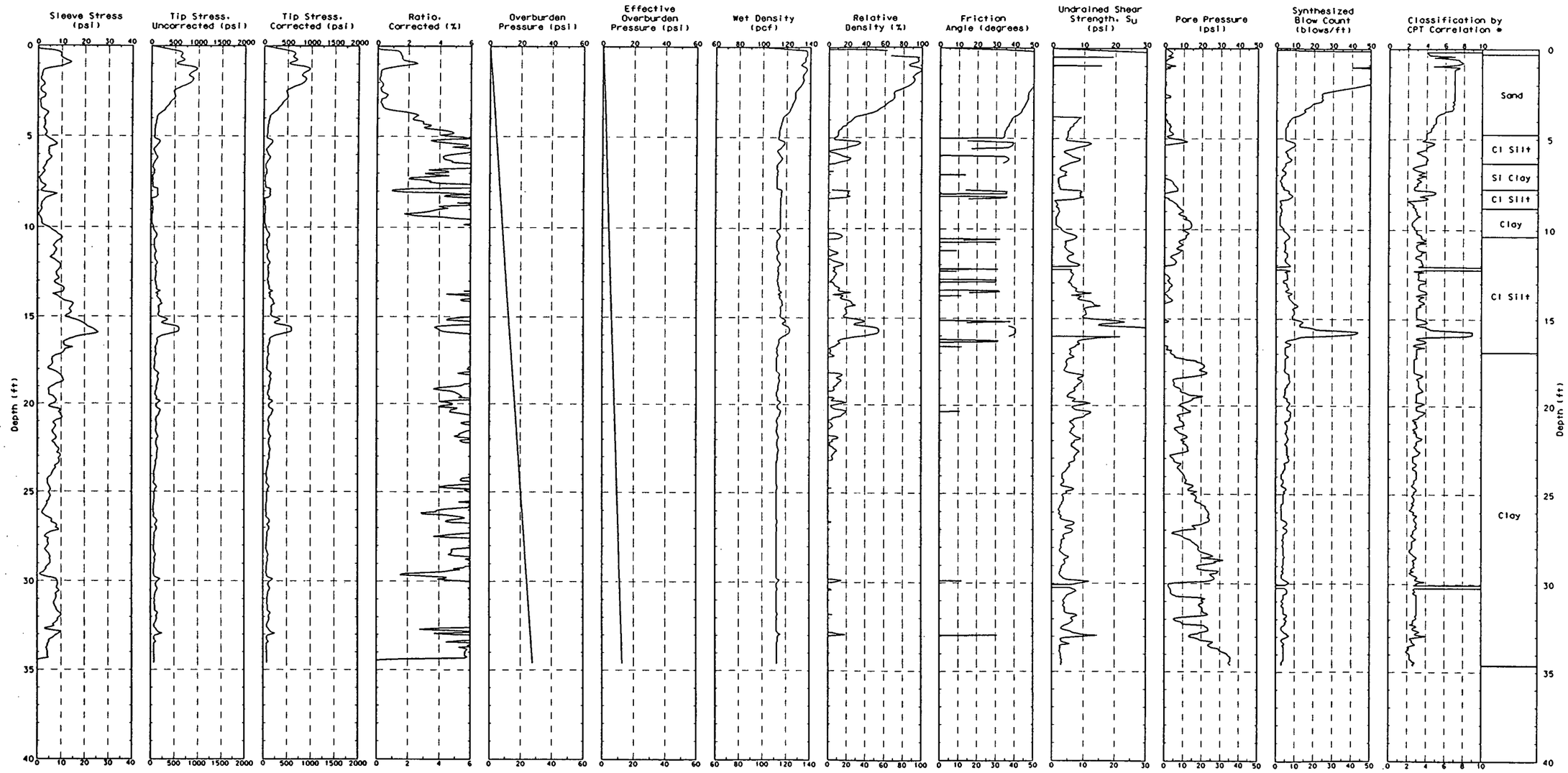
CPT ID: C3-12

CAD FILE: PO19/SKX03472.DGN

PIT: 3

CPT ID: C3-13

DATE TEST PERFORMED: 8/25/94



LOCATION			
ID	Coordinates (NAD 1983)		Ground Surface Elevation - feet (NAVD 1927)
	Northing	Easting	
C3-13	481829	1346781	589.3

LEGEND

* Classification: 1-Sensitive 2-Peat 3-Clay 4-Silt Mixture 5-Sand Mixture 6-Sand 7-Gravelly Sand 8-Overconsolidated

NOTES

1. Data Source: Applied Research Associates (ARA), Inc. File: S25G403
2. Water table set by ARA at depth: 0 feet
3. Water table setting represents approximate depth and has not been adjusted based on measured water levels.
4. CPT derived density and strength data shown are estimates based on empirical correlation by ARA and have not been adjusted based on laboratory data.
5. Stratigraphy shown in classification by CPT Correlation is from ARA interpretation.

Fernald Environmental Management Project
Dewatering Excavation Evaluation Project (DEEP)

Electric Cone Penetrometer Test Results

CPT ID: C3-13

CAD FILE: P019/SKX03473.DGN

APPENDIX B

DRAFT DEEP BORING LOGS

FEMP

LITHOLOGIC LOG

CONTROL NO.:

PAGE 1 of 0163

PROJECT NAME: OU1 Dewatering Excavation Program Geotechnical Investigation	PROJECT NO.: 10.03.06
LOCATION/NUMBER: 11563 (C1-6)	COORDINATES:
DATE STARTED: 8-11-95	DATE COMPLETED: 8-11-95
SURFACE ELEVATION:	GROUNDWATER LEVEL: NA — DATE: NA — TIME: NA
GROUNDWATER LEVEL: NA — DATE: NA — TIME: NA	
GEOLOGIST: Keith Payne	DRILLING CONTRACTOR: Alliance
DRILLING EQUIPMENT: Hollow Stem Auger	DRILLER: Martin Proctor
WATER USED DURING DRILLING: NA GAL	WATER RECOVERED DURING DRILLING: NA GAL
WATER LOST DURING DRILLING: NA GAL	

DEPTH (FEET)	SAMPLE TIME, DATE, AND NUMBER	BLOWS (per 6 inch)	RECOVERY (inches)	DESCRIPTION (Colors identified per Munsell Color Chart)	USCS SYMBOL	MEASURED CONSISTENCY (TSF)	REMARKS
1.0				DRAFT			
2.0							
3.0	0850 8-11-95		24	(2.5Y, 5/1) Gray, Sandy Silt, moist, non-plastic, possibly ash			Bγ = 100 cpm PID = 0 PPM
4.0							
5.0							
6.0							
7.0							

METER	BKGD	DATE	TIME
PID	0 ppm	8-11-95	0845
ALPHA	NA	NA	NA
BETA / GAMMA	30cpm	8-11-95	0845

SAMPLING EQUIPMENT:
TYPE OF SAMPLER: Piston Sampler with Shelby Tube
DIAMETER OF SAMPLER: 3" I.D.
WEIGHTS OF HAMMER: NA

NOTES:

* SAMPLES COLLECTED PER ASTM STANDARD PENETRATION TEST.

FS-F-3681

G:/WPSC/95-0037.DRW (07-10-95)

CONTROL NUMBER:

LITHOLOGIC LOG
(Continuation Page)

PROJECT NAME:	PROJECT NUMBER:	LOCATION NUMBER:
OU1 Dewatering Excavation Program Geotech Invest.	10.0306	11568 (C1-6)

DEPTH (FEET)	SAMPLE TIME, DATE, AND NUMBER	BLOWS (per 6 inch)	RECOVERY (inches)	DESCRIPTION (Colors identified per Munsell Color Chart)	USCS SYMBOL	MEASURED CONSISTENCY (TSF)	REMARKS
8.0	0900 8-11-95		19	(2.5Y, 5/1) Gray, Sandy Silt, moist, non-plastic, possibly ash			βγ=500 cpm PID=0 PPM Bottom two Inches of Shelby tube crushed. Rest of sample is good.
10.0							
11.0	0920 8-11-95		19	(10 YR 5/1) gray, sandy silt with 15-20% white plates. slightly moist, non-plastic			βγ=1,200 cpm PID=1.1 PPM
13.0				Bottom of Boring 13.0'			
14.0							
15.0							
16.0							

DRAFT

METER	BKGD	DATE	TIME
PID	See P. 1		
ALPHA			
BETA / GAMMA			

SAMPLING EQUIPMENT:	
TYPE OF SAMPLER	See P. 1
DIAMETER OF SAMPLER	
WEIGHTS OF HAMMER	

NOTES: water in boring as augers are pulled

* SAMPLES COLLECTED PER ASTM STANDARD PENETRATION TEST.

000888

FS-F-3681-1 7/11/95

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FEMP

LITHOLOGIC LOG

CONTROL NO.:

PROJECT NAME: OU1 Dewatering Excavation Evaluation Program Geotech. Invest			PROJECT NO.: 10.03.06
LOCATION/NUMBER: 11569(C.2-5)	COORDINATES:	DATE STARTED: 8-11-95	DATE COMPLETED: 8-11-95

SURFACE ELEVATION:	GROUNDWATER LEVEL: NA	DATE: NA	TIME: NA	GROUNDWATER LEVEL NA	DATE: NA	TIME: NA

GEOLOGIST: Keith Payne	DRILLING CONTRACTOR: Alliance	DRILLING EQUIPMENT Hollow Stem Auger	DRILLER Martin Proctor

WATER USED DURING DRILLING: NA GAL	WATER RECOVERED DURING DRILLING: NA GAL	WATER LOST DURING DRILLING NA GAL

DEPTH (FEET)	SAMPLE TIME, DATE, AND NUMBER	BLOWS (per 6 inch)	RECOVERY (inches)	DESCRIPTION (Colors identified per Munsell Color Chart)	USCS SYMBOL	MEASURED CONSISTENCY (TSF)	REMARKS
1.0				DRAFT			
2.0							
3.0	0510 8-11-95		25	(2.5Y, 8/4) Pale yellow, clayey silt, moist, slight plasticity, pudding like in texture			BG= 4,000 CPM PID= 11.5 PPM
4.0							
5.0							
6.0							
7.0							

METER	BKGD	DATE	TIME
PID	1.0 PPM	8-12-95	0505
ALPHA	NA	NA	NA
BETA / GAMMA	150 CPM	8-12-95	0505

SAMPLING EQUIPMENT:
TYPE OF SAMPLER Piston Sampler with Shelby Tube
DIAMETER OF SAMPLER 3" I.D.
WEIGHTS OF HAMMER NA

NOTES:

* SAMPLES COLLECTED PER ASTM STANDARD PENETRATION TEST.

FS-F-3681

G:/WPSC/95-0037.DRW (07-10-9

CONTROL NUMBER:

LITHOLOGIC LOG
(Continuation Page)

PROJECT NAME:	PROJECT NUMBER:	LOCATION NUMBER:
OU1 Dewatering Excavation Evaluation Program Geotech. Investigation	10.03.06	11569 (C2-5)

DEPTH (FEET)	SAMPLE TIME, DATE, AND NUMBER	BLOWS (per 6 inch)	RECOVERY (inches)	DESCRIPTION (Colors identified per Munsell Color Chart)	USCS SYMBOL	MEASURED CONSISTENCY (TSF)	REMARKS
8.0	0520 8-11-95		25	(2.5 Y, 8/4) pale yellow, clayey silt, moist, slight plasticity, with wood fragment possibly from pallet, pudding like in texture			BY = 610 cpm PID = 7.7 PPM
9.0				(7.5 YR, 6/6) reddish yellow, clayey silt, moist, slight plasticity, pudding like in texture			
10.0	0530 8-11-95		24	(5 YR, 6/8) reddish yellow, clayey silt, moist, low plasticity, pudding like in texture DRAFT			BY = 810 cpm PID = 6.9 PPM
11.0							
12.0				12.5' Bottom of Boring			
13.0							
14.0							
15.0							
16.0							

METER	BKGD	DATE	TIME	SAMPLING EQUIPMENT:	NOTES:
PID				TYPE OF SAMPLER	
ALPHA		See p. 1		DIAMETER OF SAMPLER See p. 1	
BETA / GAMMA				WEIGHTS OF HAMMER	

* SAMPLES COLLECTED PER ASTM STANDARD PENETRATION TEST.

FEMP

LITHOLOGIC LOG

CONTROL NO.:	PAGE 1 OF 4

PROJECT NAME:	PROJECT NO.:
OU1 Dewatering Excavation Program Geotechnical Investigation	10-03.06

LOCATION/NUMBER:	COORDINATES:	DATE STARTED:	DATE COMPLETED:
11570 (C3-2)		8-7-95	8-8-95

SURFACE ELEVATION:	GROUNDWATER LEVEL:	DATE:	TIME:	GROUNDWATER LEVEL	DATE:	TIME:
	NA	NA	NA	NA	NA	NA

GEOLOGIST:	DRILLING CONTRACTOR:	DRILLING EQUIPMENT	DRILLER
Keith Payne	Alliance	Hollow Stem Auger	Martin Proctor

WATER USED DURING DRILLING:	WATER RECOVERED DURING DRILLING:	WATER LOST DURING DRILLING
NA GAL	NA GAL	NA GAL

DEPTH (FEET)	SAMPLE TIME, DATE, AND NUMBER	BLOWS (per 6 inch)	RECOVERY (inches)	DESCRIPTION (Colors identified per Munsell Color Chart)	USCS SYMBOL	MEASURED CONSISTENCY (TSF)	REMARKS
0.0							
1.0							
2.0							
3.0							
4.0							
5.0							
6.0							
7.0							

DRAFT

METER	BKGD	DATE	TIME
PID	10.0 ppm	8-7-95	0700
ALPHA	0 cpm	8-7-95	0700
BETA / GAMMA	70 cpm	8-7-95	0700

SAMPLING EQUIPMENT:
TYPE OF SAMPLER Piston Sampler with Shelby Tube
DIAMETER OF SAMPLER 3" I.D.
WEIGHTS OF HAMMER NA

NOTES:

* SAMPLES COLLECTED PER ASTM STANDARD PENETRATION TEST.

FS-F-3681

G: / WPSC / 95-0037.DRW (07-10-95)

FEMP
LITHOLOGIC LOG
(Continuation Page)

CONTROL NUMBER:

PROJECT NAME: OU1 Dewatering Excavation Program Geotech Invest.

PROJECT NUMBER: 10.03.06

LOCATION NUMBER: 11570 (C[redacted]2

DEPTH (FEET)	SAMPLE TIME, DATE, AND NUMBER	BLOWS (per 6 inch)	RECOVERY (inches)	DESCRIPTION (Colors identified per Munsell Color Chart)	USCS SYMBOL	MEASURED CONSISTENCY (TSF)	REMARKS
7.0							
8.0							
9.0				DRAFT			
10.0							
11.0	0900 8-8-95	NA	31	(5YR, 4/4) Reddish Brown, clay size particles with pudding like texture, wet, non-plastic	NA	NA	BZ = 500 cpm α = 0 cpm PID = 213.5 ppm
12.0							Shelby Tube with Piston Sampler
13.0							
14.0							
15.0							
16.0	0530 8-8-95	NA	30	Shelby Tube 15.5 - 18.0'	NA	NA	

METER	BKGD	DATE	TIME
PID	15-3 ppm	8-8-95	0455
ALPHA	0 cpm	8-8-95	0455
BETA / GAMMA	100 cpm	8-8-95	0455

SAMPLING EQUIPMENT:	
TYPE OF SAMPLER	See pg. 1
DIAMETER OF SAMPLER	See pg. 1
WEIGHTS OF HAMMER	See pg. 1

NOTES:

000393

* SAMPLES COLLECTED PER ASTM STANDARD PENETRATION TEST.

FEMP
LITHOLOGIC LOG
(Continuation Page)

0163

Page 3 of 4

CONTROL NUMBER:	PROJECT NAME:	PROJECT NUMBER:	LOCATION NUMBER:
	OU1 Dewatering Excavation Program Geotech. Invest.	10.03.06	11570 (C3-[illegible]

DEPTH (FEET)	SAMPLE TIME, DATE, AND NUMBER	BLOWS (per 6 inch)	RECOVERY (inches)	DESCRIPTION (Colors identified per Munsell Color Chart)	USCS SYMBOL	MEASURED CONSISTENCY (TSF)	REMARKS
16.0							
17.0				(5YR, 8/3) pink, clay size particles, pudding like texture, medium plasticity, moist	~~NA~~	~~NA~~ KP 8-16-95	PID = 10.3 ppm α = 0.0 cpm βγ = 200 cpm Shelby Tube Piston Sampler
18.0							
19.0							
20.0				DRAFT			
21.0							
22.0							
23.0	0605 8-8-95			(7.5YR, 2.5/3) Very Dark Brown with (7.5YR, 8/3) pink flakes, non-plastic, silty clay, very moist			PID = 91.3 ppm α = 0 cpm βγ = 400 cpm
24.0		NA	30		NA	NA	
25.0							

METER	BKGD	DATE	TIME
PID	See p. 2		
ALPHA			
BETA / GAMMA			

SAMPLING EQUIPMENT:
TYPE OF SAMPLER: See p. 1
DIAMETER OF SAMPLER: See p. 1
WEIGHTS OF HAMMER: see p. 1

NOTES:

* SAMPLES COLLECTED PER ASTM STANDARD PENETRATION TEST.

000894

FEMP
LITHOLOGIC LOG
(Continuation Page)

CONTROL NUMBER:

PROJECT NAME: OU1 Dewatering Excavation Program Geotech Invest

PROJECT NUMBER: 16.03.06

LOCATION NUMBER: 11573 -2

DEPTH (FEET)	SAMPLE TIME, DATE, AND NUMBER	BLOWS (per 6 inch)	RECOVERY (inches)	DESCRIPTION (Colors identified per Munsell Color Chart)	USCS SYMBOL	MEASURED CONSISTENCY (TSF)	REMARKS
25.0							See pg 7 Tube w. Piston sampler at 23.0
26.0							
27.0							
28.0				DRAFT			
29.0							
30.0							
31.0	0630 8-8-95	NA	27	(2.5Y, 7/6) Yellow. Silty Clay, very moist, non-plastic	NA	NA	PID = 50.7 α = 30 β = 3,600 Shelby Tube with Piston Sampler
32.0							
33.0							
34.0							

METER	BKGD	DATE	TIME
PID	See Pg. 2		
ALPHA			
BETA / GAMMA			

SAMPLING EQUIPMENT:
TYPE OF SAMPLER: See p. 1
DIAMETER OF SAMPLER: See p. 1
WEIGHTS OF HAMMER: See p. 1

NOTES:

000895

* SAMPLES COLLECTED PER ASTM STANDARD PENETRATION TEST.

CONTROL NO.:

FEMP

LITHOLOGIC LOG

PAGE 1 OF 5

0163

PROJECT NAME: OU1 Dewatering Excavation Program Geotechnical Investigation	PROJECT NO.: 1003.06
LOCATION/NUMBER: 11571 (C3-9)	COORDINATES:
DATE STARTED: 8-10-95	DATE COMPLETED: 8-11-95
SURFACE ELEVATION:	GROUNDWATER LEVEL: NA — DATE: NA — TIME: NA
GROUNDWATER LEVEL: NA — DATE: NA — TIME: NA	
GEOLOGIST: Keith Payne	DRILLING CONTRACTOR: Alliance
DRILLING EQUIPMENT: Hollow Stem Auger	DRILLER: Martin Proctor
WATER USED DURING DRILLING: NA GAL	WATER RECOVERED DURING DRILLING: NA GAL
WATER LOST DURING DRILLING: NA GAL	

DEPTH (FEET)	SAMPLE TIME, DATE, AND NUMBER	BLOWS (per 6 inch)	RECOVERY (inches)	DESCRIPTION (Colors identified per Munsell Color Chart)	USCS SYMBOL	MEASURED CONSISTENCY (TSF)	REMARKS
0.0							
1.0							
2.0							
3.0							
4.0							
5.0							
6.0							
7.0							

DRAFT

METER	BKGD	DATE	TIME
PID	10.2 ppm	8-10-95	0800
ALPHA	0 cpm ~~NA~~	8-10-95 ~~NA~~	0800 ~~NA~~ KP 8-14-95
BETA / GAMMA	NA	NA	NA

SAMPLING EQUIPMENT:

TYPE OF SAMPLER: Shelby Tube with Piston Sampler

DIAMETER OF SAMPLER: 3" I.D.

WEIGHTS OF HAMMER: NA

NOTES:

* SAMPLES COLLECTED PER ASTM STANDARD PENETRATION TEST.

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000896

CONTROL NUMBER:

LITHOLOGIC LOG
(Continuation Page)

PROJECT NAME:	PROJECT NUMBER:	LOCATION NUMBER:
OU1 Dewatering Excavation Program Geotech Invest.	10.03 06	11571 (C3-9

DEPTH (FEET)	SAMPLE TIME, DATE, AND NUMBER	BLOWS (per 6 inch)	RECOVERY (inches)	DESCRIPTION (Colors identified per Munsell Color Chart)	USCS SYMBOL	MEASURED CONSISTENCY (TSF)	REMARKS
7.0							
8.0							
9.0							
10	0810 8-10-95	NA	11	(5YR, 2/1) Black, silty Sand, non-plastic, very moist	NA	NA	α = 0 cpm PID = 9.8 ppm Shelby Tube with Piston Sampler
11.0							
12.0							
13.0	0820 8-10-95	NA	18	(7.5 YR, 5/8) Strong Brown, Clayey Silt, moist non-plastic, nodules like texture	NA	NA	α = 0 cpm PID = 19.4 ppm Shelby Tube with Piston Sampler
14.0							
15.0							
16.0							

DRAFT

METER	BKGD	DATE	TIME
PID	See		
ALPHA		Pg.	
BETA / GAMMA			

SAMPLING EQUIPMENT:
TYPE OF SAMPLER: See pg. 1
DIAMETER OF SAMPLER: See pg. 1
WEIGHTS OF HAMMER: See pg. 1

NOTES:

* SAMPLES COLLECTED PER ASTM STANDARD PENETRATION TEST.

000897

CONTROL NUMBER:

LITHOLOGIC LOG
(Continuation Page)

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PROJECT NAME:	PROJECT NUMBER:	LOCATION NUMBER:
OU1 Dewatering Examination Program Geotech Invest.	10.03.06	11571 (C3-9

DEPTH (FEET)	SAMPLE TIME, DATE, AND NUMBER	BLOWS (per 6 inch)	RECOVERY (inches)	DESCRIPTION (Colors identified per Munsell Color Chart)	USCS SYMBOL	MEASURED CONSISTENCY (TSF)	REMARKS
16.0							
17.0							
18.0	0830 8-10-95	NA	24	(7.5YR, 7/6) Reddish yellow, clayey silt, non-plastic, moist, pudding like texture	NA	NA	PID = 0.6 ppm α = 0 cpm
19.0							Shelby Tube with piston sampler
20.0							
21.0							
22.0							
23.0							
24.0							
25.0							

DRAFT

METER	BKGD	DATE	TIME
PID	See pl		
ALPHA			
BETA / GAMMA			

SAMPLING EQUIPMENT:	
TYPE OF SAMPLER	See pl
DIAMETER OF SAMPLER	See pl
WEIGHTS OF HAMMER	See pl

NOTES:

* SAMPLES COLLECTED PER ASTM STANDARD PENETRATION TEST.

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000898

FEMP

LITHOLOGIC LOG
(Continuation Page)

CONTROL NUMBER:

PROJECT NAME: OU1 Dewatering Excavation Program Geotech Invest.

PROJECT NUMBER: 10.03 06

LOCATION NUMBER: 11571 (C3-4

DEPTH (FEET)	SAMPLE TIME, DATE, AND NUMBER	BLOWS (per 6 inch)	RECOVERY (inches)	DESCRIPTION (Colors identified per Munsell Color Chart)	USCS SYMBOL	MEASURED CONSISTENCY (TSF)	REMARKS
25.0							
26.0	0940 8-10-95	NA	25	(2.5 YR; 7/1) light reddish gray, clayey silt, pudding like texture, moist, non-plastic	NA	NA	PID = Dead Battery α = 0 ppm. Jolly Tube with piston sampler
27.0							
28.0							
29.0							
30.0							
31.0							
32.0							
33.0	C900 8-10-95	NA	26	(2.5Y, 7/8) pale yellow, clayey silt, with pudding like texture, slightly moist non-plastic.	NA	NA	PID = Dead Battery α = 0 ppm
34.0							

DRAFT

METER	BKGD	DATE	TIME
PID	See		
ALPHA		p. 1	
BETA / GAMMA			

SAMPLING EQUIPMENT:
TYPE OF SAMPLER: See p. 1
DIAMETER OF SAMPLER: See p. 1
WEIGHTS OF HAMMER: See p. 1

NOTES:

* SAMPLES COLLECTED PER ASTM STANDARD PENETRATION TEST.

000899

FEMP

LITHOLOGIC LOG
(Continuation Page)

CONTROL NUMBER:

0163

PROJECT NAME:	PROJECT NUMBER:	LOCATION NUMBER:
CU I Dewatering Excavation Program Geotech Invest.	10.03.06	11571 (17-9

DEPTH (FEET)	SAMPLE TIME, DATE, AND NUMBER	BLOWS (per 6 inch)	RECOVERY (inches)	DESCRIPTION (Colors identified per Munsell Color Chart)	USCS SYMBOL	MEASURED CONSISTENCY (TSF)	REMARKS
30.0				Shelby Tube with Piston Sampler 32.5 - 35.0'			
35.0				Termination of Borehole 35.0'			

DRAFT

METER	BKGD	DATE	TIME
PID	See		
ALPHA	P. 1		
BETA / GAMMA			

SAMPLING EQUIPMENT:
TYPE OF SAMPLER: See p 1
DIAMETER OF SAMPLER: See p 1
WEIGHTS OF HAMMER: See p. 1

NOTES:

* SAMPLES COLLECTED PER ASTM STANDARD PENETRATION TEST.

11572

FEMP

LITHOLOGIC LOG

CONTROL NO.:

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PROJECT NAME:

PROJECT NO.:

BORING NUMBER: C3-12

COORDINATES:

DRILLING CONTRACTOR:

DRILLER / HELPER:

SURFACE ELEVATION:

GROUNDWATER LEVEL: DATE: TIME: DATE STARTED:

GEOLOGIST:

GROUNDWATER LEVEL: DATE: TIME: DATE COMPLETED:

WATER USED DURING DRILLING: GAL

WATER RECOVERED DURING DRILLING: GAL

DRILLING EQUIPMENT:

DEPTH (FEET)	SAMPLE TIME, DATE, AND NUMBER	BLOWS (per 6 inch)	RECOVERY (inches)	DESCRIPTION (Colors identified per Munsell Color Chart)	USCS SYMBOL	MEASURED CONSISTENCY (TSF)	REMARKS	
	5-6.5 0358 8-9	4 3 2	14	(Gley 1 N2.5/) Sandy Silt Blank Moist Blak Non-plastic			α 0 βγ 150 PID 35	SS
	7.5-10.0 0400 8-9	NA	24	5YR, 5/6) Yellowish [illegible] moist silt non plastic			α = 30 βγ = 1.5K PID = 10.0	ST w pi
	10-11.5 0410 8-9	NA	18	SAA DRAFT			α = 0 βγ = 700 PID = 21.5	ST
	12.5-15.0 0420 8-9	12/15		SAA			α = 0 βγ = 46 PID = 15.7	ST w pi
	15.0-15 0715 8-9	NA	30	(7.5YR, 4/3) Brown very moist non plastic [illegible] 7.5YR [illegible] non plastic clay very moist			α = 0 βγ = no [illegible] PID = 10.1	ST w pi

INSTRUMENT	BACKGROUND	DATE	TIME
PID	1		
ALPHA	0		
BETA / GAMMA	50		

NOTES:

* SAMPLES COLLECTED PER ASTM STANDARD PENETRATION TEST.

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G: / WPSC / 95-0037.DRW (2-15-95)

FEMP

LITHOLOGIC LOG

CONTROL NO.:

PAGE _____ OF _____

PROJECT NAME:

PROJECT NO.:

BORING NUMBER:

COORDINATES:

DRILLING CONTRACTOR:

DRILLER / HELPER:

SURFACE ELEVATION:

GROUNDWATER LEVEL:

DATE:

TIME:

DATE STARTED:

GEOLOGIST:

GROUNDWATER LEVEL:

DATE:

TIME:

DATE COMPLETED:

WATER USED DURING DRILLING: GAL

WATER RECOVERED DURING DRILLING: GAL

DRILLING EQUIPMENT:

DEPTH (FEET)	SAMPLE TIME, DATE, AND NUMBER	BLOWS (per 6 inch)	RECOVERY (inches)	DESCRIPTION (Colors identified per Munsell Color Chart)	USCS SYMBOL	MEASURED CONSISTENCY (TSF)	REMARKS
	17.5-20.0 2400 8-9	NA	36	(2.5Y, 6/2) light brownish gray moist silty clay slight plasticity			γ = 0 PID 40.0 BY: broke
20 21.5	20 7.50 8-9	0	18	SAA marbled with 2.5Y, 8/1 white			γ = 0 PID 44.5
22.5 25.0	0815 8-9		32	(2.5Y, 4/1) Dark Gray silty clay moist slight plasticity marbled with (2.5Y, 7/6) yellow silty clay, moist slight plasticity			γ = 0 PID = 24.8
25.0 26.5	0820 8-9		14	SAA except layered			γ = 0 PID = 15.5

DRAFT

INSTRUMENT	BACKGROUND	DATE	TIME
PID			
ALPHA			
BETA / GAMMA			

NOTES:

* SAMPLES COLLECTED PER ASTM STANDARD PENETRATION TEST.

FS-F-3681

G: / WPSC / 95-0037.DRW (2-15-95)

000902

FEMP

LITHOLOGIC LOG

CONTROL NO.:

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PROJECT NAME:			PROJECT NO.:
BORING NUMBER:	COORDINATES:	DRILLING CONTRACTOR:	DRILLER / HELPER:

SURFACE ELEVATION:	GROUNDWATER LEVEL:	DATE:	TIME:	DATE STARTED:
GEOLOGIST:	GROUNDWATER LEVEL:	DATE:	TIME:	DATE COMPLETED:

WATER USED DURING DRILLING: GAL	WATER RECOVERED DURING DRILLING: GAL	DRILLING EQUIPMENT:

DEPTH (FEET)	SAMPLE TIME, DATE, AND NUMBER	BLOWS (per 6 inch)	RECOVERY (inches)	DESCRIPTION (Colors identified per Munsell Color Chart)	USCS SYMBOL	MEASURED CONSISTENCY (TSF)	REMARKS
27.5	8-10 0225		18	(10YR 5/6) yellow clayey silt moist slight plasticity			Blow Back; Blow Back; BY = Not Working; α = 0; PID = 76.4
30.0 32.5	8-10 0245		19	SAA			BY = Broke; α = 0; PID = 7.9
32.5 35.0	0800 8-10		19	5YR 5/4 reddish brown clayey silt moist non-plastic			α = 0; PID 5.5

DRAFT

INSTRUMENT	BACKGROUND	DATE	TIME
PID			
ALPHA			
BETA / GAMMA			

NOTES:

* SAMPLES COLLECTED PER ASTM STANDARD PENETRATION TEST.

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G: / WPSC / 95-0037.DRW (2-15-95)

FEMP

LITHOLOGIC LOG

CONTROL NO.:	
PROJECT NAME: OU1 Dewatering Excavation Evaluation - Phase Contamination Investigation	PROJECT NO.: 10.03.06
LOCATION/NUMBER: 11573 (CB1-1)	COORDINATES:
DATE STARTED: 8-12-95	DATE COMPLETED: 8-12-95
SURFACE ELEVATION:	GROUNDWATER LEVEL: NA
DATE: NA	TIME: NA
GROUNDWATER LEVEL: NA	DATE: NA
TIME: NA	
GEOLOGIST: Keith Payne.	DRILLING CONTRACTOR: Alliance.
DRILLING EQUIPMENT: Hollow Stem Auger	DRILLER: Martin Proctor
WATER USED DURING DRILLING: NA GAL	WATER RECOVERED DURING DRILLING: NA GAL
WATER LOST DURING DRILLING: NA GAL	

DEPTH (FEET)	SAMPLE TIME, DATE, AND NUMBER	BLOWS (per 6 inch)	RECOVERY (inches)	DESCRIPTION (Colors identified per Munsell Color Chart)	USCS SYMBOL	MEASURED CONSISTENCY (TSF)	REMARKS
1.0							
2.0							
3.0							
5.0	0205 8-12-95	3 3 3	10	(2.5Y, 2.5/1) Black, Clayey Silt, Slightly moist, non-plastic			BG = 1,900 cpm PID = 5.0 ppm split spoon

DRAFT

METER	BKGD	DATE	TIME
PID	10 ppm	8-12-95	0205
ALPHA	NA	NA	NA
BETA / GAMMA	150 CPM	8-12-95	0205

SAMPLING EQUIPMENT:	
TYPE OF SAMPLER	Split Spoon / Shelby Tube
DIAMETER OF SAMPLER	2" ID / 3" I.D.
WEIGHTS OF HAMMER	140 lbs / NA

NOTES:

* SAMPLES COLLECTED PER ASTM STANDARD PENETRATION TEST.

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G:/WPSC/95-0037.DRW (07-10-95

CONTROL NUMBER:

LITHOLOGIC LOG
(Continuation Page)

PROJECT NAME:	PROJECT NUMBER:	LOCATION NUMBER:
CWI Dewatering Excavation Program Geotech Investigation	10.03.06	11573 (CB1-1)

DEPTH (FEET)	SAMPLE TIME, DATE, AND NUMBER	BLOWS (per 6 inch)	RECOVERY (inches)	DESCRIPTION (Colors identified per Munsell Color Chart)	USCS SYMBOL	MEASURED CONSISTENCY (TSF)	REMARKS
8.0	0225 8-12-95			Top of Shelby Tube			Bγ = 2,000 cpm PID = 5.0 ppm
				SAA			possibly ash
9.0		NA	28	Bottom of Shelby Tube (10YR, 5/1) Gray, Clayey Silt, moist slight plasticity			Shelby Tube
10.0	0230 8-12-95	1 0 1	18	(10YR, 7/2) light gray, clayey silt, moist slight plasticity			Bγ = 1,300 cpm PID = 5.8 ppm
11.0							Split Spoon
12.0							
13.0	0240 8-12-95		27	(7.5YR, 5/6) Strong Brown, Clayey Silt, moist, non-plastic			Bγ = 2,900 cpm PID = 548.0 ppm
14.0							Shelby Tube
15.0	0255 8-12-95	0 0 1	18	(2.5, 6/3) light yellowish brown, Clayey silt moist, low plasticity			Bγ = 4,000 cpm PID = 59.1 ppm
16.0							

METER	BKGD	DATE	TIME
PID	See Pg 1		
ALPHA			
BETA / GAMMA			

SAMPLING EQUIPMENT:
TYPE OF SAMPLER: See pg 1
DIAMETER OF SAMPLER: See pg 1
WEIGHTS OF HAMMER: See pg 1

NOTES:

* SAMPLES COLLECTED PER ASTM STANDARD PENETRATION TEST.

DRAFT

RSP 358 7/14/86

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CONTROL NUMBER:

LITHOLOGIC LOG
(Continuation Page)

PROJECT NAME: OU1 Dewatering Evaluation Program Geotech Invest.

PROJECT NUMBER: 10.03.06

LOCATION NUMBER: 11573 (CB1-1)

0163

DEPTH (FEET)	SAMPLE TIME, DATE, AND NUMBER	BLOWS (per 6 inch)	RECOVERY (inches)	DESCRIPTION (Colors identified per Munsell Color Chart)	USCS SYMBOL	MEASURED CONSISTENCY (TSF)	REMARKS
				see p 2			split spoon
17.0				Bottom of Boring 16.5'			

DRAFT

METER	BKGD	DATE	TIME
PID	See pg. 1		
ALPHA			
BETA / GAMMA			

SAMPLING EQUIPMENT:
TYPE OF SAMPLER: See pg. 1
DIAMETER OF SAMPLER: See pg. 1
WEIGHTS OF HAMMER: See pg 1

NOTES:

* SAMPLES COLLECTED PER ASTM STANDARD PENETRATION TEST.

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CONTROL NO.:

FEMP

LITHOLOGIC LOG

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PROJECT NAME: OU1 Dewatering Excavation Evaluation Geotechnical Investigation	PROJECT NO.: 10.03.06

LOCATION/NUMBER:	COORDINATES:	DATE STARTED:	DATE COMPLETED:
11594 (CB3-1)		8-15-95	8-16-96

SURFACE ELEVATION:	GROUNDWATER LEVEL:	DATE:	TIME:	GROUNDWATER LEVEL	DATE:	TIME:
	NA	NA	NA	NA	NA	NA

GEOLOGIST:	DRILLING CONTRACTOR:	DRILLING EQUIPMENT	DRILLER
Keith Payne	Alliance	Hollow Stem Auger	Martin Proctor

WATER USED DURING DRILLING:	WATER RECOVERED DURING DRILLING:	WATER LOST DURING DRILLING
NA GAL	NA GAL	NA GAL

DEPTH (FEET)	SAMPLE TIME, DATE, AND NUMBER	BLOWS (per 6 inch)	RECOVERY (inches)	DESCRIPTION (Colors identified per Munsell Color Chart)	USCS SYMBOL	MEASURED CONSISTENCY (TSF)	REMARKS
1.0							
2.0							
3.0							
4.0							
5.0	0345 8-15-95	2 2 4	9	(2.5Y, 4/4) Olive Brown, Clayey Silt, slightly moist, low plasticity	NA	NA	PID = 392 ppm Bg = 2,600 cpm split spoon
6.0							
7.0							

DRAFT

METER	BKGD	DATE	TIME
PID	344 ppm	8-15-95	0340
ALPHA	NA	NA	NA
BETA / GAMMA	50 cpm	8-15-95	0340

SAMPLING EQUIPMENT:	
TYPE OF SAMPLER	Split Spoon / Shelby Tube
DIAMETER OF SAMPLER	2" I.D. / 3" I.D.
WEIGHTS OF HAMMER	140 lbs / NA

NOTES: PID readings high due to close proximity to rig

* SAMPLES COLLECTED PER ASTM STANDARD PENETRATION TEST.

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G: / WPSC / 95-0037.DRW (07-10-95)

CONTROL NUMBER:

LITHOLOGIC LOG
(Continuation Page)

PROJECT NAME:	PROJECT NUMBER:	LOCATION NUMBER:
OU1 Dewatering Excavation Evaluation Geotech Invest.	10.03.06	11574 (CB3-1)

DEPTH (FEET)	SAMPLE TIME, DATE, AND NUMBER	BLOWS (per 6 inch)	RECOVERY (inches)	DESCRIPTION (Colors identified per Munsell Color Chart)	USCS SYMBOL	MEASURED CONSISTENCY (TSF)	REMARKS
7.0							
8.0	0350 8-15-95	NA	22	(2.5Y, 5/4) light olive brown, clayey silt with trace sand and roots, slightly moist, slight plasticity	NA	NA	PID = 35.7 ppm Bγ = 125 cpm Shelby Tube
10.0	0355 8-15-95	4 2 4	12	(5Y, 5/2) Olive gray, fine sandy silt, slightly moist, non-plastic	NA	NA	PID = 34.1 ppm Bγ = 250 cpm Split Spoon
12.0							
13.1	0410 8-15-95	NA	25	(5Y, 5/2) Olive gray, clayey silt, Dry to slightly moist, non-plastic	NA	NA	PID = 34.6 ppm Bγ = 90 cpm Shelby Tube
15.0	0415 8-15-95	6 10 25	10	(7.5YR, 5/8) Strong Brown, clayey silt, slightly moist, non-plastic, mottled with (7.5YR, 4/1) dark gray, silty clay, moist, non-plastic	NA	NA	PID = ~~50 ppm~~ NA KP 8-16-95 Bγ = 50 cpm
16.0							

DRAFT

METER	BKGD	DATE	TIME
PID	See		
ALPHA		pg. 1	
BETA / GAMMA			

SAMPLING EQUIPMENT:
TYPE OF SAMPLER: See pg. 1
DIAMETER OF SAMPLER: See pg. 1
WEIGHTS OF HAMMER: See pg. 1

NOTES:

* SAMPLES COLLECTED PER ASTM STANDARD PENETRATION TEST.

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FEMP

LITHOLOGIC LOG
(Continuation Page)

CONTROL NUMBER:

PROJECT NAME:	PROJECT NUMBER:	LOCATION NUMBER:
OU 1 Demolitioning Excavation Evaluation Geotech. Invest.	10.03.06	11574 (CB3-

DEPTH (FEET)	SAMPLE TIME, DATE, AND NUMBER	BLOWS (per 6 inch)	RECOVERY (inches)	DESCRIPTION (Colors identified per Munsell Color Chart)	USCS SYMBOL	MEASURED CONSISTENCY (TSF)	REMARKS
16.0							Split Spoon 15.0-16.5
17.0							
18.0	0200 8-16-95		10	(7.5 YR, 5/8) Strong Brown, Clayey Silt, slightly moist, non-plastic, mottled with (7.5 YR, 4/1) dark gray, silty clay, moist, non-plastic	NA	NA	PID = 0.0 ppm βγ = 90 cpm 22 inches refusal encountered cobble
20.0							Shelby Tube
21.0	0215 8-16-95	6 10 11	14	(7.5 YR, 4/1) Dark Gray, Silt with trace sand, slightly moist, non-plastic, mottled with 15% (7.5 YR, 5/8) strong Brown, clayey silt with trace sand, slightly moist, non-plastic	NA	NA	PID = 0.0 ppm βγ = 70 cpm Split Spoon
22.0							
23.0	0230 8-16-95	NA	16	(2.5 Y, 4/1) Dark Grey, Clayey Silt with 20 mm × 20mm × 30 mm piece of gravel, low moisture, low plasticity	NA	NA	PID = 0.0 ppm βγ = 50 cpm
24.0							
25.0							Shelby Tube

METER	BKGD	DATE	TIME
PID	0.0 ppm	8-16-95	0150
ALPHA	NA	NA	NA
BETA / GAMMA	70cpm	8-16-95	0150

SAMPLING EQUIPMENT:
TYPE OF SAMPLER: See pg. 1
DIAMETER OF SAMPLER: See pg. 1
WEIGHTS OF HAMMER: See pg. 1

NOTES:

* SAMPLES COLLECTED PER ASTM STANDARD PENETRATION TEST.

DRAFT

FEMP
LITHOLOGIC LOG
(Continuation Page)

CONTROL NUMBER:

PROJECT NAME:	PROJECT NUMBER:	LOCATION NUMBER:
OU 1 Dewatering Excavation Evaluation Geotech. Inv.	10.03 06	11574 (CB3-

DEPTH (FEET)	SAMPLE TIME, DATE, AND NUMBER	BLOWS (per 6 inch)	RECOVERY (inches)	DESCRIPTION (Colors identified per Munsell Color Chart)	USCS SYMBOL	MEASURED CONSISTENCY (TSF)	REMARKS
25.0	0245 8-16-95	7 11 12	12	(2.5Y, 4/1) dark grey, clayey silt with some coarse sand and fine gravel, mottled with (2.5Y, 5/4) light olive brown clayey silt, moist, non-plastic	NA	NA	PID = 0.0 ppm βγ = 70 cpm Split Spoon
27.0							
28.0	0300 8-16-95	NA	13	(2.5Y, 4/1) dark grey, clayey silt with some coarse sand and fine gravel, mottled with (2.5Y, 5/4) light olive brown clayey silt, moist, non-plastic	NA	NA	PID = 0.0 ppm βγ = 50 cpm 25 inches refusa Shelby Tube
31.0	0315 8-16-95	21 28 34	14	(2.5Y, 5/4) light olive brown, sandy clay, slightly moist, non-plastic	NA	NA	PID = 0.0 ppm βγ = 100 cpm Split Spoon
32.0							
33.0	0335 8-16-95	NA	2	(2.5Y, 5/4) light olive brown, sandy clay, slightly moist, non-plastic	NA	NA	PID = 0.0 ppm βγ = 150 cpm Crushed Tube
34.0							

DRAFT

METER	BKGD	DATE	TIME
PID	See		
ALPHA		R 3	
BETA / GAMMA			

SAMPLING EQUIPMENT:
TYPE OF SAMPLER: See p. 1
DIAMETER OF SAMPLER: See p. 1
WEIGHTS OF HAMMER: See p. 1

NOTES:

* SAMPLES COLLECTED PER ASTM STANDARD PENETRATION TEST.

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FEMP
LITHOLOGIC LOG
(Continuation Page)

CONTROL NUMBER:

PROJECT NAME:	PROJECT NUMBER:	LOCATION NUMBER:
OU1 Dewatering Excavation Evaluation Geotech. Invest.	10.03.06	11574 (CB3-1

DEPTH (FEET)	SAMPLE TIME, DATE, AND NUMBER	BLOWS (per 6 inch)	RECOVERY (inches)	DESCRIPTION (Colors identified per Munsell Color Chart)	USCS SYMBOL	MEASURED CONSISTENCY (TSF)	REMARKS
34.0							
							Water Tube 32.5'-35.0'
35.0				Bottom of Boring 35.0'			
36.0							
37.0							
38.0							
39.0							
40.0							
41.0							
42.0							
43.0							

DRAFT

METER	BKGD	DATE	TIME
PID	See		
ALPHA		p. 3	
BETA / GAMMA			

SAMPLING EQUIPMENT:
TYPE OF SAMPLER: See p. 1
DIAMETER OF SAMPLER: See p. 1
WEIGHTS OF HAMMER: See p. 1

NOTES:

* SAMPLES COLLECTED PER ASTM STANDARD PENETRATION TEST.

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000311

CAW95-0140.DRW

APPENDIX C

SUMMARY OF FIELD OBSERVATIONS FROM WET TRENCHING

APPENDIX C
SUMMARY OF FIELD OBSERVATIONS FROM WET TRENCHING

C.1 INTRODUCTION

A total of seven wet (not dewatered prior to excavation) trenches have been excavated in Pits 1, 2 and 3 as part of DEEP for the purpose of evaluating conditions of the waste, and to provide information about dewatering and/or excavating a wet waste. A John Deere 690D LC tracked excavator (track hoe) was used to perform test excavations at seven locations at Pits 1, 2 and 3 (see Figure 2-2). FERMCO conducted the trenching from February 1 through March 14, 1995.

C.2 GENERAL

The trenches were conducted, using the trackhoe, at seven locations that had a prior CPT sounding and a geotechnical test boring. The excavation site was prepared for spoil piles prior to the excavation. Plastic sheets were placed on the ground surface in the vicinity of the location to collect and direct drainage from the spoil pile back to the trench. A temporary berm around the perimeter of the spoil pile areas was formed using hay bails and plastic sheets. The trench was dug between two spoil pile areas. One spoil pile was for the cover material and the other for the waste. Water tanks (3,000 - 8,000 gallon capacity) at the excavation location collected water that was pumped from the trench with portable dewatering pumps.

Excavation proceeded by creating a rectangular trench about 30 inches wide, 0.79 cy heaped bucket, and 5 feet total. The length of the trenches was about 20 to 25 feet. The long axis of the trench ran along a general north-south line, with the track hoe positioned at the north end of the trench. Excavation was done so the trench wall slope remained as steep as possible, permitting observation of trench sidewall failure. The backhoe achieved its full reach (excavated depth of 15 feet). As the trench wall material collapsed into the trench, it was excavated from the pit and placed on the spoil pile. The final width of the trench at ground surface varied from location to location, depending on the amount of sidewall failure. A field engineer recorded observations during the excavation.

During the trenching, a FERMCO sampling technician collected samples of the waste materials, taken at various depths from each trench, directly from the track hoe bucket, prior to its placement on the spoil pile. Additional material samples were collected from the waste spoil pile prior to backfilling the material into the trench. A 5-gallon plastic bucket of waste material was collected from each trench. The samples were transferred to an on-site geotechnical laboratory for moisture content tests, classification, compaction, and bearing ratio tests. The results of these geotechnical tests are not available. Additionally, waste material from each of the trenches was archived in white steel boxes for future testing by OU1.

FERMCO videotaped excavation operations at each location. The cameraman was positioned above the trench location with a four-wheel drive man-lift.

When the trench was completed, material from the waste spoil pile was backfilled into the trench and covered with material from the cover spoil pile.

The following subsections summarize field observation notes completed by the field engineers during trenching operations.

C.3 Pit 1 Trenches

Trench ID: T1-N

Location: North end of Pit 1, at stake #11352

Field Engineer: K. Ernst

Long Axis of Trench: North-South

Corresponding CPT and Test Boring:

CPT ID: C1-2
Test Boring ID: 11352

Corresponding Video Number: Trench #2

Date/Time of Trenching:

February 13, 1995
Excavation start time: 1416
Excavation end time: 1509
Backfill start time: 1510
Backfill end time: 1545

Weather Conditions:

At 1002: Cold, Temperature approx. 10 degrees F, sunny and clear. Ground surface is frozen, with about 2 - 4" of snow cover.

Description of Materials Encountered:

Note: Visual descriptions are from materials excavated from the trench and placed on the spoil piles, materials placed in sample containers, and observations of visible sections of the trench walls. Observations of the trench walls were made from the perimeter of the safety exclusion zone, about 15 to 20 feet from the excavation. Depths are estimated, from one-foot tick marks on the stick of the trackhoe stick.

Depth (feet)	Description
0 -1	yellow-brown clay (cover)
1	gray material encountered (waste)
1 - 3	gray and reddish earthen material, dry
3 - 4	reddish gray, coarse, sand-like material; reddish, gray and some black clayey sand. The gray coarse granular material was "jelly-like", but runny (flowable). The reddish granular material was wet. Black material was sandy, drier.
4	reddish gray, with some black material, dry to moist. Track hoe bucket make sides vertical sides of trench smooth, slickensided. (Note: At the end of the excavation, the east trench wall collapsed creating a bowl that undercut the 1 foot thick clay cap, exposing alternating layers of gray, brown, black, and red material varying from about 2" to 1 foot thick directly beneath the cover. The layers dipped to the north at an angle of about 30 degrees.)
5	spots of white material in waste
6 - 7	red and gray material which is somewhat "ice-cream" like in appearance. The gray material is clay-like and behaves like jelly when troweled in the plastic sample bucket. Some sand is present. Water comes to top of bucket when agitated.

7.5	red, gray clay-like, "ice-cream like material. Material transported in trackhoe bucket bounces in jelly-like fashion.
9 - 10	Mostly red, clay-like material, pockets of green granular material, wet. Green grains look like coarse subangular sand, 1/16" to 1/8" max. Brown clay-like material is present. White, soupy, granule, non plastic material also present. Some of the white material was "jelly-like".
10 - 11	White, grayish sludge pockets encountered in the mostly red, clay-like material. Gray, runny, soupy, sludge-like material, wet. Some, black, green yellow and gray material. Yellow material was flakes, sandy and wet. Black material was sandy.
12 - 14	Sandy material, primarily brownish gray sandy material. Sand is coarse grained, moist, with tints of pink color. Sand is surrounded by clay-like material. Some orange clay-like material, and some greenish yellow material.

Stability, Handling and Water Conditions During Excavation

Time	Depth (ft)	Condition
1418	1	Trackhoe operator digging off cover material, creating trench about 2 bucket widths wide
1420	1 - 3	Reddish gray material angle of repose on waste spoil pile 35 - 40 degrees
1425		Trench is "dry" (no standing water)
1428	4	Trench side slopes vertical, trackhoe bucket makes sides of trenches smooth, slickensided
1432	5	Angle of repose of waste spoil pile 35 -40 degrees. Operator in the man-lift observed a soft pocket zone in the trench from depth of about 3 to 6.5 ft below land surface that was slowly caving in while digging.
1444	8	Trench slopes still vertical. Material in trackhoe bucket bounces as if "jelly-like"

1455	11-12	Collapse of north and east trench walls, creating a bowl that undercuts the overlying material. Top of the undercut is at 5 feet
1507	13-14	Trench walls of waste material rapidly slough into the trench, creating a large bowl that undercuts overlying materials on the east and west sides of the trench. The zone of undercut extends horizontally about 3 feet from the plane of previously near vertical face at each side of the trench. The waste material that caved from the trench walls broke cleanly from the (frozen) clay cover along the cover/waste interface, leaving a 1 foot shelf of frozen ground.
1510	13-14	The maximum depth before the cave-in at 1507 was about 13 - 14 feet. No standing water was observed in the trench. The size of the trench at the ground surface before the cave-in was about 6 feet wide by 25 feet long. After the cave-in, the northern portion of the trench had a width at ground surface of about 12 feet
1535		During backfilling: the backfilled material behaves (jiggles) like jello when the trackhoe operator smoothes the waste material filled into the trench at waste final grade
1541		At completion of backfilling: after the (clay) cover material is placed over the waste in the backfilled trench, the ground surface behaves (jiggles) like jello when tamped with the hoe bucket

Trench ID: T1-S

Location: South end of Pit 1

Field Engineer: B. Catanach

Corresponding CPT and Test Boring:

CPT ID: C1-4
Test Boring ID: 11353

Corresponding Video Number: Trench #5

Date/Time of Trenching:

March 15, 1995
Excavation start time: 0905
Excavation end time: 1045

Description of Materials Encountered:

Note: Visual descriptions are from materials excavated from the trench and placed on the spoil piles, materials placed in sample containers, and observations of visible sections of the trench walls. Observations of the trench walls were made from the perimeter of the safety exclusion zone, about 15 to 20 feet from the excavation. Depths are estimated, from one-foot tick marks on the stick of the trackhoe stick.

Depth (feet)	Description
0 - 1	brown and gray cover material. Small amounts of wood and metal debris
2 -3	same as above, more metal debris
4	brown silt material with concrete and steel debris
5	gray material, light brown material, plastic. No more construction debris. (Water begins to seep rapidly into the trench)
6	black sludge material
7-8	dark gray material, plastic, jello consistency (Water level in trench at 5 ft depth)
9	same as above
11-12	gray material with some light blue, dry looking material (Water pumped down to 10 ft depth)
14	same above
15	light brown plastic material, and light gray material

Stability, Handling and Water Conditions During Excavation

Time	Depth (ft)	Condition
0905		Start trenching
0925	5	Water starts to rapidly seep in
0934	7-8	Standing water level in trench at 5 feet depth, right face of trench sloughs into trench
0940	9	Right face of trench collapses again
0950	9	Started pumping water, stopped excavating
0955	9	Filled 1800 gallons into a 2,500 gallon tank
0958	10	Restarted excavating, right face collapse again. Trench width about 9 feet at ground surface
1008	11 - 12	Left face still holding, only minor sloughing. Water level pumped down to 10 feet
1020	12 - 13	Stopped pumping. 8000 gallons pumped, water level in trench 10 feet

C.4 Pit 2 Trenches

Trench ID: T2-N

Location: North end of Pit 2, at stake #11358

Field Engineer: K. Ernst

Long Axis of Trench: North-South

Corresponding CPT and Test Boring:

CPT ID:	C2-1
Test Boring ID:	11358

Corresponding Video Number: Trench #1

Date/Time of Trenching:

February 1 - 2, 1995

Excavation start time:	1405 (February 1)
Excavation end time:	1541 (February 1)
Backfill start time:	1100 (February 2)
Backfill end time:	1715 (February 2)

Weather Conditions:

February 1 at 1245: Sunny with some clouds, temperature about 38 degrees F, snow on ground

February 2 at 1740: Overcast, temperature about 36 degrees F, ground partially covered with snow, snow melting, slush and puddles on ground, ground extremely wet.

Description of Materials Encountered:

Note: Visual descriptions are from materials excavated from the trench and placed on the spoil piles, materials placed in sample containers, and observations of visible sections of the trench walls. Observations of the trench walls were made from the perimeter of the safety exclusion zone, about 15 to 20 feet from the excavation. Depths are estimated, from one-foot tick marks on the stick of the trackhoe stick.

Depth (feet)	Description
0 - 1.5	brown to yellow brown silt and clay, grass and roots, dry to moist. (Water beginnings to seep in to the trench at depth 1.5 feet)
1.5 - 2	grayish brown soil
2 - 2.5	encounter concrete rubble
2.5 - 3	"brick-red," white and black material

3 - 6	red clay-like material, wire (2 to 5' long typical), porous slag (3 to 4" pieces, black, lava-like, 1/16 to 1/8" pores; typical; floating on water surface), black siding material, metal straps, metal buckets (10-gal typical), construction debris, concrete rubble
6 - 8	clay, brown with gray streaks, with brown, grayish brown and gray sand and gravel, very wet. Gravel is round (larger gravel) to subangular (smaller gravel), size is 1/8" to about 2.5", red and black gravel also present. Rock (3 to 5" diameter), possibly concrete rubble. Some metal, flat 1" wide by 10" long, typical. 3' x 3' x 1' piece of flat concrete excavated (water surface at depth 6 - 7 feet)
8 - 11	brown, with "brick-red" and black clay like material, wet to very wet. Trackhoe bucket scraping sound at 11 feet while excavating south end of trench, possibly large piece of concrete rubble. Gray clayey gravel-like material, 1 to 2", rounded.
11 - 13	stratified white, light greenish gray, reddish brown and tan fine-grained material, some rust colored material, low to medium plasticity, moist. Material is putty- or paste-like, very spreadable. Some material possibly lime sludge (water surface at depth 7 - 8 feet)
13 - 17	same as above, some black and burnt orange material, moist. Reddish brown material is very fine-grained, appears paste-, putty-like, and breaks into chunks along discrete lines. Lard-like white to light green tinted material. Also contains brown coarse sand to fine gravel (1/8" typical), round to subangular. Burnt orange material, approx 2" x 2" porous, friable. 18" x 18" x 1/4" to 1/8" black, hard tar-like sheet.

Stability, Handling and Water Conditions During Excavation

Time	Depth (ft)	Condition
1405	(Feb 1)	Start trenching
1412		Track hoe operator excavating cover materials to start a rectangular trench, about 15 - 17 feet long, and two bucket widths (about 5 - 6 feet) wide

1413	1.5	Water begins to seep in at east side of trench at 1.5 feet
1415	3	Water also observed seeping into trench from a level of about 3 feet
1419	4	Predominantly red clay-like material is excavated. Excavated materials in the hoe buckets come from the trench as pieces, or blocks of earthen-like materials
1422	5	Length of trench (north - south) at surface 15 - 20 feet; width 5 feet; side slopes (east and west) are vertical
1425	5 - 6	water seeping into trench from above
1430	6 - 7	angle of repose of waste pile about 35 degrees
1434	7 - 8	waste material in bucket slides easily from hoe bucket into white metal box
1435	7 - 8	Water surface in trench at about 6 foot depth, trench walls vertical
1454	7 - 8	Waste material placed on the spoil pile is very wet, causes pile to slump to about 30 degree angle of repose. Water level in trench is relatively constant at 6 - 7 foot depth
1510	11 - 13	Stratified waste material appears chalky and blocked in hoe bucket; material heaped high (2 feet) in bucket excavated from below water surface in trench. Material sticks slightly to hoe bucket, as operator has to move bucket up and down to remove material.
1525	13 - 17	Stratified waste material breaks from hoe bucket in blocks.
1541	17	Stopped digging trench
1553		Condition of trench: Length 26 - 27 feet, width about 5 feet at ground surface, about 17 feet deep. Standing

water in trench at about 6 feet below land surface. Water in the trench is brown and murky. Trench walls (that are visible above the standing water level) are vertical, and generally composed of brown to grayish brown clay. Just above the water surface there appeared to be some undercutting, but the extent could not be determined due to murky, brown water. Conditions of the trench below the water level can not be seen.

1623	Other observations: little water drained from the waste material after it was piled on the spoil pile. (Note: standing water in the hoe bucket was drained into the trench prior to placing the bucket load on the pile.) Some water puddled on the plastic sheet in the vicinity of where the waste was piled, but there was no flow or streams of water back into the open trench. Wetter waste material from depths of about 12 - 15 feet slumped more when placed on the top of the waste pile (est. angle of repose of the waste pile: 20 degrees)
1000 (Feb 2)	Condition of trench: Water level in trench about 0.5 to 1 foot below land surface. Surface water runoff from snow melt into the trench (which is located along a drainage swale) contributes to the standing water in the trench
1115	Started pumping water from trench to tank
1125	500 gallons of water in tank (pumping rate approx. 50 gpm)
1129	Water level in trench about 1.3' below land surface; 750 gallons of water in tank
1135	1000 gallons of water in tank (pumping rate approx 50 gpm)
1139	Water level in trench 1.8' below land surface; 1250 gallons of water in tank

1144	Water level in trench 2.1' below land surface; 1500 gallons in tank
1149	Water level in trench 2.5' below land surface; 1750 gallons of water in tank
1155	Water level in trench 2.8' below land surface; 2000 gallons of water in tank
1205	Stopped pumping, tank near capacity. Water level in trench about 3' below land surface; 2600 gallons of water in tank
1213	Track hoe operator backfilling trench
1220	About 1/2 of the waste spoil pile backfilled into trench. Water in trench displaced; water level 0.25 to 0.5 feet below land surface
1618	Construction personnel position an additional 2500 gallon capacity tank near the trench
1619	Trench condition: water level at or near land surface. Pieces of porous slag floating on the water surface cover about 50% of the water surface area of the trench
1620	Pump started, pumping to tank. Trench collecting surface water runoff from snow melting. Drainage is entering the trench from the northwest. Hoe operator builds berm at the north end of the trench to minimize in flow.
1630	Trackhoe operator backfilling during pumping
1650	Approximately 1500 gallons in tank
1704	Pump stopped. Approximately 2200 gallons pumped to tank (Total pumped from trench to two tanks: approximately 4800 gallons)

1708	Backfilling complete, operator grading surface with hoe bucket

Trench ID: T2-S

Location: South end of Pit 2

Field Engineer: B. Catanach

Corresponding CPT and Test Boring:

CPT ID: C2-5
Test Boring ID: 11359

Corresponding Video Number: Trench #6

Date/Time of Trenching:

March 16, 1995
Excavation start time: 1018
Excavation end time: 1152
Backfill start time: 1152
Backfill end time: 1230

Description of Materials Encountered:

Note: Visual descriptions are from materials excavated from the trench and placed on the spoil piles, materials placed in sample containers, and observations of visible sections of the trench walls. Observations of the trench walls were made from the perimeter of the safety exclusion zone, about 15 to 20 feet from the excavation. Depths are estimated, from one-foot tick marks on the stick of the trackhoe stick.

Depth (feet)	Description
0 - 1	brown to light brown clayey silt
1 - 2	mainly brown material, some plasticity

2 - 3	mainly light brown/red material, plastic small amounts of gray powdery material. Excavated two round crucibles that could not be crushed with hoe bucket.
3 - 4	light red clay-like material, very plastic. Small amounts of white material mixed in. A lot of cast iron crucibles.
4 - 7	light red and tan material, very plastic (no water infiltration into trench)
7 - 9	same as above
9 - 11	light tan and red material, very plastic, "pudding-like (no water infiltration into trench)
11 - 14	same as above (small amount of water trickling into trench from 4 - 5 feet below land surface)
14 - 16	dark brown material

Stability, Handling and Water Conditions During Excavation

Time	Depth (ft)	Condition
1018		Start excavation
1028	3	Trench walls holding vertical
1033	4	Trench walls holding vertical
1055	6 - 7	Trench walls holding vertical. No water infiltration
1102	8 - 9	Trench walls vertical.
1109	10 - 11	Trench walls vertical. No water infiltration
1125	13	Major collapse of right trench face
1140	14	Small amount of water trickling in at 4 - 5' depth below ground level

1143	15 -16	Left face of trench cave in
1152		Started backfilling
1230		Backfilling complete

C.5 Pit 3 Trenches

Trench ID: T-N

Location: North end of Pit 3, between stakes #11360 and C3-9

Field Engineer: K. Ernst

Long Axis of Trench: North-South

Corresponding CPT and Test Boring:

CPT ID: C3-9
Test Boring ID: 11360

Corresponding Video Number: Trench #4

Date/Time of Trenching:

February 16, 1995
Excavation start time: 1034
Excavation end time: 1208
Backfill start time: 1450
Backfill end time: 1525

Weather Conditions:

At 1000: Overcast, temperature about 35 degrees F, puddles and some patches of snow on the ground

Description of Materials Encountered:

Note: Visual descriptions are from materials excavated from the trench and placed on the spoil piles, materials placed in sample containers, and observations of visible sections of the trench walls. Observations of the trench walls were made from the perimeter of the safety exclusion zone, about 15 to 20 feet from the excavation. Depths are estimated, from one-foot tick marks on the stick of the trackhoe stick.

Depth (feet)	Description
0 - 1	yellow brown clay, 2" x 8" X 5' piece of lumber
1 - 3	black ash, dry to moist; many wood (lumber) debris, 1/2" to 3/4" thick, up to a few feet long, wood pallet debris (water level encountered 2 to 3' below land surface)
3 - 5	black or gray ash-like material with wood and metal debris; wood is lumber ranging in a few inches to several feet in length; typical thickness of lumber: 1" to 4 - 6".
5 - 6	brown clay with coarse sand and fine to coarse gravel (2 - 3" max.). Ash and wood debris. The east side of the trench (observed to about 6 ft depth) generally had alternating layers of clay and ash dipping to the south. The west side of the trench had crossed lumber stacked, and protruding at the trench wall.
6 - 10	brown gravelly, sandy clay, medium plasticity, wet. Gravel is fine to coarse (2 - 3" max.), subround to round, sand is fine to coarse. (water surface in trench at 4.5 feet below land surface)
10 - 13	Stratified "rust"-red, orange, white fine-grained material, some light to dark gray material. White material has a yellowish or greenish tint
13 - 15	same as above
15 - 17	same as above, red material layers are plastic, clay-like; gray layers are "jelly"-like.
17 - 18	same as above, white material is paste-like

Stability, Handling and Water Conditions During Excavation

Time	Depth (ft)	Condition
1034		Start excavation
1038	2 - 3	Encountered ground water level, trench side slopes are stable
1041	3	Standing water in trench, water black and murky
1044	4	West side of cover material falls into trench while digging; east side of trench vertical
1050	5	Water draining from waste pile (containing ash and lumber) back into trench
1103	6	Water level in trench about 3' below land surface
1130	10	Started pumping water from trench to tank (approx 8000 gal. capacity). Water level in trench about 4.5 feet below land surface
1137	15	Tank approx. 1/2 full (approx. 4000 gallons). Water level in trench at about 6 feet below land surface.
1159	17	Stratified waste material is "blocky", i.e. breaks into blocks when placed with the hoe bucket on the spoil pile. A block sitting on the pile was observed to break apart under it's own weight
1207	18	Stopped pumping from trench. Tank approx 5/8 full (approx 5000 gal). (Note: pumping was stopped from about 1140 to 1202 to clear clogged strainer valve). Standing water in trench at about 6 feet below land surface. Trench, at ground level is about 18 feet long, and 6 feet wide at south end; 9 - 10 feet wide at north end.

1440	Water level in trench about 4 feet below land surface. Pumping to tank started.
1450	Water level in trench at about 6.5 feet below land surface. Water observed pouring into the trench along a horizonal line along the north trench face at depth 5.5 feet. Bowled cave in at about depth 4 feet along east and south face of trench at south end. Bowled area is in black ash material, and extends below the water surface.
1456	Stopped pumping, tank full (appox. 7500 gal.) Water level in trench is about 6.5 feet
1457	Start backfilling trench
1525	Water level in trench at about depth 4 feet due to backfilling. Stopped backfilling.
1525	Started gravity drain of tank into trench
1528	Stopped gravity drain
1535	Started pumping water from tank into trench
1545	Water level in tank about 1/2 full (about 3500 gallons of water pumped). Water surface in trench is steady, about 3 - 4 feet below land surface.
1614	Pump looses suction. About 6700 gallons, total pumped into trench. Water level in trench about 3 - 4 feet below land surface. Recommence backfilling trench.
1622	Backfilling complete.

Trench ID: T3-C

Location: Central part of Pit 3

Field Engineer: B. Catanach

Corresponding CPT and Test Boring:

CPT ID: C3-11
Test Boring ID: 11361

Corresponding Video Number: Trench #7

Date/Time of Trenching:

March 14, 1995
Excavation start time: 0925
Excavation end time: 1045
Backfill start time: 1055
Backfill end time: 1125

Description of Materials Encountered:

Note: Visual descriptions are from materials excavated from the trench and placed on the spoil piles, materials placed in sample containers, and observations of visible sections of the trench walls. Observations of the trench walls were made from the perimeter of the safety exclusion zone, about 15 to 20 feet from the excavation. Depths are estimated, from one-foot tick marks on the stick of the trackhoe stick.

Depth (feet)	Description
0 - 1	brown clayey silt with small amounts of black ash
1 - 3	black ash
3 - 4	mostly black ash, small amounts of olive brown silt
4 - 9	mostly black ash
9 - 11	black ash, small amounts of red pudding-like material
11 - 13	black ash, pudding like, with coarse consistency, saturated, with free liquids
13 - 15	red pudding-like material

Stability, Handling and Water Conditions During Excavation

Time	Depth (ft)	Condition
0925		Start excavation
0935	4	Ash material is sloughing in off trench sidewalls. Waste (ash) stockpile angle of repose 1 to 1.
0945	5	Trench sidewalls sloughing off, left face sloughs into trench
0950	6	Right face of excavation sloughed into trench. Trench about 9 feet wide at top
1005	11	Trench at surface about 9 feet wide, trench sidewall holding
1010	13	Both trench sidewalls cave in, the excavation is 15 feet wide at ground surface. Black ash is saturated with free liquids
1055		Start backfilling trench
1125		Complete backfilling trench

Trench ID: T3-S

Location: South end of Pit 3, at stake C3-2

Field Engineer: K. Ernst

Long Axis of Trench: North, North-East

Corresponding CPT and Test Boring:

CPT ID: C3-2
Test Boring ID: 11362

Corresponding Video Number: Trench #4

Date/Time of Trenching:

February 22, 1995
Excavation start time: 1006
Excavation end time: 1111
Backfill start time: 1136
Backfill end time: 1215

Weather Conditions:

At 0907: Sunny, temperature about 31 degrees F, ground is free of snow cover,

Description of Materials Encountered:

Note: Visual descriptions are from materials excavated from the trench and placed on the spoil piles, materials placed in sample containers, and observations of visible sections of the trench walls. Observations of the trench walls were made from the perimeter of the safety exclusion zone, about 15 to 20 feet from the excavation. Depths are estimated, from one-foot tick marks on the stick of the trackhoe stick.

Depth (feet)	Description
0 - 1.5	yellowish brown clay, moist
1.5 -2	black ash, moist
2 - 3	black ash and brown clay, moist. Some "brick"-red clay-like material
3 - 5	brown and gray sandy clay material with black sandy ash, moist to wet
5 - 6	grayish brown sandy clay and sandy ask, wet
6 - 7	gray and brown sandy clay, wet
7 - 7.5	same as above, with some black ash
7.5 - 8	black ash

8 - 9.5	brown sandy clay, moist to wet
9.5 - 14	red, tan, white, gray, brown, black stratified material. Materials, except white and black materials are paste-like. White and black material are granular (fine to medium sand)
14 - 18	same as above. "Brick"-red material is soft, fine-grained, paste-like and wet. Bright white material is granular (fine to medium sand. Tan-white material is more paste-like, moist. Material is generally stratified (layer thickness 1 inch typical), however layers thinner than 1/4" are present (1/8", 1/16" typical, often the black granular material)

Stability, Handling and Water Conditions During Excavation

Time	Depth (ft)	Condition
1006		Start excavation
1009	1	Angle of repose of cover material (clay, moist) spoil pile approx. 40 degrees
1015	5	Angle of repose waste spoil pile material (sandy clay and ash, wet) approx. 25 degrees
1022	6	Grayish brown sandy clay and sandy ash sticks somewhat to hoe bucket
1035	11	Cave in of west trench wall, west side wall vertical, creating "D" shaped trench perimeter at the ground surface. Exposed face of east trench shows stratigraphy of clay and ash cover: alternating layers of clay and ash.
1044	13	Upper part (cover material) of the west trench wall falls into the trench, creating an approximately oval shaped trench perimeter at ground surface (about 18' x 10'). Some areas of the clay at the ground surface are undercut by the collapsed material.
1048	14	ash and clay caving from trench walls into trench

1057	14	excavated stratified waste material sticks somewhat to hoe bucket
1059	15	excavated stratified waste material is very soft, highly plastic when worked with the hoe bucket while placing in white metal box
1103	16 - 17	stratified waste material shows signs of dilatancy when a plastic bucket of the material is tapped with a trowel
1104	16 - 17	waste material is soft when tamped with the hoe bucket while placing in white metal box
1107	17	Angle of repose of red clay-like material on top of the waste spoil pile is approx. 20 degrees
1111	19	Track hoe boom at full extension, can dig no deeper. No standing water in trench. No drainage of water from spoil piles.
1114		Angle of repose of waste spoil pile approx. 20 - 30 degrees
1115		East edge of upper part of trench caves some more
1126		Condition of trench: cover material is layered brown; grayish brown sandy clay and black ash. The cover materials have sloughed into the trench creating an oval shaped depression about 9 to 10 feet deep to the top of the sloughed material in the trench. The side wall angles are estimated to be about 50 to 60 degrees.
1127		Hoe operator excavates the sloughed material from the trench, and creates vertical faces (i.e and notch) in the red clay-like material. Vertical faces extend from about 10 to 15 feet depths, and appear "greasy" or slickensided due to the excavator bucket. There was no standing water or seepage. After excavating to about 15 depth, the overlying sandy clay and ash material caved suddenly into the trench, filling the notch.
1136		Started backfilling trench

1137	Final dimensions of trench prior to backfilling: oval shaped, approx. 20 feet by 15 feet wide at ground surface
1145	Waste dropped into the trench while backfilling was heavy and pudding-like
1215	Completed backfilling

C.6 Analysis of Wet Trench Data for Groundwater Flux Into Trench

Rough estimates of the volumetric flux of water produced in a trench may be made from data taken during wet trenching tests. The calculated flux may be used to size dewatering pumps and requires the following input data: (1) width of trench, (2) length of trench, (3) depth of water in trench at the beginning of pumping, (4) volume of water pumped for a fixed time period, (5) length of pumping period, (6) depth of water in trench at end of pumping, and (7) estimated saturated thickness of productive (highly permeable) zone.

The following assumptions must be made to estimate the volumetric flux of water produced by the productive zone:

1) The rate of pumping is constant.

2) The trench is a rectangular box.

3) The flux of water produced is constant.

4) The supply of water in the productive zone is very large compared to the volume of water removed during trench tests.

5) The trenching takes place in soil layers (including productive and less permeable layers) of uniform thickness.

6) The entire face of the productive zone is completely exposed by the time pumping starts. If this is not the case, the saturated thickness of the zone can be decreased to reflect a more accurate time-average.

7) The only source of water into the trench is seepage from the productive zone and the only sink of water out of the trench is that which is pumped out.

The calculation proceeds from a conservation of free water mass in which the rate of water produced (volume/time) minus the rate of water pumped out of the trench equals the rate of change of water volume in the pit:

$$Q_i - Q_o = \frac{dV}{dt}$$

where

$$Q_i = .2674qT(L+W)$$

$$Q_o = \frac{.1337P}{t}$$

$$\frac{dV}{dt} = \frac{LW(D_e - D_b)}{t}$$

and

Q_i = volume flow into trench (ft^3/min)
Q_o = volume flow out of trench (ft^3/min)
V = volume of water in trench (ft^3)
q = volumetric flux of water produced (gpm/ft^2)
T = saturated thickness of productive zone (ft)
L = length of trench (ft)
W = width of trench (ft)
P = volume of water pumped in time period t (g)
t = time period for pumping (min)
D_e = depth of water in trench at end of time period t (ft)
D_b = depth of water in trench at beginning of time period t (ft)

Making substitutions and solving for q, there results

$$q = \frac{LW(D_e - D_b) + .1337P}{.2674Tt(L+W)}$$

Table 1 contains the results of the estimated groundwater flux for T1-S located in the south end of Pit 1.

Table 1 - Estimate of Groundwater Influx at Trench T1-S

Trench #	Time Period	Length (ft)	Width (ft)	Beginning Water Depth (ft)	Ending Water Depth (ft)	Volume Pumped (gal)	Pumping Period (min)	Productive Zone Thickness (ft)	Flux Into Trench (gpm/sq ft)
T1-S	0950-1020	20.0	5.0	4.0	2.0	8000	30	2.0	2.17

APPENDIX D

DEWATERING EVALUATION

APPENDIX D
DEWATERING EVALUATION

D.1 Introduction

FERMCO awarded a contract to B&B Drilling, Inc. on March 3, 1995, to perform a dewatering feasibility study at OU1 Waste Pits 1 and 3. On completion of the first of three phases of the study, B&B submitted a report to FERMCO dated August, 1995 (B&B 1995). This evaluation summarizes the major findings of Phase I and evaluates the impact of these findings on the activities and schedule for remediation of Pits 1 and 3.

The primary objective of Phase I was to determine whether groundwater can be extracted from Pit 1 and 3 sludges. If extraction was judged feasible, further objectives were to determine optimum well installation technique and well yield. Phase II of the study is to determine sludge hydrology, well spacing, and the effect of certain enhancements to well efficiencies. Phase III is to perform pilot-scale dewatering operations in Pits 1 and 3.

D-1.1 Test Configurations and Installation Techniques

Pit 1 - A linear array of wells, wellpoints, and instruments were installed in Pit 1 using various combinations of drilling techniques. Figure D-1 depicts a plan view of the array. Both wells had screen and riser diameters of 4 inches, while both wellpoints had screen and riser diameters of 1.5 inches. All wells and wellpoints were screened from 7 to 12 feet of depth. The pore pressure piezometer was screened by a canvas bag over an interval of 10 to 12 feet of depth, and the tensiometer tip was installed at a depth of 6.5 feet. Figure D-2 shows the precise location of the array within Pit 1.

The well designated as DW1-1 on Figure D-1 was installed using direct rotary techniques with water only. Well DW2-1 was installed in a similar fashion, except that the borehole was flushed with fresh water after drilling. Wellpoints WP1-1 and WP2-1 were both installed by the jet method, the difference being that WP2-1 was flushed with fresh water after drilling.

Pit 3 - Figure D-3 shows that the test array for Pit 3 had an arrangement similar to the Pit 1 array but with different spacings. Screen and riser diameters were 4 inches and 1.5 inches for the wells and wellpoints, respectively. All wells and wellpoints were screened from 10 to 30 feet of depth except DW1-3, which was screened from 9 to 29 feet. The pore pressure piezometer was screened by a canvas bag over the 27- to 29-foot interval while the tensiometer tip was installed at 9 feet. Figure D-2 shows the location of the array within Pit 3.

D.E.E.P. DEWATERING TREATABILITY STUDY

PHASE I - TEST WELL AS-BUILT LOCATION PLAN(PIT #1)

NTS

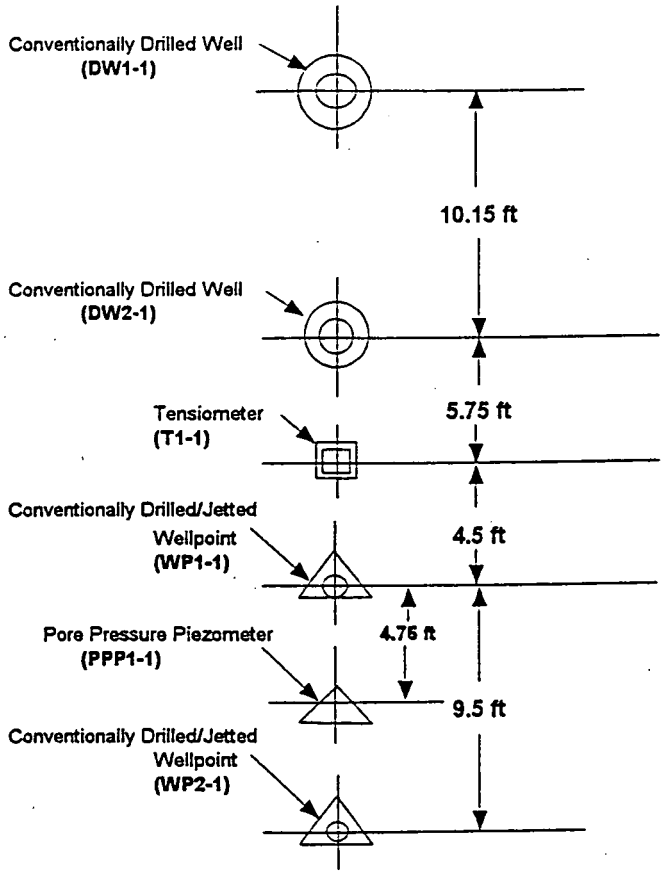

Figure D-1 - Pit 1 Test Array Plan View

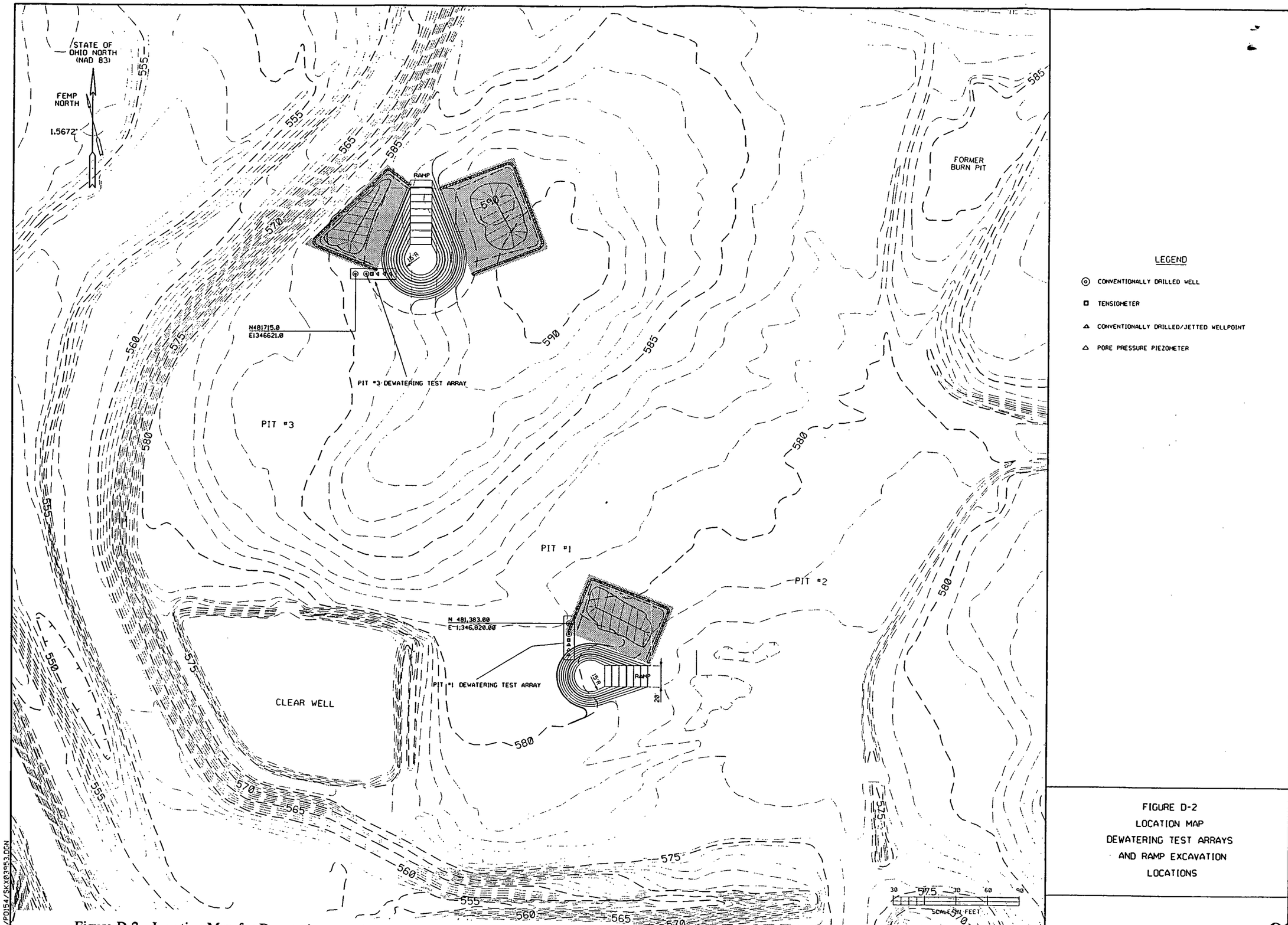

Figure D-2 - Location Map for Dewatering Test Arrays and Ramp Excavation Locations

D.E.E.P. DEWATERING TREATABILITY STUDY

PHASE I - TEST WELL AS-BUILT LOCATION PLAN(PIT #3)

NTS

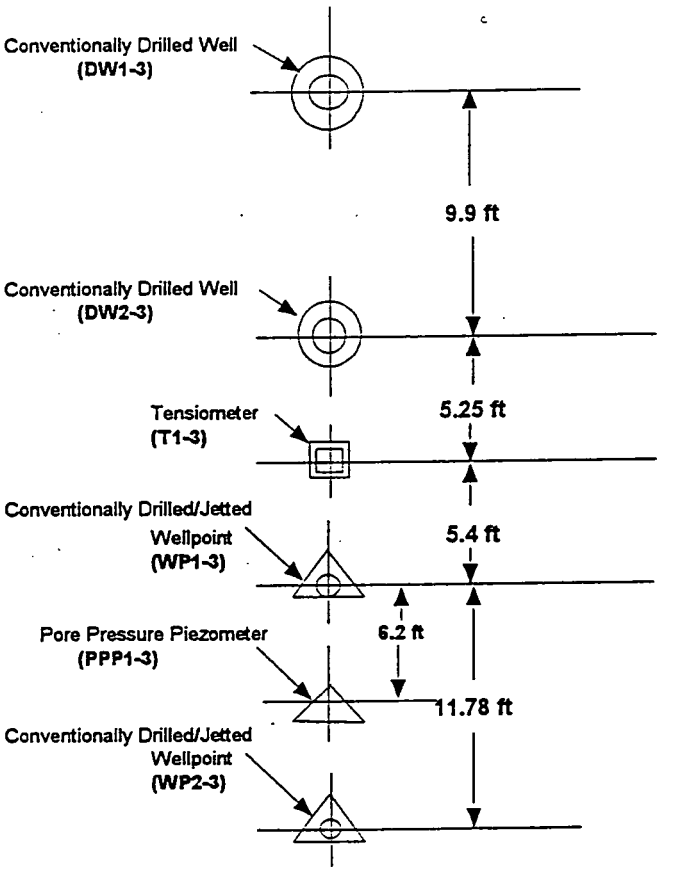

Figure D-3 - Pit 3 Test Array Plan View

Both wells were drilled using direct rotary techniques with water only, and both wellpoints were installed by the jet method.

D-1.2 Test Procedure and Results

Pit 1 - The preliminary test procedure for Pit 1 involved 1 hour of pumping, followed by measurement of post-pumping recovery. Each of the four wells and wellpoints were pumped in this manner for a total of four preliminary tests. For the two wells, the 1 hour pumping periods consisted of a 1/2 hour of pumping under gravity flow followed by a 1/2 hour of pumping with applied vacuum of 23 inches of water. The wellpoints were pumped with vacuum of 20- to 25-inches of water for the entire hour.

Wellpoint WP2-1 demonstrated the highest yield in the preliminary tests (approximately 1.3 gpm) and was then pumped for 4 hours, after which recovery was measured. Figure D-4 shows the time history of well yield during this 4 hour test. The plot shows a fluctuating yield with an average of 1.15 gpm over the 4 hours.

Pit 3 - The preliminary test procedure for Pit 3 was identical to that for Pit 1. Vacuum for the second 1/2 hour of the well pumping tests was 22 inches of water for DW1-3 and 27 to 28 inches for DW2-3. Vacuum was 24 to 27 inches for WP1-3 and 25 to 26 inches for WP2-3 for the entire hour of pumping.

Well DW2-3, which demonstrated a preliminary test average yield of .4 gpm (.65 gpm with vacuum), was selected for the 4 hour pump test. Figure D-5 shows the time history of well yield during this 4 hour test. The plot shows an almost monotonically decreasing yield with a final yield of .26 gpm at the end of 4 hours.

D.2 B&B'S Conclusions and Recommendations

From the test results presented above (and more detailed results contained in the B&B report), B&B concluded that sufficient amounts of free water exist in Pits 1 and 3 to allow sustainable yields with conventional dewatering equipment. In particular, B&B recommends 1.5-inch-diameter PVC wellpoints in Pit 1 (where suction lift is less than 18 feet) and 4-inch-diameter PVC wells for the deeper wastes of Pit 3. Installation of wellpoints and wells should be done via the jetting and drilling techniques described in the Phase I report. In all cases, flushing the borehole with fresh water immediately preceding well and filter installation is recommended. Vacuum enhancement is recommended for both wells and wellpoints, as is incorporation of ejectors in each Pit 3 well. Further advanced enhancement techniques, such as electroosmosis, are not recommended.

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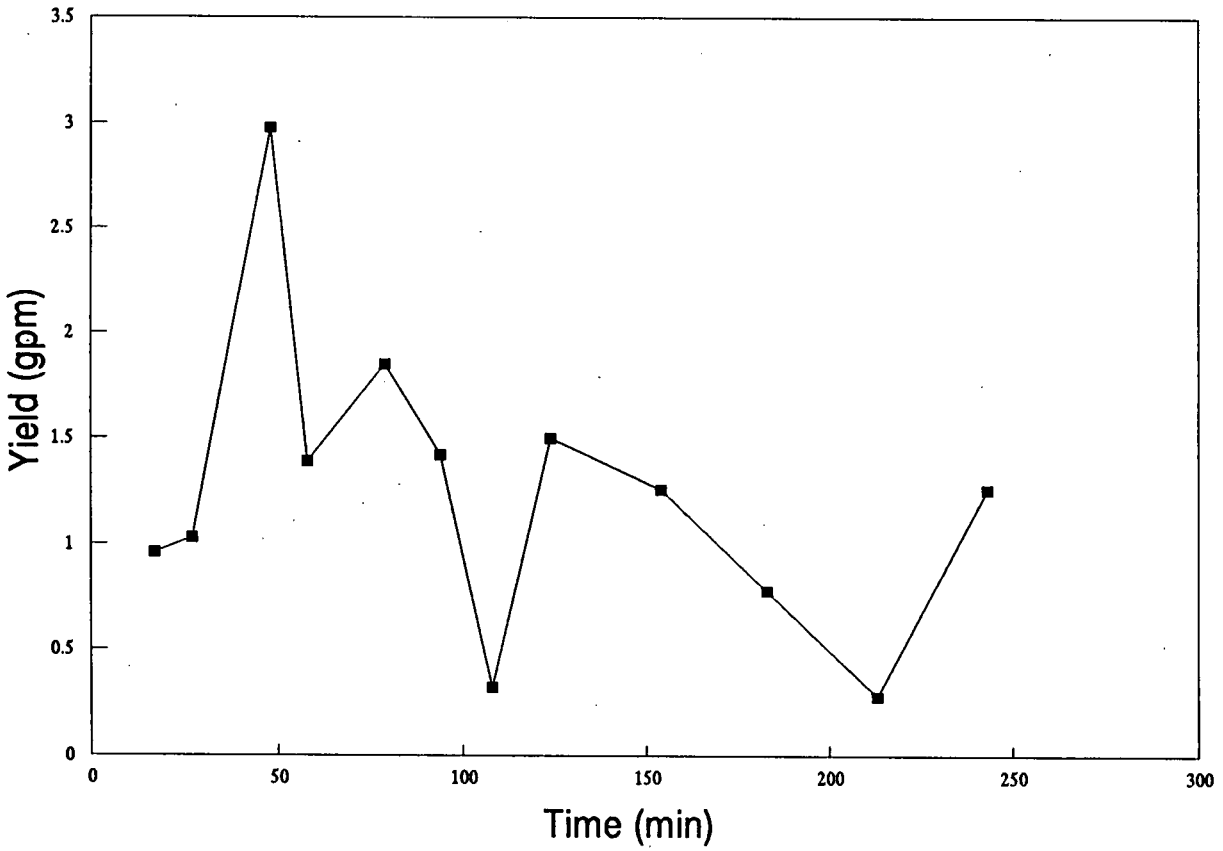

Figure D-4 - Wellpoint Yield vs. Time for Pit 1, 4-Hour Pump Test

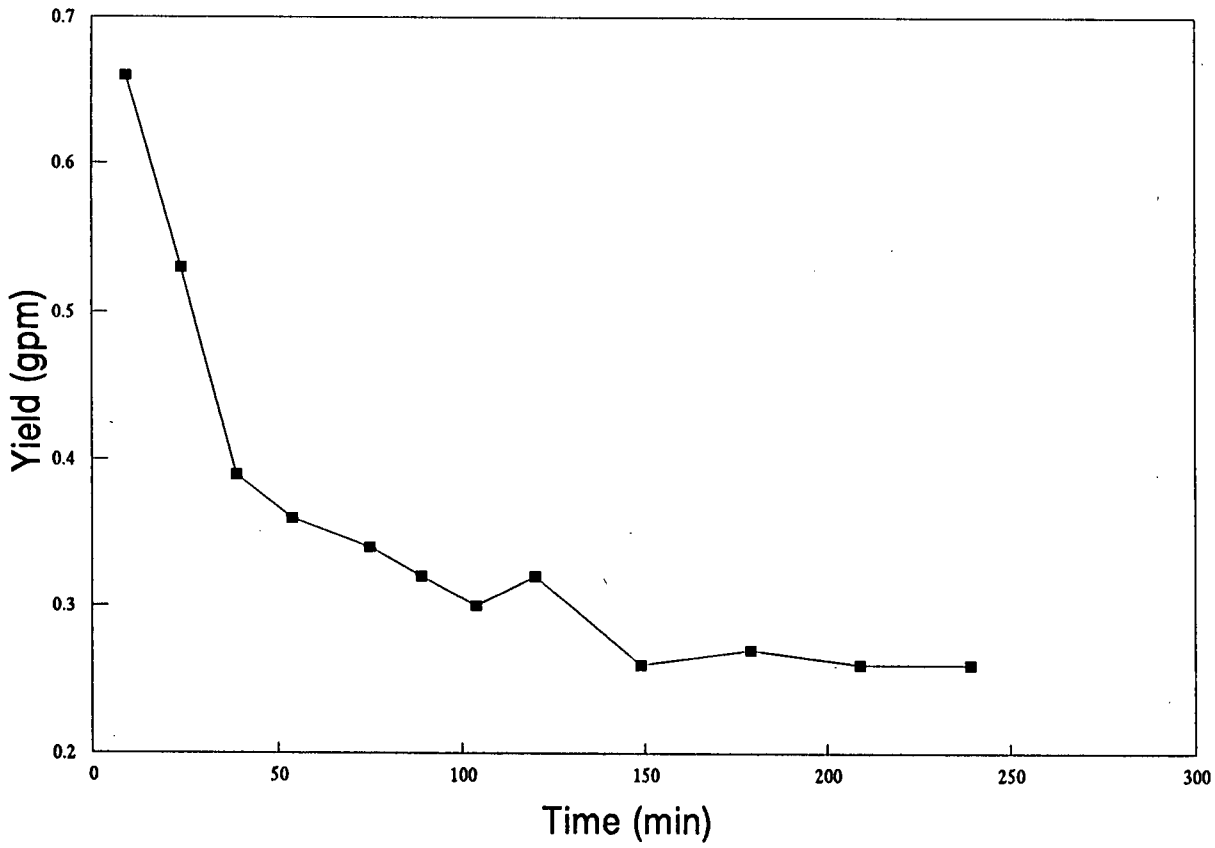

Figure D-5 - Well Yield vs. Time for Pit 3, 4-Hour Pump Test

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D.3 Evaluation

The primary benefits anticipated from pit dewatering are increased soil stability and reduction in soil water content. More stable soils will alleviate handling problems and result in a quicker, more efficient, and safer excavation process. Reduction in soil water content will shorten processing times and lower energy costs associated with soil drying.

D-3.1 Soil Stability Enhancement

Dry trenching and ramping activities are ongoing in the sections of the pits treated in Phase I to determine the degree of improvement in soil stability. The results will allow comparison of bearing capacities and angles of repose for pre- and post-Phase I soils. However, initial data from pre-dewatering strength tests indicate that pit soils are sufficiently stable for safe and efficient excavation without the use of dewatering.

D-3.2 Reduction in Soil Water Content

To evaluate the impact of dewatering on soil processing activities and schedules, the following assumptions were made:

1) Sustainable yields of 1.15 and .26 gpm can be achieved for Pits 1 and 3, respectively.

2) The above yields are reliable averages for the entire areal extent of the respective pits.

3) The volume of free water drainable from the pits equals the soil effective porosity times the total saturated pit volume. An effective porosity of .15 is assumed for both Pit 1 and 3.

4) Infiltration is negligible with respect to pumping. It is assumed that runon from heavy precipitation and perched water sources will be controlled by use of conventional devices such as sumps and drains.

5) Minimizing the duration of remediation will minimize the total cost of remediation.

6) In the absence of dewatering, the remediation duration is constrained by the rate at which the soil can be dried.

The first and most important of these assumptions deals with the sustainable yields of wells and wellpoints used in the dewatering of Pits 1 and 3. The declining yield through time depicted in Figure D-5 is a major concern. Tests longer than 4 hours in duration would be valuable in determining whether a significant sustainable yield exists, and, if so, what that yield is. If longer duration tests indicate a

negligible sustainable yield, advantage can be gained by attempting to dewater the waste pits. It should be kept in mind throughout the following evaluation that assumptions of long-term yields based on short duration tests may be suspect.

The assumption that test results from a small area of a pit are applicable to the entire pit may also be suspect. Sustainable yield data available from several locations within a pit is preferred for calculating a more reliable overall average.

The majority of materials in Waste Pits 1 and 3 are classified as silts (USCS classes ML and MH) (ALTER 1995). An effective porosity value of .15 is generally prescribed for these classes of soils (Maidment 1993). A depth to water level of 4 feet (ALTER 1995) will be used to calculate the saturated volume of soil.

The assumption of negligible infiltration implies that an equilibrium drawdown distribution will not be reached. The dewatering wells will simply remove the volume of free water initially present in the soils.

The final two assumptions dictate that the remediation duration and cost will be minimized if the time required to dewater equals the time required to dry the soils to the optimum moisture content. Because the amounts of water that will be removed by dewatering and drying are both fixed, the drying time is likewise fixed. The optimum number of wells is the number that can dewater a pit in this fixed drying time; more wells will cost more without shortening remediation, and fewer wells will make the dewatering process the time constraint.

Given the above, the following equation expressing the equality of drying and dewatering times can be solved for the number of dewatering wells:

$$\frac{M-\rho nFV}{r} = \frac{nFV}{Nq} \qquad \text{(D-1)}$$

$$N = \frac{rnFV}{q(M-\rho nFV)} \qquad \text{(D-2)}$$

where M = mass of water evaporated without dewatering (t)
ρ = water density (t/yd^3)
n = effective porosity of soil
F = saturated fraction of soil volume
V = total volume of soil in pit (yd^3)
r = dryer evaporation rate (t/d)
q = yield of each dewatering well (yd^3/d)
N = number of dewatering wells

Because an integral number of wells must be used, drying and dewatering times will vary slightly. The expression on the left side of equation D-1 represents drying time, while the right side (with the appropriate number of wells substituted) represents dewatering time.

Table D-1 lists values of the above variables, number of dewatering wells required, and treatment times with and without dewatering for Pits 1 and 3. Values for mass of water evaporated without dewatering, total volume of soil, dryer evaporation rate, and treatment time without dewatering were obtained from a FERMCO waste processing analysis (FERMCO 1995).

Table D-1 shows that 36 wells are required to dewater Pit 1 and 20 wells are required to dewater Pit 3. These figures reflect the minimum numbers of wells that should be pumping at all times during excavation to keep up with the drying rate. In actuality, an array of wells greater in number than the minimum should be installed over a limited area; as excavation proceeds, the front row of this array can be shut down and a new row at the back of the array can be turned on. This "leapfrogging" technique allows wells to be reused or disposed of in place while maintaining a core array composed of the minimum number of operating wells.

Table D-1 also gives an estimate of processing time reductions due to dewatering. Dewatering results in savings of 66 days for Pit 1 and 334 days for Pit 3. These estimates are only as reliable as the assumptions used to derive them.

Table D-1 - Calculation of Number of Dewatering Wells Required to Minimize Processing Times and Reduction in Processing Times for Pits 1 and 3

Input Data	Pit 1	Pit 3
Dryer Evaporation Rate (ton/d)	100	100
Effective Porosity of Soil	0.15	0.15
Pit Depth (ft)	17	37
Depth to Water Level (ft)	4	4
Total Volume of Soil in Pit (yd^3)	68400	307500
Yield of each Dewatering Well (gpm)	1.15	0.26
Mass of Water Evaporated without Dewatering (ton)	9245	145494
Water Density (ton/yd^3)	0.843	0.843
Treatment Time without Dewatering (d)	92	1442
Results		
Saturated Fraction of Soil Volume	0.765	0.892
Volume of Water Removed by Dewatering (yd^3)	7846	41139
Mass of Water Removed by Dewatering (ton)	6614	34680
Mass of Water Evaporated after Dewatering (ton)	2631	110814
Treatment Time with Dewatering (d)	26	1108
Required Number of Dewatering Wells	36	20
Time Saved by Dewatering (d)	66	334

APPENDIX E

GEOTECHNICAL DATA

Data Source:

1. Remdial Investigation Report for OU1 (Final), August 1994, Volume 1 and Appendix A
2. DEEP Interim Report (UC Doc. # 30-FO-016, September, 1995), Preliminary Technical Summary of Deep Test Boring, Cone Penetrometer Testing, 50% [
3. Cooperative Screening Program Final Report, ALTER, U.C., July 1994
4. Characterization Investigation Study, Geotechnical Evaluation of Waste Pit Material Properties and Boring Logs (CIS, Weston March 1988).

Notes:

% Gravel = % by wgt. retained on No. 4 sieve (4.75 mm)
% Sand = % by wgt. passing No. 4 Sieve and retained on No. 200 sieve (0.75mm)
% Silt or Clay = percent by weight passing No. 200 sieve
Clay Fraction = percent by weight finer than 0.002 mm

(1) Incomplete or questionable data in RI Report
(2) Average of two tests: 106.6 pcf, 24.6% ; 114.1 pcf, 22.1%
(3) Listed as "remolded unit weight"; assumed to be wet density
(4) Listed as "unit weight"; assumed to be wet density
(5) Pit 5, Pit 6, and Clear Well boring or grab sample locations unavailable from data source reference
(6) Harvard Miniature Compaction Test
(7) At approx 95% Standard Proctor maximum dry density (MDD)
(8) Estimated by the University of Cincinnati
(9) At 89% Standard Proctor MDD and 11 % wet of OMC
(10) These samples collected using Vibracore - Samples may be densified
(11) Identical values assumed due to testing on combined samples

SS	Split Spoon Sample
ST	Shelby Tube Sample
CAN COMP	Composite Sample of Decanted Archive Material
CAN	One Gallon Can Sample of Decanted Archive Material
COMP	Composite Sample

Group 1	Sample Numbers: 5A, 5B, 23A
Group 2	Sample Numbers: 40A, 40B, 41A, 41B, 43A, 43B
Group 3	Sample Numbers: 31A, 33A, 33B, 35A, 35B, 58A, 58B
Group 4	Sample Numbers: 11A, 11B, 16A, 16B
Group 5	Sample Numbers: 29A, 46A, 46B
Group 6	Sample Numbers: 21A, 21B, 25A
Group 7	Sample Numbers: 9A, 9B, 52A, 52B

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TABLE 1 – BORING AND SAMPLE INDEX

Sample Identification							Coordinates			General Stratum	Consistency
Pit No.	Boring No.	Sample No.	Sample Type	Top Depth (ft)	Bottom Depth (ft)	Data Source	Ohio North (NAD 1927)	Ohio East (NAD 1927)	Ground Elev. (ft)		(If reported)
1	1765	63089	ST	4.5	7.0	1	481377.70	1378289.96	580.77	Waste	Sludge
1	1765	63101	ST	14.0	16.5	1	481377.70	1378289.96	580.77	Waste	Sludge
1	1766	63050	ST	4.5	7.0	1	481349.56	1378240.51	581.21	Waste	Sludge
1	1766	63054	ST	8.5	11.0	1	481349.56	1378240.51	581.21	Waste	Sludge
1	1766	63062	ST	14.0	16.5	1	481349.56	1378240.51	581.21	Waste	Sludge
1	1767	63008	ST	3.5	6.0	1	481289.27	1378278.74	580.70	Waste	Sludge
1	11352	400053	SS	2.0	3.0	2	481376.02	1378320.29	579.94	Waste	
1	11352	400054	SS	5.5	6.0	2	481376.02	1378320.29	579.94	Waste	
1	11352	400025	ST	7.5	10.0	2	481376.02	1378320.29	579.94	Waste	
1	11352	400026	ST	11.5	14.0	2	481376.02	1378320.29	579.94	Waste	
1	11353	400047	SS	4.5	5.5	2	481256.98	1378238.46	580.23	Waste	
1	11353	400028	ST	10.0	12.5	2	481256.98	1378238.46	580.23	Waste	
1	11353	400051	SS	13.5	14.0	2	481256.98	1378238.46	580.23	Waste	
1	11354	400029	ST	7.5	10.0	2	481306.30	1378307.20	579.57	Waste	
1	11354	400030	ST	11.5	14.0	2	481306.30	1378307.20	579.57	Waste	
1	1765	1A	CAN			3	481377.70	1378289.96	580.77		
1	1765	2A	CAN			3	481377.70	1378289.96	580.77		
1	1765	3A	CAN			3	481377.70	1378289.96	580.77		
1	1766	4A	CAN			3	481349.56	1378240.51	581.21		
1	1766	5A	CAN			3	481349.56	1378240.51	581.21		
1	1766	6A	CAN			3	481349.56	1378240.51	581.21		
1	1766	7A	CAN			3	481349.56	1378240.51	581.21		
1	1767	8A	CAN			3	481289.27	1378278.74	580.70		
1		1-48	COMP	0.0	12.0	4					Clayey

TABLE 1 – BORING AND SAMPLE INDEX

Sample Identification							Coordinates			General Stratum	Consistency
Pit No.	Boring No.	Sample No.	Sample Type	Top Depth (ft)	Bottom Depth (ft)	Data Source	Ohio North (NAD 1927)	Ohio East (NAD 1927)	Ground Elev. (ft)		(if reported)
2	1768	63619	ST	11.0 (1)	13.0 (1)	1	481392.56	1378532.54	578.71	Waste	
2	1768	63619dup	ST	11.0 (1)	13.0 (1)	1	481392.56	1378532.54	578.71	Waste	
2	1769	63521	ST	12.0	14.0	1	481474.32	1378468.56	580.62	Waste	Sludge
2	1769	63530	ST	18.0	20.0	1	481474.32	1378468.56	580.62	Waste	Sludge
2	1817	63875	ST	10.5	12.5	1	481408.18	1378529.35	578.80	Fill	
2	1818	63865	ST	5.0	7.5	1	481460.40	1378477.46	580.00	Waste	
2	11358	400031	ST	6.0	8.5	2	481521.67	1378568.47	579.46	Waste	
2	11358	400062	SS	8.5	9.0	2	481521.67	1378568.47	579.46	Waste	
2	11359	400033	ST	4.5	7.0	2	481366.84	1378512.99	577.72	Waste	
2	11359	400034	ST	8.5	11.0	2	481366.84	1378512.99	577.72	Waste	
2	1768	9A	CAN			3	481392.56	1378532.54	578.71		
2	1769	10A	CAN			3	481474.32	1378468.56	580.62		
2	1818	11A	CAN			3	481460.40	1378477.46	580.00		
2	1817	12A	CAN			3	481408.18	1378529.35	578.80		
2	02-05	2-39	COMP	0.0	10.0	4	481529.03	1378595.00			Clayey

000955

TABLE 1 – BORING AND SAMPLE INDEX

Sample Identification							Coordinates			General Stratum	Consistency
Pit No.	Boring No.	Sample No.	Sample Type	Top Depth (ft)	Bottom Depth (ft)	Data Source	Ohio North (NAD 1927)	Ohio East (NAD 1927)	Ground Elev. (ft)		(if reported)
3	1770	63328	ST	4.0	6.0	1	481680.61	1378159.99	587.67	Cover	Sludge
3	1770	63357	ST	20.0	22.0	1	481680.61	1378159.99	587.67	Waste	Sludge
3	1770	63370	ST	28.0	30.0	1	481680.61	1378159.99	587.67	Waste	Sludge
3	1771	63458	ST	32.0	34.0	1	481638.22	1378298.05	589.62	Waste	Sludge
3	1772	63278	ST	19.5	22.0	1	481771.63	1378500.36	583.43	Waste	Sludge
3	11360	400097	SS	13.0	13.5	2	481837.28	1378331.84	586.94	Waste	
3	11360	400100	SS	13.5	14.0	2	481837.28	1378331.84	586.94	Waste	
3	11360	400035	ST	20.5	23.0	2	481837.28	1378331.84	586.94	Waste	
3	11361	400038	ST	10.5	13.0	2	481668.80	1378202.98	589.49	Waste	
3	11361	400039	ST	21.0	22.5	2					
3	11361	400040	ST	29.0	31.5	2	481668.80	1378202.98	589.49	Waste	
3	11362	400076	SS	6.0	6.5	2	481516.62	1378062.08	584.53	Waste	
3	11362	400077	SS	6.5	7.0	2	481516.62	1378062.08	584.53	Waste	
3	11362	400041	ST	19.0	21.5	2	481516.62	1378062.08	584.53	Waste	
3	11362	400042	ST	23.0	25.5	2	481516.62	1378062.08	584.53	Waste	
3	11363	400044	ST	12.0	14.5	2	481444.31	1378102.59	585.98	Waste	
3	11363	400045	ST	19.0	21.5	2	481444.31	1378102.59	585.98	Waste	
3	1770	13A	CAN			3	481680.61	1378159.99	587.67		
3	1770	14A	CAN			3	481680.61	1378159.99	587.67		
3	1770	15A	CAN			3	481680.61	1378159.99	587.67		
3	1771	16A	CAN			3	481638.22	1378298.05	589.62		
3	1771	17A	CAN			3	481638.22	1378298.05	589.62		
3	1772	18A	CAN			3	481771.63	1378500.36	583.43		
3	1772	19A	CAN			3	481771.63	1378500.36	583.43		
3	03-05	3-52	COMP	0.0	20.0	4	481658.38	1378073.25			Sludge
3	03-05	3-52 Redue	COMP	0.0	20.0	4	481658.38	1378073.25			Sludge
3	03-02	3-90	COMP	0.0	20.0	4	481815.44	13785447.75			Sludge
3	03-02	3-90 Redue	COMP	0.0	20.0	4	481815.44	13785447.75			Sludge

TABLE 1 – BORING AND SAMPLE INDEX

Sample Identification							Coordinates			General Stratum	Consistency
Pit No.	Boring No.	Sample No.	Sample Type	Top Depth (ft)	Bottom Depth (ft)	Data Source	Ohio North (NAD 1927)	Ohio East (NAD 1927)	Ground Elev. (ft)		(If reported)
4	1773	63747	ST	11.0	13.0	1	481696.36	1378864.51	588.80	Waste	
4	1774	63670	ST	10.0	12.0	1	481765.34	1378912.61	590.50	Waste	
4	1774	63687	ST	20.0	22.0	1	481765.34	1378912.61	590.50	Waste	
4	1775	63826	ST	15.0	17.0	1	481688.37	1378835.02	588.40	Waste	
4	1773	21A	CAN			3	481696.36	1378864.51	588.80		
4	1773	22A	CAN			3	481696.36	1378864.51	588.80		
4	1773	23A	CAN			3	481696.36	1378864.51	588.80		
4	1775	24A	CAN			3	481688.37	1378835.02	588.40		
4	1775	25A	CAN			3	481688.37	1378835.02	588.40		
4	1775	26A	CAN			3	481688.37	1378835.02	588.40		
4	04-01	4-02	COMP	0.0	20.0	4	481822.09	1378853.13			Clayey
4	04-04	4-62	COMP	0.0	20.0	4	481696.72	1378864.63			Clayey
4	04-04	4-62 Redue	COMP	0.0	20.0	4	481696.72	1378864.63			Clayey

TABLE 1 – BORING AND SAMPLE INDEX

Sample Identification							Coordinates			General Stratum	Consistency
Pit No.	Boring No.	Sample No.	Sample Type	Top Depth (ft)	Bottom Depth (ft)	Data Source	Ohio North (NAD 1927)	Ohio East (NAD 1927)	Ground Elev. (ft)		(if reported)
5	(3)	30A	CAN			3					
5	(3)	31A	CAN			3					
5	(3)	32A	CAN			3					
5	(3)	33A	CAN			3					
5	(3)	34A	CAN			3					
5	(3)	35A	CAN			3					
5	(3)	36A	CAN			3					
5	(3)	37A	CAN			3					
5	(3)	38A	CAN			3					
5	(3)	39A	CAN			3					
5	(3)	40A	CAN			3					
5	(3)	41A	CAN			3					
5	(3)	57A	CAN			3					
5	(3)	58A	CAN			3					
5	05-04	5-25	COMP	10.0	29.0	4	482103.13	1378635.75			Clayey
5	1	*****		14.0	14.5						
5	1	*****		19.0	19.5						
5	1	*****		24.5	25.0						
5	3	*****		13.5	14.0						
5	3	*****		19.0	19.5						
5	3	*****		23.5	24.0						
5	5	*****		14.5	15.0						
5	5	*****		19.5	20.0						
5	5	*****		24.5	25.0						
5	7	*****		13.5	14.0						
5	7	*****		18.5	19.0						
5	7	*****		23.5	24.0						
5	9	*****		15.0	15.5						
5	9	*****		20.0	20.5						
5	9	*****		25.0	25.5						
5	11	*****		13.5	14.0						
5	11	*****		18.5	19.0						
5	11	*****		23.5	24.0						
5	13	*****		13.5	14.0						
5	13	*****		18.5	19.0						
5	13	*****		23.5	24.0						
5	15	*****		13.5	14.0						
5	15	*****		18.5	19.0						
5	15	*****		23.5	24.0						
5	17	*****		13.5	14.0						
5	17	*****		18.5	19.0						
5	17	*****		23.5	24.0						
5	19	*****		13.5	14.0						
5	19	*****		18.5	19.0						
5	19	*****		23.5	24.0						
5	23	*****		12.0	12.5						
5	23	*****		17.0	17.5						
5	23	*****		22.0	22.5						
5	25	*****		15.5	16.0						
5	27	*****		13.5	14.0						
5	29	*****		10.5	11.0						
5	29	*****		15.5	16.0						
5	*****	*****		***	***						

TABLE 1 – BORING AND SAMPLE INDEX

Sample Identification							Coordinates			General Stratum	Consistency
Pit No.	Boring No.	Sample No.	Sample Type	Top Depth (ft)	Bottom Depth (ft)	Data Source	Ohio North (NAD 1927)	Ohio East (NAD 1927)	Ground Elev. (ft)		(If reported)
6	1	405344		12.5	13.0						
6	Ret Sludge	405346		11.5	12.0						
6	3	405348		8.5	9.0						
6	3	405348		13.5	14.0						
6	4	405350		10.5	11.0						
6	5	405352		7.0	7.5						
6	5	405352		12.5	13.0						
6	5	405352		18.0	18.5						
6	6	405354		7.5	8.0						
6	6	405354		12.5	13.0						
6	6	405354		17.5	18.0						
6	7	405355		12.5	13.0						
6	7	405355		17.5	18.0						
6	(3)	43A	CAN			3					
6	(3)	45A	CAN			3					
6	(3)	45C	CAN			3					
6	(3)	46A	CAN			3					
6	(3)	47A	CAN			3					
6	06-04	6-10	COMP	0.0	10.0	4	481887.47	1379205.00			Sludge
6	06-03	6-22	COMP	0.0	15.0	4	481938.28	1379176.38			Sludge

000958

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TABLE 1 – BORING AND SAMPLE INDEX

Sample Identification							Coordinates			General Stratum	Consistency
Pit No.	Boring No.	Sample No.	Sample Type	Top Depth (ft)	Bottom Depth (ft)	Data Source	Ohio North (NAD 1927)	Ohio East (NAD 1927)	Ground Elev. (ft)		(if reported)
CW	(3)	49A	CAN			3					
CW	(3)	50A	CAN			3					
CW	(3)	51A	CAN			3					
CW	(3)	52A	CAN			3					
CW	(3)	53A	CAN			3					
CW	(3)	54A	CAN			3					
CW	(3)	55A	CAN			3					
CW	(3)	56A	CAN			3					

TABLE 1 – BORING AND SAMPLE INDEX

Sample Identification							Coordinates			General Stratum	Consistency
Pit No.	Boring No.	Sample No.	Sample Type	Top Depth (ft)	Bottom Depth (ft)	Data Source	Ohio North (NAD 1927)	Ohio East (NAD 1927)	Ground Elev. (ft)		(if reported)
BP	1776	63176	ST	4.5	6.0	1	481718.86	1378630.15	584.80		
BP	1776	27A	CAN			3					
BP	1777	28A	CAN			3					
BP	1819	29A	CAN			3					
BP	07-01	7-02	COMP	0.0	10.0	4	481887.94	1378639.50			Sludge
BP	07-04	7-34	COMP	0.0	16.0	4	481729.66	1378575.50			Sludge
BP	07-04	7-34 Redue	COMP	0.0	16.0	4	481729.66	1378575.50			Sludge
BP	07-06	7-52	COMP	0.0	16.0	4	481630.91	1378527.75			Sludge

TABLE 1 – BORING AND SAMPLE INDEX

Sample Identification							Coordinates			General Stratum	Consistency
Pit No.	Boring No.	Sample No.	Sample Type	Top Depth (ft)	Bottom Depth (ft)	Data Source	Ohio North (NAD 1927)	Ohio East (NAD 1927)	Ground Elev. (ft)		(if reported)
1, 4	1766, 1773	Group 1	CAN COMP			3					
6, 6	(3)	Group 2	CAN COMP			3					
5	(3)	Group 3	CAN COMP			3					
2, 3	1818, 1771	Group 4	CAN COMP			3					
6, BP	1819(3)	Group 5	CAN COMP			3					
4	1773, 1775	Group 6	CAN COMP			3					
2, CW	1768(3)	Group 7	CAN COMP			3					

TABLE 2 – BORING LOG VISUAL DESCRIPTION

Sample Identification							Boring Log Visual Description	SPT
Pit No.	Boring No.	Sample No.	Sample Type	Top Depth (ft)	Bottom Depth (ft)	Data Source	Boring log description of shelby tube (ST) ends or underlying split spoon (SS) sample	SPT N Value
1	1765	63089	ST	4.5	7.0	1	7–7.5 ft SS = Loose(10YR4/1)dk gray mottled with(2.5Y4/4)reddish brown clay–like material, moderate cohesion and plasticity, very moist	
1	1765	63101	ST	14.0	16.5	1	16.5–17 ft SS= Very loose(10YR4/1)dark gray silty clay like material,gelatinous in nature,good plasticity,poor cohesion,very moist	
1	1766	63050	ST	4.5	7.0	1	7–7.5 ft SS=Medium dense(2.5Y N4) gray claylike material, low plasticity, slight cohesion, moderately moist	
1	1766	63054	ST	8.5	11.0	1	11–11.5 ft SS=Firm (2.5Y N3/) very dark gray silty clay like, moderate cohesion,moderate plasticity, moist	
1	1766	63062	ST	14.0	16.5	1	16.5–17 ft SS=Soft(2.5Y N3) very dark gray clay–sized particles, consitency similar to gelatin, low plasticity, very moist	
1	1767	63008	ST	3.5	6.0	1	Bot ST = ash like powdery material with a waxy consistency, color was mottled gray, white, black, and yellow, moist.	
1	11352	400053	SS	2.0	3.0	2	Stiff, (2.5 YR 5/4) reddish brown, silt or ash–like to clay–like material, low to medium plasticity, lightweight, moist	6
1	11352	400054	SS	5.5	6.0	2	V. soft, (2.5 YR N/5) gray, clay size particle, paste–like material, cohesive, moist to wet	3
1	11352	400025	ST	7.5	10.0	2	Top ST= (2.5YR5/4) rdish brn silt– or ash–like to clay–like, moist to wet;Bot ST= hard (2.5YN/8) wht clay–silt matrix, f to m coarse grains, moist	
1	11352	400026	ST	11.5	14.0	2	Bot ST= very stiff, (2.5Y N/5) gray silty clay–like material, moist	
1	11353	400047	SS	4.5	5.5	2	Strat matl: stf (2.5Y4/4) olv brn sl clay w/gv, moist (4"); green granules, wet (2"), med stiff, (2.5Y4/4) olv brn sl clay w/ blk jelly, wet(2")	13
1	11353	400028	ST	10.0	12.5	2	Bot ST= (2.5Y N/5) gray fine to med sand–like matl, metal–like, silvery, moist (some particles dryed to white–gray powder)	
1	11353	400051	SS	13.5	14.0	2	Very soft, (2.5 Y N/7) lt gray, pudding– to "cake icing–" like material, smooth to granular, very light weight, wet	3
1	11354	400029	ST	7.5	10.0	2	Bot ST = (2.5 Y N/7) lt gray powdery, waxy material, slightly cohesive, very light weight, moist (drys to a white very fine powder)	
1	11354	400030	ST	11.5	14.0	2	14–14.5 ft SS= Soft, (2.5 Y N/2), black sandy clay–like material, med grains, pockets of white waxy material, some cly sand matl, moist to wet	
1	1765	1A	CAN			3		
1	1765	2A	CAN			3		
1	1765	3A	CAN			3		
1	1766	4A	CAN			3		
1	1766	5A	CAN			3		
1	1766	6A	CAN			3		
1	1766	7A	CAN			3		
1	1767	8A	CAN			3		
1		1–46	COMP	0.0	12.0	4		

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TABLE 2 – BORING LOG VISUAL DESCRIPTION

Sample Identification							Boring Log Visual Description	
Pit No.	Boring No.	Sample No.	Sample Type	Top Depth (ft)	Bottom Depth (ft)	Data Source	Boring log description of shelby tube (ST) ends or underlying split spoon (SS) sample	SPT N Value
2	1768	63619	ST	11.0 (1)	13.0 (1)	1	13–13.5 ft SS=Very soft (2.5Y N7) light gray clay size material interspersed with white granular material, wet pasty consistency	
2	1768	63619dup	ST	11.0 (1)	13.0 (1)	1	13–13.5 ft SS=Very soft (2.5Y N7) light gray clay size material interspersed with white granular material, wet pasty consistency	
2	1769	63521	ST	12.0	14.0	1	14–14.5 ft SS= Very loose (5Y 6/3) pale olive, clay–like material, pasty consistency, wet	
2	1769	63530	ST	18.0	20.0	1	20–20.5 ft SS= Very soft (5Y 8/1) white clay size material with some black streaking, pasty consistency, wet	
2	1817	63675	ST	10.5	12.5	1	13–13.5 ft SS= Very soft (10YR, 8/2) white clay material streaked with black, pasty consistency, very moist	
2	1818	63665	ST	5.0	7.5	1	7.5–8.0 ft SS= Very dense (10YR, 3/3) dark brown silty clay, fragments of brick, very wet	
2	11358	400031	ST	6.0	8.5	2	8.5–9.0 SS= V. soft (10 YR 8/8) brrlsh yel, lt wt matl, vesicular appearance of "ice cream", somewhat clay–like, low to med plas, v. moist	
2	11358	400062	SS	8.5	9.0	2	V. soft (10 YR 6/8) brnish yel, lt wt matl, vesicular appearance of "ice cream", somewhat clay–like, low to med plas, v. moist	
2	11359	400033	ST	4.5	7.0	2	Bot of ST: Very soft, (7.5 YR 5/8) stong brown "clay–like" material, high plasticity, very moist	0
2	11359	400034	ST	8.5	11.0	2	Bot of ST: Very soft, (7.5 YR 5/8) stong brown "clay–like" material, high plasticity, very moist	
2	1768	9A	CAN			3		
2	1769	10A	CAN			3		
2	1818	11A	CAN			3		
2	1817	12A	CAN			3		
2	02–05	2–39	COMP	0.0	10.0	4		

TABLE 2 – BORING LOG VISUAL DESCRIPTION

Sample Identification							Boring Log Visual Description	
Pit No.	Boring No.	Sample No.	Sample Type	Top Depth (ft)	Bottom Depth (ft)	Data Source	Boring log description of shelby tube (ST) ends or underlying split spoon (SS) sample	SPT SPT N Value
3	1770	63328	ST	4.0	6.0	1	6–6.5 ft SS= Loose (10YR 2/1) black medium sand with sparse angular gravel poor cohesion, very wet	
3	1770	63357	ST	20.0	22.0	1	22–22.5 ft SS= Very loose (2.5Y 4/8) red clay–like material pudding consistency, very moist	
3	1770	63370	ST	28.0	30.0	1	30–30.5 ft SS= Very loose (2.5Y 4/6) red clay–like material, pasty consistency, very moist	
3	1771	63458	ST	32.0	34.0	1	34–34.5 ft SS=Very loose(2.5YR4/8) red clay like mat. streaked w black & sparse(5Y8/4) pale yellow material, pasty consistency, very moist	
3	1772	63278	ST	19.5	22.0	1	22–22.5 ft SS= Loose (5Y 2.5/1) black fine to medium sand, poor cohesion, wet	
3	11360	400097	SS	13.0	13.5	2	Strat matl: v soft gray gvly clay w/sd, fiberous roots, wet(1"); stf, lt olive brn sandy clay, mst (2"); v. soft yllsh red & brn "pudding–like" matl, wet	
3	11360	400100	SS	13.5	14.0	2	V soft, (10 YR 3/1) very dark gray sandy (fine sand) clay with silt, wet	4
3	11360	400035	ST	20.5	23.0	2	Bot ST = Very stiff (2.5Y 4/2) dark grayish brown sandy, silty clay with fine to coarse sand, high plasticity, very moist	4
3	11361	400038	ST	10.5	13.0	2	9.0–10.5 ft SS= Very soft (10R 5/8) red clay–like, high plasticity, moist to wet	
3	11361	400039	ST	21.0	22.5	2		
3	11361	400040	ST	29.0	31.5	2	28.0–29.0 ft SS= Very soft (7.5YR 3/4) brown pudding–like w/some red clay–like material, blk flyash and brnish yellow paste–like material mixed, wet	
3	11362	400076	SS	6.0	6.5	2	Loose, (2.5 Y N2) black, silty–like coal ash, metallic luster or sheen, wet	
3	11362	400077	SS	6.5	7.0	2	Loose, (2.5 Y N2) black, silty–like coal ash, metallic luster or sheen, wet	10
3	11362	400041	ST	19.0	21.5	2	Bot ST: Very soft, (2.5YR 4/8) red "pudding–like" and (10 YR 6/3) pale brown "dough–like" material, swirled together, wet	10
3	11362	400042	ST	23.0	25.5	2	Bot ST: (2.5 Y 5/4) olive brown silty "clay–like" waxy material, light weight, moist	
3	11363	400044	ST	12.0	14.5	2	Top ST: v soft (2.5 Y 4/2) dk grayish brown sl clay, some f to c sand, trace flyash and yel part, high plast, v moist; Bot ST: blk granular sludge, wet	
3	11363	400045	ST	19.0	21.5	2	Loose, (2.5 N/2) black granular sludge, fine to coarse, wet	
3	1770	13A	CAN			3		
3	1770	14A	CAN			3		
3	1770	15A	CAN			3		
3	1771	16A	CAN			3		
3	1771	17A	CAN			3		
3	1772	18A	CAN			3		
3	1772	19A	CAN			3		
3	03–05	3–52	COMP	0.0	20.0	4		
3	03–05	3–52 Redue	COMP	0.0	20.0	4		
3	03–02	3–90	COMP	0.0	20.0	4		
3	03–02	3–90 Redue	COMP	0.0	20.0	4		

TABLE 2 – BORING LOG VISUAL DESCRIPTION

Sample Identification							Boring Log Visual Description	SPT
Pit No.	Boring No.	Sample No.	Sample Type	Top Depth (ft)	Bottom Depth (ft)	Data Source	Boring log description of shelby tube (ST) ends or underlying split spoon (SS) sample	SPT N Value
4	1773	63747	ST	11.0	13.0	1	13.0–13.5 ft SS = Dense (2.5 Y N2/) black, clayey, sludgy material w/ flecks of purple, yellow and green material, very wet, consistency of used motor oil, flows like mud, some large chunks of material	
4	1774	63870	ST	10.0	12.0	1	12.0–12.5 ft SS = Medium dense (2.5 Y N3/) very dark gray silty clayey material, very moist to wet, jello like consistency (rubbery), waxy appearance	
4	1774	63887	ST	20.0	22.0	1	22.0–22.5 ft SS = Dense (2.5, N3/) clay–like material consistent throughout, uniformly moist, greasy consistency	
4	1775	63828	ST	15.0	17.0	1	17.0–17.5 ft SS = loose, very soft (2.5 Y, N3/) very dark gray clay–like material with streaks of yellowish material, wet, flowing, jello–like	
4	1773	21A	CAN			3		
4	1773	22A	CAN			3		
4	1773	23A	CAN			3		
4	1775	24A	CAN			3		
4	1775	25A	CAN			3		
4	1775	26A	CAN			3		
4	04–01	4–02	COMP	0.0	20.0	4		
4	04–04	4–62	COMP	0.0	20.0	4		
4	04–04	4–62 Redue	COMP	0.0	20.0	4		

TABLE 2 – BORING LOG VISUAL DESCRIPTION

Sample Identification							Boring Log Visual Description	
Pit No.	Boring No.	Sample No.	Sample Type	Top Depth (ft)	Bottom Depth (ft)	Data Source	Boring log description of shelby tube (ST) ends or underlying split spoon (SS) sample	SPT SPT N Value
5	(3)	30A	CAN			3		
5	(3)	31A	CAN			3		
5	(3)	32A	CAN			3		
5	(3)	33A	CAN			3		
5	(3)	34A	CAN			3		
5	(3)	35A	CAN			3		
5	(3)	36A	CAN			3		
5	(3)	37A	CAN			3		
5	(3)	38A	CAN			3		
5	(3)	39A	CAN			3		
5	(3)	40A	CAN			3		
5	(3)	41A	CAN			3		
5	(3)	57A	CAN			3		
5	(3)	58A	CAN			3		
5	05-04	5-25	COMP	10.0	29.0	4		
5	1	*****		14.0	14.5			
5	1	*****		19.0	19.5			
5	1	*****		24.5	25.0			
5	3	*****		13.5	14.0			
5	3	*****		19.0	19.5			
5	3	*****		23.5	24.0			
5	5	*****		14.5	15.0			
5	5	*****		19.5	20.0			
5	5	*****		24.5	25.0			
5	7	*****		13.5	14.0			
5	7	*****		18.5	19.0			
5	7	*****		23.5	24.0			
5	9	*****		15.0	15.5			
5	9	*****		20.0	20.5			
5	9	*****		25.0	25.5			
5	11	*****		13.5	14.0			
5	11	*****		18.5	19.0			
5	11	*****		23.5	24.0			
5	13	*****		13.5	14.0			
5	13	*****		18.5	19.0			
5	13	*****		23.5	24.0			
5	15	*****		13.5	14.0			
5	15	*****		18.5	19.0			
5	15	*****		23.5	24.0			
5	17	*****		13.5	14.0			
5	17	*****		18.5	19.0			
5	17	*****		23.5	24.0			
5	19	*****		13.5	14.0			
5	19	*****		18.5	19.0			
5	19	*****		23.5	24.0			
5	23	*****		12.0	12.5			
5	23	*****		17.0	17.5			
5	23	*****		22.0	22.5			
5	25	*****		15.5	16.0			
5	27	*****		13.5	14.0			
5	29	*****		10.5	11.0			
5	29	*****		15.5	16.0			
5	*****	*****		***	***			

TABLE 2 – BORING LOG VISUAL DESCRIPTION

Sample Identification							Boring Log Visual Description	SPT
Pit No.	Boring No.	Sample No.	Sample Type	Top Depth (ft)	Bottom Depth (ft)	Data Source	Boring log description of shelby tube (ST) ends or underlying split spoon (SS) sample	SPT N Value
6	1	405344		12.5	13.0			
6	Ret Sludge	405346		11.5	12.0			
6	3	405348		8.5	9.0			
6	3	405348		13.5	14.0			
6	4	405350		10.5	11.0			
6	5	405352		7.0	7.5			
6	5	405352		12.5	13.0			
6	5	405352		18.0	18.5			
6	6	405354		7.5	8.0			
6	6	405354		12.5	13.0			
6	6	405354		17.5	18.0			
6	7	405355		12.5	13.0			
6	7	405355		17.5	18.0			
6	(3)	43A	CAN			3		
6	(3)	45A	CAN			3		
6	(3)	45C	CAN			3		
6	(3)	46A	CAN			3		
6	(3)	47A	CAN			3		
6	06-04	6-10	COMP	0.0	10.0	4		
6	06-03	6-22	COMP	0.0	15.0	4		

TABLE 2 – BORING LOG VISUAL DESCRIPTION

Sample Identification							Boring Log Visual Description	SPT
Pit No.	Boring No.	Sample No.	Sample Type	Top Depth (ft)	Bottom Depth (ft)	Data Source	Boring log description of shelby tube (ST) ends or underlying split spoon (SS) sample	SPT N Value
CW	(3)	49A	CAN			3		
CW	(3)	50A	CAN			3		
CW	(3)	51A	CAN			3		
CW	(3)	52A	CAN			3		
CW	(3)	53A	CAN			3		
CW	(3)	54A	CAN			3		
CW	(3)	55A	CAN			3		
CW	(3)	56A	CAN			3		

TABLE 2 – BORING LOG VISUAL DESCRIPTION

Sample Identification							Boring Log Visual Description	
Pit No.	Boring No.	Sample No.	Sample Type	Top Depth (ft)	Bottom Depth (ft)	Data Source	Boring log description of shelby tube (ST) ends or underlying split spoon (SS) sample	SPT SPT N Value
BP	1776	63176	ST	4.5	6.0	1	6.0–6.5 ft SS = Loose (2.5 Y 4/2) dark grayish brown silty clay, moderate cohesion and plasticity, wet	
BP	1776	27A	CAN			3		
BP	1777	28A	CAN			3		
BP	1819	29A	CAN			3		
BP	07–01	7–02	COMP	0.0	10.0	4		
BP	07–04	7–34	COMP	0.0	16.0	4		
BP	07–04	7–34 Redue	COMP	0.0	16.0	4		
BP	07–06	7–52	COMP	0.0	16.0	4		

TABLE 2 – BORING LOG VISUAL DESCRIPTION

Sample Identification							Boring Log Visual Description	SPT
Pit No.	Boring No.	Sample No.	Sample Type	Top Depth (ft)	Bottom Depth (ft)	Data Source	Boring log description of shelby tube (ST) ends or underlying split spoon (SS) sample	SPT N Value
1, 4	1766, 1773	Group 1	CAN COMP			3		
5, 6	(3)	Group 2	CAN COMP			3		
5	(3)	Group 3	CAN COMP			3		
2, 3	1818, 1771	Group 4	CAN COMP			3		
6, BP	1819(3)	Group 5	CAN COMP			3		
4	1773, 1775	Group 6	CAN COMP			3		
2, CW	1768(3)	Group 7	CAN COMP			3		

TABLE 3 – INDEX PROPERTIES DATA

Sample Identification							Index Property Data										
Pit No.	Boring No.	Sample No.	Sample Type	Top Depth (ft)	Bottom Depth (ft)	Data Source	Moisture Content (%dry wgt.)	Specific Gravity Gs	Grain Size Analysis				Atterberg Limits			USCS Group Symbol	Group Name
									Gravel (%)	Sand (%)	Silt or Clay (%)	Clay Fract. (%)	LL	PL	PI		
1	1765	63089	ST	4.5	7.0	1	23.6	3.03	0.1	9.6	90.3	4.0	NP	NP	NP	ML (NP)	Silt (NP)
1	1765	63101	ST	14.0	16.5	1	20.9	2.92	0.0	8.3	91.7	10.0	NP	NP	NP	ML (NP)	Silt (NP)
1	1766	63050	ST	4.5	7.0	1	19.3	3.03	0.2	8.6	91.2	8.0	20.0	17.0	3.0	CL	Lean Clay
1	1766	63054	ST	8.5	11.0	1	15.9	3.15	0.0	10.0	90.0	4.0	NP	NP	NP	ML (NP)	Silt (NP)
1	1766	63062	ST	14.0	16.5	1	21.8	3.03	0.0	10.2	89.8	5.0	NP	NP	NP	ML (NP)	Silt (NP)
1	1767	63008	ST	3.5	6.0	1	23.3	3.07	3.1	25.8	71.1	3.0	NP	NP	NP	ML (NP)	Silt (NP) with Sand
1	11352	400053	SS	2.0	3.0	2	33.9		0.0	4.0	96.0	10.0	24.9	26.4		ML (NP)	Silt (NP)
1	11352	400054	SS	5.5	6.0	2	27.7		0.0	6.0	94.0	5.5	20.2	22.3		ML (NP)	Silt (NP)
1	11352	400025	ST	7.5	10.0	2	19.6	3.09	0.7	10.3	89.0	7.5	19.1	22.8		ML (NP)	Silt (NP)
1	11352	400026	ST	11.5	14.0	2	44.8	3.05	5.5	48.5	46.0	3.5	42.1	42.5		SM	Silty Sand
1	11353	400047	SS	4.5	5.5	2	19.3		19.0	28.0	53.0	13.0				ML (NP)	Sandy Silt (NP) with Gravel
1	11353	400028	ST	10.0	12.5	2	18.3	3.05	1.0	15.5	83.5	6.5	19.9	20.8		ML (NP)	Silt (NP) with Sand
1	11353	400051	SS	13.5	14.0	2	30.9		3.0	28.3	68.7	1.3				ML (NP)	Sandy Silt (NP)
1	11354	400029	ST	7.5	10.0	2	23.1	3.11	0.1	3.9	96.0	7.3	18.9	22.9		ML (NP)	Silt (NP)
1	11354	400030	ST	11.5	14.0	2	47.3	2.80	2.0	50.0	48.0	6.7	67.7	68.2		SM	Silty Sand
1	1765	1A	CAN			3	20.3		0.0	14.2	85.5		NP	NP	NP	ML (NP)	Silt (NP)
1	1765	2A	CAN			3	24.7		0.0	13.2	86.8		NP	NP	NP	ML (NP)	Silt (NP)
1	1765	3A	CAN			3	39.1		2.9	26.8	70.3		NP	NP	NP	ML (NP)	Silt (NP) with Sand
1	1766	4A	CAN			3	18.0		0.0	9.0	91.0		NP	NP	NP	ML (NP)	Silt (NP)
1	1766	5A	CAN			3	20.7	3.02	0.4	10.8	88.8	0.0	NP	NP	NP	ML (NP)	Silt (NP)
1	1766	6A	CAN			3	21.1		0.0	9.0	91.0		NP	NP	NP	ML (NP)	Silt (NP)
1	1766	7A	CAN			3	20.7		1.1	9.8	89.1		NP	NP	NP	ML (NP)	Silt (NP)
1	1767	8A	CAN			3	22.7		3.9	37.6	58.5		NP	NP	NP	ML (NP)	Silt (NP)
1		1-48	COMP	0.0	12.0	4	17.2	2.62	32.5	24.5	43.0	14.0	34.0	23.0	11.0	GC	Clayey Gravel with Sand

TABLE 3 – INDEX PROPERTIES DATA

Sample Identification							Index Property Data										
Pit No.	Boring No.	Sample No.	Sample Type	Top Depth (ft)	Bottom Depth (ft)	Data Source	Moisture Content (%dry wgt.)	Specific Gravity Gs	Grain Size Analysis				Atterberg Limits			USCS Group Symbol	Group Name
									Gravel (%)	Sand (%)	Silt or Clay (%)	Clay Fract. (%)	LL	PL	PI		
2	1768	63619	ST	11.0 (1)	13.0 (1)	1	290.0	2.80	0.0	39.0	61.0	5.0	NP	NP	NP	ML (NP)	Sandy Silt (NP)
2	1768	63619dup	ST	11.0 (1)	13.0 (1)	1	316.6	2.79	0.0	28.5	71.5	3.0	NP	NP	NP	ML (NP)	Silt (NP) with Sand
2	1769	63521	ST	12.0	14.0	1	231.2	2.64	0.3	40.2	59.5	4.0	117.0	73.0	44.0	MH	Sandy Elastic Silt
2	1769	63530	ST	18.0	20.0	1	169.8	2.64	1.8	40.1	58.1	4.0	181.0	109.0	72.0	MH	Sandy Elastic Silt
2	1817	63875	ST	10.5	12.5	1	32.7	2.65	25.4	45.5	29.1	8.0	36.0	28.0	8.0	SM	Silty Sand with Gravel
2	1818	63865	ST	5.0	7.5	1	21.4	2.20	18.1	67.3 (1)	14.6 (1)	8.0	24.0	14.0	10.0	SC	Clayey Sand with Gravel
2	11358	400031	ST	6.0	8.5	2	24.1	2.69	21.5	32.2	46.3	11.0	33.4	20.3	13.2	SC	Clayey Sand with Gravel
2	11358	400062	SS	8.5	9.0	2	245.7		0.0	0.0	100.0	8.6					
2	11359	400033	ST	4.5	7.0	2	109.6	3.02	0.0	1.3	98.7	8.0	78.1	64.0	15.3	MH	Elastic Silt
2	11359	400034	ST	8.5	11.0	2	98.2	2.86	4.7	14.0	81.3	1.8	76.3	66.2	10.2	MH	Elastic Silt with Sand
2	1768	9A	CAN			3	35.4		1.0	55.1	43.9		33.1	23.2	9.9	SM	Silty Sand
2	1769	10A	CAN			3	38.3	2.72	7.6	26.1	66.3	22.2	42.3	23.1	19.2	CL	Sandy Lean Clay
2	1818	11A	CAN			3	70.5	2.67	5.5	27.8	66.7	11.7	66.8	42.2	24.6	MH	Sandy Elastic Silt
2	1817	12A	CAN			3	16.7		4.2	22.3	73.5		44.1	16.2	27.9	CL	Lean Clay with Sand
2	02-05	2-39	COMP	0.0	10.0	4	31.9	2.59	20.0	19.0	61.0	22.0	53.0	32.0	21.0	MH	Gravelly Elastic Silt with Sand

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TABLE 3 – INDEX PROPERTIES DATA

Sample Identification							Index Property Data										
Pit No.	Boring No.	Sample No.	Sample Type	Top Depth (ft)	Bottom Depth (ft)	Data Source	Moisture Content (%dry wgt.)	Specific Gravity Gs	Grain Size Analysis				Atterberg Limits			USCS Group Symbol	Group Name
									Gravel (%)	Sand (%)	Silt or Clay (%)	Clay Fract. (%)	LL	PL	PI		
3	1770	63328	ST	4.0	6.0	1	63.7	2.20	0.5	56.0	43.5	8.0	NP	NP	NP	SM	Silty Sand
3	1770	63357	ST	20.0	22.0	1	138.7	2.84	0.2	56.4	43.4	6.0	116.0	55.0	61.0	SM	Silty Sand
3	1770	63370	ST	28.0	30.0	1	131.1	2.77	1.1	48.6	50.3	4.0	119.0	48.0	71.0	MH	Sandy Elastic Silt
3	1771	63458	ST	32.0	34.0	1	55.1	2.84	0.2	37.1	62.7	3.0	93.0	68.0	25.0	MH	Sandy Elastic Silt
3	1772	63278	ST	19.5	22.0	1	35.4	2.45	1.3	45.8	52.9	15[1]	NP	NP	NP	ML	Sandy Silt
3	11360	400097	SS	13.0	13.5	2	54.3		0.8	11.2	88.0	10.0	45.4	28.1	18.7	ML	Silt
3	11360	400100	SS	13.5	14.0	2	54.3[1]		0.8[1]	11.2[1]	88.0[1]	10.0[1]	45.4[1]	28.1[1]			
3	11360	400035	ST	20.5	23.0	2	18.0	2.69	4.0	24.5	71.5	25.3	26.3	16.2	10.1	CL	Lean Clay with Sand
3	11361	400038	ST	10.5	13.0	2	196.9	2.88	0.0				92.2	74.6	18.6	MH	
3	11361	400039	ST	21.0	22.5	2											
3	11361	400040	ST	29.0	31.5	2	102.8	2.96	0.0	4.0	96.0	7.3	45.7	33.9	12.2	ML	Silt
3	11362	400076	SS	6.0	6.5	2	84.6[1]		7.0[1]	32.7[1]	60.3[1]	6.3[1]	51.0[1]	57.8[1]		ML (NP)	
3	11362	400077	SS	6.5	7.0	2	84.6		7.0	32.7	60.3	6.3	51.0	57.8		ML (NP)	Sandy Silt (NP)
3	11362	400041	ST	19.0	21.5	2	87.5	2.88	2.5	47.8	49.7		73.2	56.2	17.0	SM	Silty Sand
3	11362	400042	ST	23.0	25.5	2	173.6	2.60	0.6	42.9	56.5		91.0	56.9	34.1	MH	Sandy Elastic Silt
3	11363	400044	ST	12.0	14.5	2	25.3	2.79	5.3	22.4	72.3	23.0	30.0	24.8	4.6	ML	Silt with Sand
3	11363	400045	ST	19.0	21.5	2	44.7	2.39	2.4	30.7	66.9	7.3	45.7	53.7		ML (NP)	Sandy Silt (NP)
3	1770	13A	CAN			3	145.4		3.2	33.7	63.1		89.7	55.8	33.9	MH	Sandy Elastic Silt
3	1770	14A	CAN			3	152.7		3.5	23.8	72.7		81.8	58.9	22.9	MH	Elastic Silt with Sand
3	1770	15A	CAN			3	42.2	2.69	6.5	25.8	67.7	3.1	46.9	31.7	15.2	ML	Sandy Silt
3	1771	16A	CAN			3	96.8	2.72	3.3	27.0	69.7	15.7	77.8	44.3	33.5	MH	Sandy Elastic Silt
3	1771	17A	CAN			3	142.0		1.0	15.3	83.7		69.9	53.9	16.0	MH	Elastic Silt with Sand
3	1772	18A	CAN			3	41.9		2.5	40.9	56.6		37.9	30.5	7.4	ML	Sandy Silt
3	1772	19A	CAN			3	36.1		6.0	19.9	74.1		44.1	25.2	18.9	CL	Lean Clay with Sand
3	03-05	3-52	COMP	0.0	20.0	4	55.9	2.54			67.0	10.0	52.0	32.0	20.0	MH	Sandy Elastic Silt
3	03-05	3-52 Redue	COMP	0.0	20.0	4	57.0		9.0	25.0	66.0	13.0					
3	03-02	3-90	COMP	0.0	20.0	4	43.3				68.0	11.0	38.0	33.0	5.0	ML	Sandy Silt
3	03-02	3-90 Redue	COMP	0.0	20.0	4	41.6	2.65	5.0	29.0	66.0	15.0					

TABLE 3 – INDEX PROPERTIES DATA

Sample Identification							Index Property Data										
Pit No.	Boring No.	Sample No.	Sample Type	Top Depth (ft)	Bottom Depth (ft)	Data Source	Moisture Content (%dry wgt.)	Specific Gravity Gs	Grain Size Analysis				Atterberg Limits			USCS Group Symbol	Group Name
									Gravel (%)	Sand (%)	Silt or Clay (%)	Clay Fract. (%)	LL	PL	PI		
4	1773	63747	ST	11.0	13.0	1	21.4	2.62	2.1	41.4	56.5	19.0	34.0	26.0	8.0	CL	Sandy Lean Clay
4	1774	63670	ST	10.0	12.0	1	15.9	2.79	0.8	22.6	76.6	20.0	32.0	22.0	10.0	CL	Lean Clay with Sand
4	1774	63687	ST	20.0	22.0	1	17.6	3.10	0.3	7.6	92.1	11.0	NP	NP	NP	ML (NP)	Silt (NP)
4	1775	63826	ST	15.0	17.0	1	61.5	3.59	0.1	36.0	63.9	4.0	41.0	34.0	7.0	CL-ML	Sandy Silty Clay
4	1773	21A	CAN			3	18.0	3.25	6.4	29.5	64.1	6.6	28.4	18.5	9.9	CL	Sandy Lean Clay
4	1773	22A	CAN			3	23.3		0.0	12.0	88.0		NP	NP	NP	ML (NP)	Silt (NP)
4	1773	23A	CAN			3	22.2	3.02	0.8	15.2	84.0	8.4	NP	NP	NP	ML (NP)	Silt (NP) with Sand
4	1775	24A	CAN			3	10.1		13.4	24.7	61.9		33.9	16.7	17.2	CL	Sandy Lean Clay
4	1775	25A	CAN			3	25.4		1.2	34.7	64.1		34.1	21.8	12.3	CL	Sandy Lean Clay
4	1775	26A	CAN			3	29.3		1.2	18.0	80.8		NP	NP	NP	ML (NP)	Silt (NP) with Sand
4	04-01	4-02	COMP	0.0	20.0	4	27.0	2.75	0.0	6.0	94.0	6.0	NP	NP	NP	ML (NP)	Silt (NP)
4	04-04	4-62	COMP	0.0	20.0	4	28.6	3.33	7.0	38.0	55.0	6.0	NP	NP	NP	ML (NP)	Sandy Silt (NP)
4	04-04	4-62 Redue	COMP	0.0	20.0	4		3.63									

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TABLE 3 – INDEX PROPERTIES DATA

Sample Identification							Index Property Data										
Pit No.	Boring No.	Sample No.	Sample Type	Top Depth (ft)	Bottom Depth (ft)	Data Source	Moisture Content (%dry wgt.)	Specific Gravity Gs	Grain Size Analysis: Gravel (%)	Sand (%)	Silt or Clay (%)	Clay Fract. (%)	Atterberg Limits: LL	PL	PI	USCS Group Symbol	Group Name
5	(3)	30A	CAN			3	173.0		0.0	5.0	95.0		70.7	57.7	13.0	MH	Elastic Silt
5	(3)	31A	CAN			3	497.5		0.0	5.2	94.8		94.2	50.6	43.6	MH	Elastic Silt
5	(3)	32A	CAN			3	483.0		0.0	3.4	96.6		102.2	80.5	21.7	MH	Elastic Silt
5	(3)	33A	CAN			3	507.3		0.0	1.3	98.7		108.4	71.8	36.6	MH	Elastic Silt
5	(3)	34A	CAN			3	451.7		0.0	1.9	98.1		102.2	64.4	37.6	MH	Elastic Silt
5	(3)	35A	CAN			3	161.1	2.70	0.0	11.9	88.1	14.5	90.9	60.2	30.7	MH	Elastic Silt
5	(3)	36A	CAN			3	342.4		0.0	8.1	91.9		103.8	75.6	28.2	MH	Elastic Silt
5	(3)	37A	CAN			3	620.0		0.0	0.2	99.8		93.0	58.0	35.0	MH	Elastic Silt
5	(3)	38A	CAN			3	495.7	2.74	0.0	2.7	97.3		112.3	68.1	44.2	MH	Elastic Silt
5	(3)	39A	CAN			3	448.5		0.0	5.9	94.1		112.0	69.6	42.4	MH	Elastic Silt
5	(3)	40A	CAN			3	114.5		0.0	5.5	94.5		NP	NP	NP	ML (NP)	Silt (NP)
5	(3)	41A	CAN			3	109.3	2.71	0.0	6.0	94.0	8.9	NP	NP	NP	ML (NP)	Silt (NP)
5	(3)	57A	CAN			3	242.3		0.0	14.6	85.4		87.7	60.9	26.8	MH	Elastic Silt
5	(3)	58A	CAN			3	295.7	2.70	0.0	10.4	89.6	10.2	77.1	52.7	24.4	MH	Elastic Silt
5	05-04	5-25	COMP	10.0	29.0	4	189.5	2.43	0.0	30.0	70.0	2.0	81.0	52.0	29.0	MH	Sandy Elastic Silt
5	1	*****		14.0	14.5												
5	1	*****		19.0	19.5												
5	1	*****		24.5	25.0												
5	3	*****		13.5	14.0												
5	3	*****		19.0	19.5												
5	3	*****		23.5	24.0												
5	5	*****		14.5	15.0												
5	5	*****		19.5	20.0												
5	5	*****		24.5	25.0												
5	7	*****		13.5	14.0												
5	7	*****		18.5	19.0												
5	7	*****		23.5	24.0												
5	9	*****		15.0	15.5												
5	9	*****		20.0	20.5												
5	9	*****		25.0	25.5												
5	11	*****		13.5	14.0												
5	11	*****		18.5	19.0												
5	11	*****		23.5	24.0												
5	13	*****		13.5	14.0												
5	13	*****		18.5	19.0												
5	13	*****		23.5	24.0												
5	15	*****		13.5	14.0												
5	15	*****		18.5	19.0												
5	15	*****		23.5	24.0												
5	17	*****		13.5	14.0												
5	17	*****		18.5	19.0												
5	17	*****		23.5	24.0												
5	19	*****		13.5	14.0												
5	19	*****		18.5	19.0												
5	19	*****		23.5	24.0												
5	23	*****		12.0	12.5												
5	23	*****		17.0	17.5												
5	23	*****		22.0	22.5												
5	25	*****		15.5	16.0												
5	27	*****		13.5	14.0												
5	29	*****		10.5	11.0												
5	29	*****		15.5	16.0												
5	*****	*****		***	***												

TABLE 3 – INDEX PROPERTIES DATA

Sample Identification							Index Property Data										
									Grain Size Analysis				Atterberg Limits				
Pit No.	Boring No.	Sample No.	Sample Type	Top Depth (ft)	Bottom Depth (ft)	Data Source	Moisture Content (%dry wgt.)	Specific Gravity Gs	Gravel (%)	Sand (%)	Silt or Clay (%)	Clay Fract. (%)	LL	PL	PI	USCS Group Symbol	Group Name
6	1	405344		12.5	13.0												
6	Ret Sludge	405346		11.5	12.0												
6	3	405348		8.5	9.0												
6	3	405348		13.5	14.0												
6	4	405350		10.5	11.0												
6	5	405352		7.0	7.5												
6	5	405352		12.5	13.0												
6	5	405352		18.0	18.5												
6	6	405354		7.5	8.0												
6	6	405354		12.5	13.0												
6	6	405354		17.5	18.0												
6	7	405355		12.5	13.0												
6	7	405355		17.5	18.0												
6	(3)	43A	CAN			3	425.1		0.0	3.7	96.3		NP	NP	NP	ML (NP)	Silt (NP)
6	(3)	45A	CAN			3	26.8	3.21	0.0	27.6	72.4	9.6	NP	NP	NP	ML (NP)	Silt (NP) with Sand
6	(3)	45C	CAN			3	117.6		0.0	51.3	48.7		NP	NP	NP	SM	Silty Sand
6	(3)	46A	CAN			3	107.4	2.98	0.0	13.8	86.2	27.9	47.0	28.4	18.6	ML	Silt
6	(3)	47A	CAN			3	111.4	2.85	0.0	9.8	90.2	35.2	64.9	33.1	31.8	MH	Elastic Silt
6	06-04	6-10	COMP	0.0	10.0	4	60.4	2.87	0.0	21.0	79.0	7.0	NP	NP	NP	ML (NP)	Silt (NP) with Sand
6	06-03	6-22	COMP	0.0	15.0	4	50.5		0.0	32.0	68.0	8.0	NP	NP	NP	ML (NP)	Sandy Silt (NP)

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TABLE 3 – INDEX PROPERTIES DATA

Sample Identification							Index Property Data										
Pit No.	Boring No.	Sample No.	Sample Type	Top Depth (ft)	Bottom Depth (ft)	Data Source	Moisture Content (%dry wgt.)	Specific Gravity Gs	Grain Size Analysis				Atterberg Limits			USCS Group Symbol	Group Name
									Gravel (%)	Sand (%)	Silt or Clay (%)	Clay Fract. (%)	LL	PL	PI		
CW	(3)	49A	CAN			3	53.4		3.3	31.1	65.6		43.9	25.6	18.3	CL	Sandy Lean Clay
CW	(3)	50A	CAN			3	65.1		10.9	36.4	52.7		50.6	32.5	18.1	MH	Sandy Elastic Silt
CW	(3)	51A	CAN			3	61.9		0.0	51.5	48.5		45.0	28.0	17.0	SM	Silty Sand
CW	(3)	52A	CAN			3	40.2		8.5	47.0	44.5		39.3	24.9	14.4	SM	Silty Sand
CW	(3)	53A	CAN			3	35.4	2.69	0.0	39.4	60.6	22.3	35.1	18.0	17.1	CL	Sandy Lean Clay
CW	(3)	54A	CAN			3	73.9		0.5	22.5	77.0		54.7	39.2	15.5	MH	Elastic Silt with Sand
CW	(3)	55A	CAN			3	71.7	2.78	1.8	23.7	74.5	23.8	52.4	38.0	14.4	MH	Elastic Silt with Sand
CW	(3)	56A	CAN			3	68.5		3.3	31.3	65.4		53.3	40.2	13.1	MH	Sandy Elastic Silt

TABLE 3 – INDEX PROPERTIES DATA

Sample Identification							Index Property Data										
Pit No.	Boring No.	Sample No.	Sample Type	Top Depth (ft)	Bottom Depth (ft)	Data Source	Moisture Content (%dry wgt.)	Specific Gravity Gs	Grain Size Analysis				Atterberg Limits			USCS Group Symbol	Group Name
									Gravel (%)	Sand (%)	Silt or Clay (%)	Clay Fract. (%)	LL	PL	PI		
BP	1776	63176	ST	4.5	6.0	1	43.3	3.74	6.9	46.0	47.1	9.0	NP	NP	NP	SM	Silty Sand
BP	1776	27A	CAN			3	25.5		2.6	26.2	71.2		41.3	24.7	16.6	CL	Lean Clay with Sand
BP	1777	28A	CAN			3	25.6		4.4	37.0	58.6		35.1	31.0	4.1	ML	Sandy Silt
BP	1819	29A	CAN			3	30.0	2.50	8.5	38.2	53.3	15.0	37.8	26.7	11.1	ML	Sandy Silt
BP	07-01	7-02	COMP	0.0	10.0	4	30.1	2.46	10.0	54.0	36.0	4.0	NP	NP	NP	SM	Silty Sand
BP	07-04	7-34	COMP	0.0	16.0	4	30.2		13.0	30.0	57.0	15.0	36.0	34.0	2.0	ML	Sandy Silt
BP	07-04	7-34 Redue	COMP	0.0	16.0	4							33.0	30.0	3.0		
BP	07-06	7-52	COMP	0.0	16.0	4	29.2	2.35	13.0	47.0	40.0	6.0	NP	NP	NP	SM	Silty Sand

TABLE 3 – INDEX PROPERTIES DATA

Sample Identification							Index Property Data										
Pit No.	Boring No.	Sample No.	Sample Type	Top Depth (ft)	Bottom Depth (ft)	Data Source	Moisture Content (%dry wgt.)	Specific Gravity Gs	Grain Size Analysis				Atterberg Limits			USCS Group Symbol	Group Name
									Gravel (%)	Sand (%)	Silt or Clay (%)	Clay Fract. (%)	LL	PL	PI		
1, 4	1766, 1773	Group 1	CAN COMP			3							21.3	NP	NP	ML (NP1)	Non-plastic Silt 1
5, 6	(3)	Group 2	CAN COMP			3							48.9	NP	NP	ML (NP2)	Non-plastic Silt 2
5	(3)	Group 3	CAN COMP			3							89.3	56.9	32.4	MH1	Elastic Silt 1
2, 3	1818, 1771	Group 4	CAN COMP			3							59.8	40.1	19.7	MH2	Elastic Silt 2
6, BP	1819(3)	Group 5	CAN COMP			3							36.8	27.8	9.0	ML	Silt
4	1773, 1775	Group 6	CAN COMP			3							28.2	19.4	8.8	CL	Clay
2, CW	1768(3)	Group 7	CAN COMP			3							32.2	23.8	8.4	SM	Silty Sand

TABLE 4 – IN SITU PHYSICAL PROPERTIES

Sample Identification							Unit Weight Data			UU Triaxial Data				CU Triaxial Data				Lab Perm. Data	Consolidation Test Data		
Pit No.	Boring No.	Sample No.	Sample Type	Top Depth (ft)	Bottom Depth (ft)	Data Source	Dry Density (pcf)	Moisture Content (% dry wgt)	Wet Density (pcf)	Minor Princ. Stress (psi)	Major Princ. Stress (psi)	Max. Dev. Stress (psi)	Axial Strain (%)	$Ø_c$ (deg)	c_c (psi)	$Ø_d$ (deg)	c_d (psi)	Coeff. of Permeability (cm/sec)	Compression Index C_c	Recompression Index C_r	Initial Void Ratio
1	1765	63089	ST	4.5	7.0	1	110.4 (2)	23.4 (2)													
1	1765	63101	ST	14.0	16.5	1	120.5	20.9		85.0	132.4	47.4	15.0								
1	1766	63050	ST	4.5	7.0	1	114.9	19.5													
1	1766	63054	ST	8.5	11.0	1	117.9	18.7										1.20E-05	0.08	0.01	0.13
1	1766	63062	ST	14.0	16.5	1															
1	1767	63008	ST	3.5	6.0	1															
1	11352	400053	SS	2.0	3.0	2															
1	11352	400054	SS	5.5	6.0	2															
1	11352	400025	ST	7.5	10.0	2	115.4	19.7	138.1												
1	11352	400026	ST	11.5	14.0	2	74.9	44.9	108.5												
1	11353	400047	SS	4.5	5.5	2															
1	11353	400028	ST	10.0	12.5	2	109.4	24.0	135.7												
1	11353	400051	SS	13.5	14.0	2															
1	11354	400029	ST	7.5	10.0	2	111.2	23.0	138.8												
1	11354	400030	ST	11.5	14.0	2															
1	1765	1A	CAN			3															
1	1765	2A	CAN			3															
1	1765	3A	CAN			3															
1	1766	4A	CAN			3															
1	1766	5A	CAN			3															
1	1766	6A	CAN			3															
1	1766	7A	CAN			3															
1	1767	8A	CAN			3															
1		1-48	COMP	0.0	12.0	4															

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TABLE 4 – IN SITU PHYSICAL PROPERTIES

Sample Identification							Unit Weight Data			UU Triaxial Data				CU Triaxial Data				Lab Perm. Data	Consolidation Test Data		
Pit No.	Boring No.	Sample No.	Sample Type	Top Depth (ft)	Bottom Depth (ft)	Data Source	Dry Density (pcf)	Moisture Content (% dry wgt)	Wet Density (pcf)	Minor Princ. Stress (psi)	Major Princ. Stress (psi)	Max. Dev. Stress (psi)	Axial Strain (%)	$Ø_c$ (deg)	c_c (psi)	$Ø_d$ (deg)	c_d (psi)	Coeff. of Permeability (cm/sec)	Compression Index C_c	Recompression Index C_r	Initial Void Ratio
2	1768	63619	ST	11.0 (1)	13.0 (1)	1	19.86(1)	290.0													
2	1768	63619dup	ST	11.0 (1)	13.0 (1)	1	18.15(1)	316.6													
2	1769	63521	ST	12.0	14.0	1		231.2	78.5 (1)												
2	1769	63530	ST	16.0	20.0	1												1.30E-07	2.20	0.10	6.00
2	1817	63875	ST	10.5	12.5	1		32.7	112.5 (1)												
2	1818	63885	ST	5.0	7.5	1													0.40	0.02	0.96
2	11358	400031	ST	6.0	8.5	2	105.7	24.1	131.2												
2	11358	400062	SS	8.5	9.0	2															
2	11359	400033	ST	4.5	7.0	2	42.9	109.6	90.0												
2	11359	400034	ST	8.5	11.0	2	45.6	97.7	90.2												
2	1768	9A	CAN			3															
2	1769	10A	CAN			3															
2	1818	11A	CAN			3															
2	1817	12A	CAN			3															
2	02-05	2-39	COMP	0.0	10.0	4															

TABLE 4 – IN SITU PHYSICAL PROPERTIES

Sample Identification							Unit Weight Data			UU Triaxial Data				CU Triaxial Data				Lab Perm. Data	Consolidation Test Data		
Pit No.	Boring No.	Sample No.	Sample Type	Top Depth (ft)	Bottom Depth (ft)	Data Source	Dry Density (pcf)	Moisture Content (% dry wgt)	Wet Density (pcf)	Minor Princ. Stress (psi)	Major Princ. Stress (psi)	Max. Dev. Stress (psi)	Axial Strain (%)	$Ø_s$ (deg)	c_s (psi)	$Ø_d$ (deg)	c_d (psi)	Coeff. of Permeability (cm/sec)	Compression Index C_c	Recompression Index C_r	Initial Void Ratio
3	1770	63328	ST	4.0	6.0	1		63.7	81.3 (*)	90.0	131.8	41.8	15.0								
3	1770	63357	ST	20.0	22.0	1		138.7	90.1 (*)												
3	1770	63370	ST	28.0	30.0	1												7.60E-07	1.20	0.05	3.75
3	1771	63458	ST	32.0	34.0	1		35.4	75.1 (*)									3.80E-07			
3	1772	63278	ST	19.5	22.0	1													0.40	0.05	1.75
3	11360	400097	SS	13.0	13.5	2															
3	11360	400100	SS	13.5	14.0	2															
3	11360	400035	ST	20.5	23.0	2	110.0	17.9	129.7												
3	11361	400038	ST	10.5	13.0	2	25.5	196.9	75.7												
3	11361	400039	ST	21.0	22.5	2															
3	11361	400040	ST	29.0	31.5	2	44.8	102.5	90.7					23.9	0.0	33.7	0.0				
3	11362	400076	SS	6.0	6.5	2															
3	11362	400077	SS	6.5	7.0	2															
3	11362	400041	ST	19.0	21.5	2															
3	11362	400042	ST	23.0	25.5	2								15.0	1.5	39.0	0.0				
3	11363	400044	ST	12.0	14.5	2								16.0	0.7	32.9	0.0				
3	11363	400045	ST	19.0	21.5	2	64.3	44.6	93.0												
3	1770	13A	CAN			3															
3	1770	14A	CAN			3															
3	1770	15A	CAN			3															
3	1771	16A	CAN			3															
3	1771	17A	CAN			3															
3	1772	18A	CAN			3															
3	1772	19A	CAN			3															
3	03-05	3-52	COMP	0.0	20.0	4															
3	03-05	3-52 Reduc	COMP	0.0	20.0	4															
3	03-02	3-90	COMP	0.0	20.0	4															
3	03-02	3-90 Reduc	COMP	0.0	20.0	4															

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TABLE 4 – IN SITU PHYSICAL PROPERTIES

Sample Identification							Unit Weight Data			UU Triaxial Data				CU Triaxial Data				Lab Perm. Data	Consolidation Test Data		
Pit No.	Boring No.	Sample No.	Sample Type	Top Depth (ft)	Bottom Depth (ft)	Data Source	Dry Density (pcf)	Moisture Content (% dry wgt)	Wet Density (pcf)	Minor Princ. Stress (psi)	Major Princ. Stress (psi)	Max. Dev. Stress (psi)	Axial Strain (%)	$Ø_s$ (deg)	c_s (psi)	$Ø_d$ (deg)	c_d (psi)	Coeff. of Permeability (cm/sec)	Compression Index C_c	Recompression Index C_r	Initial Void Ratio
4	1773	63747	ST	11.0	13.0	1		21.4	148.4 (*)												
4	1774	63870	ST	10.0	12.0	1		15.9	110.7 (*)	90.0	155.8	65.8	15.0								
4	1774	63687	ST	20.0	22.0	1															
4	1775	63826	ST	15.0	17.0	1		61.5	110.7 (*)									4.80E-06	0.09	0.02	0.41
4	1773	21A	CAN			3															
4	1773	22A	CAN			3															
4	1773	23A	CAN			3															
4	1775	24A	CAN			3															
4	1775	25A	CAN			3															
4	1775	26A	CAN			3															
4	04-01	4-02	COMP	0.0	20.0	4															
4	04-04	4-62	COMP	0.0	20.0	4															
4	04-04	4-62 Redue	COMP	0.0	20.0	4															

TABLE 4 – IN SITU PHYSICAL PROPERTIES

Sample Identification							Unit Weight Data			UU Triaxial Data				CU Triaxial Data				Lab Perm. Data	Consolidation Test Data		
Pit No.	Boring No.	Sample No.	Sample Type	Top Depth (ft)	Bottom Depth (ft)	Data Source	Dry Density (pcf)	Moisture Content (% dry wgt)	Wet Density (pcf)	Minor Princ. Stress (psi)	Major Princ. Stress (psi)	Max. Dev. Stress (psi)	Axial Strain (%)	$Ø_s$ (deg)	c_s (psi)	$Ø_d$ (deg)	c_d (psi)	Coeff. of Permeability (cm/sec)	Compression Index C_c	Recompression Index C_r	Initial Void Ratio
5	(3)	30A	CAN			3															
5	(3)	31A	CAN			3															
5	(3)	32A	CAN			3															
5	(3)	33A	CAN			3															
5	(3)	34A	CAN			3															
5	(3)	35A	CAN			3															
5	(3)	36A	CAN			3															
5	(3)	37A	CAN			3															
5	(3)	38A	CAN			3															
5	(3)	39A	CAN			3															
5	(3)	40A	CAN			3															
5	(3)	41A	CAN			3															
5	(3)	57A	CAN			3															
5	(3)	58A	CAN			3															
5	05-04	5-25	COMP	10.0	29.0	4															
5	1	*****		14.0	14.5		5.2 (UU)	1141.2	64.7 (UU)												
5	1	*****		19.0	19.5		11.0 (UU)	529.1	69.0 (UU)												
5	1	*****		24.5	25.0		15.6 (UU)	380.7	72.0 (UU)												
5	3	*****		13.5	14.0		19.5 (UU)	302.8	78.6 (UU)												
5	3	*****		18.0	18.5		12.8 (UU)	454.6	69.8 (UU)												
5	3	*****		23.5	24.0		10.3 (UU)	566.0	68.7 (UU)												
5	5	*****		14.5	15.0		18.4 (UU)	293.2	72.3 (UU)												
5	5	*****		19.5	20.0		10.8 (UU)	523.2	67.0 (UU)												
5	5	*****		24.5	25.0		12.1 (UU)	500.8	72.4 (UU)												
5	7	*****		13.5	14.0		12.4 (UU)	447.8	68.1 (UU)												
5	7	*****		18.5	19.0		10.7 (UU)	551.0	69.6 (UU)												
5	7	*****		23.5	24.0		18.2 (UU)	295.0	71.7 (UU)												
5	9	*****		15.0	15.5		12.6 (UU)	448.4	69.1 (UU)												
5	9	*****		20.0	20.5		13.5 (UU)	418.6	70.2 (UU)												
5	9	*****		25.0	25.5		15.1 (UU)	372.1	71.1 (UU)												
5	11	*****		13.5	14.0		6.5 (UU)	931.6	67.4 (UU)												
5	11	*****		18.5	19.0		10.2 (UU)	576.7	69.0 (UU)												
5	11	*****		23.5	24.0		28.6 (UU)	182.9	81.7 (UU)												
5	13	*****		13.5	14.0		11.1 (UU)	525.6	69.4 (UU)												
5	13	*****		18.5	19.0		10.1 (UU)	576.2	68.0 (UU)												
5	13	*****		23.5	24.0		28.1 (UU)	185.5	80.1 (UU)												
5	15	*****		13.5	14.0		10.8 (UU)	537.1	68.8 (UU)												
5	15	*****		18.5	19.0		12.7 (UU)	457.1	70.9 (UU)												
5	15	*****		23.5	24.0		38.8 (UU)	120.4	85.6 (UU)												
5	17	*****		13.5	14.0		6.9 (UU)	870.8	66.7 (UU)												
5	17	*****		18.5	19.0		11.5 (UU)	505.5	68.9 (UU)												
5	17	*****		23.5	24.0		31.6 (UU)	182.8	83.1 (UU)												
5	19	*****		13.5	14.0		16.6 (UU)	351.1	74.7 (UU)												
5	19	*****		18.5	19.0		19.5 (UU)	281.5	74.3 (UU)												
5	19	*****		23.5	24.0		57.7 (UU)	73.4	100.1 (UU)												
5	23	*****		12.0	12.5		23.7 (UU)	197.2	70.5 (UU)												
5	23	*****		17.0	17.5		33.5 (UU)	107.0	69.3 (UU)												
5	23	*****		22.0	22.5		51.6 (UU)	77.9	92.2 (UU)												
5	25	*****		15.5	16.0		27.4 (UU)	156.2	70.9 (UU)												
5	27	*****		13.5	14.0		32.1 (UU)	124.6	72.0 (UU)												
5	29	*****		10.5	11.0		23.9 (UU)	196.1	70.9 (UU)												
5	29	*****		15.5	16.0		25.2 (UU)	195.9	74.6 (UU)												
5	*****	*****		***	***		20.1 (UU)	241.0	68.6 (UU)												

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TABLE 4 – IN SITU PHYSICAL PROPERTIES

Sample Identification							Unit Weight Data			UU Triaxial Data				CU Triaxial Data				Lab Perm. Data	Consolidation Test Data		
Pit No.	Boring No.	Sample No.	Sample Type	Top Depth (ft)	Bottom Depth (ft)	Data Source	Dry Density (pcf)	Moisture Content (% dry wgt)	Wet Density (pcf)	Minor Princ. Stress (psi)	Major Princ. Stress (psi)	Max. Dev. Stress (psi)	Axial Strain (%)	$Ø_s$ (deg)	c_s (psi)	$Ø_d$ (deg)	c_d (psi)	Coeff. of Permeability (cm/sec)	Compression Index C_c	Recompression Index C_r	Initial Void Ratio
6	1	405344		12.5	13.0		35.4	135.6	83.4												
6	Ret Sludge	405346		11.5	12.0		108.3	23.4	133.6												
6	3	405348		8.5	9.0		137.7	14.7	157.9												
6	3	405348		13.5	14.0		138.2	13.1	156.3												
6	4	405350		10.5	11.0		90.8	36.1	123.6												
6	5	405352		7.0	7.5		130.2	15.9	150.9												
6	5	405352		12.5	13.0		142.9	15.2	164.6												
6	5	405352		18.0	18.5		96.8	33.6	129.3												
6	6	405354		7.5	8.0		139.7	11.2	155.4												
6	6	405354		12.5	13.0		143.2	12.3	160.8												
6	6	405354		17.5	18.0		148.5	14.6	170.2												
6	7	405355		12.5	13.0		138.7	17.1	162.4												
6	7	405355		17.5	18.0		142.6	13.4	161.7												
6	(3)	43A	CAN			3															
6	(3)	45A	CAN			3															
6	(3)	45C	CAN			3															
6	(3)	46A	CAN			3															
6	(3)	47A	CAN			3															
6	06-04	6-10	COMP	0.0	10.0	4															
6	06-03	6-22	COMP	0.0	15.0	4															

TABLE 4 – IN SITU PHYSICAL PROPERTIES

Sample Identification							Unit Weight Data			UU Triaxial Data				CU Triaxial Data				Lab Perm. Data	Consolidation Test Data		
Pit No.	Boring No.	Sample No.	Sample Type	Top Depth (ft)	Bottom Depth (ft)	Data Source	Dry Density (pcf)	Moisture Content (% dry wgt)	Wet Density (pcf)	Minor Princ. Stress (psi)	Major Princ. Stress (psi)	Max. Dev. Stress (psi)	Axial Strain (%)	$Ø_s$ (deg)	c_s (psi)	$Ø_d$ (deg)	c_d (psi)	Coeff. of Permeability (cm/sec)	Compression Index C_c	Recompression Index C_r	Initial Void Ratio
CW	(3)	49A	CAN			3															
CW	(3)	50A	CAN			3															
CW	(3)	51A	CAN			3															
CW	(3)	52A	CAN			3															
CW	(3)	53A	CAN			3															
CW	(3)	54A	CAN			3															
CW	(3)	55A	CAN			3															
CW	(3)	56A	CAN			3															

TABLE 4 – IN SITU PHYSICAL PROPERTIES

Sample Identification							Unit Weight Data			UU Triaxial Data				CU Triaxial Data				Lab Perm. Data	Consolidation Test Data		
Pit No.	Boring No.	Sample No.	Sample Type	Top Depth (ft)	Bottom Depth (ft)	Data Source	Dry Density (pcf)	Moisture Content (% dry wgt)	Wet Density (pcf)	Minor Princ. Stress (psi)	Major Princ. Stress (psi)	Max. Dev. Stress (psi)	Axial Strain (%)	$Ø_u$ (deg)	c_u (psi)	$Ø_d$ (deg)	c_d (psi)	Coeff. of Permeability (cm/sec)	Compression Index C_c	Recompression Index C_r	Initial Void Ratio
BP	1776	63176	ST	4.5	6.0	1		43.3	101.4 (1)									5.20E-07	0.20	0.02	1.35
BP	1776	27A	CAN			3															
BP	1777	28A	CAN			3															
BP	1819	29A	CAN			3															
BP	07-01	7-02	COMP	0.0	10.0	4															
BP	07-04	7-34	COMP	0.0	16.0	4															
BP	07-04	7-34 Redue	COMP	0.0	16.0	4															
BP	07-06	7-52	COMP	0.0	16.0	4															

TABLE 4 – IN SITU PHYSICAL PROPERTIES

Sample Identification							Unit Weight Data			UU Triaxial Data				CU Triaxial Data				Lab Perm. Data	Consolidation Test Data		
Pit No.	Boring No.	Sample No.	Sample Type	Top Depth (ft)	Bottom Depth (ft)	Data Source	Dry Density (pcf)	Moisture Content (% dry wgt)	Wet Density (pcf)	Minor Princ. Stress (psi)	Major Princ. Stress (psi)	Max. Dev. Stress (psi)	Axial Strain (%)	$Ø_s$ (deg)	c_s (psi)	$Ø_d$ (deg)	c_d (psi)	Coeff. of Permeability (cm/sec)	Compression Index C_c	Recompression Index C_r	Initial Void Ratio
1, 4	1766, 1773	Group 1	CAN COMP			3															
5, 6	(3)	Group 2	CAN COMP			3															
5	(3)	Group 3	CAN COMP			3															
2, 3	1818, 1771	Group 4	CAN COMP			3															
6, BP	1819(3)	Group 5	CAN COMP			3															
4	1773, 1775	Group 6	CAN COMP			3															
2, CW	1768(3)	Group 7	CAN COMP			3															

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TABLE 5 – REMOLDED PHYSICAL PROPERTIES

Sample Identification							Unit Weight	Compaction Test Data		Remolded Strength				Rem. Lab Perm.	Remolded Consilidation Tests					
										UCS		Direct Shear								
Pit No.	Boring No.	Sample No.	Sample Type	Top Depth (ft)	Bottom Depth (ft)	Data Source	Remolded Wet Density	OMC (%)	Std. Proc. MDD (pcf)	q_u (psf)	c_u (psf)	c_{ad} (psf)	$\varnothing_{ad}$ (degrees)	Coeff of Perm. k (cm/s)	Dry Density (pcf)	Moisture Content (%)	Avg. Coeff. of Consol. C_v (cm^2/sec)	Comp. Index C_c	Initial Void Ratio	Percent Compact.
1	1765	63089	ST	4.5	7.0	1														
1	1765	63101	ST	14.0	16.5	1														
1	1766	63050	ST	4.5	7.0	1														
1	1766	63054	ST	8.5	11.0	1														
1	1766	63062	ST	14.0	16.5	1														
1	1767	63008	ST	3.5	6.0	1														
1	11352	400053	SS	2.0	3.0	2														
1	11352	400054	SS	5.5	8.0	2														
1	11352	400025	ST	7.5	10.0	2														
1	11352	400026	ST	11.5	14.0	2														
1	11353	400047	SS	4.5	5.5	2														
1	11353	400028	ST	10.0	12.5	2														
1	11353	400051	SS	13.5	14.0	2														
1	11354	400029	ST	7.5	10.0	2														
1	11354	400030	ST	11.5	14.0	2														
1	1765	1A	CAN			3														
1	1765	2A	CAN			3														
1	1765	3A	CAN			3														
1	1766	4A	CAN			3														
1	1766	5A	CAN			3														
1	1766	6A	CAN			3														
1	1766	7A	CAN			3														
1	1767	8A	CAN			3														
1		1-46	COMP	0.0	12.0	4		17.3 (*)	109.4 (*)						103.6	20.0	1.8E-03	0.138	0.58	94.7

TABLE 5 – REMOLDED PHYSICAL PROPERTIES

Sample Identification							Unit Weight	Compaction Test Data		Remolded Strength				Rem. Lab Perm.	Remolded Consolidation Tests					
										UCS		Direct Shear								
Pit No.	Boring No.	Sample No.	Sample Type	Top Depth (ft)	Bottom Depth (ft)	Data Source	Remolded Wet Density	OMC (%)	Std. Proc. MDD (pcf)	q_u (psf)	c_u (psf)	c_{ed} (psf)	$\varnothing_{ed}$ (degrees)	Coeff of Perm. k (cm/s)	Dry Density (pcf)	Moisture Content (%)	Avg. Coeff. of Consol. C_v (cm^2/sec)	Comp. Index C_c	Intial Void Ratio	Percent Compact.
2	1768	63619	ST	11.0 (1)	13.0 (1)	1														
2	1768	63619dup	ST	11.0 (1)	13.0 (1)	1														
2	1769	63521	ST	12.0	14.0	1														
2	1769	63530	ST	18.0	20.0	1	116.6 (3)													
2	1817	63875	ST	10.5	12.5	1														
2	1818	63865	ST	5.0	7.5	1	145.7 (3)													
2	11358	400031	ST	6.0	8.5	2														
2	11358	400062	SS	8.5	9.0	2														
2	11359	400033	ST	4.5	7.0	2														
2	11359	400034	ST	8.5	11.0	2														
2	1768	9A	CAN			3														
2	1769	10A	CAN			3														
2	1818	11A	CAN			3														
2	1817	12A	CAN			3														
2	02-05	2-39	COMP	0.0	10.0	4		17.5 (5)	86.3 (5)						81.8	20.3	5.8E-03	0.244	0.98	94.8

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TABLE 5 – REMOLDED PHYSICAL PROPERTIES

Sample Identification							Unit Weight	Compaction Test Data		Remolded Strength				Rem. Lab Perm.	Remolded Consolidation Tests					
										UCS		Direct Shear								
Pit No.	Boring No.	Sample No.	Sample Type	Top Depth (ft)	Bottom Depth (ft)	Data Source	Remolded Wet Density	OMC (%)	Std. Proc. MDD (pcf)	q_u (psf)	c_u (psf)	c_{ed} (psf)	$\varnothing_{ed}$ (degrees)	Coeff of Perm. k (cm/s)	Dry Density (pcf)	Moisture Content (%)	Avg. Coeff. of Consol. C_v (cm^2/sec)	Comp. Index C_c	Initial Void Ratio	Percent Compact.
3	1770	63328	ST	4.0	6.0	1														
3	1770	63357	ST	20.0	22.0	1														
3	1770	63370	ST	28.0	30.0	1														
3	1771	63458	ST	32.0	34.0	1	116.3 (3)													
3	1772	63278	ST	19.5	22.0	1	118.3 (3)													
3	11360	400097	SS	13.0	13.5	2														
3	11360	400100	SS	13.5	14.0	2														
3	11360	400035	ST	20.5	23.0	2														
3	11361	400038	ST	10.5	13.0	2														
3	11361	400039	ST	21.0	22.5	2														
3	11361	400040	ST	29.0	31.5	2														
3	11362	400076	SS	6.0	6.5	2														
3	11362	400077	SS	6.5	7.0	2														
3	11362	400041	ST	19.0	21.5	2														
3	11362	400042	ST	23.0	25.5	2														
3	11363	400044	ST	12.0	14.5	2														
3	11363	400045	ST	19.0	21.5	2														
3	1770	13A	CAN			3														
3	1770	14A	CAN			3														
3	1770	15A	CAN			3														
3	1771	16A	CAN			3														
3	1771	17A	CAN			3														
3	1772	18A	CAN			3														
3	1772	19A	CAN			3														
3	03-05	3-52	COMP	0.0	20.0	4														
3	03-05	3-52 Redue	COMP	0.0	20.0	4														
3	03-02	3-90	COMP	0.0	20.0	4														
3	03-02	3-90 Redue	COMP	0.0	20.0	4		26.4 (5)	88.3 (5)						83.0	30.1	1.6E-02	0.135	0.91	94.0

TABLE 5 – REMOLDED PHYSICAL PROPERTIES

Sample Identification							Unit Weight	Compaction Test Data		Remolded Strength				Rem. Lab Perm.	Remolded Consilidation Tests					
										UCS		Direct Shear								
Pit No.	Boring No.	Sample No.	Sample Type	Top Depth (ft)	Bottom Depth (ft)	Data Source	Remolded Wet Density	OMC (%)	Std. Proc. MDD (pcf)	q_u (psf)	c_u (psf)	c_{sd} (psf)	$\varnothing_{sd}$ (degrees)	Coeff of Perm. k (cm/s)	Dry Density (pcf)	Moisture Content (%)	Avg. Coeff. of Consol. C_v (cm^2/sec)	Comp. Index C_c	Intial Void Ratio	Percent Compact.
4	1773	63747	ST	11.0	13.0	1														
4	1774	63670	ST	10.0	12.0	1														
4	1774	63687	ST	20.0	22.0	1														
4	1775	63826	ST	15.0	17.0	1														
4	1773	21A	CAN			3														
4	1773	22A	CAN			3														
4	1773	23A	CAN			3														
4	1775	24A	CAN			3														
4	1775	25A	CAN			3														
4	1775	26A	CAN			3														
4	04-01	4-02	COMP	0.0	20.0	4														
4	04-04	4-62	COMP	0.0	20.0	4		18.2 (6)	120.6 (6)						114.3	22.4	1.8E-02	0.159	0.98	94.8
4	04-04	4-62 Redue	COMP	0.0	20.0	4														

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TABLE 5 – REMOLDED PHYSICAL PROPERTIES

Sample Identification							Unit Weight	Compaction Test Data		Remolded Strength				Rem. Lab Perm.	Remolded Consilidation Tests					
										UCS		Direct Shear								
Pit	Boring No.	Sample No.	Sample Type	Top Depth (ft)	Bottom Depth (ft)	Data Source	Remolded Wet Density	OMC (%)	Std. Proc. MDD (pcf)	q_u (psf)	c_u (psf)	c_{ad} (psf)	ϕ_{ad} (degrees)	Coeff of Perm. k (cm/s)	Dry Density (pcf)	Moisture Content (%)	Avg. Coeff. of Consol. C_v (cm^2/sec)	Comp. Index C_c	Intial Void Ratio	Percent Compact.
5	(3)	30A	CAN			3														
5	(3)	31A	CAN			3														
5	(3)	32A	CAN			3														
5	(3)	33A	CAN			3														
5	(3)	34A	CAN			3														
5	(3)	35A	CAN			3														
5	(3)	36A	CAN			3														
5	(3)	37A	CAN			3														
5	(3)	38A	CAN			3														
5	(3)	39A	CAN			3														
5	(3)	40A	CAN			3														
5	(3)	41A	CAN			3														
5	(3)	57A	CAN			3														
5	(3)	58A	CAN			3														
5	05-04	5-25	COMP	10.0	29.0	4		50.4 (6)	82.5 (6)						59.8	54.7	1.7E-02	0.425	1.54	95.7
5	1	*****		14.0	14.5															
5	1	*****		19.0	19.5															
5	1	*****		24.5	25.0															
5	3	*****		13.5	14.0															
5	3	*****		19.0	19.5															
5	3	*****		23.5	24.0															
5	5	*****		14.5	15.0															
5	5	*****		19.5	20.0															
5	5	*****		24.5	25.0															
5	7	*****		13.5	14.0															
5	7	*****		18.5	19.0															
5	7	*****		23.5	24.0															
5	9	*****		15.0	15.5															
5	9	*****		20.0	20.5															
5	9	*****		25.0	25.5															
5	11	*****		13.5	14.0															
5	11	*****		18.5	19.0															
5	11	*****		23.5	24.0															
5	13	*****		13.5	14.0															
5	13	*****		18.5	19.0															
5	13	*****		23.5	24.0															
5	15	*****		13.5	14.0															
5	15	*****		18.5	19.0															
5	15	*****		23.5	24.0															
5	17	*****		13.5	14.0															
5	17	*****		18.5	19.0															
5	17	*****		23.5	24.0															
5	19	*****		13.5	14.0															
5	19	*****		18.5	19.0															
5	19	*****		23.5	24.0															
5	23	*****		12.0	12.5															
5	23	*****		17.0	17.5															
5	23	*****		22.0	22.5															
5	25	*****		15.5	16.0															
5	27	*****		13.5	14.0															
5	29	*****		10.5	11.0															
5	29	*****		15.5	16.0															
5	*****	*****		***	***															

TABLE 5 – REMOLDED PHYSICAL PROPERTIES

Sample Identification							Unit Weight	Compaction Test Data		Remolded Strength				Rem. Lab Perm.	Remolded Consilidation Tests					
										UCS		Direct Shear								
Pit No.	Boring No.	Sample No.	Sample Type	Top Depth (ft)	Bottom Depth (ft)	Data Source	Remolded Wet Density	OMC (%)	Std. Proc. MDD (pcf)	q_u (psf)	c_u (psf)	c_{ad} (psf)	$Ø_{ad}$ (degrees)	Coeff of Perm. k (cm/s)	Dry Density (pcf)	Moisture Content (%)	Avg. Coeff. of Consol. C_v (cm^2/sec)	Comp. Index C_c	Initial Void Ratio	Percent Compact.
6	1	405344		12.5	13.0															
6	Ret Sludge	405346		11.5	12.0															
6	3	405348		8.5	9.0															
6	3	405348		13.5	14.0															
6	4	405350		10.5	11.0															
6	5	405352		7.0	7.5															
6	5	405352		12.5	13.0															
6	5	405352		18.0	18.5															
6	6	405354		7.5	8.0															
6	6	405354		12.5	13.0															
6	6	405354		17.5	18.0															
6	7	405355		12.5	13.0															
6	7	405355		17.5	18.0															
6	(3)	43A	CAN			3														
6	(3)	45A	CAN			3														
6	(3)	45C	CAN			3														
6	(3)	46A	CAN			3														
6	(3)	47A	CAN			3														
6	06-04	6-10	COMP	0.0	10.0	4														
6	06-03	6-22	COMP	0.0	15.0	4		23.0 (6)	101.2 (6)						96.6	25.4	5.7E-03	0.242	0.86	95.4

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TABLE 5 – REMOLDED PHYSICAL PROPERTIES

Sample Identification							Unit Weight	Compaction Test Data		Remolded Strength				Rem. Lab Perm.	Remolded Consolidation Tests					
										UCS		Direct Shear								
Pit No.	Boring No.	Sample No.	Sample Type	Top Depth (ft)	Bottom Depth (ft)	Data Source	Remolded Wet Density	OMC (%)	Std. Proc. MDD (pcf)	q_u (psf)	c_u (psf)	c_{ed} (psf)	$\varnothing_{ed}$ (degrees)	Coeff of Perm. k (cm/s)	Dry Density (pcf)	Moisture Content (%)	Avg. Coeff. of Consol. C_v (cm^2/sec)	Comp. Index C_c	Intial Void Ratio	Percent Compact.
CW	(3)	49A	CAN			3														
CW	(3)	50A	CAN			3														
CW	(3)	51A	CAN			3														
CW	(3)	52A	CAN			3														
CW	(3)	53A	CAN			3														
CW	(3)	54A	CAN			3														
CW	(3)	55A	CAN			3														
CW	(3)	56A	CAN			3														

TABLE 5 – REMOLDED PHYSICAL PROPERTIES

Sample Identification							Unit Weight	Compaction Test Data		Remolded Strength				Rem. Lab Perm.	Remolded Consolidation Tests					
										UCS		Direct Shear								
Pit No.	Boring No.	Sample No.	Sample Type	Top Depth (ft)	Bottom Depth (ft)	Data Source	Remolded Wet Density	OMC (%)	Std. Proc. MDD (pcf)	q_u (psf)	c_u (psf)	c_{ad} (psf)	$\varnothing_{ad}$ (degrees)	Coeff of Perm. k (cm/s)	Dry Density (pcf)	Moisture Content (%)	Avg. Coeff. of Consol. C_v (cm^2/sec)	Comp. Index C_c	Initial Void Ratio	Percent Compact.
BP	1776	83176	ST	4.5	6.0	1														
BP	1776	27A	CAN			3														
BP	1777	28A	CAN			3														
BP	1819	29A	CAN			3														
BP	07-01	7-02	COMP	0.0	10.0	4														
BP	07-04	7-34	COMP	0.0	16.0	4														
BP	07-04	7-34 Redue	COMP	0.0	16.0	4														
BP	07-06	7-52	COMP	0.0	16.0	4		9.5 (6)	81.2 (6)											

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TABLE 5 – REMOLDED PHYSICAL PROPERTIES

Sample Identification							Unit Weight	Compaction Test Data		Remolded Strength				Rem. Lab Perm.	Remolded Consilidation Tests					
										UCS		Direct Shear								
Pit No.	Boring No.	Sample No.	Sample Type	Top Depth (ft)	Bottom Depth (ft)	Data Source	Remolded Wet Density	OMC (%)	Std. Proc. MDD (pcf)	q_u (psf)	c_u (psf)	c_{ed} (psf)	$\varnothing_{ed}$ (degrees)	Coeff of Perm. k (cm/s)	Dry Density (pcf)	Moisture Content (%)	Avg. Coeff. of Consol. C_v (cm^2/sec)	Comp. Index C_c	Intial Void Ratio	Percent Compact.
1, 4	1766, 1773	Group 1	CAN COMP			3		13.4	116.6			0.0 (7)	40 (7)	4.3E-06 (7)						
5, 6	(5)	Group 2	CAN COMP			3		36.2	76.9			6.3 (7)	31 (7)	NA						
5	(5)	Group 3	CAN COMP			3		56.0 (8)	65.0 (8)	2425 (7)	1212 (7)	1.7 (7)	33 (7)	1.2E-07 (7)(9)						
2, 3	1816, 1771	Group 4	CAN COMP			3		35.4	77.8	2936 (7)	1468 (7)	7.6 (7)	29 (7)	6.6E-08 (7)						
6, BP	1818(5)	Group 5	CAN COMP			3		19.9	99.0	5744 (7)	2872 (7)	2.6 (7)	37 (7)	5.9E-07 (7)						
4	1773, 1775	Group 6	CAN COMP			3		18.7	116.4	3014 (7)	1507 (7)	0.0 (7)	36 (7)	2.3E-07 (7)						
2, CW	1768(5)	Group 7	CAN COMP			3		20.1	102.3	2962 (7)	1481 (7)	2.4 (7)	32 (7)	2.6E-07 (7)						

266000

Waste Pit 1 - Statistical Evaluation of Waste Pit Properties

Sample Identification									Index Property Data										Unit Weight Data		
Pit No.	Boring No.	Sample No.	Sample Type	Top Depth (ft)	Bottom Depth (ft)	Data Source	Moisture Content (%dry wgt.)	Specific Gravity Gs	Grain Size Analysis: Gravel (%)	Sand (%)	Silt or Clay (%)	Clay Fract. (%)	Atterberg Limits: LL	PL	PI	USCS Group Symbol	Group Name	Dry Density (pcf)	Moisture Content (% dry wgt)	Wet Density (pcf)
1	1766	63050	ST	4.5	7.0	1	19.3	3.03	0.2	8.6	91.2	8.0	20.0	17.0	3.0	CL	Lean Clay	114.9	19.5	
1		1-48	COMP	0.0	12.0	4	17.2	2.62	32.5	24.5	43.0	14.0	34.0	23.0	11.0	GC	Clayey Gravel with Sand			
1	11353	400051	SS	13.5	14.0	2	30.9		3.0	28.3	68.7	1.3				ML (NP)	Sandy Silt (NP)			
1	11353	400047	SS	4.5	5.5	2	19.3		19.0	28.0	53.0	13.0				ML (NP)	Sandy Silt (NP) with Gravel			
1	1766	6A	CAN			3	21.1		0.0	9.0	91.0		NP	NP	NP	ML (NP)	Silt (NP)			
1	1766	7A	CAN			3	20.7		1.1	9.8	89.1		NP	NP	NP	ML (NP)	Silt (NP)			
1	1767	8A	CAN			3	22.7		3.9	37.6	58.5		NP	NP	NP	ML (NP)	Silt (NP)			
1	1765	2A	CAN			3	24.7		0.0	13.2	86.8		NP	NP	NP	ML (NP)	Silt (NP)			
1	1766	5A	CAN			3	20.7	3.02	0.4	10.8	88.8	0.0	NP	NP	NP	ML (NP)	Silt (NP)			
1	1766	4A	CAN			3	18.0		0.0	9.0	91.0		NP	NP	NP	ML (NP)	Silt (NP)			
1	1765	1A	CAN			3	20.3		0.0	14.2	85.5		NP	NP	NP	ML (NP)	Silt (NP)			
1	11352	400053	SS	2.0	3.0	2	33.9		0.0	4.0	96.0	10.0	24.9	26.4		ML (NP)	Silt (NP)			
1	1765	63089	ST	4.5	7.0	1	23.6	3.03	0.1	9.6	90.3	4.0	NP	NP	NP	ML (NP)	Silt (NP)	110.4 (2)	23.4 (2)	
1	11352	400054	SS	5.5	6.0	2	27.7		0.0	6.0	94.0	5.5	20.2	22.3		ML (NP)	Silt (NP)			
1	11354	400029	ST	7.5	10.0	2	23.1	3.11	0.1	3.9	96.0	7.3	18.9	22.9		ML (NP)	Silt (NP)	111.2	23.0	136.8
1	11352	400025	ST	7.5	10.0	2	19.6	3.09	0.7	10.3	89.0	7.5	19.1	22.8		ML (NP)	Silt (NP)	115.4	19.7	138.1
1	1766	63054	ST	8.5	11.0	1	15.9	3.15	0.0	10.0	90.0	4.0	NP	NP	NP	ML (NP)	Silt (NP)	117.9	18.7	
1	1766	63062	ST	14.0	16.5	1	21.8	3.03	0.0	10.2	89.8	5.0	NP	NP	NP	ML (NP)	Silt (NP)			
1	1765	63101	ST	14.0	16.5	1	20.9	2.92	0.0	8.3	91.7	10.0	NP	NP	NP	ML (NP)	Silt (NP)	120.5	20.9	
1	1765	3A	CAN			3	39.1		2.9	26.8	70.3		NP	NP	NP	ML (NP)	Silt (NP) with Sand			
1	1767	63008	ST	3.5	6.0	1	23.3	3.07	3.1	25.8	71.1	3.0	NP	NP	NP	ML (NP)	Silt (NP) with Sand			
1	11353	400028	ST	10.0	12.5	2	18.3	3.05	1.0	15.5	83.5	6.5	19.9	20.8		ML (NP)	Silt (NP) with Sand	109.4	24.0	135.7
1	11354	400030	ST	11.5	14.0	2	47.3	2.80	2.0	50.0	48.0	6.7	67.7	68.2		SM	Silty Sand			
1	11352	400026	ST	11.5	14.0	2	44.8	3.05	5.5	48.5	46.0	3.5	42.1	42.5		SM	Silty Sand	74.9	44.9	108.5

Statistics for ML (NP):

Number:	20	9	20	20	20	13	NP	NP	NP	6	6	3
Maximum:	39.1	3.15	19.0	37.6	96.0	13.0	NP	NP	NP	120.5	24.0	138.1
Minimum:	15.9	2.92	0.0	3.9	53.0	0.0	NP	NP	NP	109.4	18.7	135.7
Average:	23.3	3.05	1.8	14.5	83.7	5.9	NP	NP	NP	114.1	21.6	136.9
Std. Dev.:	5.7	0.06	4.3	9.5	12.4	3.7	NP	NP	NP	4.5	2.2	1.2

Waste Pit 2 - Statistical Evaluation of Waste Pit Properties

Sample Identification							Index Property Data												Unit Weight Data		
Pit No.	Boring No.	Sample No.	Sample Type	Top Depth (ft)	Bottom Depth (ft)	Data Source	Moisture Content (%dry wgt.)	Specific Gravity Gs	Grain Size Analysis: Gravel (%)	Sand (%)	Silt or Clay (%)	Clay Fract. (%)	Atterberg Limits: LL	PL	PI	USCS Group Symbol	Group Name	Dry Density (pcf)	Moisture Content (% dry wgt)	Wet Density (pcf)
2	11358	400062	SS	8.5	9.0	2	245.7		0.0	0.0	100.0	8.6								
2	1817	12A	CAN			3	16.7		4.2	22.3	73.5		44.1	16.2	27.9	CL	Lean Clay with Sand			
2	1769	10A	CAN			3	38.3	2.72	7.6	26.1	66.3	22.2	42.3	23.1	19.2	CL	Sandy Lean Clay			
2	11359	400033	ST	4.5	7.0	2	109.6	3.02	0.0	1.3	98.7	8.0	78.1	64.0	15.3	MH	Elastic Silt	42.9	109.8	90.0
2	11359	400034	ST	8.5	11.0	2	98.2	2.86	4.7	14.0	81.3	1.8	76.3	66.2	10.2	MH	Elastic Silt with Sand	45.6	97.7	90.2
2	02-05	2-39	COMP	0.0	10.0	4	31.9	2.59	20.0	19.0	61.0	22.0	53.0	32.0	21.0	MH	Gravelly Elastic Silt with Sand			
2	1818	11A	CAN			3	70.5	2.67	5.5	27.8	66.7	11.7	66.8	42.2	24.6	MH	Sandy Elastic Silt			
2	1769	63521	ST	12.0	14.0	1	231.2	2.64	0.3	40.2	59.5	4.0	117.0	73.0	44.0	MH	Sandy Elastic Silt		231.2	78.5
2	1769	63530	ST	18.0	20.0	1	169.8	2.64	1.8	40.1	58.1	4.0	181.0	109.0	72.0	MH	Sandy Elastic Silt			
2	1768	63619	ST	11.0 (1)	13.0 (1)	1	290.0	2.80	0.0	39.0	61.0	5.0	NP	NP	NP	ML (NP)	Sandy Silt (NP)	19.86(1)	290.0	
2	1768	63619dup	ST	11.0 (1)	13.0 (1)	1	316.6	2.79	0.0	28.5	71.5	3.0	NP	NP	NP	ML (NP)	Silt (NP) with Sand	18.15(1)	316.6	
2	1818	63865	ST	5.0	7.5	1	21.4	2.20	18.1	67.3 (1)	14.6 (1)	8.0	24.0	14.0	10.0	SC	Clayey Sand with Gravel			
2	11358	400031	ST	6.0	8.5	2	24.1	2.69	21.5	32.2	46.3	11.0	33.4	20.3	13.2	SC	Clayey Sand with Gravel	105.7	24.1	131.2
2	1768	9A	CAN			3	35.4		1.0	55.1	43.9		33.1	23.2	9.9	SM	Silty Sand			
2	1817	63875	ST	10.5	12.5	1	32.7	2.65	25.4	45.5	29.1	8.0	36.0	28.0	8.0	SM	Silty Sand with Gravel		32.7	112.5
				Statistics for MH:																
				Number:			6	6	6	6	6	6	6	6	6			2	3	3
				Maximum:			231.2	3.02	20.0	40.2	98.7	22.0	181.0	109.0	72.0			45.6	231.2	90.2
				Minimum:			31.9	2.59	0.0	1.3	58.1	1.8	53.0	32.0	10.2			42.9	97.7	78.5
				Average:			118.5	2.74	5.4	23.7	70.9	8.6	95.4	64.4	31.2			44.3	146.2	86.2
				Std. Dev.:			71.6	0.17	7.5	15.3	16.1	7.5	47.1	26.9	23.1			1.9	73.8	6.7

Waste Pit 3 - Statistical Evaluation of Waste Pit Properties

Sample Identification									Index Property Data									Unit Weight Data		
Pit No.	Boring No.	Sample No.	Sample Type	Top Depth (ft)	Bottom Depth (ft)	Data Source	Moisture Content (%dry wgt.)	Specific Gravity Gs	Grain Size Analysis: Gravel (%)	Sand (%)	Silt or Clay (%)	Clay Fract. (%)	Atterberg Limits: LL	PL	PI	USCS Group Symbol	Group Name	Dry Density (pcf)	Moisture Content (% dry wgt)	Wet Density (pcf)
3	03-02	3-90 Redue	COMP	0.0	20.0	4	41.6	2.65	5.0	29.0	66.0	15.0								
3	03-05	3-52 Redue	COMP	0.0	20.0	4	57.0		9.0	25.0	66.0	13.0								
3	11362	400076	SS	6.0	6.5	2	57.0 (II)	0.00 (II)	9.0 (II)	25.0 (II)	66.0 (II)	13.0 (II)	0.0 (II)	0.0 (II)						
3	11360	400100	SS	13.5	14.0	2	57.0 (II)		9.0 (II)	25.0 (II)	66.0 (II)	13.0 (II)	0.0 (II)	0.0 (II)						
3	1772	19A	CAN			3	36.1		6.0	19.9	74.1		44.1	25.2	18.9	CL	Lean Clay with Sand			
3	11360	400035	ST	20.5	23.0	2	18.0	2.69	4.0	24.5	71.5	25.3	26.3	16.2	10.1	CL	Lean Clay with Sand	110.0	17.9	129.7
3	11361	400038	ST	10.5	13.0	2	196.9	2.88	0.0				92.2	74.6	18.6	MH		25.5	196.9	75.7
3	1771	17A	CAN			3	142.0		1.0	15.3	83.7		69.9	53.9	16.0	MH	Elastic Silt with Sand			
3	1770	14A	CAN			3	152.7		3.5	23.8	72.7		81.8	58.9	22.9	MH	Elastic Silt with Sand			
3	1771	16A	CAN			3	96.8	2.72	3.3	27.0	69.7	15.7	77.8	44.3	33.5	MH	Sandy Elastic Silt			
3	1770	13A	CAN			3	145.4		3.2	33.7	63.1		89.7	55.8	33.9	MH	Sandy Elastic Silt			
3	03-05	3-52	COMP	0.0	20.0	4	55.9	2.54			67.0	10.0	52.0	32.0	20.0	MH	Sandy Elastic Silt			
3	11362	400042	ST	23.0	25.5	2	173.6	2.60	0.6	42.9	56.5		91.0	56.9	34.1	MH	Sandy Elastic Silt			
3	1770	63370	ST	28.0	30.0	1	131.1	2.77	1.1	48.6	50.3	4.0	119.0	48.0	71.0	MH	Sandy Elastic Silt			
3	1771	63458	ST	32.0	34.0	1	55.1	2.84	0.2	37.1	62.7	3.0	93.0	68.0	25.0	MH	Sandy Elastic Silt			
3	1772	18A	CAN			3	41.9		2.5	40.9	56.6		37.9	30.5	7.4	ML	Sandy Silt			
3	1770	15A	CAN			3	42.2	2.69	6.5	25.8	67.7	3.1	46.9	31.7	15.2	ML	Sandy Silt			
3	03-02	3-90	COMP	0.0	20.0	4	43.3				68.0	11.0	38.0	33.0	5.0	ML	Sandy Silt			
3	1772	63278	ST	19.5	22.0	1	35.4	2.45	1.3	45.8	52.9	15.0 (I)	NP	NP	NP	ML	Sandy Silt		35.4	75.1
3	11360	400097	SS	13.0	13.5	2	54.3		0.8	11.2	88.0	10.0	45.4	28.1	18.7	ML	Silt			
3	11361	400040	ST	29.0	31.5	2	102.8	2.96	0.0	4.0	96.0	7.3	45.7	33.9	12.2	ML	Silt	44.8	102.5	90.7
3	11363	400044	ST	12.0	14.5	2	25.3	2.79	5.3	22.4	72.3	23.0	30.0	24.8	4.6	ML	Silt with Sand			
3	11362	400077	SS	6.5	7.0	2	84.6		7.0	32.7	60.3	6.3	51.0	57.8		ML (NP)	Sandy Silt (NP)			
3	11363	400045	ST	19.0	21.5	2	44.7	2.39	2.4	30.7	66.9	7.3	45.7	53.7		ML (NP)	Sandy Silt (NP)	64.3	44.6	93.0
3	1770	63328	ST	4.0	6.0	1	63.7	2.20	0.5	56.0	43.5	8.0	NP	NP	NP	SM	Silty Sand		63.7	81.3
3	11362	400041	ST	19.0	21.5	2	87.5	2.88	2.5	47.8	49.7		73.2	56.2	17.0	SM	Silty Sand			
3	1770	63357	ST	20.0	22.0	1	138.7	2.84	0.2	56.4	43.4	6.0	116.0	55.0	61.0	SM	Silty Sand		138.7	90.1

Statistics for MH:

Number:	8	5	7	7	8	4	8	8	8
Maximum:	173.6	2.84	3.5	48.6	83.7	15.7	119.0	68.0	71.0
Minimum:	55.1	2.54	0.2	15.3	50.3	3.0	52.0	32.0	16.0
Average:	119.1	2.69	1.8	32.6	65.7	8.2	84.3	52.2	32.1
Std. Dev.:	44.8	0.12	1.4	11.5	10.2	5.9	19.5	10.8	17.2

Statistics for ML:

Number:	7	4	6	6	7	6	7	7	7	1	2	2
Maximum:	102.8	2.96	6.5	45.8	96.0	23.0	46.9	33.9	18.7	44.8	102.5	90.7
Minimum:	25.3	2.45	0.0	4.0	52.9	3.1	0.0	0.0	0.0	44.8	35.4	75.1
Average:	49.3	2.72	2.7	25.0	71.6	11.6	34.8	26.0	9.0	44.8	68.9	82.9
Std. Dev.:	25.2	0.21	2.6	16.3	15.6	6.9	16.5	11.9	6.6		47.4	11.0

APPENDIX F

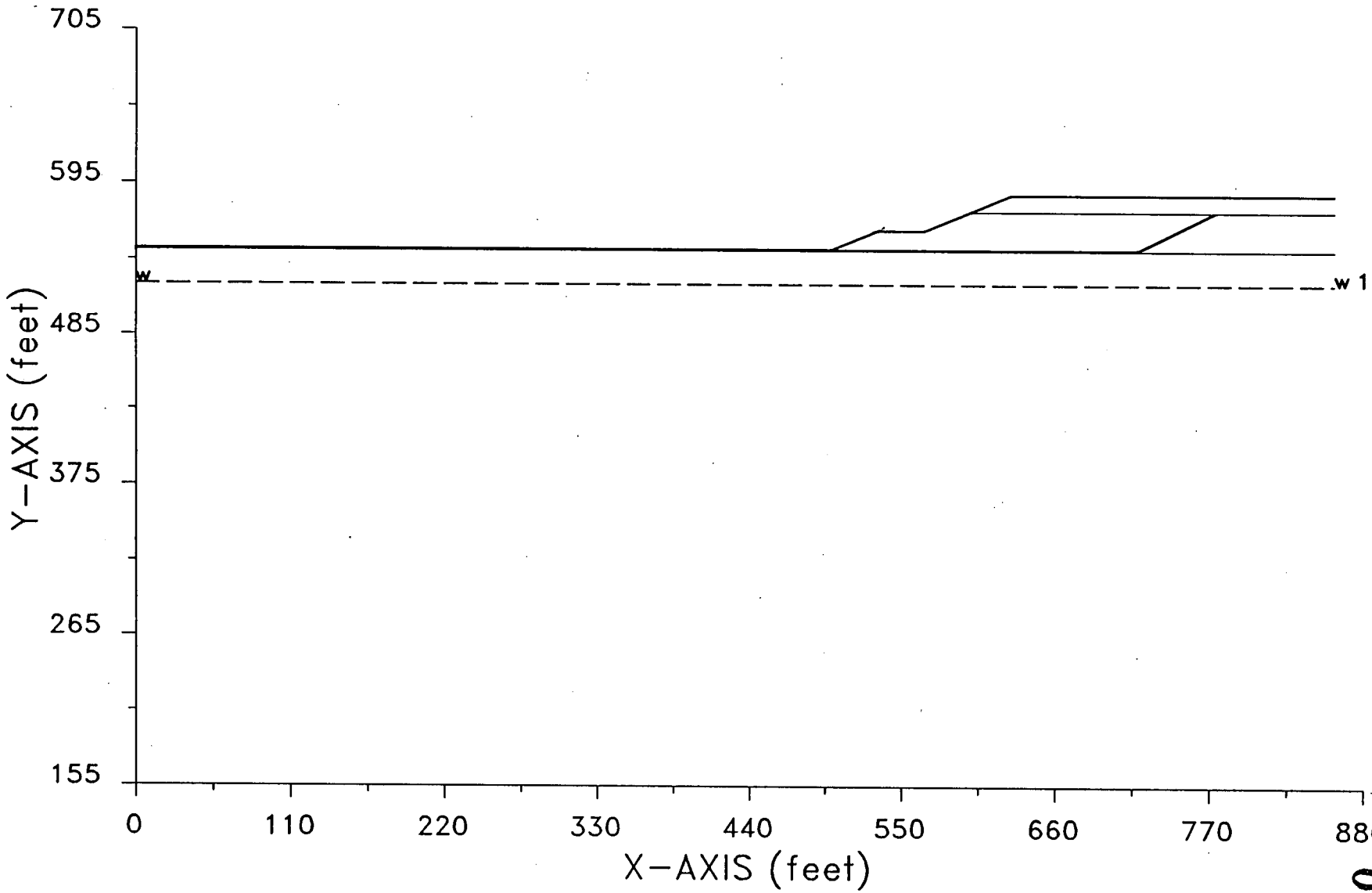
SLOPE STABILITY DATA FILES

SOIL PARAMETERS							
SOIL LAYER NUMBER	SOIL TYPE	MOIST UNIT WEIGHT (PCF)	SATURATED UNIT WEIGHT (PCF)	TOTAL STRESS		EFFECTIVE STRESS	
				COHESION (PSF)	FRICTION ANGLE (DEG.)	COHESION (PSF)	FRICTION ANGLE (DEG.)
1	Clay Liner	133.1	145.0	0.0	22.0	0.0	22.0
2	Pit 3 Waste	64.3	93.0	50.0	15.0	50.0	33.0
3	Cap	100.0	112.3	0.0	26.0	0.0	26.0
4	Berm	120.0	130.0	300.0	19.0	300.0	19.0
5	GMA	140.0	149.8	0.0	33.0	0.0	33.0

001003

DATA FOR THE MOST CRITICAL FAILURE SURFACE					
CASE DESCRIPTION	CURVE NUMBER	RADIUS (FT)	CENTER OF CURVE		FOS
			X (FT)	Y (FT)	W/O SEISMIC LOADS
2.5 to 1 - Undrained Condition		57.56	584.44	619.75	0.997
3 to 1 - Undrained Condition		57.20	583.11	621.99	1.187
4 to 1 - Undrained Condition		75.59	558.81	634.10	1.484
2.5 to 1 - Drained Condition		57.42	570.86	621.02	1.616
3 to 1 - Drained Condition		56.61	573.87	624.30	1.836
4 to 1 - Drained Condition		55.71	580.40	628.80	2.222

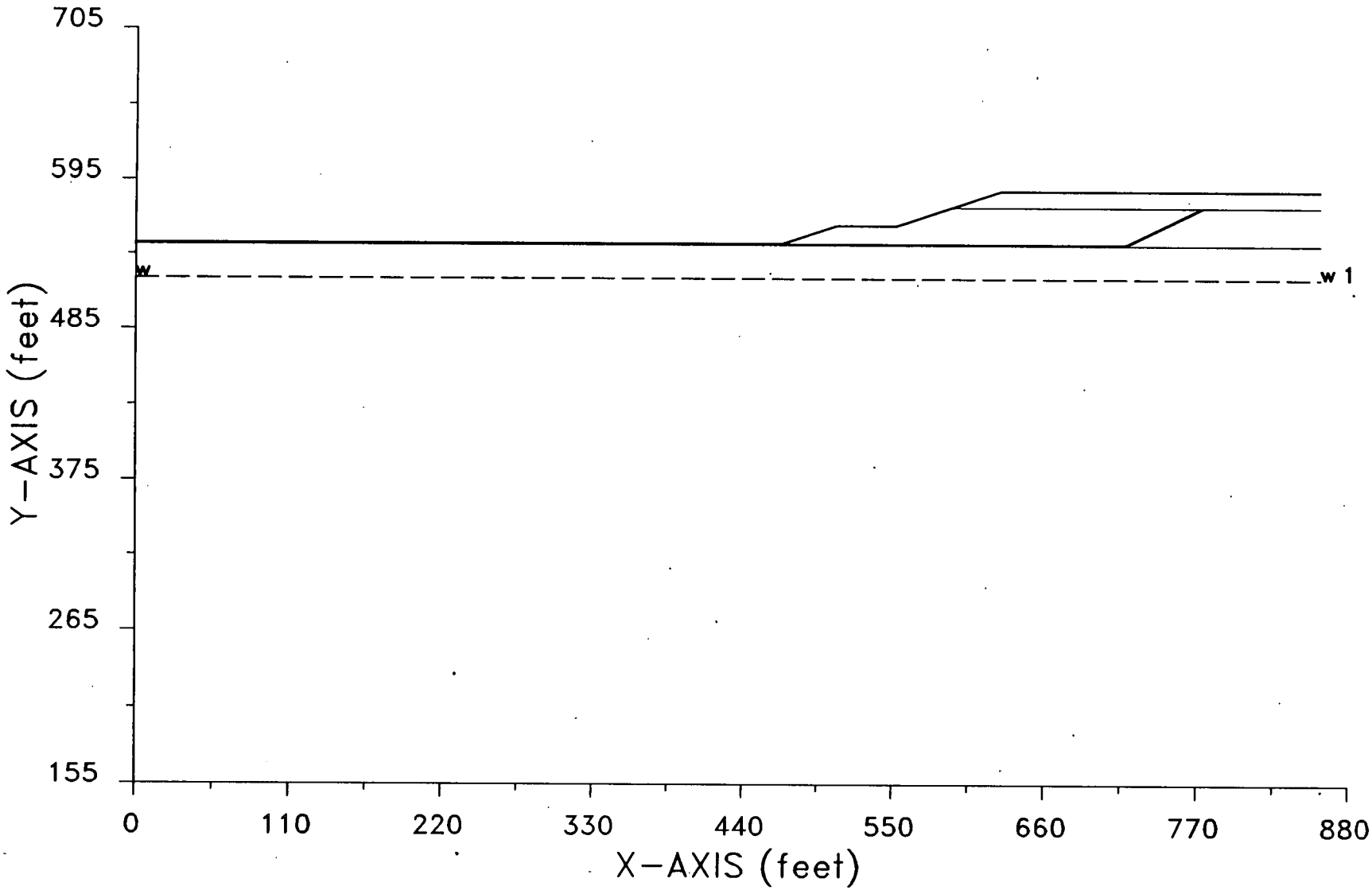
PO 145 – 2.5 to 1 Undrain Condition



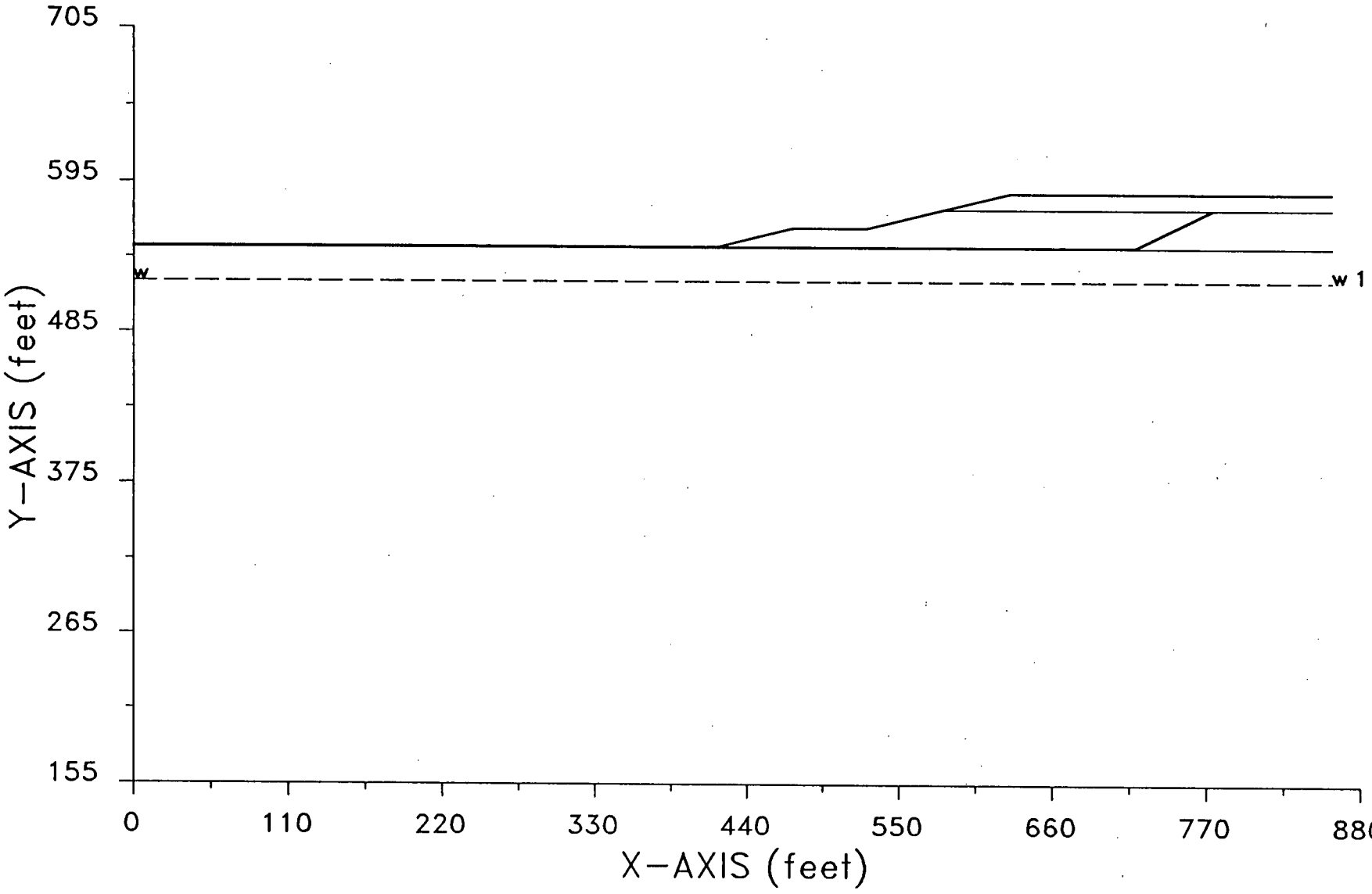
3T01 9-21-95 13:57

001005

PO 145 – 3 to 1 Undrain Condition



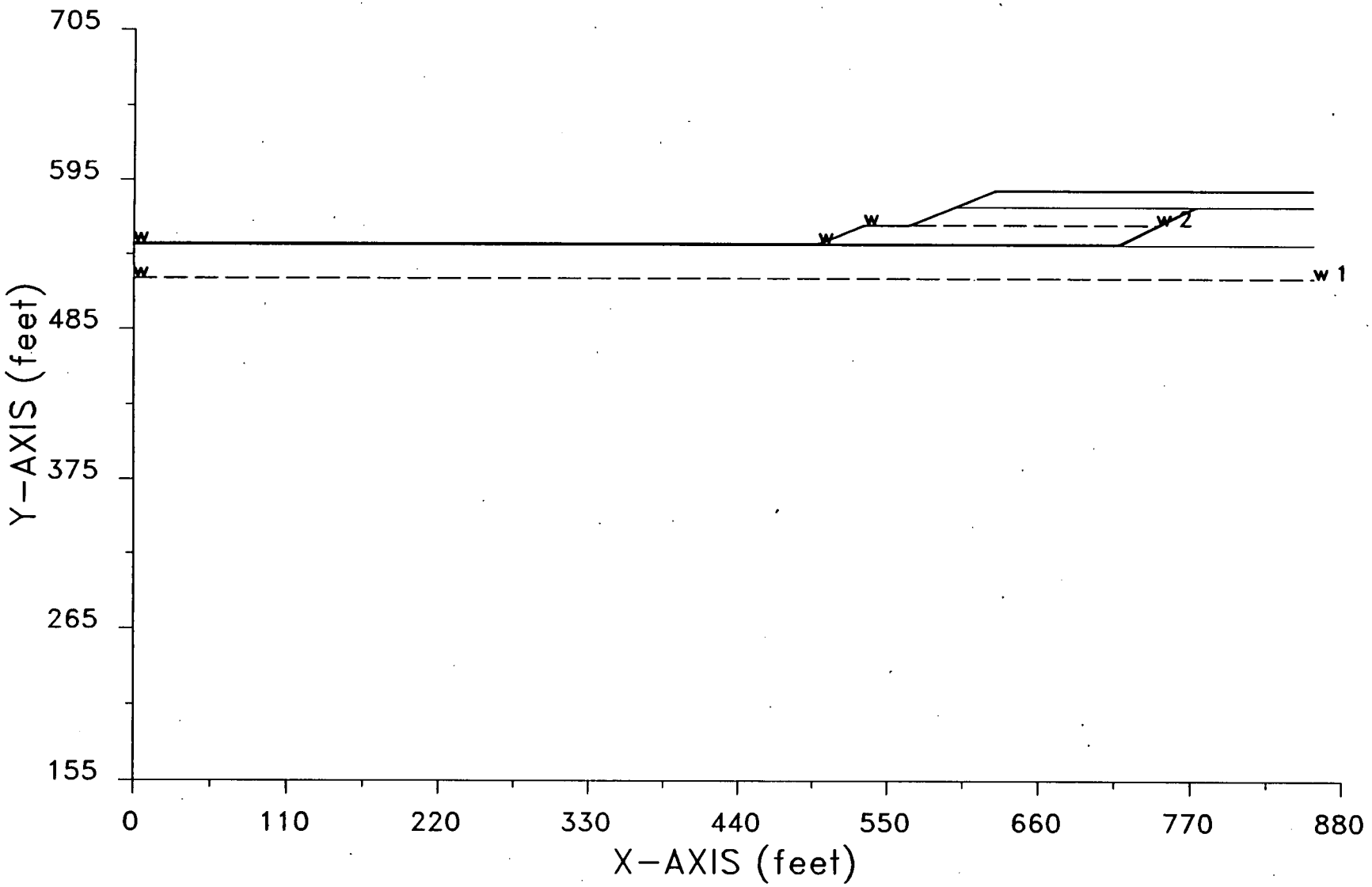
PO 145 – 4 to 1 Undrain Condition



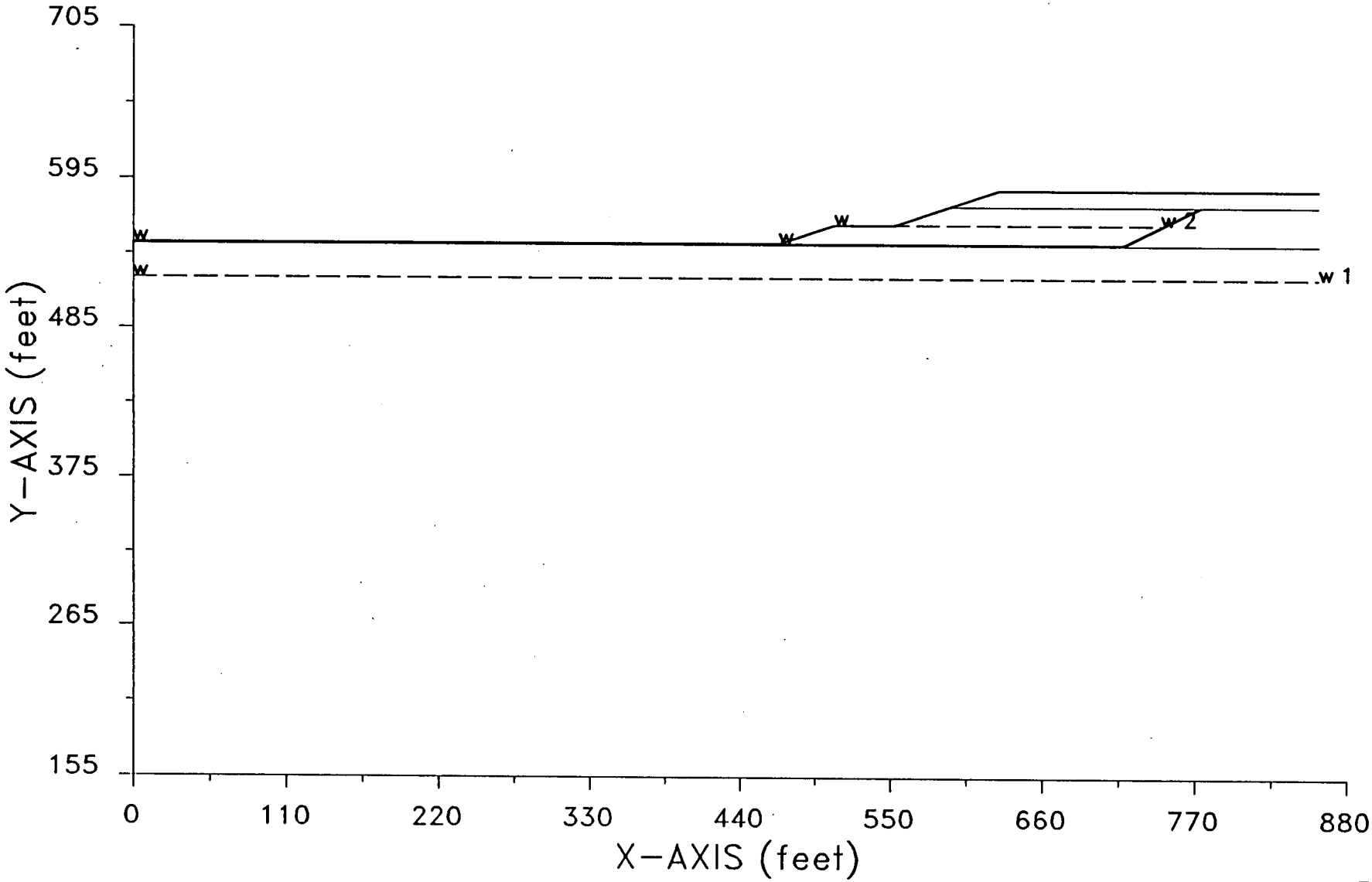
25T01D 9-21-95 13:58

001007

PO 145 – 2.5 to 1 Drained Condition



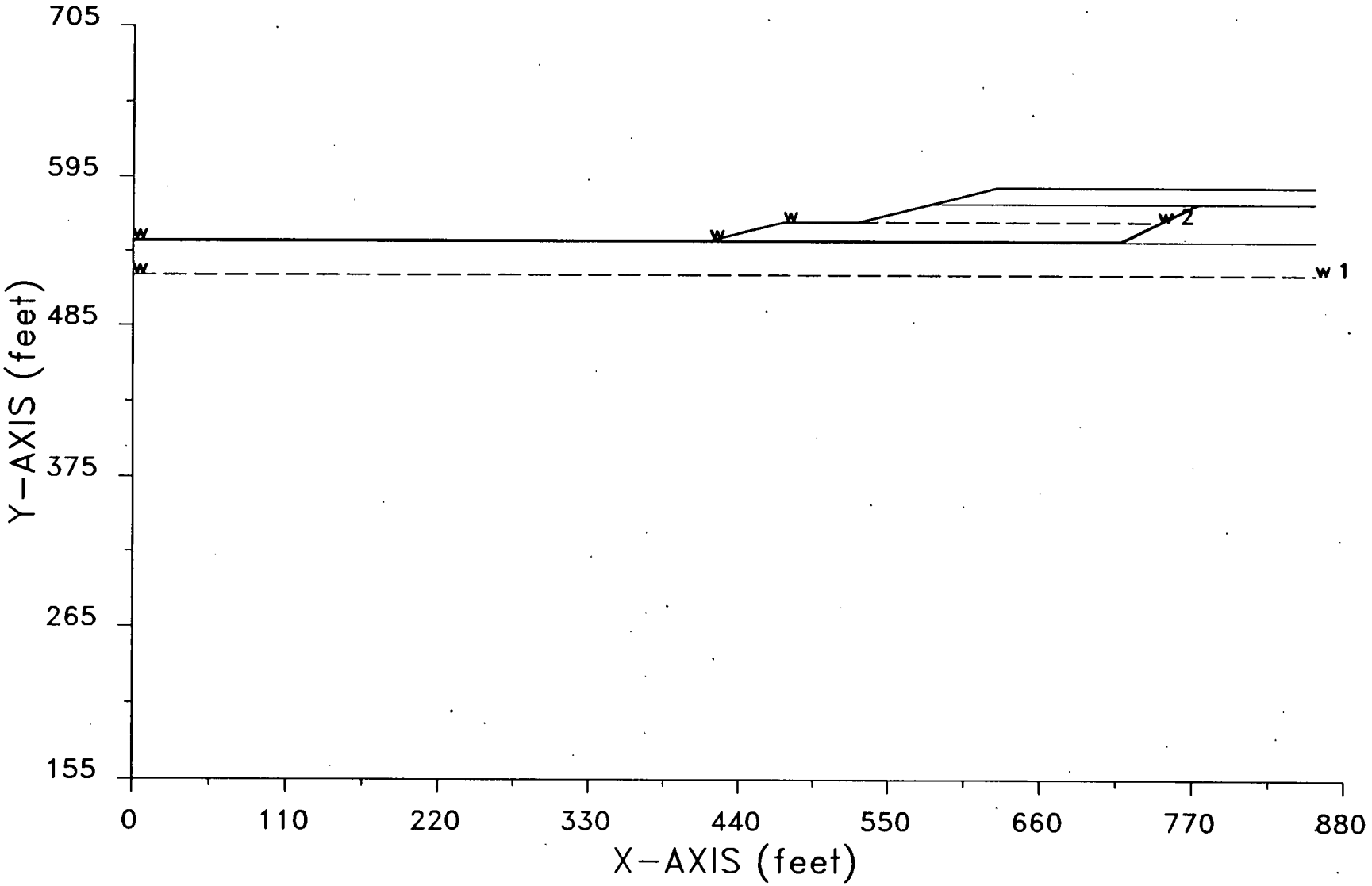
PO 145 – 3 to 1 Drained Condition



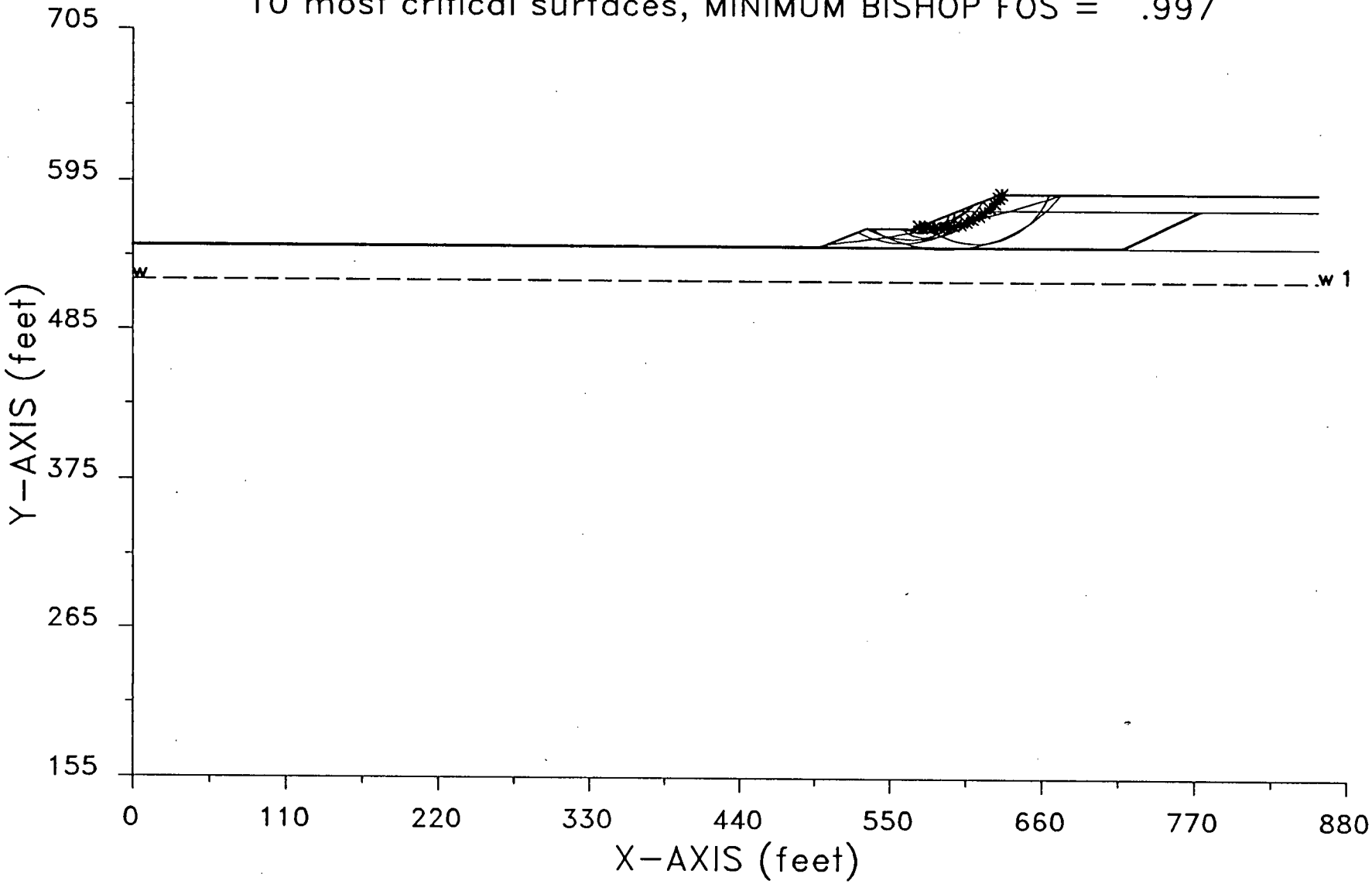
4T01D 9-21-95 14:00

001009

PO 145 – 4 to 1 Drained Condition

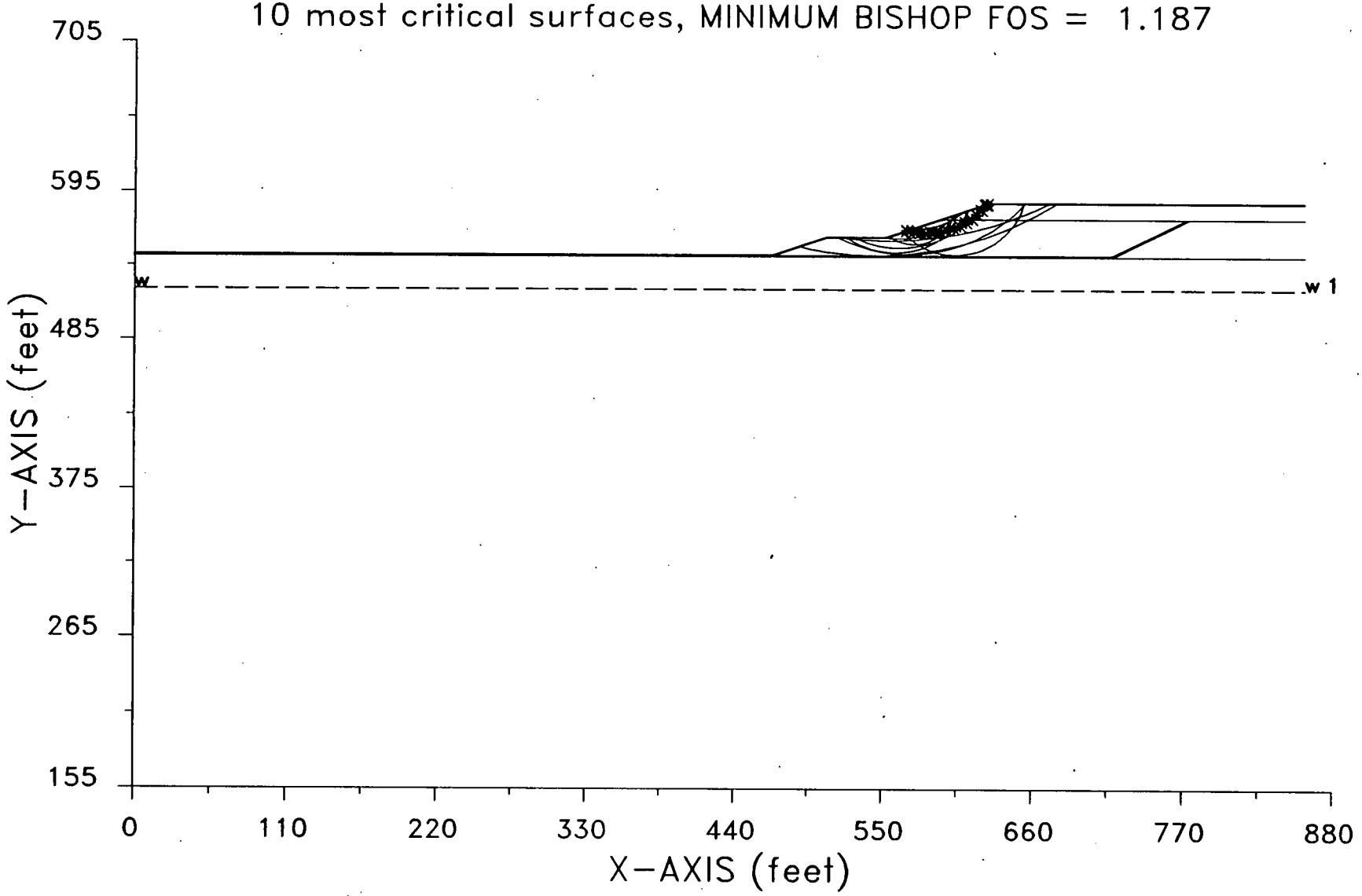


PO 145 – 2.5 to 1 Undrain Condition
10 most critical surfaces, MINIMUM BISHOP FOS = .997

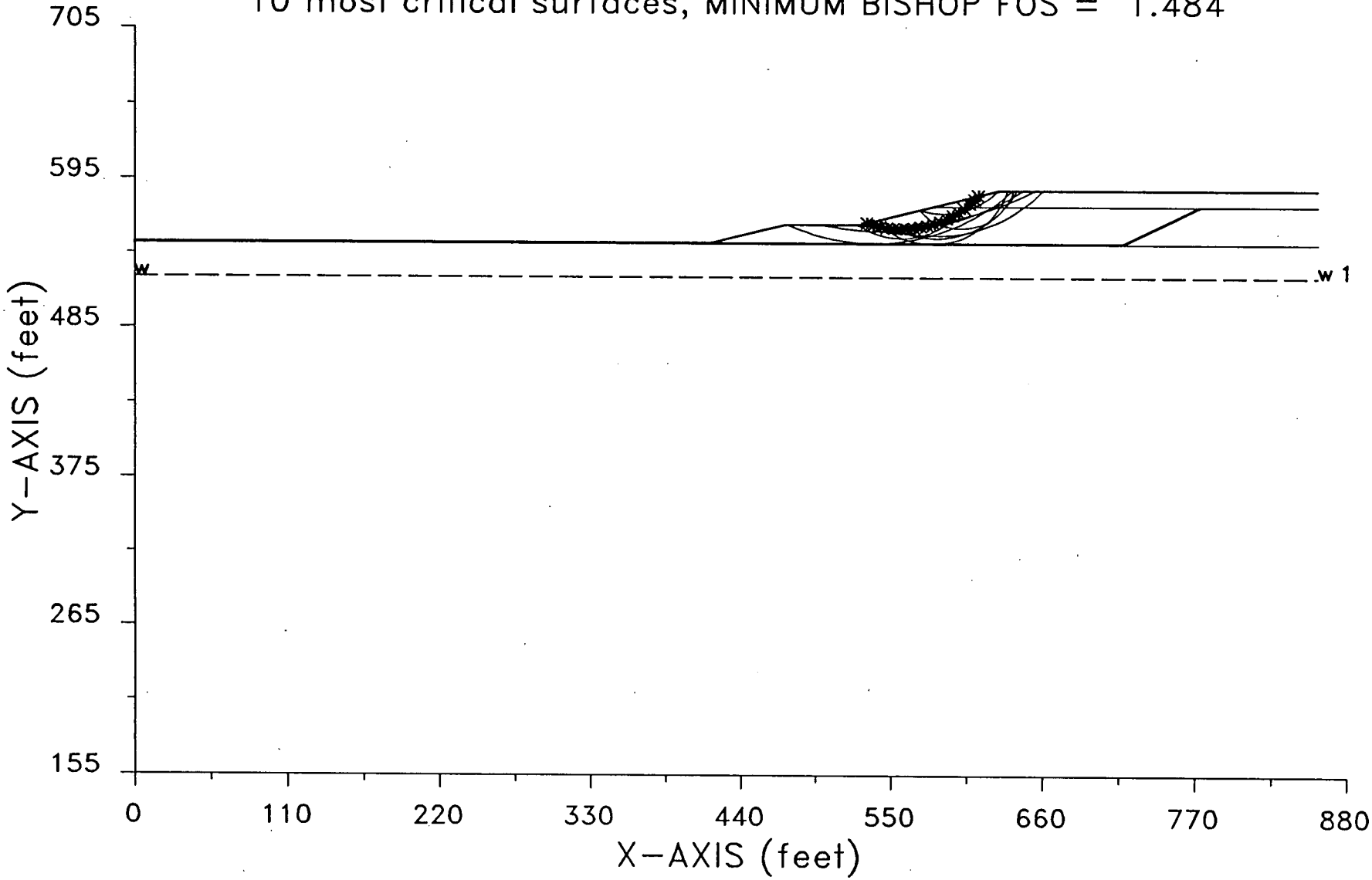


001011

PO 145 – 3 to 1 Undrain Condition
10 most critical surfaces, MINIMUM BISHOP FOS = 1.187



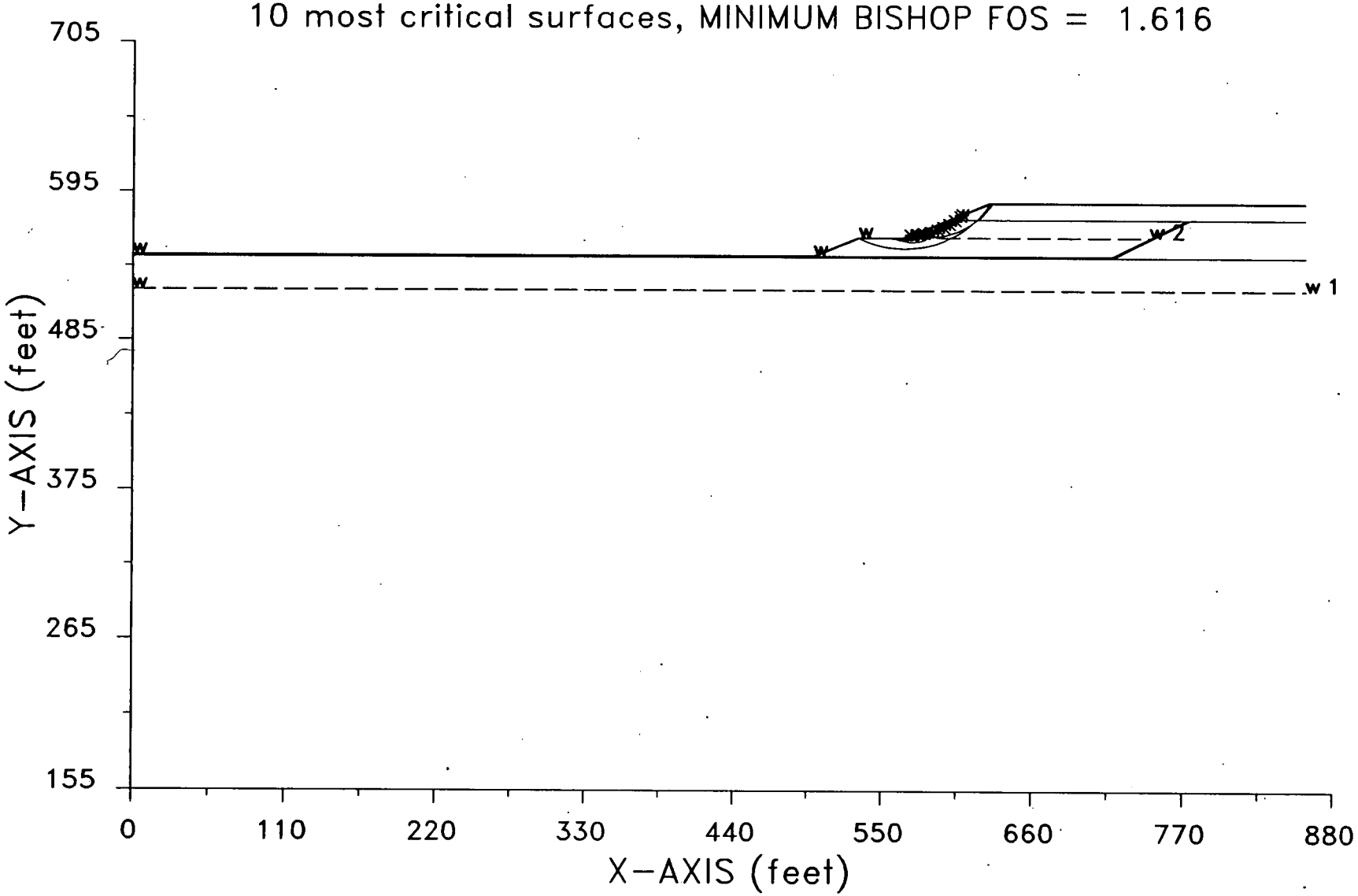
PO 145 – 4 to 1 Undrain Condition
10 most critical surfaces, MINIMUM BISHOP FOS = 1.484



25T01D 9-21-95 13:58

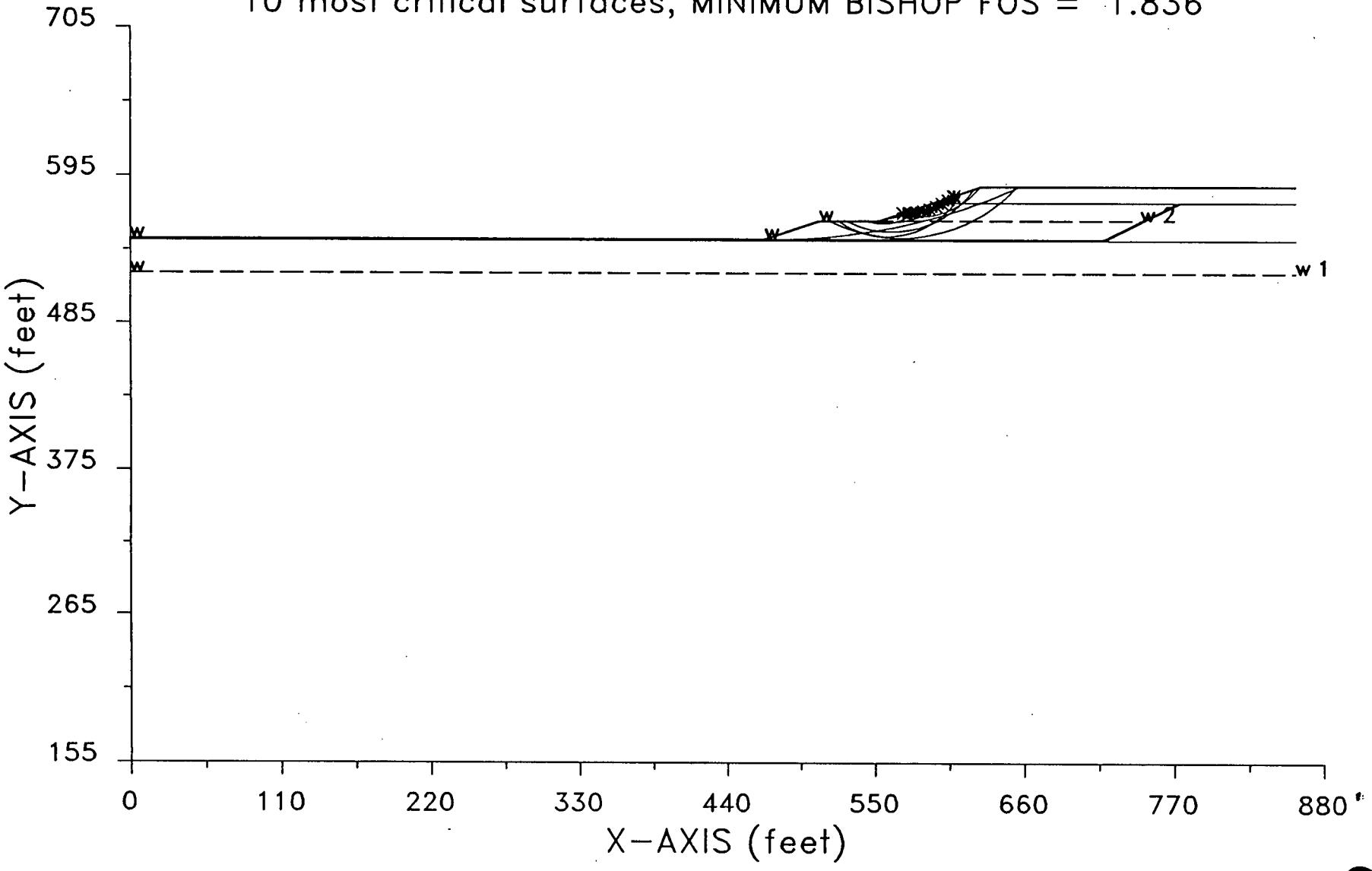
PO 145 – 2.5 to 1 Drained Condition

10 most critical surfaces, MINIMUM BISHOP FOS = 1.616



PO 145 – 3 to 1 Drained Condition

10 most critical surfaces, MINIMUM BISHOP FOS = 1.836

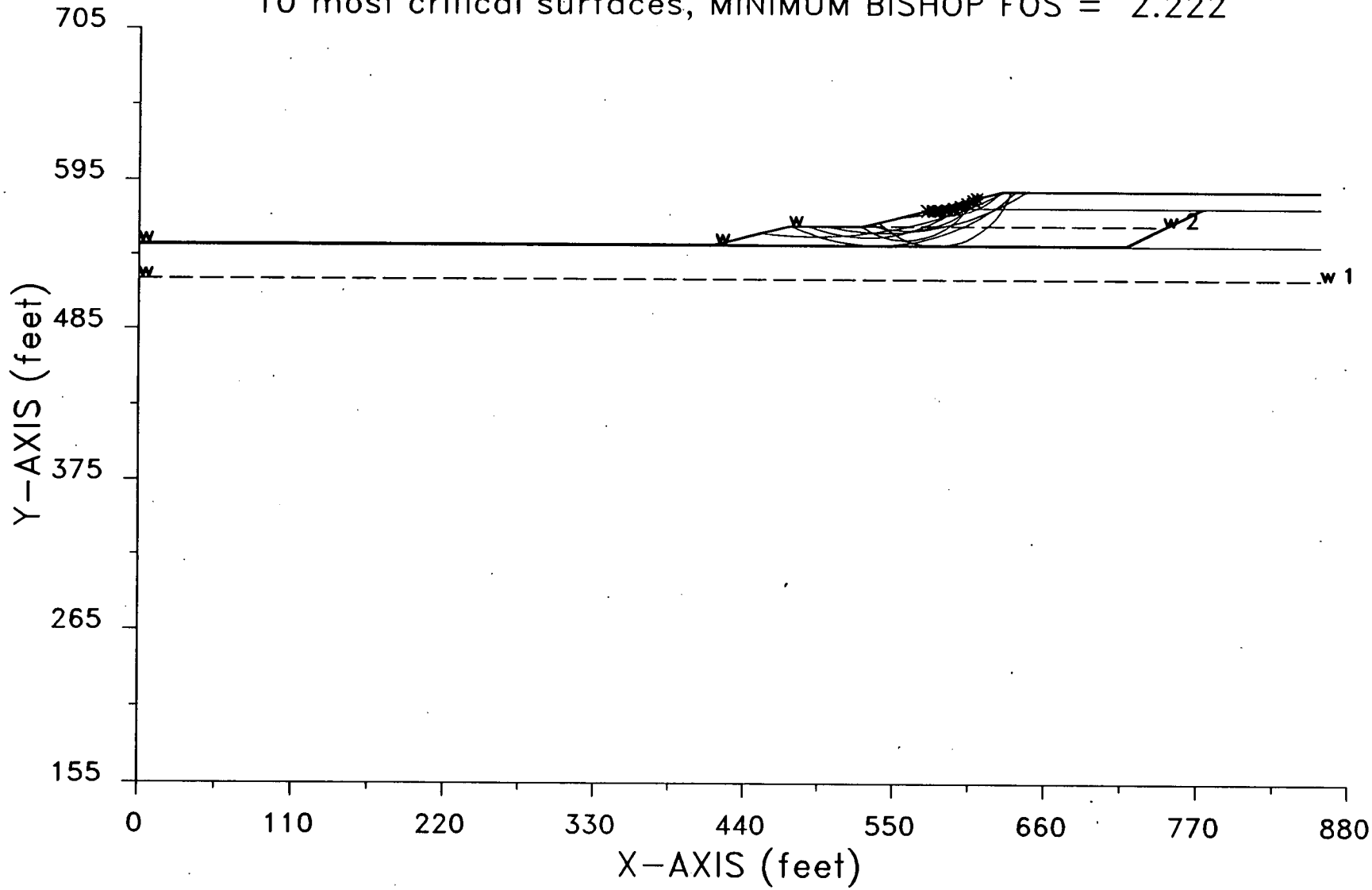


4T01D 9-21-95 14:00

001015

PO 145 – 4 to 1 Drained Condition

10 most critical surfaces, MINIMUM BISHOP FOS = 2.222



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*****************************************
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*                                       *
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*               using the               *
*            Method of Slices           *
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Problem Description : PO 145 - 2.5 to 1 Undrain Condition

SEGMENT BOUNDARY COORDINATES
---

6 SURFACE boundary segments

Segment No.	x-left (ft)	y-left (ft)	x-right (ft)	y-right (ft)	Soil Unit Below Segment
1	.0	548.0	500.0	548.0	1
2	500.0	548.0	533.3	561.5	2
3	533.3	561.5	566.6	561.5	2
4	566.6	561.5	600.0	575.0	2
5	600.0	575.0	629.6	587.0	3
6	629.6	587.0	860.5	587.0	3

16 SUBSURFACE boundary segments

Segment No.	x-left (ft)	y-left (ft)	x-right (ft)	y-right (ft)	Soil Unit Below Segment
1	.0	548.0	500.0	548.0	1
2	500.0	548.0	533.3	561.5	2
3	533.3	561.5	566.6	561.5	2
4	566.6	561.5	600.0	575.0	2
5	600.0	575.0	773.6	575.0	2
6	773.6	575.0	775.8	575.0	1
7	775.8	575.0	860.5	575.0	4
8	.0	548.0	500.0	548.0	1
9	500.0	548.0	719.6	548.0	1
10	719.6	548.0	773.6	575.0	1
11	773.6	575.0	775.8	575.0	1
12	775.8	575.0	860.5	575.0	4
13	.0	547.0	719.8	547.0	5
14	719.8	547.0	775.8	575.0	4

15	775.8	575.0	860.5	575.0	4
16	.0	547.0	860.5	547.0	5

ISOTROPIC Soil Parameters
---

5 Soil unit(s) specified

Soil Unit No.	Unit Weight Moist (pcf)	Unit Weight Sat. (pcf)	Cohesion Intercept (psf)	Friction Angle (deg)	Pore Pressure Parameter Ru	Pore Pressure Constant (psf)	Water Surface No.
1	133.1	145.0	.0	22.00	.000	.0	0
2	64.3	93.0	50.0	15.00	.000	.0	0
3	100.0	112.3	.0	26.00	.000	.0	0
4	120.0	130.0	300.0	19.00	.000	.0	0
5	140.0	149.8	.0	33.00	.000	.0	1

1 Water surface(s) have been specified

Unit weight of water = 62.40 (pcf)

Water Surface No. 1 specified by 2 coordinate points

****
PHREATIC SURFACE,
****

Point No.	x-water (ft)	y-water (ft)
1	.00	522.00
2	860.50	522.00

A critical failure surface searching method, using a random technique for generating CIRCULAR surfaces has been specified.

120 trial surfaces will be generated and analyzed.

3 Surfaces initiate from each of 40 points equally spaced along the ground surface between x = 450.0 ft
and x = 575.0 ft

Each surface terminates between x = 575.0 ft
and x = 825.0 ft

Unless further limitations were imposed, the minimum elevation at which a surface extends is y = .0 ft

5.0 ft line segments define each trial failure surface. 0163

ANGULAR RESTRICTIONS :

The first segment of each failure surface will be inclined within the angular range defined by :

Lower angular limit := -45.0 degrees
Upper angular limit := (slope angle - 5.0) degrees

Factors of safety have been calculated by the :

* * * * * SIMPLIFIED BISHOP METHOD * * * * *

The most critical circular failure surface is specified by 15 coordinate points

Point No.	x-surf (ft)	y-surf (ft)
1	571.80	563.60
2	576.72	562.72
3	581.70	562.26
4	586.70	562.24
5	591.68	562.65
6	596.61	563.50
7	601.44	564.76
8	606.15	566.45
9	610.70	568.53
10	615.04	571.00
11	619.16	573.84
12	623.01	577.02
13	626.58	580.53
14	629.82	584.33
15	631.72	587.00

**** Simplified BISHOP FOS = .997 ****

The following is a summary of the TEN most critical surfaces

Problem Description : PO 145 - 2.5 to 1 Undrain Condition

FOS (BISHOP)	Circle Center x-coord (ft)	Circle Center y-coord (ft)	Radius (ft)	Initial x-coord (ft)	Terminal x-coord (ft)	Resisting Moment (ft-lb)

1.	.997	584.44	619.75	57.56	571.80	631.72	7.288E+05
2.	1.257	567.26	628.77	75.34	533.33	629.89	1.682E+06
3.	1.357	566.84	622.30	61.80	555.77	611.58	3.879E+05
4.	1.403	570.86	621.02	57.42	571.80	609.98	2.144E+05
5.	1.521	612.79	606.86	56.47	575.00	665.67	2.769E+0[illegible]
6.	1.616	573.43	579.44	21.17	562.18	593.19	9.798E+04
7.	1.648	559.55	620.78	69.94	526.92	617.90	1.473E+06
8.	1.656	574.79	578.80	23.44	558.97	597.70	1.844E+05
9.	1.659	426.69	1311.23	765.38	504.49	674.28	2.754E+07
10.	1.673	590.90	652.21	105.75	536.54	674.12	8.351E+06

* * * END OF FILE * * *

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*****************************************
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```

Problem Description : PO 145 - 3 to 1 Undrain Condition

SEGMENT BOUNDARY COORDINATES
---

6 SURFACE boundary segments

Segment No.	x-left (ft)	y-left (ft)	x-right (ft)	y-right (ft)	Soil Unit Below Segment
1	.0	548.0	469.1	548.0	1
2	469.1	548.0	509.6	561.5	2
3	509.6	561.5	553.1	561.5	2
4	553.1	561.5	593.6	575.0	2
5	593.6	575.0	629.6	587.0	3
6	629.6	587.0	860.5	587.0	3

16 SUBSURFACE boundary segments

Segment No.	x-left (ft)	y-left (ft)	x-right (ft)	y-right (ft)	Soil Unit Below Segment
1	.0	548.0	469.1	548.0	1
2	469.1	548.0	509.6	561.5	2
3	509.6	561.5	553.1	561.5	2
4	553.1	561.5	593.6	575.0	2
5	593.6	575.0	773.6	575.0	2
6	773.6	575.0	775.8	575.0	1
7	775.8	575.0	860.5	575.0	4
8	.0	548.0	469.1	548.0	1
9	469.1	548.0	719.6	548.0	1
10	719.6	548.0	773.6	575.0	1
11	773.6	575.0	775.8	575.0	1
12	775.8	575.0	860.5	575.0	4
13	.0	547.0	719.8	547.0	5
14	719.8	547.0	775.8	575.0	4

15	775.8	575.0	860.5	575.0	4
16	.0	547.0	860.5	547.0	5

ISOTROPIC Soil Parameters
---

5 Soil unit(s) specified

Soil Unit No.	Unit Weight Moist (pcf)	Unit Weight Sat. (pcf)	Cohesion Intercept (psf)	Friction Angle (deg)	Pore Pressure Parameter Ru	Pore Pressure Constant (psf)	Water Surface No.
1	133.1	145.0	.0	22.00	.000	.0	0
2	64.3	93.0	50.0	15.00	.000	.0	0
3	100.0	112.3	.0	26.00	.000	.0	0
4	120.0	130.0	300.0	19.00	.000	.0	0
5	140.0	149.8	.0	33.00	.000	.0	1

1 Water surface(s) have been specified

Unit weight of water = 62.40 (pcf)

Water Surface No. 1 specified by 2 coordinate points

****
PHREATIC SURFACE,
****

Point No.	x-water (ft)	y-water (ft)
1	.00	522.00
2	860.50	522.00

A critical failure surface searching method, using a random technique for generating CIRCULAR surfaces has been specified.

120 trial surfaces will be generated and analyzed.

3 Surfaces initiate from each of 40 points equally spaced along the ground surface between x = 450.0 ft
and x = 575.0 ft

Each surface terminates between x = 575.0 ft
and x = 825.0 ft

Unless further limitations were imposed, the minimum elevation at which a surface extends is y = .0 ft

5.0 ft line segments define each trial failure surface.

ANGULAR RESTRICTIONS :

The first segment of each failure surface will be inclined within the angular range defined by :

Lower angular limit := -45.0 degrees
Upper angular limit := (slope angle - 5.0) degrees

```
*************************************************************************
   --  WARNING  --  WARNING  --  WARNING  --  WARNING  --  (# 48)
*************************************************************************
Negative effective stresses were calculated at the base of a slice.
This warning is usually reported for cases where slices have low self
weight and a relatively high "c" shear strength parameter.  In such
cases, this effect can only be eliminated by reducing the "c" value.
*************************************************************************
```

USER SELECTED option to maintain strength greater than zero

Factors of safety have been calculated by the :

* * * * * SIMPLIFIED BISHOP METHOD * * * * *

The most critical circular failure surface is specified by 15 coordinate points

Point No.	x-surf (ft)	y-surf (ft)
1	568.59	566.66
2	573.48	565.61
3	578.44	564.98
4	583.43	564.79
5	588.43	565.04
6	593.38	565.72
7	598.26	566.84
8	603.01	568.37
9	607.62	570.32
10	612.04	572.66
11	616.24	575.37
12	620.18	578.45
13	623.84	581.85
14	627.19	585.57
15	627.82	586.41

**** Simplified BISHOP FOS = 1.187 ****

The following is a summary of the TEN most critical surfaces

Problem Description : PO 145 - 3 to 1 Undrain Condition

	FOS (BISHOP)	Circle Center x-coord (ft)	Circle Center y-coord (ft)	Radius (ft)	Initial x-coord (ft)	Terminal x-coord (ft)	Resisting Moment (ft-lb)
1.	1.187	583.11	621.99	57.20	568.59	627.82	6.555E+05
2.	1.320	563.29	627.13	73.53	530.13	623.49	1.652E+06
3.	1.323	569.68	665.30	116.27	517.31	655.56	5.851E+06
4.	1.406	562.72	618.12	57.53	552.56	604.47	4.056E+05
5.	1.552	555.80	819.68	260.58	520.51	673.10	1.001E+07
6.	1.577	573.81	586.26	29.92	555.77	602.46	3.340E+05
7.	1.583	604.10	600.79	52.33	565.39	654.53	2.595E+06
8.	1.587	545.13	795.07	247.20	488.46	678.52	1.719E+07
9.	1.590	559.64	613.04	62.82	523.72	614.14	1.509E+06
10.	1.605	573.87	624.30	56.61	571.80	609.42	2.033E+05

* * * END OF FILE * * *

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```

Problem Description : PO 145 - 4 to 1 Undrain Condition

SEGMENT BOUNDARY COORDINATES
---

6 SURFACE boundary segments

Segment No.	x-left (ft)	y-left (ft)	x-right (ft)	y-right (ft)	Soil Unit Below Segment
1	.0	548.0	419.6	548.0	1
2	419.6	548.0	473.6	561.5	2
3	473.6	561.5	527.6	561.5	2
4	527.6	561.5	581.6	575.0	2
5	581.6	575.0	629.6	587.0	3
6	629.6	587.0	860.5	587.0	3

16 SUBSURFACE boundary segments

Segment No.	x-left (ft)	y-left (ft)	x-right (ft)	y-right (ft)	Soil Unit Below Segment
1	.0	548.0	419.6	548.0	1
2	419.6	548.0	473.6	561.5	2
3	473.6	561.5	527.6	561.5	2
4	527.6	561.5	581.6	575.0	2
5	581.6	575.0	773.6	575.0	2
6	773.6	575.0	775.8	575.0	1
7	775.8	575.0	860.5	575.0	4
8	.0	548.0	419.6	548.0	1
9	419.6	548.0	719.6	548.0	1
10	719.6	548.0	773.6	575.0	1
11	773.6	575.0	775.8	575.0	1
12	775.8	575.0	860.5	575.0	4
13	.0	547.0	719.8	547.0	5
14	719.8	547.0	775.8	575.0	4

15	775.8	575.0	860.5	575.0	4
16	.0	547.0	860.5	547.0	5

ISOTROPIC Soil Parameters
---

5 Soil unit(s) specified

Soil Unit No.	Unit Weight Moist (pcf)	Unit Weight Sat. (pcf)	Cohesion Intercept (psf)	Friction Angle (deg)	Pore Pressure Parameter Ru	Pore Pressure Constant (psf)	Water Surface No.
1	133.1	145.0	.0	22.00	.000	.0	0
2	64.3	93.0	50.0	15.00	.000	.0	0
3	100.0	112.3	.0	26.00	.000	.0	0
4	120.0	130.0	300.0	19.00	.000	.0	0
5	140.0	149.8	.0	33.00	.000	.0	1

1 Water surface(s) have been specified

Unit weight of water = 62.40 (pcf)

Water Surface No. 1 specified by 2 coordinate points

****
PHREATIC SURFACE,
****

Point No.	x-water (ft)	y-water (ft)
1	.00	522.00
2	860.50	522.00

A critical failure surface searching method, using a random technique for generating CIRCULAR surfaces has been specified.

120 trial surfaces will be generated and analyzed.

3 Surfaces initiate from each of 40 points equally spaced along the ground surface between x = 450.0 ft
and x = 575.0 ft

Each surface terminates between x = 575.0 ft
and x = 825.0 ft

Unless further limitations were imposed, the minimum elevation at which a surface extends is y = .0 ft

5.0 ft line segments define each trial failure surface.

ANGULAR RESTRICTIONS :

The first segment of each failure surface will be inclined within the angular range defined by :

Lower angular limit := -45.0 degrees
Upper angular limit := (slope angle - 5.0) degrees

****
-- WARNING -- WARNING -- WARNING -- WARNING -- (# 48)
****
Negative effective stresses were calculated at the base of a slice. This warning is usually reported for cases where slices have low self weight and a relatively high "c" shear strength parameter. In such cases, this effect can only be eliminated by reducing the "c" value.
****

USER SELECTED option to maintain strength greater than zero

Factors of safety have been calculated by the :

* * * * * SIMPLIFIED BISHOP METHOD * * * * *

The most critical circular failure surface is specified by 19 coordinate points

Point No.	x-surf (ft)	y-surf (ft)
1	533.33	562.93
2	538.09	561.40
3	542.95	560.19
4	547.87	559.31
5	552.83	558.75
6	557.83	558.52
7	562.83	558.62
8	567.81	559.05
9	572.75	559.81
10	577.63	560.90
11	582.43	562.30
12	587.13	564.02
13	591.70	566.05
14	596.12	568.37
15	600.39	570.99
16	604.47	573.88
17	608.35	577.03

18	612.01	580.43
19	614.70	583.27

**** Simplified BISHOP FOS = 1.484 ****

The following is a summary of the TEN most critical surfaces

Problem Description : PO 145 - 4 to 1 Undrain Condition

	FOS (BISHOP)	Circle Center x-coord (ft)	Circle Center y-coord (ft)	Radius (ft)	Initial x-coord (ft)	Terminal x-coord (ft)	Resisting Moment (ft-lb)
1.	1.484	558.81	634.10	75.59	533.33	614.70	1.364E+06
2.	1.528	583.54	617.55	66.13	542.95	642.20	2.880E+06
3.	1.534	543.75	747.35	190.64	501.28	646.86	6.859E+06
4.	1.542	582.92	661.00	107.76	536.54	661.21	5.525E+06
5.	1.591	588.53	626.60	56.58	571.80	628.66	6.274E+05
6.	1.602	545.84	796.60	236.46	520.51	655.32	7.820E+06
7.	1.646	558.71	606.56	55.14	526.92	607.87	1.400E+06
8.	1.749	538.36	696.25	148.63	475.64	639.14	8.216E+06
9.	1.780	601.95	599.18	40.23	571.80	640.28	1.184E+06
10.	1.787	580.93	604.67	57.50	539.74	635.55	2.979E+06

* * * END OF FILE * * *

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```

Problem Description : PO 145 - 2.5 to 1 Drained Condition

SEGMENT BOUNDARY COORDINATES
---

6 SURFACE boundary segments

Segment No.	x-left (ft)	y-left (ft)	x-right (ft)	y-right (ft)	Soil Unit Below Segment
1	.0	548.0	500.0	548.0	1
2	500.0	548.0	533.3	561.5	2
3	533.3	561.5	566.6	561.5	2
4	566.6	561.5	600.0	575.0	2
5	600.0	575.0	629.6	587.0	3
6	629.6	587.0	860.5	587.0	3

16 SUBSURFACE boundary segments

Segment No.	x-left (ft)	y-left (ft)	x-right (ft)	y-right (ft)	Soil Unit Below Segment
1	.0	548.0	500.0	548.0	1
2	500.0	548.0	533.3	561.5	2
3	533.3	561.5	566.6	561.5	2
4	566.6	561.5	600.0	575.0	2
5	600.0	575.0	773.6	575.0	2
6	773.6	575.0	775.8	575.0	1
7	775.8	575.0	860.5	575.0	4
8	.0	548.0	500.0	548.0	1
9	500.0	548.0	719.6	548.0	1
10	719.6	548.0	773.6	575.0	1
11	773.6	575.0	775.8	575.0	1
12	775.8	575.0	860.5	575.0	4
13	.0	547.0	719.8	547.0	5
14	719.8	547.0	775.8	575.0	4

15	775.8	575.0	860.5	575.0	4
16	.0	547.0	860.5	547.0	5

ISOTROPIC Soil Parameters
---

5 Soil unit(s) specified

Soil Unit No.	Unit Weight Moist (pcf)	Unit Weight Sat. (pcf)	Cohesion Intercept (psf)	Friction Angle (deg)	Pore Pressure Parameter Ru	Pore Pressure Constant (psf)	Water Surface No.
1	133.1	145.0	.0	22.00	.000	.0	2
2	64.3	93.0	.0	33.00	.000	.0	2
3	100.0	112.3	.0	26.00	.000	.0	0
4	120.0	130.0	300.0	19.00	.000	.0	0
5	140.0	149.8	.0	33.00	.000	.0	1

2 Water surface(s) have been specified

Unit weight of water = 62.40 (pcf)

Water Surface No. 1 specified by 2 coordinate points

****
PHREATIC SURFACE,
****

Point No.	x-water (ft)	y-water (ft)
1	.00	522.00
2	860.50	522.00

Water Surface No. 2 specified by 4 coordinate points

****
PHREATIC SURFACE,
****

Point No.	x-water (ft)	y-water (ft)
1	.00	548.00
2	500.00	548.00
3	533.30	561.50
4	746.60	561.50

A critical failure surface searching method, using a random technique for generating CIRCULAR surfaces has been specified.

120 trial surfaces will be generated and analyzed.

3 Surfaces initiate from each of 40 points equally spaced along the ground surface between x = 450.0 ft
and x = 575.0 ft

Each surface terminates between x = 575.0 ft
and x = 825.0 ft

Unless further limitations were imposed, the minimum elevation at which a surface extends is y = .0 ft

5.0 ft line segments define each trial failure surface.

ANGULAR RESTRICTIONS :

The first segment of each failure surface will be inclined within the angular range defined by :

Lower angular limit := -45.0 degrees
Upper angular limit := (slope angle - 5.0) degrees

Factors of safety have been calculated by the :

* * * * * SIMPLIFIED BISHOP METHOD * * * * *

The most critical circular failure surface is specified by 10 coordinate points

Point No.	x-surf (ft)	y-surf (ft)
1	571.80	563.60
2	576.79	563.90
3	581.73	564.63
4	586.60	565.79
5	591.34	567.37
6	595.93	569.35
7	600.33	571.73
8	604.51	574.48
9	608.43	577.58
10	609.98	579.05

**** Simplified BISHOP FOS = 1.616 ****

The following is a summary of the TEN most critical surfaces

Problem Description : PO 145 - 2.5 to 1 Drained Condition

	FOS (BISHOP)	Circle Center x-coord (ft)	Circle Center y-coord (ft)	Radius (ft)	Initial x-coord (ft)	Terminal x-coord (ft)	Resisting Moment (ft-lb)
1.	1.616	570.86	621.02	57.42	571.80	609.98	2.470E+05
2.	1.631	584.44	619.75	57.56	571.80	631.72	1.192E+06
3.	1.657	566.84	622.30	61.80	555.77	611.58	4.735E+05
4.	1.704	567.26	628.77	75.34	533.33	629.89	2.279E+06
5.	1.763	575.22	574.31	9.42	575.00	581.92	9.716E+02
6.	1.902	569.59	573.62	12.83	565.39	580.32	1.333E+04
7.	1.914	567.02	577.00	17.47	558.97	581.60	2.733E+04
8.	1.915	569.44	572.15	11.40	565.39	579.18	1.016E+04
9.	1.923	573.43	579.44	21.17	562.18	593.19	1.166E+05
10.	1.991	571.23	572.30	12.28	565.39	582.58	2.191E+04

* * * END OF FILE * * *

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*****************************************
```

Problem Description : PO 145 - 3 to 1 Drained Condition

SEGMENT BOUNDARY COORDINATES
---

6 SURFACE boundary segments

Segment No.	x-left (ft)	y-left (ft)	x-right (ft)	y-right (ft)	Soil Unit Below Segment
1	.0	548.0	469.1	548.0	1
2	469.1	548.0	509.6	561.5	2
3	509.6	561.5	553.1	561.5	2
4	553.1	561.5	593.6	575.0	2
5	593.6	575.0	629.6	587.0	3
6	629.6	587.0	860.5	587.0	3

16 SUBSURFACE boundary segments

Segment No.	x-left (ft)	y-left (ft)	x-right (ft)	y-right (ft)	Soil Unit Below Segment
1	.0	548.0	469.1	548.0	1
2	469.1	548.0	509.6	561.5	2
3	509.6	561.5	553.1	561.5	2
4	553.1	561.5	593.6	575.0	2
5	593.6	575.0	773.6	575.0	2
6	773.6	575.0	775.8	575.0	1
7	775.8	575.0	860.5	575.0	4
8	.0	548.0	469.1	548.0	1
9	469.1	548.0	719.6	548.0	1
10	719.6	548.0	773.6	575.0	1
11	773.6	575.0	775.8	575.0	1
12	775.8	575.0	860.5	575.0	4
13	.0	547.0	719.8	547.0	5
14	719.8	547.0	775.8	575.0	4

15	775.8	575.0	860.5	575.0	4
16	.0	547.0	860.5	547.0	5

ISOTROPIC Soil Parameters
---

5 Soil unit(s) specified

Soil Unit No.	Unit Weight Moist (pcf)	Unit Weight Sat. (pcf)	Cohesion Intercept (psf)	Friction Angle (deg)	Pore Pressure Parameter Ru	Pore Pressure Constant (psf)	Water Surface No.
1	133.1	145.0	.0	22.00	.000	.0	2
2	64.3	93.0	.0	33.00	.000	.0	2
3	100.0	112.3	.0	26.00	.000	.0	0
4	120.0	130.0	300.0	19.00	.000	.0	0
5	140.0	149.8	.0	33.00	.000	.0	1

2 Water surface(s) have been specified

Unit weight of water = 62.40 (pcf)

Water Surface No. 1 specified by 2 coordinate points

****
PHREATIC SURFACE,
****

Point No.	x-water (ft)	y-water (ft)
1	.00	522.00
2	860.50	522.00

Water Surface No. 2 specified by 4 coordinate points

****
PHREATIC SURFACE,
****

Point No.	x-water (ft)	y-water (ft)
1	.00	548.00
2	469.10	548.00
3	509.60	561.50
4	746.60	561.50

A critical failure surface searching method, using a random technique for generating CIRCULAR surfaces has been specified.

120 trial surfaces will be generated and analyzed.

3 Surfaces initiate from each of 40 points equally spaced along the ground surface between x = 450.0 ft
and x = 575.0 ft

Each surface terminates between x = 575.0 ft
and x = 825.0 ft

Unless further limitations were imposed, the minimum elevation at which a surface extends is y = .0 ft

5.0 ft line segments define each trial failure surface.

ANGULAR RESTRICTIONS :

The first segment of each failure surface will be inclined within the angular range defined by :

Lower angular limit := -45.0 degrees
Upper angular limit := (slope angle - 5.0) degrees

Factors of safety have been calculated by the :

* * * * * SIMPLIFIED BISHOP METHOD * * * * *

The most critical circular failure surface is specified by 10 coordinate points

Point No.	x-surf (ft)	y-surf (ft)
1	571.80	567.73
2	576.80	567.77
3	581.77	568.25
4	586.69	569.16
5	591.50	570.51
6	596.18	572.27
7	600.69	574.45
8	604.98	577.01
9	609.03	579.93
10	609.42	580.27

**** Simplified BISHOP FOS = 1.836 ****

The following is a summary of the TEN most critical surfaces

Problem Description : PO 145 - 3 to 1 Drained Condition

	FOS (BISHOP)	Circle Center x-coord (ft)	Circle Center y-coord (ft)	Radius (ft)	Initial x-coord (ft)	Terminal x-coord (ft)	Resisting Moment (ft-lb)
1.	1.836	573.87	624.30	56.61	571.80	609.42	2.326E+05
2.	1.892	563.29	627.13	73.53	530.13	623.49	2.367E+06
3.	1.900	583.11	621.99	57.20	568.59	627.82	1.049E+06
4.	1.924	478.37	976.54	428.59	469.23	657.14	2.401E+07
5.	1.983	550.57	630.81	67.87	558.97	584.06	6.134E+04
6.	1.998	558.31	605.82	41.48	562.18	579.74	2.077E+04
7.	2.028	562.72	618.12	57.53	552.56	604.47	5.853E+05
8.	2.058	557.40	592.36	32.84	546.15	582.59	1.374E+05
9.	2.074	569.68	665.30	116.27	517.31	655.56	9.170E+06
10.	2.117	559.64	613.04	62.82	523.72	614.14	2.009E+06

* * * END OF FILE * * *

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*              X S T A B L              *
*                                       *
*        Slope Stability Analysis       *
*               using the               *
*            Method of Slices           *
*                                       *
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*                                       *
*  Ver. 5.101a                95 - 1316 *
*****************************************
```

Problem Description : PO 145 - 4 to 1 Drained Condition

SEGMENT BOUNDARY COORDINATES
---

6 SURFACE boundary segments

Segment No.	x-left (ft)	y-left (ft)	x-right (ft)	y-right (ft)	Soil Unit Below Segment
1	.0	548.0	419.6	548.0	1
2	419.6	548.0	473.6	561.5	2
3	473.6	561.5	527.6	561.5	2
4	527.6	561.5	581.6	575.0	2
5	581.6	575.0	629.6	587.0	3
6	629.6	587.0	860.5	587.0	3

16 SUBSURFACE boundary segments

Segment No.	x-left (ft)	y-left (ft)	x-right (ft)	y-right (ft)	Soil Unit Below Segment
1	.0	548.0	419.6	548.0	1
2	419.6	548.0	473.6	561.5	2
3	473.6	561.5	527.6	561.5	2
4	527.6	561.5	581.6	575.0	2
5	581.6	575.0	773.6	575.0	2
6	773.6	575.0	775.8	575.0	1
7	775.8	575.0	860.5	575.0	4
8	.0	548.0	419.6	548.0	1
9	419.6	548.0	719.6	548.0	1
10	719.6	548.0	773.6	575.0	1
11	773.6	575.0	775.8	575.0	1
12	775.8	575.0	860.5	575.0	4
13	.0	547.0	719.8	547.0	5
14	719.8	547.0	775.8	575.0	

15	775.8	575.0	860.5	575.0	4
16	.0	547.0	860.5	547.0	5

ISOTROPIC Soil Parameters
---

5 Soil unit(s) specified

Soil Unit No.	Unit Weight Moist (pcf)	Unit Weight Sat. (pcf)	Cohesion Intercept (psf)	Friction Angle (deg)	Pore Pressure Parameter Ru	Pore Pressure Constant (psf)	Water Surface No.
1	133.1	145.0	.0	22.00	.000	.0	2
2	64.3	93.0	.0	33.00	.000	.0	2
3	100.0	112.3	.0	26.00	.000	.0	0
4	120.0	130.0	300.0	19.00	.000	.0	0
5	140.0	149.8	.0	33.00	.000	.0	1

2 Water surface(s) have been specified

Unit weight of water = 62.40 (pcf)

Water Surface No. 1 specified by 2 coordinate points

****
PHREATIC SURFACE,
****

Point No.	x-water (ft)	y-water (ft)
1	.00	522.00
2	860.50	522.00

Water Surface No. 2 specified by 4 coordinate points

****
PHREATIC SURFACE,
****

Point No.	x-water (ft)	y-water (ft)
1	.00	548.00
2	419.60	548.00
3	473.60	561.50
4	746.60	561.50

A critical failure surface searching method, using a random technique for generating CIRCULAR surfaces has been specified.

120 trial surfaces will be generated and analyzed.

3 Surfaces initiate from each of 40 points equally spaced along the ground surface between x = 450.0 ft
and x = 575.0 ft

Each surface terminates between x = 575.0 ft
and x = 825.0 ft

Unless further limitations were imposed, the minimum elevation at which a surface extends is y = .0 ft

5.0 ft line segments define each trial failure surface.

ANGULAR RESTRICTIONS :

The first segment of each failure surface will be inclined within the angular range defined by :

Lower angular limit := -45.0 degrees
Upper angular limit := (slope angle - 5.0) degrees

Factors of safety have been calculated by the :

* * * * * SIMPLIFIED BISHOP METHOD * * * * *

The most critical circular failure surface is specified by 9 coordinate points

Point No.	x-surf (ft)	y-surf (ft)
1	575.00	573.35
2	579.99	573.09
3	584.99	573.28
4	589.95	573.91
5	594.83	574.99
6	599.60	576.50
7	604.21	578.43
8	608.63	580.77
9	611.11	582.38

**** Simplified BISHOP FOS = 2.222 ****

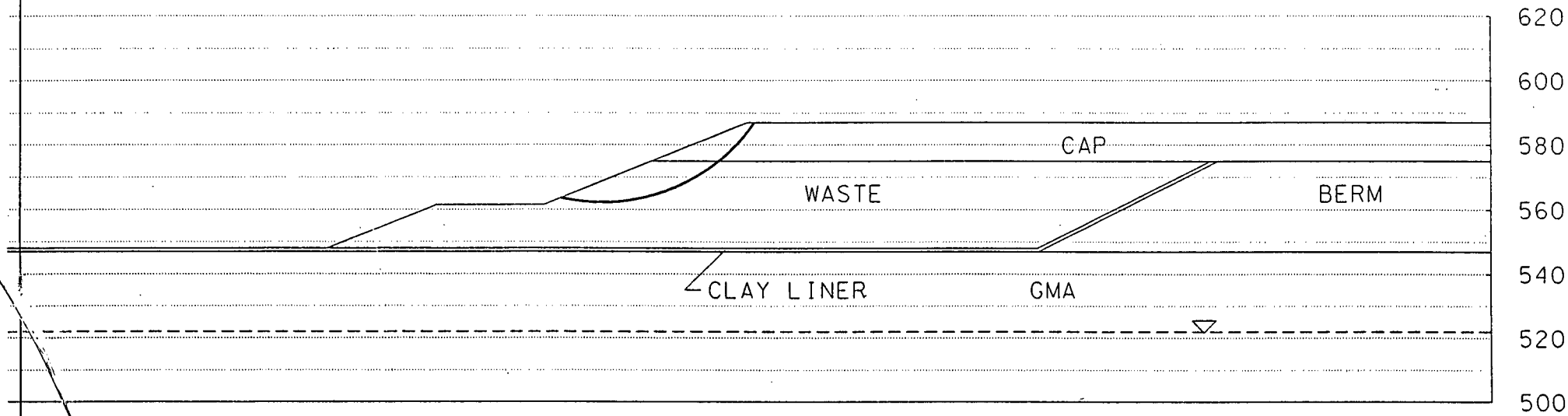
The following is a summary of the TEN most critical surfaces

Problem Description : PO 145 - 4 to 1 Drained Condition

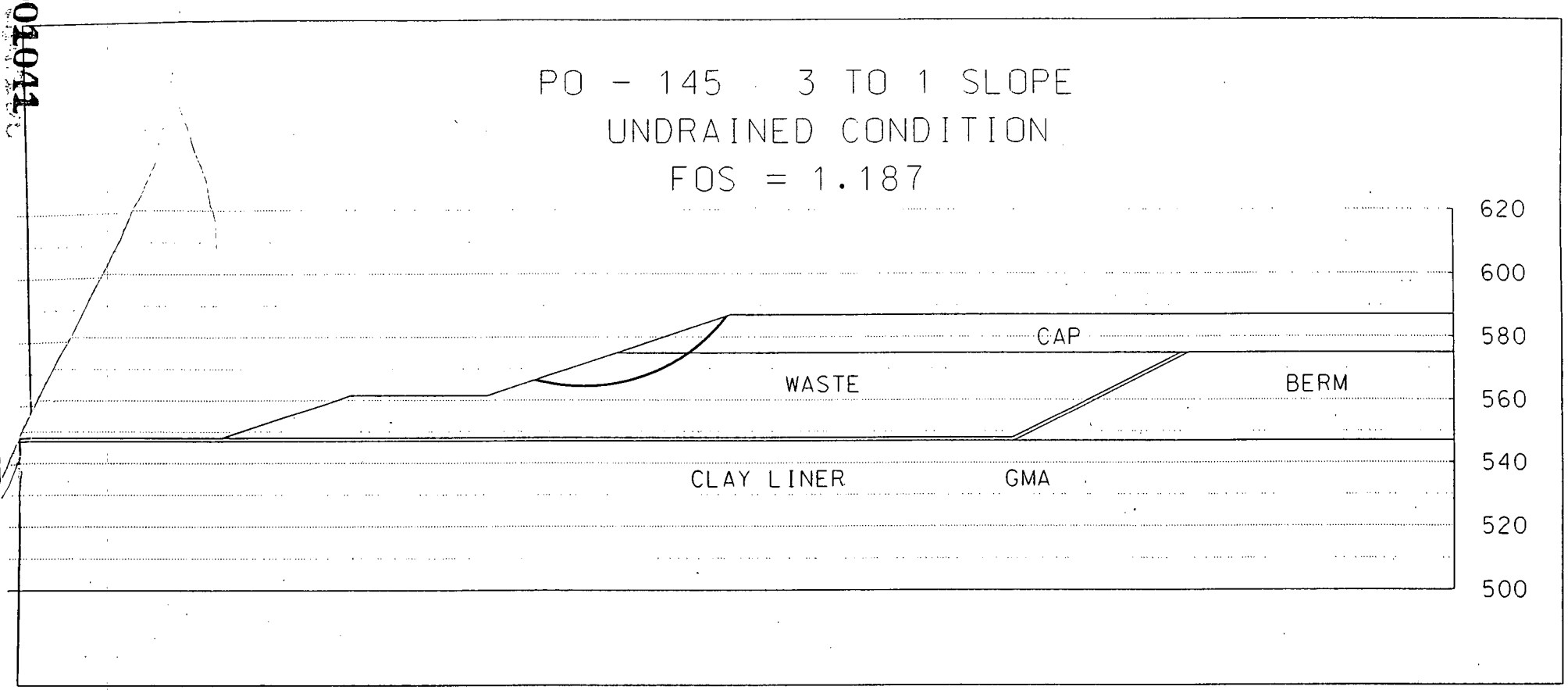
	FOS (BISHOP)	Circle Center x-coord (ft)	Circle Center y-coord (ft)	Radius (ft)	Initial x-coord (ft)	Terminal x-coord (ft)	Resisting Moment (ft-lb)
1.	2.222	580.40	628.80	55.71	575.00	611.11	2.232E+05
2.	2.295	538.36	696.25	148.63	475.64	639.14	1.078E+07
3.	2.350	547.08	696.82	128.57	555.77	599.72	3.395E+05
4.	2.395	588.53	626.60	56.58	571.80	628.66	9.446E+05
5.	2.406	543.75	747.35	190.64	501.28	646.86	1.076E+07
6.	2.501	558.81	634.10	75.59	533.33	614.70	2.299E+06
7.	2.560	558.71	606.56	55.14	526.92	607.87	2.177E+06
8.	2.590	580.93	604.67	57.50	539.74	635.55	4.317E+06
9.	2.599	530.59	666.04	112.71	488.46	604.08	3.321E+06
10.	2.622	492.27	861.42	307.51	453.21	630.99	1.096E+07

* * * END OF FILE * * *

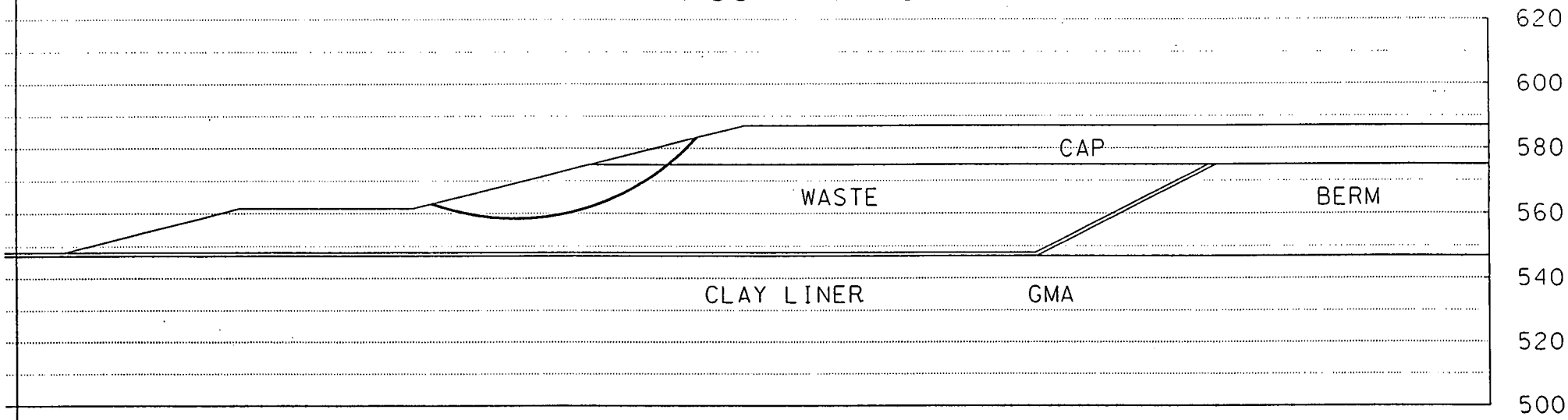
PO - 145 2.5 TO 1 SLOPE
UNDRAINED CONDITION
FOS = 0.997



001011


PO - 145 3 TO 1 SLOPE
UNDRAINED CONDITION
FOS = 1.187
620
600
580
560
540
520
500
CAP
WASTE
BERM
CLAY LINER
GMA

PO - 145 4 TO 1 SLOPE
UNDRAINED CONDITION
FOS = 1.484

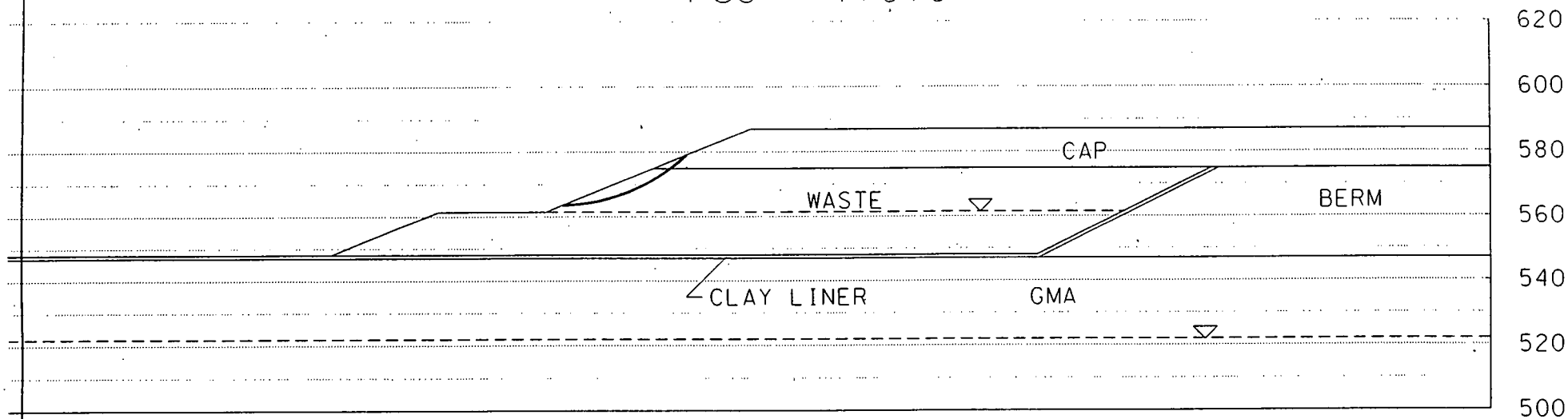


001042

016

001043

PO - 145 2.5 TO 1 SLOPE
DRAINED CONDITION
FOS = 1.616



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DRAINED CONDITION
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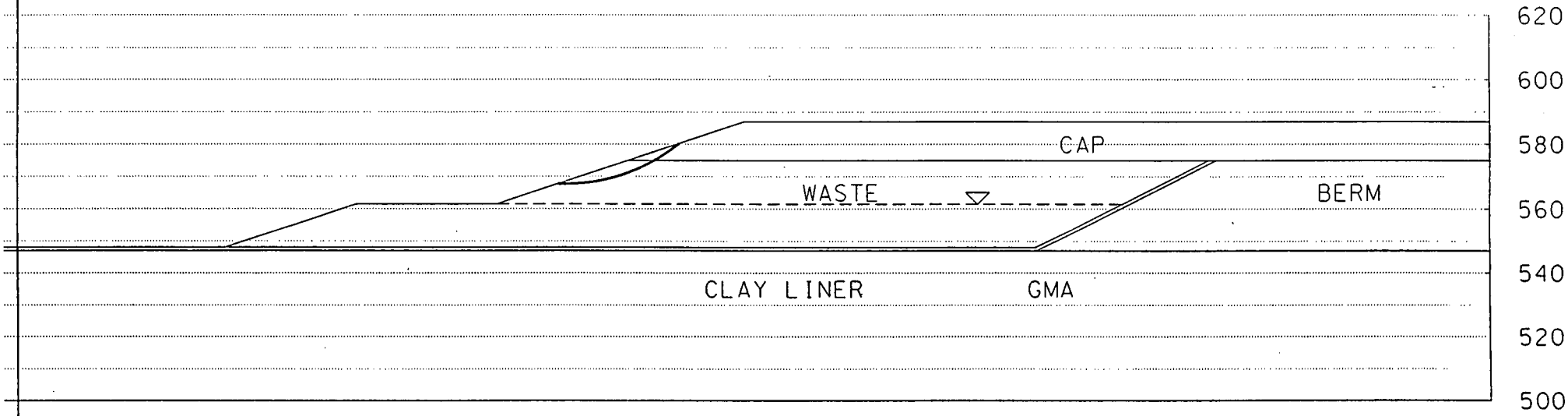
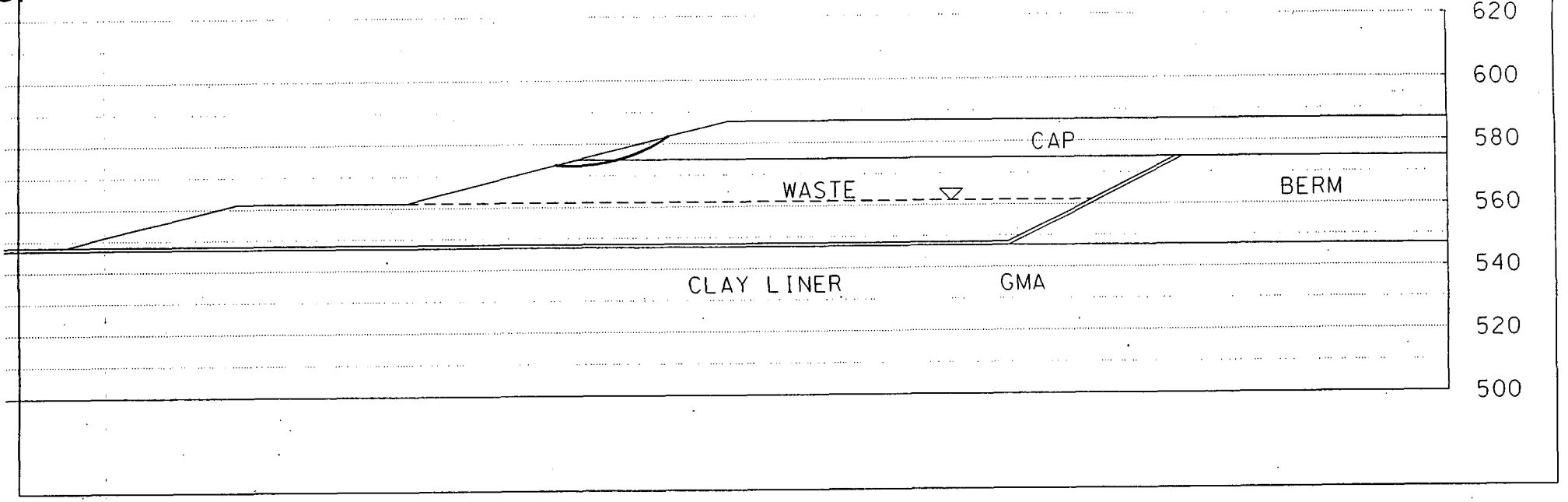


S40100

PO - 145 4 TO 1 SLOPE
DRAINED CONDITION
FOS = 2.222



TRANSPORTATION & DISPOSAL PLAN

DRAFT
Transportation And Disposal Plan

October 1995
Revision C

Prepared for:

The United States Department of Energy
Fernald Field Office
Fernald, Ohio

Prepared by:

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LIST OF ACRONYMS AND ABBREVIATIONS

CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CFR	Code of Federal Regulations
CSXT	CSX Transportation, Inc.
DOE	U.S. Department of Energy
DOE-HQ	U.S. Department of Energy-Headquarters
DOE-FN	U.S. Department of Energy-Fernald Area Office
DOE-NV	U.S. Department of Energy-Nevada
DOT	U.S. Department of Transportation
EOC	FEMP Emergency Operations Center
EM	Environmental Management
FEMP	Fernald Environmental Management Project
FERMCO	Fernald Environmental Restoration Corporation
FR	Federal Register
FRA	Federal Railroad Administration
FRMAC	Federal Radiological Monitoring and Assessment Center
HAZMAT	(DOT) Hazardous Material
IAFF	International Association of Firefighters
LLRW	Low Level Radioactive Waste
LSA	Low Specific Activity
NRC	Nuclear Regulatory Commission
NTS	Nevada Test Site
OU1	Operable Unit 1
PCB	Polychlorinated biphenyl
PCDF	Permitted Commercial Disposal Facility
RPCDF	Representative Commercial Disposal Facility
ppm	parts per million
RCRA	Resource Conservation and Recovery Act
SNM	Special Nuclear Material
TLD	Thermoluminescent Dosimeter
UPRR	Union Pacific Railroad Company
WAC	Waste Acceptance Criteria

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EXECUTIVE SUMMARY

Purpose

The United States Department of Energy (DOE) has developed this Transportation and Disposal Plan to facilitate the remediation of the waste pits comprising Operable Unit 1 (OU1), from the DOE's Fernald Environmental Management Project (FEMP), located near Fernald, Ohio. This document is the third element (of three elements) of Package II of the Remedial Design Project Documentation and Deliverables. The other two elements in Package II are the Excavation Plan and the Site Restoration Plan. The five elements of the Package I are the Plant Facilities Design Criteria Package, Plant Facilities Engineering, Equipment Specifications, Site Improvement Plan, and Construction Plan.

The primary objective is to refine the remedial alternative as presented in the *Final Feasibility Study for Operable Unit 1* (DOE 1994b) and in the *Final Proposed Plan for Operable Unit 1* (DOE 1994c), and as selected in the *Record of Decision For Remedial Actions at Operable Unit 1* (DOE 1995a), by describing the logistics of rail transportation, and providing objectives and criteria to be implemented in the detailed design phase. This plan highlights operational aspects of waste transportation sufficiently to demonstrate that wastes can be transported safely in accordance with all applicable regulations. The document serves as a transition between conceptualization (*i.e.*, the feasibility study) and implementation (*i.e.*, remedial action).

At this time, services for disposal have not been procured, the contract with the railroads has not been negotiated, and the designs of the on-site OU1 waste treatment and waste loading facilities have not been finalized. In addition, many aspects of this Transportation and Disposal Plan interface with design features described in the other elements of the Remedial Design Project Documentation and Deliverables. Therefore, some aspects of this plan are preliminary or conceptual in nature and the details remain to be developed. Actions or activities to be completed are identified in this plan.

This document also supports the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) community involvement process by identifying and evaluating anticipated transportation issues and providing recommended resolutions for presentation in public meetings and incorporation in the detailed design effort.

OU1 Waste Characterization

Operable Unit 1 consists of eight OU1 subunits, Waste Pits 1 through 6, the Clearwell, and the Burn Pit. The waste materials contained in these units were generated by chemical and metallurgical processes associated with the uranium purification mission of the former Feed Materials Production Center. The wastes consist of a variety of heterogeneous process waste residues including slags, sludges, precipitates,

and filter cakes. Some pits were covered with soil after being taken out of active service. In addition, building debris was disposed in the waste pits. (DOE 1994a)

Analytical data indicate that OU1 waste will meet the criteria for Low Specific Activity (LSA) material under criteria in 49 CFR 173 (See Appendix A of the main report). LSA material is the lowest hazard transportation category of radioactive material. Transport requirements for LSA material are defined in 49 CFR 173.425, and described in Appendix B of the main report.

Operable Unit 1 Remedial Plan

As described in the *Operable Unit 1 Record of Decision* (DOE 1995a), the selected remedy consists of the following items:

1) Excavation of wastes from OU1's six waste pits, Clearwell, Burn Pit, and soils with in the OU1 boundary, liners, *etc.*
2) Pretreatment (*e.g.*, sorting, crushing, shredding)
3) Treatment by thermal drying
4) Off-site disposal at a permitted commercial disposal facility (PCDF)

The untreated waste pit material has a high moisture content and is heterogeneous in nature, physically and radiologically. The excavated OU1 material will be treated to meet the PCDF's waste acceptance criteria (WAC) for a relatively homogeneous waste product with low activity. These processing operations will generate approximately 724,000 tons (670,000 cubic yards) of soil-like materials and debris, which will be loaded into railcars and transported to disposal facilities over a seven-year period, projected to start in 1998.

For design purposes, it is estimated that at least 90 per cent of the treated wastes will be disposed at a representative PCDF (RPCDF). For planning purposes, a facility located near Clive, Utah, is used as the RPCDF. As a contingency, waste that does not meet the acceptance criteria of the RPCDF can be shipped to the Nevada Test Site (NTS).

Community Involvement

To facilitate community involvement, the FEMP organized four transportation meetings. Based on these four meetings, the public's primary concerns included the following items:

1) The condition of the CSX Transportation (CSXT) Branch Line from the FEMP to Cottage Grove, Indiana
2) Staging of loaded cars at the Shandon Yard switchyard near the FEMP

3) Time that trains would be delayed at Cottage Grove waiting for clearance onto the main line.

This Transportation and Disposal Plan addresses these concerns in the following manner:

1) The track and other infrastructure on the branch line will be inspected and repaired (as needed) before initiation of rail traffic associated with this project.
2) As a result of the OU1 Record of Decision and a recently-completed study, the DOE will not use the Shandon Yard switchyard to store loaded and unloaded cars.
3) CSXT has committed to exert all efforts to keep delays at Cottage Grove to less than one hour.

The DOE will continue to offer opportunities for public involvement beyond those required by the CERCLA regulations and U.S. Environmental Protection Agency (EPA) guidance, during the Remedial Design (RD) and Remedial Action (RA) phases of the remediation. As details of the transportation plans are finalized, interested stakeholders will be informed. Further information regarding FEMP initiatives is presented in Section 8.

Selection Of Transportation Mode

For planning purposes, the principal disposal site is assumed to be the RPCDF which is located in Clive, Utah. This facility has direct rail access and "roll-over" equipment for unloading gondola railcars. A NEPA Impact Analysis was performed as part of the *Feasibility Study Report for Operable Unit 1*. A cost-benefit study of various shipment options indicated that direct rail transport to the RPCDF is the most economical mode and is also most acceptable to the public (FERMCO 1995d). Cost factors, evaluated in the study, included: (1) railcar and container pricing and maintenance, (2) cover and liner, (3) transportation, (4) on/off-site rail upgrades, (5) on-site structures, and (5) acquisition and operation cost of site locomotive.

The optimal rail configuration is a unit train, consisting of gondola cars where the load is contained by a disposable liner and a hard cover.

The most direct rail route between the FEMP and the RPCDF involves only two railroads, CSX Transportation and Union Pacific Railroad (UPRR). A brief profile of these two railroads is provided in Section 2.1 of the main report. Both CSXT and UPRR are among the five largest railroads in the United States and have ample capacity to handle the anticipated OU1 traffic.

A unit train is a train that makes a direct run between the point of origin and the destination point. The unit train receives priority right-of-way and expedited switching, and stays intact along the whole route, (*i.e.*, it does not receive additional freight, nor drop any freight). The gondola railcar was selected as the most cost-effective means of transporting bulk quantities of material. The DOE has committed that

railcars with OU1 material will be lined with a synthetic material liner and covered with a secured hard cover (See Figure 2-1). For further information on the train configuration, see Section 2 of this report.

Railcar Logistics at the FEMP

To support rail transportation operations, a major upgrade of facilities at the FEMP will be required. Site improvements include construction of the waste loading facility, installation of new tracks, installation of fencing around all tracks, and construction of a railcar maintenance facility, car wash facility, and radiation monitoring facility. The proposed upgrade program of the FEMP railroad infrastructure is shown in Figure 3-2. For details on the facilities, see Section 3 and Appendix D of the main report.

Two refurbished switchyard locomotives, and possibly the FEMP Trackmobile®, will move the cars around the FEMP. A carmover will be used in the loading building. After loading in the waste loading facility, cars will be decontaminated (if necessary) and radiologically surveyed before being placed in a holding area. Cars will be held in storage until analytical results indicate it is acceptable to release the cars. Details of the waste loading process are provided in the *Site Improvement Plan*. A detailed description of the movement of gondola cars at the FEMP and process description of unit train assembly is presented in Appendix D.

Prior to releasing the unit train from the FEMP, the train will be radiologically surveyed again, and inspected for mechanical safety (*e.g.*, brakes). In addition, shipping papers will be prepared for the railroad and the disposal facility. The disposal facility will require certification that the waste has been analyzed and meets the disposal facility's WAC.

Logistics of Rail Transport to the RPCDF

CSXT will move the loaded unit trains from the FEMP through Cincinnati, Ohio, to East St. Louis. UPRR will move the unit train from East St. Louis to the RPCDF.

On the basis of the design load and rating, CSXT indicates that three trestles are not satisfactory for the rail traffic associated with this project. These three trestles are located on the Branch Line from the FEMP to Cottage Grove:

1) Camp Run
2) South Wynn Road
3) Bucks Run and Road (Okeana Trestle)

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CSXT believes these trestles need to be rebuilt prior to commencement of rail traffic associated with this project. These efforts can be effected with nominal disruption of the current rail traffic. The DOE is committed to upgrading these structures before waste shipment.

The away-from-site round-trip cycle for a unit train is 15 calendar days which includes: one day for en-route delays, and four days at the disposal facility. With the addition of two days (one at the start and one at the conclusion of the trip) for assembling and breaking-down the unit train at the FEMP, the total cycle time used for planning purposes is 17 calendar days. After production operations with one waste dryer have stabilized in FY 1999, on the average a unit train will depart every 14 days with 42 loaded cars. Two unit trains will be used. In FY 2001, when two treatment systems are operable, a unit train could depart every 8 days with 53 loaded cars. This effort would require three unit trains. For further details on the train schedule, see Section 4.2 of this report and Appendix D.

Tracking the location of railcars is standard practice with all major railroad companies. Tracking data are received from railroad transponders located at main switches along the tracks. With this system, the location of each car can be determined based on the last transmission. At any time, OU1's traffic management organization access the system to determine the locations of the trains/cars. If cars are stopped due to a transportation incident, the FEMP would be immediately notified by railroads' control centers.

Permitted Commercial Disposal Facility

The RPCDF is licensed to accept for disposal: (a) specific low concentrations of radionuclides within the low-level radioactive waste (LLRW) classification (b) Naturally Occurring Radioactive Material (NORM), (c) mixed waste, and (d) 11e.(2) by-product materials (uranium and thorium mill tailings). The disposal facility of approximately 540 acres is next to a DOE mill tailings disposal site (100 acres). The facility is located near Clive, Utah, about 75 miles west (65 miles by air) (NRC 1993) of Salt Lake City, Utah. The disposal facility has been successful in working with their regulators in obtaining additional licenses and processing amendments to its existing licenses and has ample disposal capacity to accept OU1 material.

The disposal site is located one mile south of the main line of UPRR and is connected by a rail spur. It has facilities to accommodate 300 railcars at one time. Gondola cars are unloaded with the roll-over device shown on Figure 5-2.

The FEMP will make every effort to ensure that all waste material shipped to the disposal facility meets its WAC. The FEMP will perform confirmatory analysis prior to its shipment to the RPCDF (see Sampling and Analysis Plan). In the unlikely event that any waste arriving at the disposal facility does not conform to the accepted waste profile based on the facility's sampling and analysis of the waste

shipment, then the waste material will not be unloaded. The FEMP would be notified immediately, and the material would be resampled and analyzed.

The disposal facility is able to process some non-conforming waste, such as waste with free liquids, into an acceptable form, and then accept the waste for disposal. However, if the waste exceeds the chemical/radiological acceptance criteria, the waste will be returned to the FEMP. Due to the waste acceptance procedure of the NTS, transshipment from the RPCDF is not currently believed to be feasible. After the railcar returns to the FEMP, material will be removed by a backhoe, positioned on a ramp adjacent to the car. If the FEMP's evaluation confirms that the rejected material, after reprocessing, could not be accepted by the RPCDF, then the waste would be re-packaged for transportation and disposal at the NTS unless analysis indicates that the waste exceeds the Land Disposal Restrictions. The latter event is not believed likely. For further information on the disposal operations at the RPCDF, see Section 5 of the main report.

Transport and Disposal at the NTS

The NTS is located in Nye County, Nevada, about 65 miles northwest of Las Vegas. The NTS encompasses about 1350 square miles and has been the primary location for testing the nation's nuclear weapons since January 1951. Since 1978, the NTS has also served as a major LLRW disposal facility for several DOE sites.

Material that cannot be treated to meet the RPCDF's WAC will be disposed of at the NTS. Before any waste material leaves the FEMP, the waste will be analyzed to ensure compliance with the NTS WAC (DOE *et al.* 1992). Prior to shipment of OU1 material to the NTS, the FEMP will submit the appropriate application for DOE approval.

Current FEMP procedures for shipment of LLRW to the NTS specify the use of disposable metal containers transported by truck. For disposal of limited quantities of material, use of disposable containers is practical. However, for bulk quantities of material, the metal containers would be emptied at the disposal cell and returned for repeated use. Transport to the NTS is by truck, along existing routes, in accordance with existing procedures. The FEMP has been shipping LLRW to the NTS since 1986. For further information on the NTS, see Section 6 of the main report.

Emergency Response Planning And Training

Federal regulations and DOE orders require the FEMP (as shipper), the DOE, and the carriers to have emergency plans and procedures in place to respond to transportation accidents. Currently, the FEMP has a *Transportation Emergency Plan* (FERMCO 1995a) and associated emergency preparedness procedures that cover only truck transport incidents. Before initiation of OU1 shipments, the existing

plan and procedures will be revised to include rail transport accidents. In addition, the DOE will offer emergency training to first responders in the nearby communities and will participate, as requested, in periodic training programs sponsored by the railroad and other organizations responsible for emergency planning (DOE 1995a). As part of emergency response preparations, the DOE is committed to contact and work with representatives from Ohio, Utah, and transited states prior to the first waste shipment to brief them on shipment plans.

On July 18, 1995, the FEMP and the DOE took a significant step toward honoring their commitments with respects to emergency planning, training, and assistance to local communities. The FEMP awarded a $1 million contract to the International Association of Fire Fighters to develop a custom-tailored emergency response training program for first responders. The program will specifically include all waste shipments from the FEMP, including OU1 material.

In the event of an emergency, there are at least six different generic organizations involved in responding, as shown on Figure 7-1. The functions of the six organizations are identified below.

1) Train crews are trained to make an initial notification and assessment of the emergency.

2) Railroad companies have contingency plans, technical and communications personnel, and remediation contractors in place to respond to transportation incidents.

3) Local authorities at the scene of the accident serve as the on-scene incident commander. All other parties support the on-scene commander.

4) States have emergency response organizations and personnel for monitoring and administrative functions. These may include state police and national guard, state departments of transportation, health (State Radiation Control Programs), and environmental protection.

5) The DOE has a network of regional Radiological Assistance Teams that can respond to support local response agencies.

6) The FEMP's existing emergency response program will be revised to support the management of off-site rail emergencies, and to support the railroad and on-scene commander with both technical and communication personnel.

Further details regarding emergency preparedness are provided in Section 7 of the main report.

Training and emergency response initiatives will be developed as appropriate in response to all applicable future rules and regulations, such as those in Docket No. HM-169A (60 FR 50292; September 28, 1995).

Pre-Shipment Notification

Under Department of Transportation (DOT) regulations, LLRW, such as the OU1 remediation wastes, are regulated and shipped as hazardous materials. For shipments to the RPCDF, the states of Ohio, Utah, and transited states do not require prior formal notification of LLRW and there are no known corresponding local requirements. The DOT and the Nuclear Regulatory Commission, through their rule making process and related studies, have determined that prior notification is not required for LLRW. State and local provisions requiring pre-notification, which are inconsistent with federal regulations, have been determined to be incompatible with the national need for uniform transport regulations; consequently, these state and local regulations are preempted.

Currently, the FEMP does not provide advance notification of specific truck shipments to stakeholders. However, reports that address aggregate projected and completed shipments are prepared and distributed to stakeholders. Recognizing the interest of Fernald stakeholders in rail transportation issues, the FEMP will periodically present plans prior to shipment for waste shipment by rail to interested members of the public or interested stakeholders during routine public briefings. These plans will include the following information:

1) Time frames over which waste shipment will occur
2) The number of shipments anticipated
3) Quantities and types of waste planned

The FEMP intends to continue to work with interested stakeholders. Public information sessions will be held to address concerns regarding shipment and staging of these wastes prior to transport. Feedback will be incorporated in the development of detailed transportation plans. Any public notification given for rail shipments leaving the FEMP would be coordinated with the rail carrier.

The FEMP will contact representatives from Ohio, Utah, Nevada, and transited states, prior to the first waste shipment, to brief them on overall shipment plans. This information will allow states to prepare, as necessary, for any potential emergency response activities involving FEMP wastes and ensure that potential first responders are aware of the transport of these wastes.

Ongoing Compliance Initiative

It may be expected that regulatory, and other, requirements/conditions will change during implementation of OU1's remedial alternative. Thus, revisions to planning and execution documents/procedures will be periodically necessary.

For example, this document was prepared prior to the September 28, 1995 promulgation of amended DOT regulations (60 FR 50292). An initial review of the regulations, which will become effective on April 1, 1996, indicates that OU1's planned transportation activities will not be substantially impacted. The Transportation and Disposal Plan in the Pre-final Design Review Package will address compliance with these regulations.

SECTION 1

INTRODUCTION

1.1 Purpose

The United States Department of Energy (DOE) has developed this Transportation and Disposal Plan to facilitate the remediation of the waste pits comprising Operable Unit 1 (OU1), from the DOE's Fernald Environmental Management Project (FEMP), located near Fernald, Ohio. This document is the third element (of three elements) of Package II of the Remedial Design Project Documentation and Deliverables. The other two elements in Package II are the Excavation Plan and the Site Restoration Plan. The five elements of the Package I are the Plant Facilities Design Criteria Package, Plant Facilities Engineering, Equipment Specifications, Site Improvement Plan, and Construction Plan.

The primary objective is to refine the remedial alternative as presented in the *Final Feasibility Study for Operable Unit 1* (DOE 1994b) and in the *Final Proposed Plan for Operable Unit 1* (DOE 1994c), and as selected in the *Record of Decision For Remedial Actions at Operable Unit 1* (DOE 1995a), by describing the logistics of rail transportation, and providing objectives and criteria to be implemented in the detailed design phase. This plan highlights operational aspects of waste transportation sufficiently to demonstrate that wastes can be transported safely in accordance with all applicable regulations. The document serves as a transition between conceptualization (*i.e.*, the feasibility study) and implementation (*i.e.*, remedial action).

At this time, services for disposal have not been procured, the contract with the railroads has not been negotiated, and the designs of the on-site OU1 waste treatment and waste loading facilities have not been finalized. In addition, many aspects of this Transportation and Disposal Plan interface with design features described in the other elements of the Remedial Design Project Documentation and Deliverables. Therefore, some aspects of this plan are preliminary or conceptual in nature and the details remain to be developed. Actions or activities to be completed are identified in this plan.

This document also supports the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) community involvement process by identifying and evaluating anticipated transportation issues and providing recommended resolutions for presentation in public meetings and incorporation in the detailed design effort.

1.2 OU1 Waste Characterization

In general, eight OU1 subunits, Waste Pits 1 through 6, the Clearwell, and the Burn Pit, were excavated into clay lens(es). In certain instances, additional clay and/or synthetic materials were then installed to form liners and the wastes were subsequently emplaced. The waste materials contained in these units were generated by chemical and metallurgical processes associated with the uranium purification mission of the former Feed Materials Production Center. The wastes consist of a variety of heterogeneous process waste residues including slags, sludges, precipitates, and filter cakes. Some pits were covered with soil after being taken out of active service. In addition, building debris was disposed in the waste pits. (DOE 1994a)

Materials excavated from the pits will be pretreated (*e.g.*, sorted, crushed) and dried (as required to meet the waste acceptance criteria (WAC) of the disposal facility), before transportation to a waste disposal site. Waste samples will be analyzed to ensure that wastes meet physical, chemical, and radiological acceptance criteria for disposal. Data from the *Final Remedial Investigation for Operable Unit 1* (DOE 1994a) indicate the waste pits are contaminated with uranium, thorium, and other heavy metals, as well as with organic compounds. However, very little, if any, OU1 waste will be hazardous under federal and state regulations. The regulatory analysis (Table J.6-3) in the OU1 Feasibility Study (DOE 1994b) determined that "OU1 does not contain any listed RCRA [Resource Conservation and Recovery Act] wastes. Post-treated wastes are not expected to exhibit any hazardous characteristics." Additional testing will be performed on the processed materials for routine quality assurance and quality control purposes.

Analytical data indicate that OU1 waste will meet the criteria for Low Specific Activity (LSA) material under criteria in 49 CFR 173 (See Appendix A). LSA material is the lowest hazard transportation category of radioactive material. Transport requirements for LSA material are defined in 49 CFR 173.425, and described in Appendix B.

1.3 Operable Unit 1 Remedial Plan

As described in the *Operable Unit 1 Record of Decision* (DOE 1995a), the selected remedy consists of the following items:

1) Excavation of wastes from OU1's six waste pits, Clearwell, Burn Pit, and soils with in the OU1 boundary, liners, *etc.*
2) Pretreatment (*e.g.*, sorting, crushing, shredding)
3) Treatment by thermal drying
4) Off-site disposal at a permitted commercial disposal facility (RPCDF)

The untreated waste pit material has a high moisture content and is heterogeneous in nature, physically and radiologically. The excavated OU1 material will be treated to meet the RPCDF's WAC for a relatively homogeneous waste product with low activity. These processing operations will generate approximately 724,000 tons (670,000 cubic yards) of soil-like materials and debris, which will be loaded into railcars and transported to disposal facilities over a seven-year period, projected to start in 1998.

For design purposes, it is estimated that at least 90 per cent of the treated wastes will be disposed at a RPCDF. For planning purposes, a facility located near Clive, Utah, is used as the RPCDF. As a contingency, waste that does not meet the acceptance criteria of the RPCDF can be shipped to the Nevada Test Site (NTS).

1.4 Selection Of Transportation Mode

A cost-benefit study of several transportation modes (FERMCO 1995d) determined that bulk rail transport directly to the RPCDF is the most economical and safest mode. The optimal configuration is a unit train, consisting of gondola cars, where the load is contained by a disposable liner and a hard railcar cover (See Section 4). Since the NTS does not have rail access, waste must be shipped in containers to the NTS and delivered by truck.

Rail shipment was selected as the transportation mode to the RPCDF for the following primary reasons:

1) Safety: Rail transportation is safer than transportation by truck and provides less overall potential for exposure to the public.

2) Regulatory Compliance: Rail shipment can be implemented in full conformance with all federal and state requirements for transportation and waste management. (See Appendix B for a description of the transportation regulatory drivers.)

3) Availability: The RPCDF has direct rail access and bulk railcar unloading facilities.

4) Cost: Rail transportation is generally less expensive than shipment by truck.

1.5 Community Involvement

To facilitate community involvement in the OU1 remedy selection process, three transportation meetings were held: Transportation Workshop (August 9, 1994), CSX Transportation Availability Session (August 16, 1994), and the OU1 Public Meeting (August 23, 1994). Additionally, a combined Operable Unit 1 and Operable Unit 4 transportation meeting was held as part of the remedial design process on June 29, 1995. Based on these four meetings, the public's primary concerns included the following items:

1) The condition of the CSX Transportation (CSXT) Branch Line from the FEMP to Cottage Grove, Indiana
2) Staging of loaded cars at the Shandon Yard switchyard near the FEMP
3) Time that trains would be delayed at Cottage Grove waiting for clearance onto the main line.

This document addresses these concerns in the following manner:

1) The track and other infrastructure on the branch line will be inspected and repaired (as needed) before initiation of rail traffic associated with this project.
2) As a result of the OU1 Record of Decision and a recently-completed study, the DOE will not use the Shandon Yard switchyard to store loaded and unloaded cars.
3) All efforts will be made to keep delays at Cottage Grove to less than one hour.

The DOE will continue to offer opportunities for public involvement beyond those required by the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) regulations and U.S. Environmental Protection Agency (EPA) guidance, during the Remedial Design (RD) and Remedial Action (RA) phases of the remediation. As details of the transportation plans are finalized, interested stakeholders will be informed. Further information regarding FEMP initiatives is presented in Section 8.2.

1.6 Organization

The report is divided into eight sections, as shown below:

1) Introduction and background information
2) Transportation Modes From the FEMP to the waste disposal facilities
3) Railcar handling and waste loading at the FEMP
4) Logistics of Rail Transportation from the FEMP to the RPCDF
5) RPCDF operation and logistics
6) NTS disposal operation and logistics
7) Emergency Response Planning and Training
8) Pre-shipment Notification

References and appendices are presented at the end of the report.

2

SECTION 2

DESCRIPTION OF TRANSPORTATION MODE

This section describes the principal transportation mode to move OU1 waste off site to the disposal site. For the purposes of transportation planning, the principal disposal site is assumed to be a RPCDF, which has railcar unloading facilities, and is located in Clive, Utah. A cost-benefit study of various transportation mode options indicated that direct rail transport to the disposal site is the most economical and the safest mode (FERMCO 1995d). The optimal rail configuration is a unit train, consisting of gondola cars where the load is contained by a disposable liner and a hard cover. As a contingency, any waste unable to meet the WAC of the RPCDF will be disposed at the NTS. The assumed mode of transportation for NTS waste is truck, the current mode of operation.

The DOE is committed to specify in its contract with the railroads that they comply with all applicable regulations regarding the integrity and safety of the railroad line. The DOE will require the railroads to document their compliance with the regulations and laws before shipment, and will require that the railroad document their continuing compliance. In this manner, the DOE will be assured that the tracks and associated rail structures, such as culverts and crossings, are in a safe condition before shipment. In addition, the DOE will require the railroads comply with applicable Ohio transportation regulations, as well as with regulations of states through which the waste may be routed. (DOE 1995a)

2.1 Railroad Companies

The only rail carrier serving the FEMP is CSXT. The main rail carrier serving the RPCDF is Union Pacific Railroad Company (UPRR). The most direct rail route between the FEMP and the RPCDF involves only these two railroads, CSXT and UPRR. A brief profile of these two railroads is provided below. A switching railroad may be used as a subcontractor for the transfer of the trains from CSXT to UPRR (westbound) and from UPRR to CSXT (eastbound).

Both CSXT and UPRR are considered Class I railroads, the highest classification of railroads. The Interstate Commerce Commission classifies railroads based on their annual operating revenue. There are only twelve railroads in the United States that have the Class I designation. Based on 1992 data, UPRR is the number one railroad in terms of operating revenue, while CSXT is number three.

Rail transport of OU1 waste material from the FEMP originates on the CSXT line. As the originating railroad, CSXT is the point of contact between the FEMP and both railroads. CSXT is responsible for furnishing any railroad-owned cars, as requested. The rail routes are described in Section 4.1.

2.1.1 CSX Transportation Inc.

CSXT, with headquarters in Jacksonville Florida, is part of the CSX Corporation. This corporation is composed of several international transportation companies, offering rail, intermodal shipping (*e.g.*, rail/truck, using containers or trailers), barging, trucking and related services. CSXT's rail transportation and distribution services accounted for 49 percent of CSX's 1993 total operating revenue of $8.9 billion and 74 percent of CSX's total operating income of $913 million (CSX 1994).

Rail traffic is controlled from a single dispatching and switching center in a weather-proof facility in Jacksonville. This facility displays a schematic diagram of the entire rail system (including the FEMP-Cottage Grove Branch Line), showing the real-time position of each train. Its dispatchers are in instantaneous voice and data link with each locomotive. See Section 4.3 for further details on this tracking system.

Based on 1993 data, CSXT has the following statistical profile:

States/Provinces served	21 plus the District of Columbia
Miles of track owned	18,779
Traffic	
Average trains per day	1,300
Average carloads per day	15,000
Total 1993 carloads	4,203,000
Equipment	
Locomotives	2,810
Freight cars	105,136
Average employment	29,000

(CSX 1995c)

CSXT has extensive experience transporting radioactive materials, as a result of its status as the exclusive rail carrier for the DOE's Savannah River Site. Most recently, CSXT transported foreign spent nuclear reactor fuel to the Savannah River Site.

2.1.2 Union Pacific Railroad Company

UPRR, with headquarters in Omaha, Nebraska, is part of the Union Pacific Corporation. This corporation is involved in rail and truck transportation services, and hydrocarbon and minerals operations. UPRR's rail transportation and distribution services accounted for 66 percent of UPRR's 1993 total operating revenue of $7.6 billion (UP 1994). (On August 3, 1995, Union Pacific and Southern Pacific

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representatives agreed to a merger of the two companies; the proposed merger is under review by the U.S. Department of Justice.)

Similar to CSXT, UPRR's rail traffic is controlled from a single dispatching and switching center in a weather-proof facility in Omaha. See Section 4.3 for further details on the UPRR tracking system.

Based on 1993 data, UPRR has the following statistical profile:

States/Provinces served	19
Miles of track owned	17,835
Traffic	
Average trains per day	750
Average carloads per day	12,603
Total 1993 carloads	4,600,000
Equipment	
Locomotives	3,121
Freight cars	66,813
Average employment	29,000

UPRR has extensive experience transporting radioactive materials because of its status as the exclusive rail carrier for the DOE's Idaho National Engineering Laboratory at Idaho Falls, Idaho. This experience includes shipments of spent nuclear fuel from U.S. Navy ships, nuclear fuel debris from the Three Mile Island accident, transuranic waste from several DOE facilities, uranium mill tailings from Salt Lake City, contaminated soils originating from many states (*e.g.*, Colorado, Illinois, and New Jersey) and radium export shipments.

2.2 Anticipated FEMP Rail Traffic

The anticipated rail traffic, resulting from the off-site shipment of OU1 waste, is insignificant in comparison to the existing rail traffic of CSXT and UPRR. This section illustrates this finding with a statistical comparison.

From Appendix D, after production with a single waste treatment unit has stabilized in FY 1999, two unit trains, composed of about 42 to 45 loaded gondola cars are planned. In this scenario, each train departs the FEMP at an average interval of 14 calendar days. An average of 3.0 to 3.2 cars is loaded per calendar day. When the second waste treatment unit becomes operational, three 50 to 53 car unit trains will be necessary. This operating mode involves a departure every 8 calendar days, with an average loading rate of 6.0 to 6.7 cars per calendar day. Depending on the frequency of shipments, between 130

and 190 gondola cars are dedicated for OU1 waste shipments. (See Section Appendix D for more details on the FEMP's rail car requirements.)

In contrast, based on the statistical profiles presented in Section 2.1, CSXT and UPRR average about 1000 trains per day and transport over 12,000 railcars per day. The anticipated average FEMP rail traffic is approximately 0.1 trains per day, or about three to seven railcars per day.

From a national perspective, approximately 1,400 million tons of freight are transported by rail annually (1992). In contrast, OU1 is expected to ship less than 0.1 million tons of waste per year for about seven years.

CSXT transports about 209 billion ton-miles of freight each year (1992), and UPRR transports about 147 billion ton-miles per year (1992). OU1 waste is equivalent about 0.4 billion ton-miles per year.

The UPRR main line west of Salt Lake City, Utah, current traffic averages 20 trains per day (NRC 1993). At peak operation, the OU1 unit train is an incremental addition of one train every eight days.

There are more than 1.1 million freight cars in service nationally, including more than 140,000 gondola cars. The number of new gondola cars, to be procured by the FEMP from manufacturers or leasing entities, for transporting OU1 waste represents an increase of about 0.1 percent of the national fleet of gondola cars.

In summary, comparison of the anticipated magnitude of OU1 rail traffic to the current magnitude of rail traffic for the designated rail carriers, shows that the designated carriers have sufficient transport capacity to satisfy the project requirements. Similarly, the number of gondola cars required for this project is insignificant in comparison to the number of railcars in service in the national fleet. In conclusion, CSXT and UPRR can easily accommodate this additional OU1 traffic.

2.3 Rail Transportation Configuration

The optimal rail transportation configuration for transporting OU1 waste to a RPCDF, with direct rail access and a rotary railcar unloader, was determined by a detailed cost-benefit study (FERMCO 1995d). This configuration is a unit train consisting of DOE-controlled (*i.e.*, owned or leased) gondola cars where the load is contained by a disposable liner and a hard railcar cover. A detailed description is provided below.

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2.3.1 Unit Train

A unit train is a train that makes a direct run between the point of origin and the destination point. The unit train receives priority right-of-way and expedited switching, and stays intact along the whole route, (*i.e.*, it does not receive additional freight, nor drop any freight). Thus, the use of unit train service affords compliance with Department of Transportation (DOT) regulations (49 CFR 174.14) which require expeditious handling of railcars moving radioactive materials.

The unit train concept offers several key advantages over regular freight service:

1) Lower transportation cost (volume discount)
2) Shorter transit time, which increases the utilization of the railcar fleet
3) Improved train safety by minimizing idle time on rail sidings and eliminating individual railcar switching/handling
4) Improved railcar security and tracking
5) Immediate return of all empty railcars, which cannot be easily accomplished under regular freight service
6) Reduced maintenance costs

Unit train status is achieved when there are at least forty freight cars in a train. With less than forty cars, the transportation cost is raised significantly for the same degree of service. Consequently, there is a strong economic incentive to use the unit train concept.

DOT regulations (49 CFR 174.85 (b)) specify that a car placarded "RADIOACTIVE" cannot be placed next to a locomotive or an occupied caboose[1]. Therefore, a unit train of radioactive material must have a railcar inserted between the locomotive(s) and the RADIOACTIVE-placarded gondola cars. This car can be either supplied by the railroad or the FEMP. However, to ensure its stability, the car must be loaded with any non-radioactive material (as defined by DOT).

Radiation exposure of the rail crew is limited under DOT regulation (49 CFR 174.700(g)(3)), which sets the maximum allowable radiation level to 2 millirem per hour for any normally occupied position in the train or adjacent railcar.

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[1] Cabooses are no longer commonly used by the railroads.

2.3.2 Gondola Railcar

Although there are several types, most gondola railcars are long, low cars, loaded and unload from the top. It can be unloaded by means of a car roll-over unit. The design specifications of the representative gondola car, for purposes of this plan, are shown below (Grnbr 1994):

Inside length	52' 6"
Inside width	9' 7.5"
Inside height	5' 6" (one foot higher than "standard")
Cargo capacity	107 tons/ 103 cubic yards
Empty weight	36 tons
Outside length	57' 1.5" (coupler-to-coupler)
Turning radius	209 feet (when coupled)

A gondola car is expected to contain about 90 tons of OU1 material, when loaded to about one foot below the top of the car (*i.e.*, one foot "freeboard"). The treated waste material is assumed to have an estimated density of 80 pounds per cubic foot or 1.08 tons per cubic yard.

The gondola railcar was selected as the most cost-effective means of transporting bulk material. This car offers the minimum logistical and space requirements. The implementability of this rail mode is enhanced since the RPCDF has a roll-over unloading facility and is experienced in its use. Another alternative, top-loading and bottom-unloading hopper car, is prohibited by federal regulations (49 CFR 174.700(e)).

2.3.3 Liners and Hard Cover

To address public concerns documented in the Responsiveness Summary to the Record of Decision (DOE 1995a), the DOE has committed that railcars with OU1 material will be lined with a synthetic material liner and covered with a secured hard cover (See Figure 2-1). Liners cannot be used with high wall gondola cars, due to interference with the internal cross bracing.

The purposes of the disposal liner are to prevent external contamination of the railcar during loading (when the flaps are folded over the outside of the car), prevent release of material during transport, prevent infiltration of water into the dried material during shipment, and minimize contamination of the inside surface of the railcar. The hard cover is designed to prevent human intrusion, infiltration of precipitation, and inadvertent release of the OU1 material.

The design requirements for the liner and hard cover will satisfy DOT regulations (49 CFR 173.425 and 174.700(g)(1)), which specify that LSA material be transported in a "strong tight package" in a closed transportation vehicle, under exclusive use conditions. A strong, tight package is a package that will

Figure 2-1 - Gondola Car with Hard Cover

prevent the release of any radioactive material under normal transport conditions. For shipments of hazardous waste, the liner must be compatible with the waste.

2.4 Options Planning

A number of options to the baseline rail transportation scenario for shipment to the RPCDF are described below. Contingency planning for wastes rejected by the RPCDF is addressed by Section 5.

2.4.1 Small Volume Shipments to the NTS

The objective of the OU1 waste treatment unit is to process all pit waste, such that the waste will satisfy the WAC at the RPCDF. As a contingency, small volumes of material that do not meet the WAC at the RPCDF will be shipped to the NTS by truck. For the purpose of this document, it is assumed such material will satisfy the WAC at the NTS. The FEMP has extensive experience in shipping low level radioactive waste (LLRW) to the NTS by truck, and has procedures in place that ensure compliance with all transportation requirements.

Current NTS procedures for shipment of waste (to the NTS) specify the use of disposable metal containers transported by truck. The standard metal containers at NTS are steel drums (7.5 cubic feet) and "white metal boxes" (100 cubic feet). Use of loaded containers weighing over 9000 lb require explicit prior notification of and approval by the NTS. (See Section 8 for further details.)

2.4.2 Flexibility in Loadout Configuration

The baseline loadout configuration is shipment of OU1 material in a lined gondola car with a hard cover. Alternative loadout configurations include the use of large bags and metal containers.

The bags are made of a high strength material, which can contain a ton or more of material, and have been used by others to transport material to the RPCDF. In this option, loaded bags from the FEMP are transported to RPCDF in a gondola car with a hard cover.

Alternatively, the OU1 waste material can be loaded in returnable bulk metal containers. The maximum weight for truck transport (without obtaining an overweight permit) is 20 tons. Several (three to four) of these standard 20-ton containers could also be placed on a flatbed railcar for transport to the RPCDF. The "Intermodal" concept of using standard 20-ton containers for both truck and rail transport to the disposal facility is discussed below.

2.4.3 Intermodal Shipment

In the event that the baseline rail transportation scenario cannot be implemented, intermodal shipment provides a contingent means to transport the OU1 material off site. The key feature of intermodal transport is its inherent flexibility to utilize both road and rail transport.

The intermodal transport scenario consists of the following segments:

1) Load the OU1 material into lined 20-ton intermodal containers

2) Employ short-haul trucking to transport the containers to a rail terminal

3) Long distance rail transport to either the disposal site, or a transfer terminal near the disposal site, for the final short-haul truck transport to the disposal site

4) Return of the empty containers to the FEMP

A description of container handling at the disposal facility is presented in Section 5.2.2.

Alternatively, the containers from the FEMP could be transported directly by rail to the disposal site or a nearby transfer terminal for short-haul transport.

DOT regulations ((49 CFR 173.425(b)(1) and (4)) governing exclusive-use shipment of LSA material in strong and tight containers) require that the loading and the unloading of containers be performed under the supervision of the shipper (Fernald Environmental Management Corporation (FERMCO)) or the consignee (disposal facility). Thus, only trained radiological personnel are permitted to handle or move LSA containers. Otherwise, transport must be performed with certified, Type A containers instead of LSA containers.

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SECTION 3

RAILROAD CAR HANDLING AT THE FEMP

This section addresses management of railcars and processed waste materials at the site, including the preparation of unit trains, before departure from the site. The section discusses waste handling, rail facilities, the inspection/maintenance facility, and transportation documentation. The design of the FEMP loading process is in the preliminary design phase; refer to the *Site Improvement Plan* for details.

The FEMP will use the "staggered" unit train concept to ship waste off site. The details of this scheduling concept, which allows time between the departure of one loaded train and the arrival of the inbound train of empty cars, are discussed in Appendix D.

3.1 Rail Facilities

3.1.1 Current Facilities

The existing railroad track system at the FEMP is shown on Figure 3-1. The rail system was most recently used to move coal to the site and to move selected wastes from the site.

From the CSXT Branch Line, the FEMP spur, a single line of DOE-owned track, extends east, crosses Paddy's Run Road, runs north of the OU1 area. The FEMP spur extends east into the former process area, and divides into two parallel tracks (Tracks 1 and 2), with crossovers. This trackage supports five "trailing point" curving yard spurs that allow cars to be pushed south into the former processing area. The crossovers function as "double-ended" sidings to allow an engine to be cut off and move to the other end of a string of cars to push them onto the single "facing-point" siding (Track 12), which curves around the west side of the site.

The FEMP spur and Track 12 were constructed with heavy rail (131 pounds per linear yard), which has sufficient structural capacity for the projected rail traffic. Certain FEMP trackage (*e.g.*, Track 12) was constructed with used rail. However, Tracks 1 and 2 are constructed with 80-pound rail and will be used only to store empty cars.

3.1.2 Proposed Facilities

To support rail transportation operations, a major phased upgrade of facilities at the FEMP will be required. Site improvements include upgrading existing tracks, installing new tracks, installing of fencing around all tracks, and constructing the: (1) waste loading facility, (2) railcar unloading pad, (3)

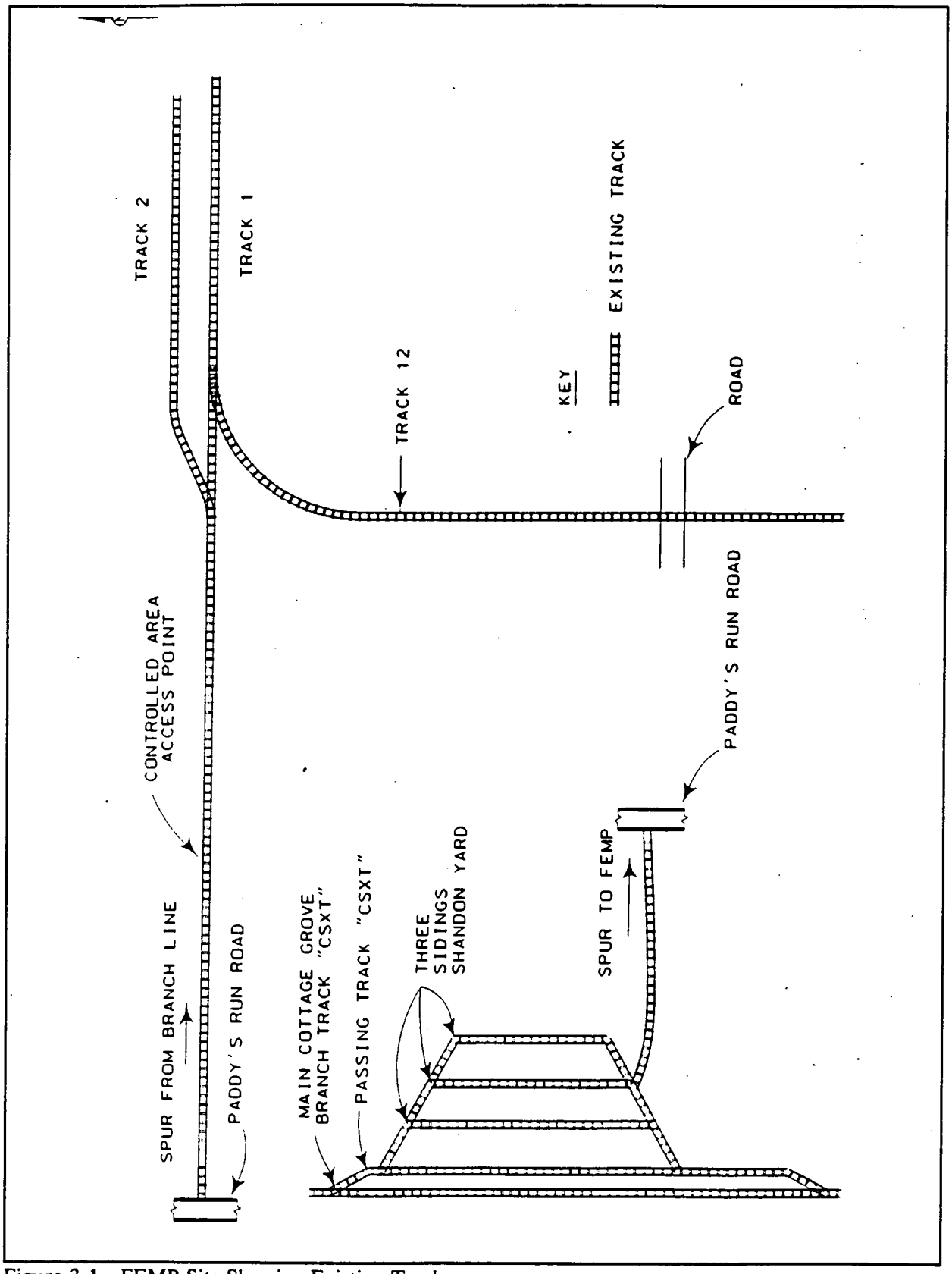

Figure 3-1 - FEMP Site Showing Existing Trackage

locomotive and railcar maintenance building, (4) railcar wash and exit radiation monitoring facility. Phase I of the proposed upgrade is shown in Figure 3-2, and is composed of the following trackage elements:

- "Upfront cost" (to be credited) for rebuilding CSXT Shandon Yard switches.
- Inspection of the Main FEMP Spur and the FEMP trestle (upgrading, if necessary).
- Inspection, upgrading, and east extension of Tracks 1 and 2 for staging empty railcars.
- Construction of:
    - o New curve to connect the Main FEMP Spur with Track 12.
    - o Tracks 13 (loading) and 14 (unloading).
    - o Track 17 (storage of cars pending QA approval).
    - o Tracks 15 and 16 (storage of QA-approved cars).

Phase II involves the construction of Tracks 18, 19 and 20.

3.2 Waste Handling

The proposed location for the waste loading facility is adjacent to Track 13, as shown in Figure 3-2.

Two site locomotives will be used to move railcars to and from the loading facility, and to assemble unit trains.

Processed waste will be stored only in sealed and covered railcars, or in the process facility. If empty railcars are not available and no option exists for off-site shipment due to an unforeseen scheduling difficulty, the FEMP will adjust the waste treatment rate to prevent an accumulation of processed waste.

3.2.1 Loading Process

A carmover, not the two site locomotives, will move cars through the waste loading facility. In general, the hard fiberglass cover is removed and the liner will be installed. The liner, made of a disposable reinforced synthetic material, is draped over the sides to avoid contamination of the car. The liner is inspected to ensure containment integrity. Then, the waste material is loaded into the gondola railcars; cars are considered full when loaded to a 1-foot freeboard or the weight capacity of the car including the liner and the lid is reached. Samples for waste acceptance testing and certification are collected at this time. After loading is complete, the lap-over top of the liner is sealed (either tape or heat seal) over the load. Finally, the hard cover is placed on the loaded car. The hard cover is secured by four heavy metal clamps; one clamp per car is secured with a tamper proof seal.

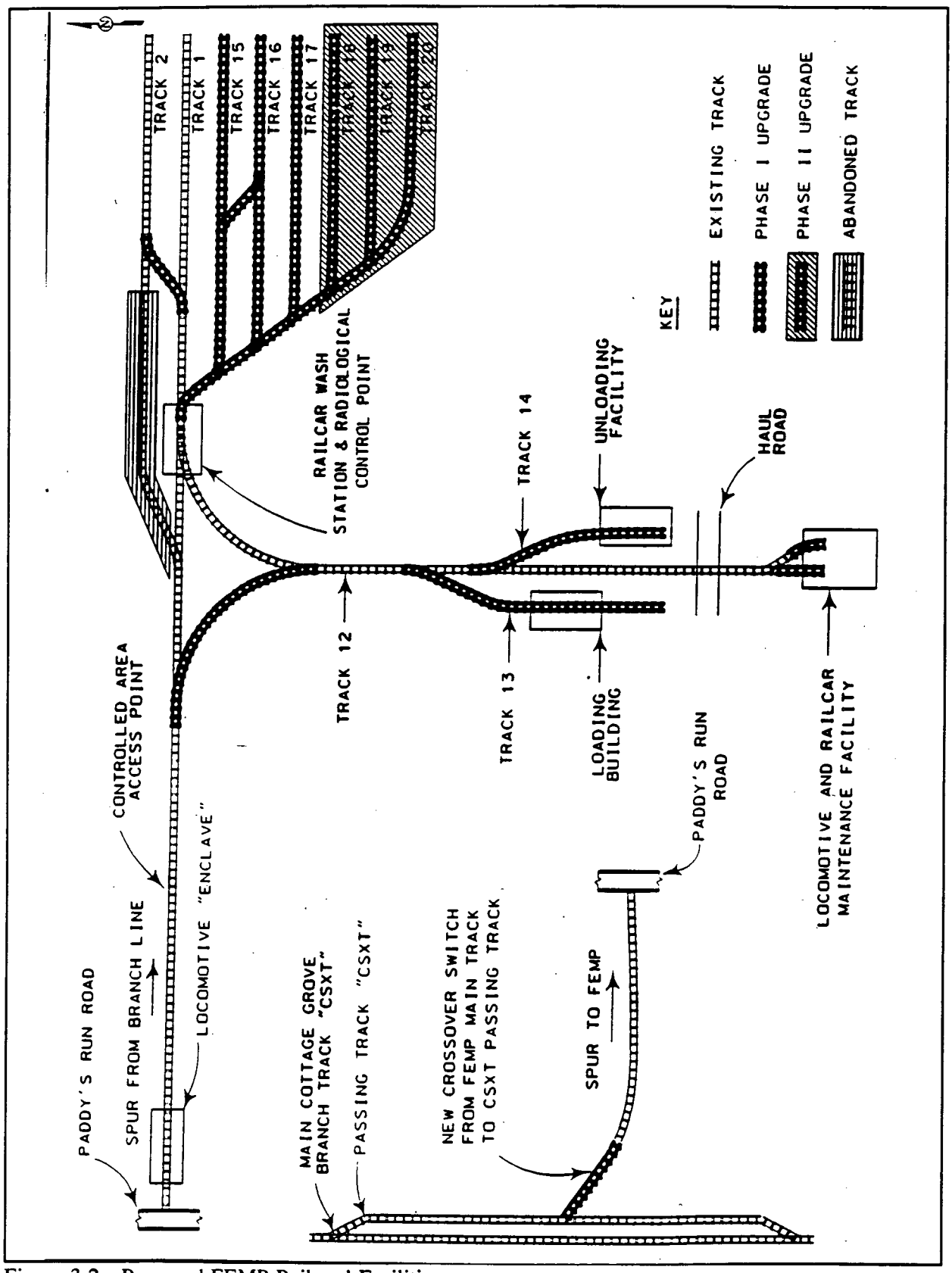

Figure 3-2 - Proposed FEMP Railroad Facilities

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After remediation starts, operations will support loading at a rate ranging from 3.5 to 6.7 cars per day. Details of the waste loading process are provided in the *Site Improvement Plan*.

A detailed description of the movement of gondola cars at the FEMP and process description of unit train assembly is presented in Appendix D.

3.2.2 FEMP Waste Sampling and Quality Control

Most excavated OU1 material must be treated to meet the RPCDF's WAC. The DOE is committed to ensuring that the waste will meet the WAC for the receiving facility before the loaded railcars or containers depart the FEMP. (DOE 1995a) Before shipment, all loads are sampled and analyzed to enable the shipper (*i.e.*, FERMCO) to certify that the waste satisfies the WAC of the disposal facility. Specific sampling and analysis activities will be addressed in the *Sampling and Analysis Plan*, submitted in accordance with the OU1 Remedial Action Work Plan. The *Sampling and Analysis Plan* will include applicable requirements of the disposal facility. All analyses will be conducted in accordance the *Sitewide CERCLA Quality Assurance Project Plan* (WEMCO 1992).

Samples collected for RPCDF waste acceptance testing will require a two to six day turnaround period. This may present a scheduling issue, particularly if the last cars making up a unit train do not produce acceptable results. Accordingly, a reserve of loaded cars will be maintained.

If the analytical results indicate the loaded railcar contains hazardous waste, FEMP personnel will confirm that the RPCDF can accept the material for treatment and disposal. If so, the railcar is placarded and manifested for shipment as hazardous waste.

3.2.3 Exterior Decontamination of Loaded Railcars/Containers

Following waste loading, each railcar will enter an enclosed area for decontamination (if needed). The hard cover and the decontamination process will be designed to avoid introducing water into the sealed cargo. The gondola cars are then transferred to a heavy rail, access-controlled storage spur, and held until results of the various analyses are determined.

3.2.4 Radiological Monitoring Requirements and Quality Control For Railcar Release

Before release of the loaded railcars from the site, each railcar will be externally surveyed for external contamination and acceptable radiation levels, in accordance with the *Sitewide CERCLA Quality Assurance Project Plan* and existing FEMP survey procedures. Specific criteria for the transportation of radioactive material are listed in 49 CFR 173.

Two types of radiation surveys will be conducted on each railcar. Both surveys are expected to be performed in less than one hour. The first survey measures direct radiation per 49 CFR 173.441; results are available immediately. The second survey measures removable external contamination per 173.443(b), using a wipe test or using a roller with an adhesive surface; results are available overnight.

In addition to the radiation surveys, as appropriate, thermoluminescent dosimeters (TLDs) may be attached to the exteriors of several gondola cars, pursuant to agreements to be negotiated with the railroads. TLDs are monitored as necessary to track the external radiation fields.

In general, the radioactivity limits for loaded railroad cars are based upon the isotopic and radioactivity concentrations of the involved materials. Assuming that concentrations measured in the OU1 Remedial Investigation (DOE 1994a) are representative of the wastes to be transported to the RPCDF, the following maximum limits are applicable:

1) 200 millirem per hour reading on any external surface
2) 10 millirem per hour at any point 2 meters from the outer surface
3) 2 millirem per hour in any normally occupied space, such as cab of the train

The OU1 material is expected to exhibit much lower radiation levels, so that compliance with this requirement is not expected to be a problem.

Pursuant to 49 CFR 174.715(b), if the interior surface of the unloaded railcar, yields a radiation dose that exceeds 10 millirem per hour or 2 millirem at 1 meter (3 feet), the car must be conspicuously stenciled with the words: "FOR RADIOACTIVE MATERIALS USE ONLY" in lettering at least 8 cm (3 inches) high on both sides of car. The car must be kept closed to prevent inadvertent access, except for loading and unloading operations. It is recommended that the cars be factory-painted with the stencil which could be covered if it is determined that the above-noted criteria can be achieved.

3.3 Inspection/Maintenance Facility

A maintenance facility will be constructed at the FEMP to perform routine maintenance on the locomotives. Major service and repairs will be performed off site. The location of the FEMP facility is at the southern end of Track 12. See the *Site Improvement Plan* for details of the facility.

In addition, the facility would allow certified outside contract personnel to provide routine/preventive maintenance of FEMP-owned/leased cars. This maintenance facility eliminates the need to decontaminate railcars and lose their availability for extended time periods. However, major service and repairs of the rolling stock will be performed off site by commercial railroad-approved maintenance shop(s). Railroads have repair facilities to correct maintenance problems developed *en route*, but this is disruptive of unit

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train service and must be avoided. The lease/purchase of new cars will minimize this problem. The mechanisms for performing routine and *en route* repairs will be documented in contracts with the railroads and the railcar manufacturer or leasing firm.

To minimize the need for unscheduled off-site maintenance, the railcar owner (i.e., the FEMP or the leasing company) will develop a rigorous railcar inspection and preventive maintenance program.

3.4 Rail Shipment Documentation

Disposal facilities require load-specific documentation, including a 72-hour shipment notification and a Radioactive Waste Shipment & Disposal Record to ship waste. Loads, if any, of hazardous waste will be transported under a hazardous waste manifest.

To support preparation of waste-specific shipment documentation, the following systems are planned:

1) Automated shipping document generation: The generation of the documentation necessary to ship waste from the FEMP takes several (*i.e.*, two to six) days after car loading due to the laboratory turn-around time. A lengthy delay to generate the documentation could cause an accumulation of loaded railcars. To minimize this possibility, all documents necessary for each car/container are computer-generated from an integrated database. This system integrates the data from the loading equipment, car register, and analytical data base. The necessary documents for each car/container are generated for each loaded car as it is released from the storage area.

   During this process, the hazardous materials shipping documentation for each car is verified to ensure that the description of the contents of the loaded car reflects the analytical results from the waste characterization (*e.g.*, verify the waste is LSA). Also, these analytical results are reviewed to ensure that all required transportation placarding is posted. These reviews are performed by an individual who has DOT HM-126F training.

   The computer system will compare the analytical results for the material to be shipped, obtained by testing pursuant to the Sampling and Analysis Plan which will be developed, with the RPCDF's WAC to ensure the criteria are satisfied. This would prevent shipping papers from being prepared for waste which had not cleared the FEMP's Quality Assurance process. In the event that the PCDF were to reject a carload, this data would be the first point of reference in addressing the problem.

2) Automatic scale at loading station: The scale weighs the car as it is loaded and assists in the loading process. The scale provides important information for shipping documentation, since the

railroads are typically paid by weight shipped. Railroads will accept a customer's weight representation, but periodically spot-check cars.

This documentation is the basis for preparation of a Consist Report. A typical CSXT Consist Report shows the following information for each railcar:

1) Identification number
2) Position within the train
3) Status (empty/full)
4) Weight
5) Contents and related emergency instructions

The Consist contains critical information in the event of an emergency (See Section 9).

At East St. Louis, Illinois, the UPRR crew receives this documentation from the CSXT crew; it travels with the train until arrival at its ultimate destination.

The above-noted hard-copy "paper trail" for the shipment in progress is supplemented by the railroads' real-time car-tracing data bases as described in Section 4.3.

Placarding of railcars by FEMP personnel is required. The specific placard will be determined by the specific nature of the waste. Based on the OU1 Remedial Investigation (DOE 1994a), a "RADIOACTIVE" placard is required for planned waste shipments (See Section 2.3.1).

In addition, to have a record of the radiation field in the occupied portion of the locomotive, a TLD may be attached to the official shipping papers carried by the train crew. Upon arrival at the RPCDF, this TLD is removed and mailed to the FEMP or a measurement laboratory by the disposal facility personnel. Details of this procedure have not been finalized.

CSXT connects to the loaded unit train at the FEMP gate; consequently, the CSXT locomotive is not surveyed. If the CSXT train crew enters the FEMP to inspect the train, crew members will be monitored (with TLDs). Current plans (See Appendix D) assume that CSXT will perform their inspection outside the FEMP boundary. A work procedure will be developed to detail the activities involved with the train inspection and turnover to CSXT.

3.5 Unit Train Transfer

The unit train is assembled one to two days before its scheduled departure. At this time, a final radiation survey is contemplated as the cars may collect dust due to being stored on tracks near areas where

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remediation activities will be in progress. The need for such testing will be evaluated further. After the unit train has been assembled, an initial stationary brake test and final radiation survey (for site release) is conducted on site by FEMP personnel. When the CSXT locomotive arrives, the train is pulled out to the Branch Line. The entire train is inspected again by CSXT prior to acceptance and movement from the FEMP to confirm that the cars are mechanically fit and all safety equipment is present and operable. (See Appendix D)

4

SECTION 4

LOGISTICS OF RAIL TRANSPORT TO THE REPRESENTATIVE PERMITTED COMMERCIAL DISPOSAL FACILITY

This section details the plans and logistics associated with the rail transport from the FEMP to the RPCDF, including the route, schedule, and tracking of unit trains. Only the primary routes proposed by the railroads are identified below.

4.1 Route

For planning purposes, a RPCDF is used as the basis for this analysis. Although the entire route to Clive, Utah is reviewed in this section, attention is focused on the portion of the route where the traffic associated with this project would cause a major rail traffic increase (*i.e.*, the Branch Line between the Shandon Yard and its junction with CSXT's main line at the Cottage Grove, Indiana yard).

4.1.1 CSX Transportation (Fernald to East St. Louis, Illinois)

CSXT will transport the OU1 waste from the FEMP to East St. Louis, Illinois, CSXT's western terminal yard.

4.1.1.1 Fernald to Cottage Grove

Unit trains will transit the 24-mile long branch line between the FEMP and the Cottage Grove yard on a regular basis. Trains move at a maximum speed of 25 miles per hour along the route, shown in Figure 4-1. CSXT's current traffic on this line is three local freight trains per week; once FEMP begins rail shipments, this rate will increase.

4.1.1.1.1 Shandon Yard

This switch yard parallels CSXT's line at the junction of the FEMP spur and consists of three parallel tracks. Shandon Yard will not be used as a staging area for unit trains.

A switch will be constructed to connect the FEMP spur directly to the CSXT Branch Line.

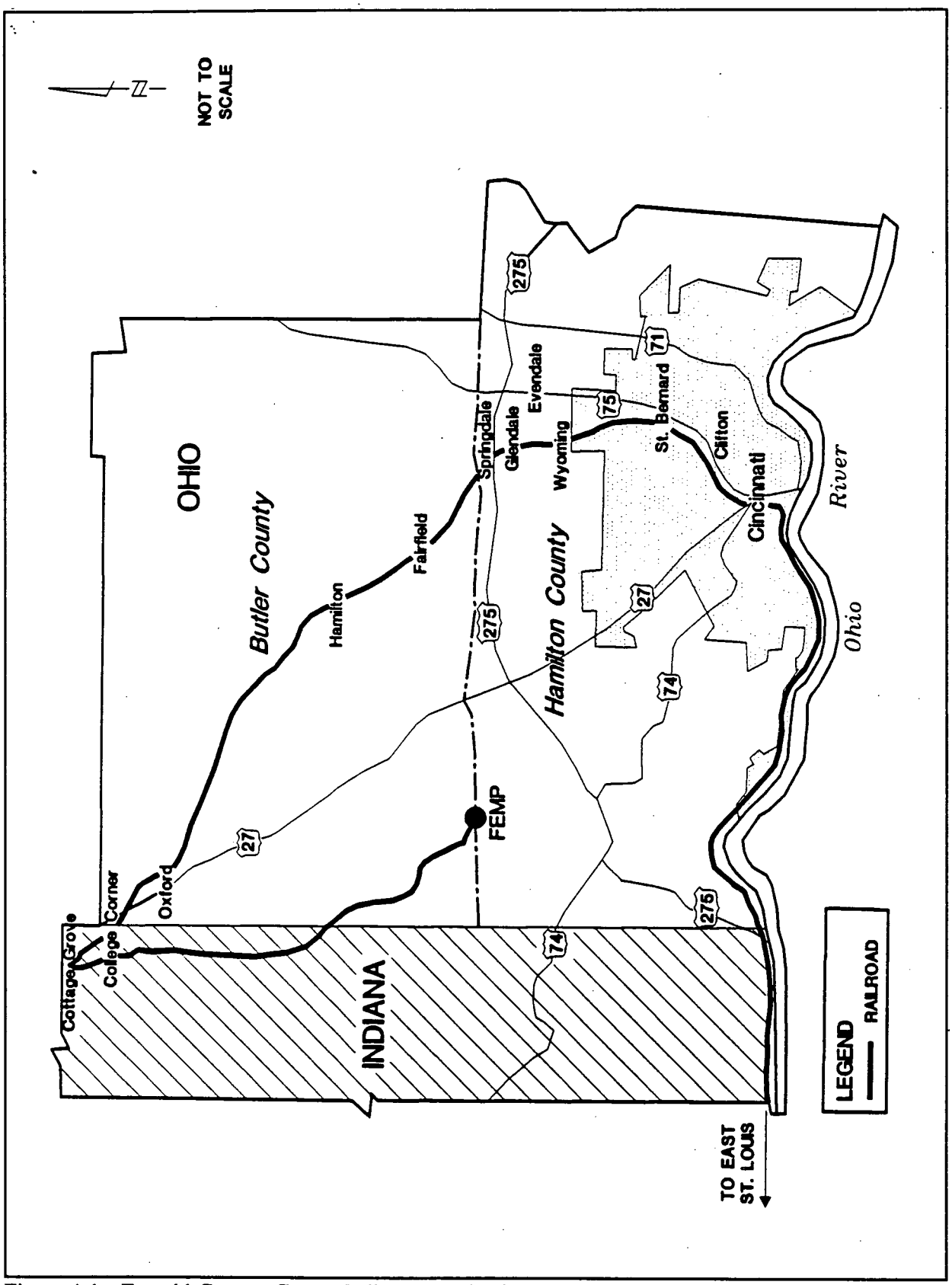

Figure 4-1 - Fernald-Cottage Grove, Indiana Branch Line

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4.1.1.1.2 Cottage Grove Yard

Located in the town of Cottage Grove, Indiana, this yard has ample capacity for unit trains, but the trains might have to wait a maximum time of approximately one hour for clearance onto the main line. The FEMP will make arrangements with CSXT to minimize the holding time at Cottage Grove by obtaining clearance prior to departure from the FEMP.

4.1.1.1.3 Track Condition

The Branch Line between the Shandon and Cottage Grove yards is a Class 2 track, as defined by 49 CFR 213.9, which establishes a 25 mph speed limit. Other tracks for the balance of the trip to Clive, Utah are equal or higher in class. All track is inspected as required by 49 CFR 213, Federal Railroad Administration (FRA) Regulations, to determine the condition of the following:

1) Rails
2) Rail joints
3) Crossties
4) Switches/crossovers
5) Crossings (track and grade)
6) Ballast
7) Tieplates
8) Rail Fastenings

Before initiation of rail shipments, the FEMP will request that CSXT perform a track inspection of the Branch Line between the FEMP and Cottage Grove, and certify that all required project-specific maintenance and upgrades needed to support the OU1 rail shipments have been performed. This FRA certification will document that this work was completed.

Public comments on the condition on rail track and associated property from the FEMP to Cottage Grove should be directed to CSXT at (812) 288-1844.

4.1.1.1.4 Bridge and Trestle Upgrades

Based on information provided by CSXT, trains, *en route* from the FEMP to Cottage Grove, cross five bridges/trestles of wood or wood and steel construction and of various ages. These structures have received substantial maintenance since the time of construction and, reportedly, are adequate for current rail traffic.

The trestles are routinely inspected for the following items:

1) Track Condition
2) Superstructure
3) Substructure
4) Waterway obstructions (if applicable)

On the basis of the design load and rating, CSXT indicates that three bridges or trestles are not satisfactory for the unit train rail traffic associated with this project. These three trestles span:

1) Camp Run
2) South Wynn Road
3) Bucks Run (Okeana Trestle)

CSXT believes these trestles need to be replaced or rebuilt prior to commencement of rail traffic associated with this project. Specifically, CSXT has advised the FEMP that the use of the branch line to support the proposed additional train traffic requires that the trestles identified above be strengthened. These efforts can be effected with nominal disruption of the current rail traffic. The structure of primary concern is the 846 foot long and 65 foot high "Okeana Trestle" at Bucks Run Road, of which 646 linear feet is timber construction. The DOE is committed to upgrading these structures before waste shipment. (DOE 1995a) The *Site Improvement Plan*, another design deliverable submitted with the OU1 Remedial Design package, contains the details, engineering work, and schedule of three planned trestle upgrades.

4.1.1.1.5 Grade Crossings

FEMP personnel have identified 24 "at grade" road crossings (*i.e.*, without a bridge or a overpass) located on the route shown by Figure 4-1. All crossings have the "crossbuck" signs as required by federal regulations. None has crossing gates; most do not have flashing lights. Installation of gates and/or flashing lights at these crossings is the responsibility of the Ohio and Indiana Departments of Transportation on the basis of analysis of vehicular and rail traffic. At present, the DOE has no plans to install such equipment as part of this project.

4.1.1.2 Cottage Grove to East St. Louis

Trains join main line traffic between Cincinnati, and Indianapolis, at Cottage Grove, Indiana.

As shown on Figure 4-1, rail traffic from the FEMP travels north to Cottage Grove, then east and south to the Cincinnati terminal. From Cincinnati, trains head west through Mitchell, Indiana, and Vincennes, Indiana (See Figure 4-2). CSXT service terminates in East St. Louis, Illinois.

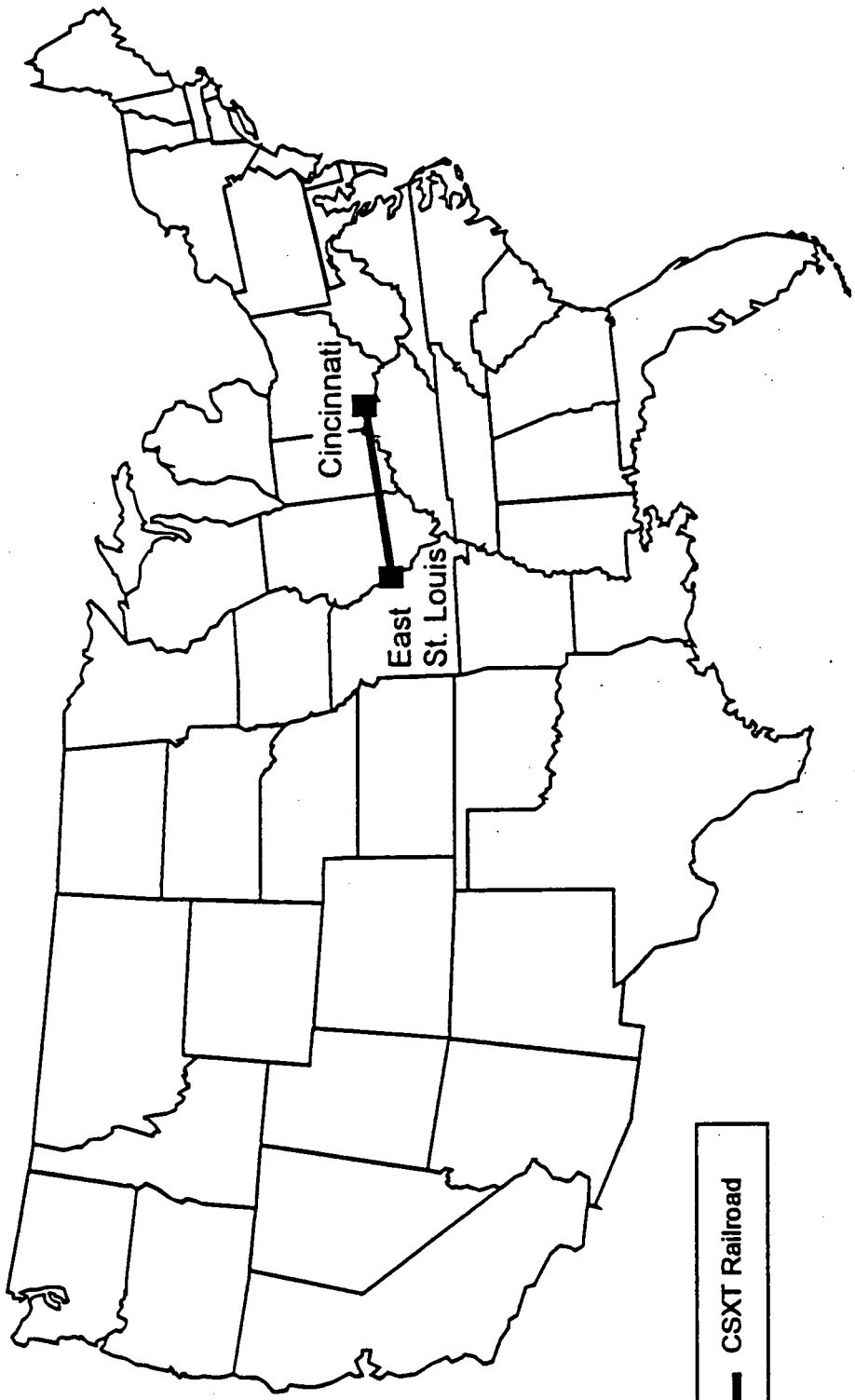

Figure 4-2 - Rail Route from Cincinnati to St. Louis

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This portion of the route is over main line track that receives constant surveillance and maintenance attention. No non-routine infrastructure upgrades are required.

4.1.2 Union Pacific (East St. Louis, Illinois to Clive, Utah)

In East St. Louis, an inter-terminal switch occurs between CSXT's Cone Yard and UPRR's Valley Junction Yard, and the CSXT crew is replaced by UPRR personnel (See Figure 4-3). A switching railroad may be used to transfer the unit train from CSXT to UPRR; if so, it will be considered a subcontractor to CSXT or UPRR and will be subject to the terms of the transportation agreement to be negotiated among FERMCO, the DOE, CSXT, and UPRR. Depending upon the arrangements between the railroads, the locomotives may be changed from CSXT equipment to UPRR equipment.

As shown in Figure 4-4, unit trains, under UPRR control, move westward to the Clive, Utah yard through the following major metropolitan areas:

1) St. Louis, Missouri
2) Kansas City, Missouri
3) Topeka, Kansas
4) Cheyenne, Wyoming
5) Ogden, Utah
6) Salt Lake City, Utah

The route traverses Missouri, the northeast corner of Kansas, most of Nebraska, a small part of northeast Colorado, the length of Wyoming, and across northern Utah. The final leg is from Salt Lake City west to Clive, Utah. The need for UPRR's Wendover Utah/Nevada yard to turn-around the unit train is being determined. All trackage is main line, and no non-routine upgrades are necessary for this project.

Car inspections are performed by the receiving company at the transfer between:

1) the FEMP and CSXT
2) CSXT and UPRR
3) the RPCDF and UPRR

Additional inspections are performed by train crews, while *en route* to the RPCDF. In accordance with standard railroad procedures, train inspections are typically performed with each change in crew, with each train refueling, every 1000 miles, and at major rail terminals.

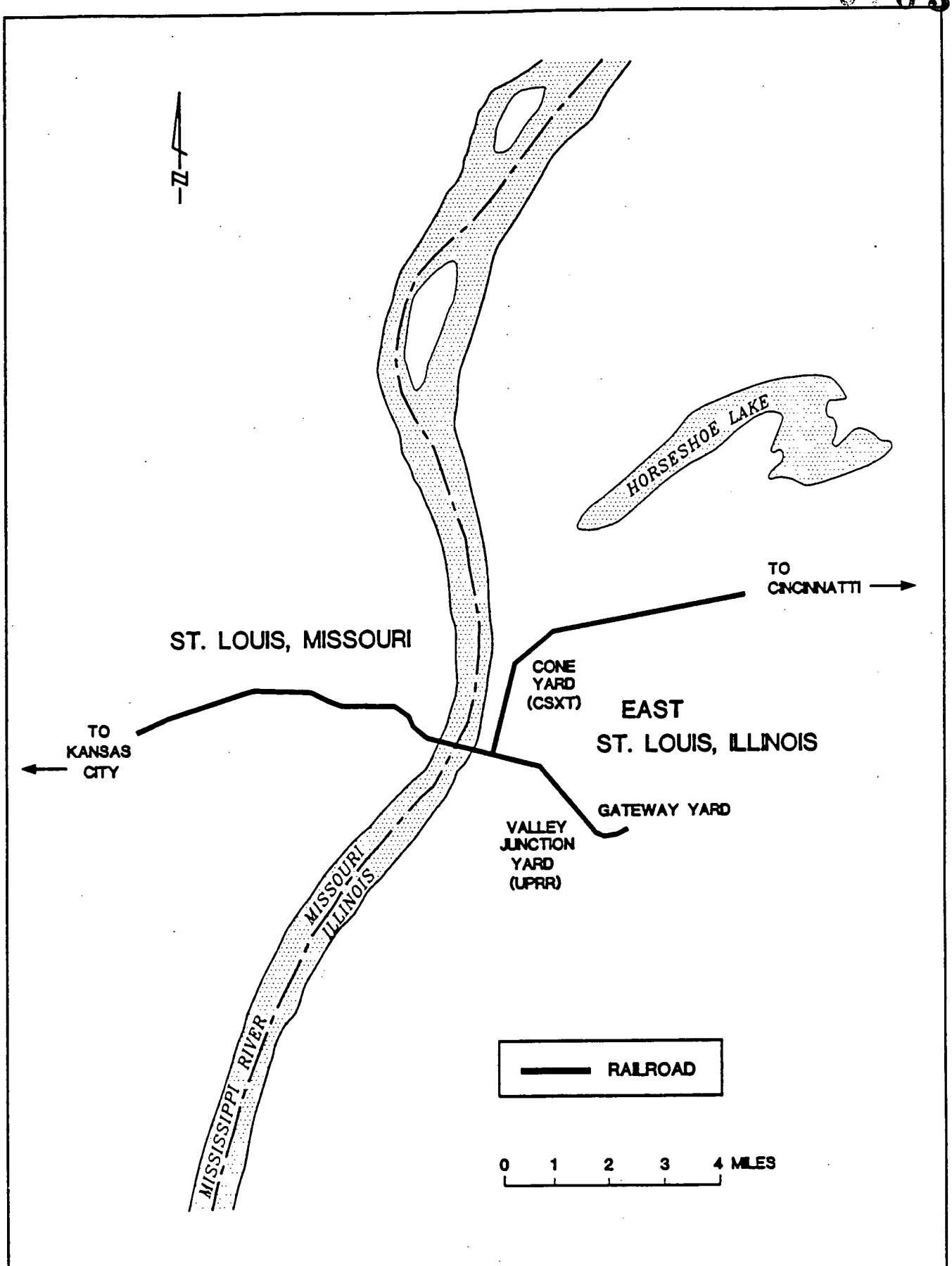

Figure 4-3 - Location of Cone Yard and Valley Junction Switch Yard

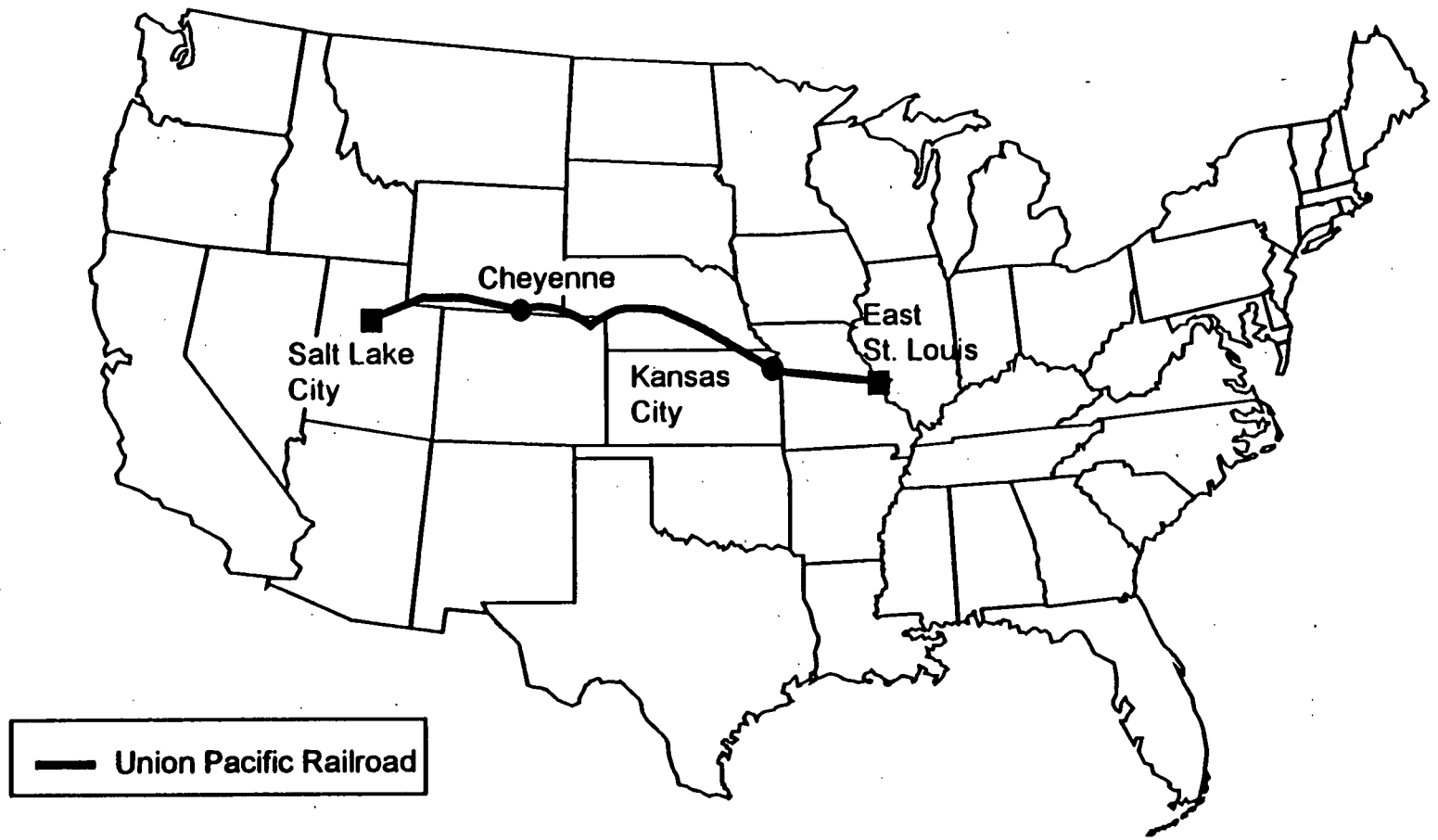

Figure 4-4 - Rail Route from St. Louis to Salt Lake City

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4.2 Unit Train Schedule

As shown in Table 4-1, the total round trip cycle time for a unit train is 15 calendar days, assuming one day for delays. A 16-day trip cycle is used for planning purposes, including 1 day for train disassembly. This estimate includes a 4 day turnaround time at the disposal facility.

Table 4-1 - Unit Train Schedule for Unit Train

Railroad	From	To	Days	
			FEMP	In-Transit
N/A	FEMP train makeup		1	
CSXT	FEMP	East St. Louis, IL		1
UPRR	East St. Louis, IL	Clive, UT		4
N/A	RPCDF			4
UPRR	Clive, UT	East St. Louis, IL		4
CSXT	East St. Louis, IL	FEMP		1
N/A	FEMP train disassembly		1	
Delays	N/A	N/A		1
TOTAL			2	15

Initially, when only one waste dryer is available, two unit trains with a 14-day loading cycle, are sufficient to meet transportation needs. The 14-day cycle is based on the expected waste processing rate; assuming 24-hour operation and 75% availability, the FEMP can process (and consequently load) 3.2 railcars per day. At this rate, the site can prepare one unit train (40 loaded cars) every 12 days. Later, if and when two treatment systems are placed into operation, three unit trains, with an 8-day loading cycle, are required to meet all transportation needs. In addition, several spare cars are required to meet various operational contingencies (*e.g.*, replacement cars, empty cars to use as buffers, loaded cars waiting for analytical results, cars in the loading facility). (See Appendix D)

Unit trains are normally scheduled with a seven day notice. For the first year of shipments, CSXT has agreed to allow some scheduling flexibility (with 48 hour verification) to accommodate startup problems.

The schedule of the returning empty unit train does not interfere with the assembly of the outbound unit train, which will require one to two days.

4.3 Location And Status Tracking

Tracking the location of railcars is standard practice with all major railroad companies. CSXT offers this service as an optional computer-accessible package called Mercury®. UPRR's system is TELE-TRANS®. Tracking data are received from railroad car interrogators/transponders located at main switches along the tracks. With this system, the location of each car can be determined based on the last transponder. These units are separated by various distances, typically ranging from a few miles to about 20 miles. At any time, the FEMP can access the system to determine the locations of the trains/cars.

If cars are stopped due to a transportation incident, the FEMP would be immediately notified by railroads' control centers. The system provides automatic notification if one of the cars is delayed for non-routine safety-related reasons or mechanical repairs. In addition, the train locomotive is capable of voice communication with the railroad's control center. (See Section 7 for a discussion of emergency response.)

SECTION 5

PERMITTED COMMERCIAL DISPOSAL FACILITY

For planning purposes, a RPCDF located in western Utah, is under consideration for disposal of LSA radioactive waste generated from the remediation of OU1 and has been and will be used as the disposal facility for planning purposes, until the final disposal site is selected. This RPCDF was used as the RPCDF in the OU1 Feasibility Study/Proposed Plan (DOE 1994b).

To comply with Off-site Rule for CERCLA waste (40 CFR 300.440), the DOE will audit the RPCDF before shipping OU1 material to confirm the facility's status and compliance history. The review will be conducted annually throughout the term of the remediation project. In the event the compliance status of the RPCDF changes, the DOE will suspend waste shipments until the actions/requirements for regaining acceptability status are implemented and the facility becomes acceptable.

5.1 Facility Overview

The RPCDF is licensed to accept for disposal: (a) specific low concentrations of radionuclides within the classification LLRW (b) Naturally Occurring Radioactive Material (NORM), (c) mixed waste, and (d) 11e.(2) by-product materials (uranium and thorium mill tailings). The RPCDF of approximately 540 acres is next to a DOE mill tailings disposal site (100 acres). The facility is located in the Great Salt Lake Desert, near Clive Utah, about 75 miles west (65 miles by air) (NRC 1993) of Salt Lake City, Utah. The site is located within the ten square mile industrial area designated by Tooele County exclusively for commercial hazardous waste treatment, storage, and disposal facilities. (This zoning designation will prevent future residential development near the RPCDF.) The RPCDF has been successful in working with their regulators in obtaining additional licenses and processing amendments to its existing licenses.

5.1.1 Disposal Capacity

The facility has a total disposal capacity of 14 million cubic yards of waste. The currently-developed portion of the site with constructed disposal cells has the following disposal capacities:

1) 1.5 million cubic yards for LLRW
2) 1.0 million cubic yards for NORM
3) 1.0 million cubic yards for mixed waste
4) 3 million cubic yards for mill tailings

OU1 waste is designated for disposal in the LLRW cell, which has ample capacity at this time.

5.1.2 RPCDF Waste Analysis and Acceptance

The RPCDF's Waste Characterization Plan describes the procedures that the waste generator and the RPCDF must follow to characterize the waste and to verify acceptability of the waste at the facility (See Figure 5-1). A partial list of the conditions in the facility's Radioactive Material License, which may affect acceptance of OU1 material, is presented on Table 5-1. (Note: Table 5-1 is not all inclusive. Refer to the actual license for a complete list of conditions.) The RPCDF is in the process of amending its disposal limits for specific radioisotopes.

As part of the RPCDF's pre-shipment waste acceptance process, the RPCDF requires submittal of a waste profile, (including laboratory analyses and completed forms) with five 2-pound or 1-liter analytic samples The (intended to represent the range of expected concentrations of radionuclides) and one large (50 lb) physical sample to establish acceptance parameters for future shipments. The physical sample is used to determine compaction ratios (Standard Proctor Test). The five analytic samples will be analyzed at the RPCDF's on-site laboratory. Ideally, the collection should include two high concentration samples, two low concentration samples, and one intermediate concentration. Analytical results will be compared to the submitted waste profile for consistency.

Subsequently, waste shipments will be sampled upon receipt and fingerprint analyses will be performed to confirm that the received waste is within the range established by the preshipment sampling and analysis. As-received peak radiological test values are permitted to be ten times the bulk average values. If the RPCDF's analytical results for a shipment exceed the pre-shipment tolerance range, the shipment may be returned. Additional characterization may be required before the waste can be accepted. However, acceptance of waste shipments may be delayed if additional samples, analytical results and/or written confirmation are needed to correct discrepancies between the FEMP's Quality Assurance tests and the RPCDF's post-shipment waste acceptance analyses.

About six months are expected to be required to gain initial acceptance for a waste stream, *i.e.*, to perform the analytical tests and to verify consistency with the facility's license conditions.

As the FEMP proceeds through the cleanup process, it is possible that sampling activities will detect material(s) differing from, or exceeding the tolerances of, the pre-shipment samples. If this occurs, it is necessary for the FEMP to contact the RPCDF concerning the need for additional samples of the material (as above-noted) to establish new acceptance parameters. This will help avoid rejected shipments of the new/different material.

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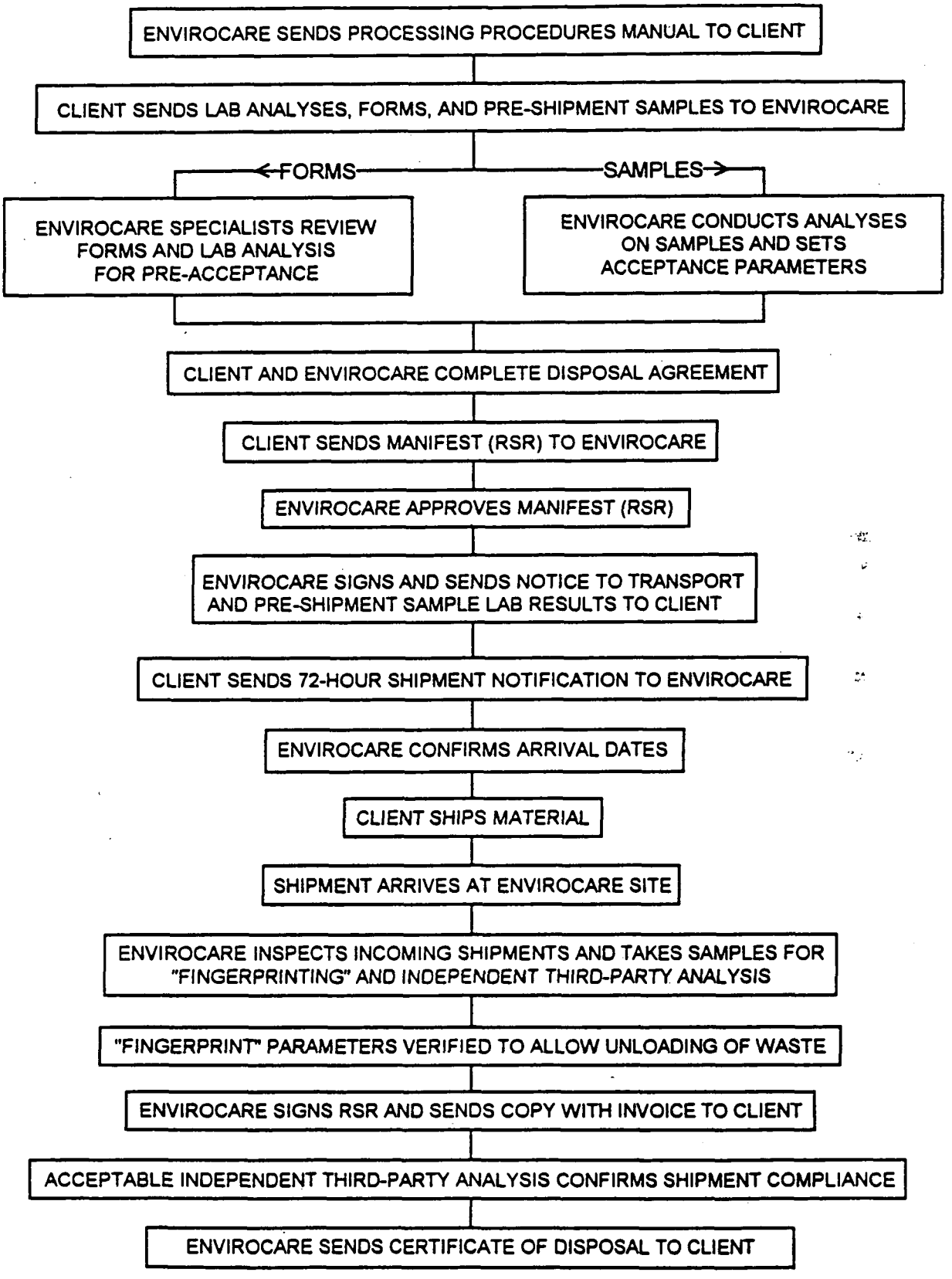

Figure 5-1- Acceptance and Shipment Process

Table 5-1 - Excerpts from the RPCDF's Radioactive Material License

9. AUTHORIZED USE. . . The licensee shall not accept low-level radioactive waste generated outside the region...unless the provisions of Articles IV and V of the Compact are met. Before receipt of any such shipments, the licensee shall submit to the Utah Division of Radiation Control documentation evidencing compliance . . .

13. The maximum quantity of special nuclear material [enriched or fissile material] which the licensee may possess, undisposed of, at any one time shall not exceed: 350 grams of U-235, 200 grams of U-233, and 200 grams of Pu, or any combination of them . . .

14. License material . . . shall not be placed in a disposal cell unless it has be determined that the concentrations of radionuclides is approximately homogeneous within the physical form of the waste . . .

18. Radioactive waste containing free liquid shall not be accepted for disposal . . .

38. For the purpose of this license, debris is defined as any radioactive waste for disposal other than soils. Compactible debris is defined as: (A) having a gradation that will pass through a four inch (4") grizzly and; (B) as having a density greater (sic) than seventy pounds per cubic foot . . . Contaminated materials, other than soil, not meeting either of these criteria are defined as noncompactible debris.

40. In-place bulk radioactive waste shall be compacted at a moisture content up to three percent (3%) above optimum as determined by the Standard Proctor Method ASTM D-698.

41. The licensee shall compact each lift to not less than ninety percent (90%) of optimum density...

42. All debris shall be less than ten inches (10") in at least one (1) dimension, and no longer than eight feet (8') in any dimension.

43. A lift or any portion of a lift shall be limited to less than ten percent (10%) by volume of debris and the debris shall be uniformly distributed throughout the lift. However, noncompactible debris in the form of concrete, stone or metal may be placed in the lift up to twenty-five percent (25%) by volume, of the total lift, uniformly distributed throughout . . .

52B. Waste containing more than 0.1% chelating agents by weight must be identified . . .

53. The licensee shall not accept radioactive waste for storage and disposal unless the licensee has received a complete "Radioactive Waste Shipment and Disposal Record," (Form #E-100) from the shipper.

5.1.3 Debris Content and Limitation

The RPCDF's Radioactive Material License with the State of Utah defines the term, "debris" as anything other than soil (see Table 5-1, conditions 38, 42, and 43). In addition, on a case-by-case basis, debris shall not exceed ten percent of the volume of the waste material, and no single piece shall be larger than eight feet by eight feet by ten inches.

In accordance with its license, debris that does not meet the above specification is not acceptable for disposal at the RPCDF. If any such debris is received by the RPCDF, it can either return the debris to the shipper or process the debris to meet its license conditions at an additional cost.

5.1.4 Moisture Content and Limitation

The RPCDF imposes a:

1) Minimum moisture content of five to seven percent to minimize dust generation problems at the RPCDF.
2) Upper-bound constraint of no free liquids.

The OU1 waste treatment process is designed to generate a treated waste product near optimum moisture content. The maximum acceptable moisture content (Table 5-1, condition 40) is three percent above optimum, as determined by the Standard Proctor test. Additionally, no free liquid is allowed in the waste.

To reduce the possibility of the OU1 material becoming frozen in-place in the railcar during the winter, the OU1 waste treatment unit may need to produce a drier product during in the winter season. This change means a reduced waste processing rate during a time (between December 1 and March 1) when the RPCDF also experiences reduced productivity because of the climate.

5.1.5 Other Limitations

There are no known or anticipated regulatory limitations by the State of Utah that may impact the acceptance of OU1 material, *i.e.*, there are no volumetric nor physical nor chemical limitations. Radiological analyses performed to date show that homogenized, processed OU1 material will meet the maximum permitted average concentration for all radionuclides.

At present, License Condition 13 specifies a 350 gram aggregate limit for the possession of Special Nuclear Material (SNM), which is applicable to all undisposed waste at the RPCDF. Since OU1 does not have a meaningful quantity of SNM, this limitation should not be an active constraint.

The RPCDF also prohibits the disposal of LLRW containing pathogens, infectious wastes, or other etiologic agents. The Feasibility Study (DOE 1994b) regulatory analysis (Appendix J, Table J.6-3) previously determined that this requirement does "not apply to OU1 wastes because the wastes do not contain pathogens or infectious wastes."

Under the RPCDF's mixed waste license, waste regulated as asbestos may not be accepted by the facility. However, this requirement does not prohibit the facility from accepting radioactive waste with some asbestos contamination. Such waste may be accepted on a case by case basis. The Feasibility Study regulatory analysis (Appendix J, Table J.6-4) previously determined that, "None of the waste in OU1 is regulated as asbestos waste. Although a small portion of OU1 waste may contain asbestos, the total is less than 1%, which is the regulatory threshold."

In addition, under the RPCDF's mixed waste license, polychlorinated biphenyl (PCB)-contaminated waste will not be accepted unless the PCB concentrations meet municipal solid waste disposal levels. The Feasibility Study regulatory analysis (Appendix J, Table J.6-4) previously determined that this requirement does "not apply to OU1 wastes because the RI [Remedial Investigation] has documented that PCBs in the waste pits does not exceed . . . 50 ppm [parts per million] (regulatory threshold)."

5.2 Logistics

The RPCDF has excellent transportation access. The disposal site is located 1-mile south of the main line of the UPRR and is connected by a rail spur. The site is also connected to I-80 by a 2.7-mile four-lane divided highway. This highway facilitates a high volume of truck traffic to the disposal site.

5.2.1 Railroad Traffic

The RPCDF has two 1-mile and one 1.75-mile spurs on its property. Railroad cars are delivered from UPRR's main line, and then "spotted" for staging or unloading by the facility's two locomotives. The facility operator notes that unit trains arrive at the site on a more dependable schedule than blocks of regularly-scheduled freight cars. Representatives of the RPCDF indicate the facility can accommodate the anticipated OU1 traffic.

The RPCDF has represented that it can easily accommodate the anticipated type of gondola car and traffic thereof. The current three parallel facility spurs limit the number of railcars that can be on site at once to a maximum of 300 cars. The facility's infrastructure has the following capabilities:

1) Handling 120-ton (net weight) 57-foot gondola cars
2) Turning around a unit train within a four calendar day period under normal weather conditions
3) Providing security for storage of loaded cars in an off-site yard or siding

In current operations, most bulk materials arrive in open top gondola cars, which are pushed, one at a time, through the facility's permitted railcar roll-over device (See Figure 5-2). This unit straddles the spur and effects a controlled "drop" of the waste material into an adjacent concrete pit. The unloading operation can be sprayed with water to reduce the amount of airborne dust. The material is then loaded into dump trucks, transported to the disposal cell, placed in one-foot "lifts" (or levels), compacted, and covered. The empty railcars continue along the spur. When the capacity of the spur behind the roll-over device is reached (about ten cars), the empty cars are moved for decontamination and interim storage.

Daily railroad car unloading capacity of the facility's roll-over device varies from 10 in winter, when frozen loads in railcars have to be hydraulically "jackhammered" to facilitate unloading, to 150 in a 24-hour period campaign during favorable weather. The RPCDF adds a ten percent surcharge for deliveries between December 1 and March 1. The FEMP is considering measures that would avoid the need to "jackhammer" the railcar to unload it (*e.g.*, drier waste material).

During times of inclement weather, such as precipitation or high winds, disposal operations are not performed.

The facility operator recommends bulk transport in membrane-lined gondola cars with hard covers. However, the operator has reported experiencing operational difficulties in handling certain types of liners and metal covers. Thus, during the selection process for the liner and hard cover for the gondola cars, operational experience of the RPCDF operator will be considered. A fiberglass cover manufactured and maintained by EcoFab is recommended by the RPCDF operator.

5.2.2 Container Traffic

The RPCDF is capable of receiving waste *via* intermodal containers on flatbed railcars. About one percent of the facility's waste is currently received in intermodal containers. If intermodal containers were the selected mode of transport (see Section 2.4.3) for OU1 material, a new handling facility could be readily constructed to handle high-volume OU1 waste shipments. The container handling activities at the RPCDF could follow either of the following two scenarios.

Scenario 1 - Containers Moved Directly to Disposal Cell

An unloading/loading pad would be constructed next to the existing rail spur to permit a "piggypacker" (large container forklift) to access two flatcars at a time. The pad would serve as an interim container storage/sampling location, if necessary. The containers would be successively placed directly onto trucks which would proceed to the disposal cell and unloaded using the containers' end gates. After decontamination, the closed containers will be returned to the unloading pad, removed from the trucks and placed back on the flatbed railcars.

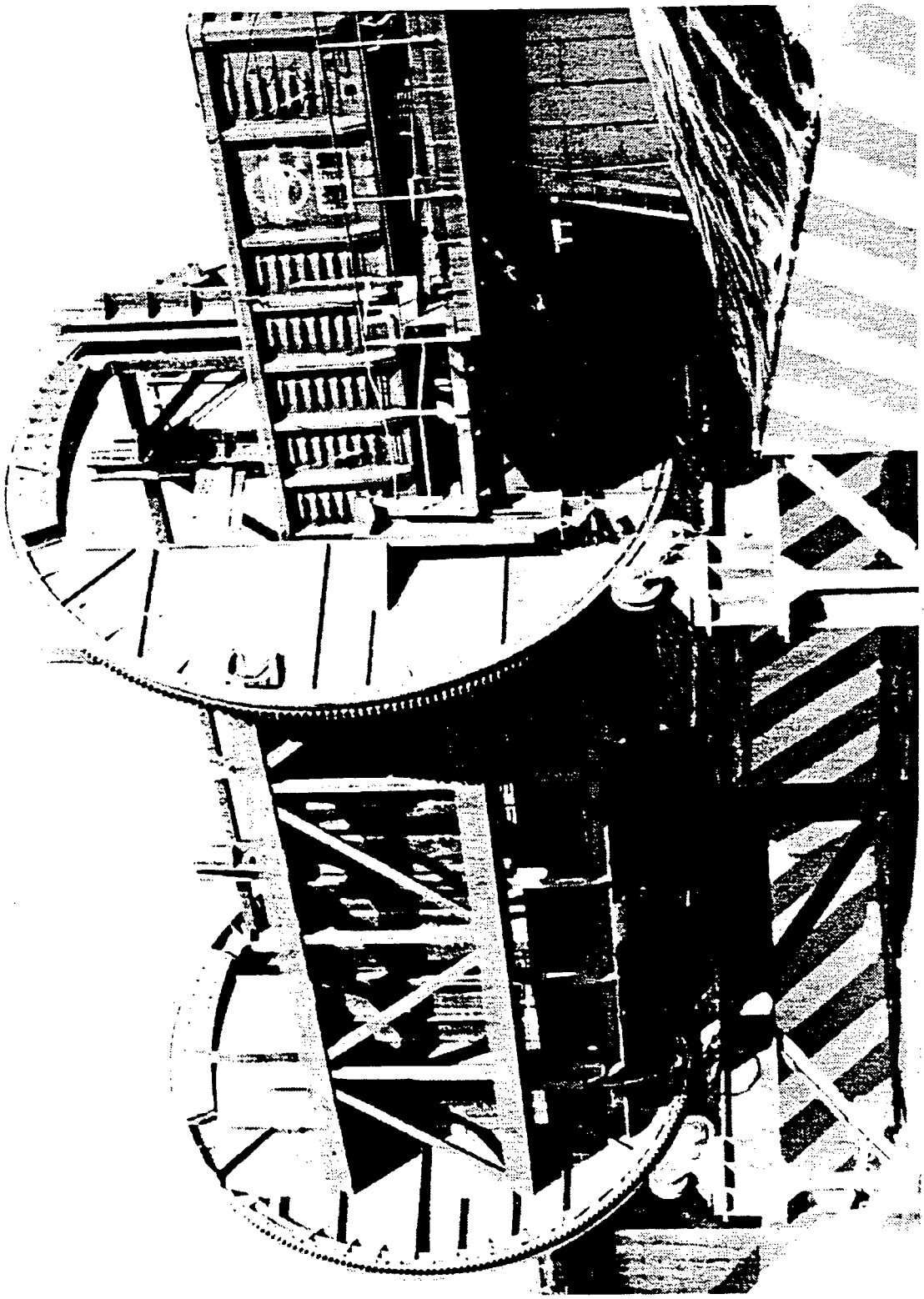

Figure 5-2 Gondola Car Roll-Over Facility

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Scenario 2 - Containers Staged Before Disposal

Using the above-noted pad, a less schedule-intensive method of handling containers would be for the piggypacker to unload full containers and immediately replace them with empty containers. Although this "decouples" waste disposal and train loading/unloading activities, an extra set of containers is required.

5.2.3 Decontamination

The exterior of all gondola cars is currently decontaminated with high pressure brackish water spray hoses by facility personnel. This method is effective in their current operations because all materials received are either in plastic lined cars or 2000 pound bulk bags. The lining or containerization eliminates almost all direct contact of the waste with the car internals, thereby minimizing the need for additional decontamination efforts. A similar method could be used on intermodal containers.

Federal regulations (49 CFR 174.715(b)) specify that the interior of a gondola car need not be decontaminated after each use as long as the car is used exclusively for radioactive materials and is kept closed at all times (except for loading and unloading) and if a survey shows that the radiation dose does not exceed 10 millirem per hour at the interior surface or 2 millirem per hour at 3 feet from any interior surface. If internal contamination exceeds these levels, then the interior of the car must be decontaminated to be considered an empty unplacarded railcar.

5.2.4 Radiological Monitoring Requirements and Quality Assurance

Radiological monitoring and quality assurance verification are performed to ensure that the exterior of each railcar and/or container used for transporting radioactive waste is not externally contaminated prior to its release from the RPCDF. The facility's License Condition #28 mandates that each transport vehicle be radiological surveyed prior to leaving the facility and that appropriate records of this survey be kept. The license specifies the limits for average and maximum radiation levels to be 0.2 and 1.0 millirad/hour, respectively. Further, the maximum allowable removable surface contamination may not exceed the limits set in Table 10 of 49 CFR 173.443(a). If any of these limits are exceeded, the vehicle must be decontaminated until it passes these release limits for external contamination.

5.3 Noncomplying Waste

The FEMP will make every effort to ensure that all waste material shipped to the RPCDF meets its WAC. The FEMP will perform confirmatory analysis prior to its shipment to the RPCDF (see Sampling and Analysis Plan). In the unlikely event that any waste arriving at the RPCDF does not conform to the accepted waste profile based on the facility's sampling of the waste shipment, then the waste material will

not be unloaded. The FEMP is notified, and the following Contingency Plan for Non-Conforming Results is implemented.

The RPCDF is able to process some Non-Conforming waste, such as waste with free liquids, into an acceptable form, and then accept the waste for disposal. However, if the waste exceeds the chemical/radiological acceptance criteria, the waste will be returned to the FEMP. Material will be removed by a backhoe, positioned on a ramp. If the FEMP's evaluation confirms that the rejected material could not be accepted by the RPCDF, then the waste would be re-packaged for transportation and disposal at the NTS.

Normal procedure at the RPCDF is to wait for the confirmatory analysis before disposal. However, if after the waste is disposed and the results from a state-approved laboratory or from the deferred chemical screening parameters analysis show that the waste is beyond the limits of the license, the facility operator must follow the procedure below:

1) Within 24 hours of discovering that non-conforming material had been disposed, the RPCDF must notify the Utah Division of Radiation Control of the situation. Non-conforming waste is material that:
   (1) The waste exceeds the limits of the radioactive material disposal license.
   (2) The waste exhibits hazardous waste characteristics that exceed land disposal restrictions and has not been granted a case-by-case variance from the Utah Division of Water Quality.

2) Within seven calendar days of the notice, the RPCDF must provide the Utah Division of Radiation Control with a written description of the situation. The following information must be included in the written description:
   (1) Name of Generator
   (2) Name of Non-Conforming Waste Stream
   (3) Amount of Non-Conforming Disposed Waste
   (4) Location of Non-Conforming Waste in the Disposal Cell
   (5) Date Non-Conforming Waste was Accepted
   (6) Date Non-Conforming Waste was Placed in Disposal Cell
   (7) Description of Waste Placed on and Around Non-Conforming Waste
   (8) Plan of Action for Resolving Non-Conformance
   (9) Compliance Schedule

The finding of noncomplying waste by the RPCDF resulting from a radiological analysis has a number of possible causes: (a) waste shipment as a whole was complying, but the random sample taken the RPCDF was not representative (*e.g.*, statistical "hot spot" due to waste not being sufficiently homogenized/processed by the FEMP), (b) waste shipment was complying, but the RPCDF analysis was

faulty (*i.e.*, not the FEMP's fault), and (c) waste shipment was noncomplying, but passed through FEMP screening and sampling program (*i.e.*, inadequate waste: homogenization [a statistical "cold spot" was sampled], screening and analysis at the FEMP).

To avoid the shipment of non-acceptable waste material, the FEMP will address this problem in the sampling program and in the waste treatment process. First, the FEMP has made it a high priority to develop and institute a systematic and representative statistical sampling and screening program for the processed waste material (see *Sampling and Analysis Plan*). Second, to assure that the analytical results at FEMP and the disposal site are reasonably representative and consistent, the waste material will be blended. The OU1 waste treatment system is being design with this key objective in mind. A number of quality control features will be incorporated into the design to assure the production of a reasonably homogeneous product. (See *Plant Facilities Engineering*.)

Before any off-site waste shipment, the waste material will have been screened, sampled and analyzed, and compared to the submitted waste profile. If the analytical results are not consistent with the submitted waste profile, the waste profile may be revised by notifying the disposal site, as long as the revised profile does not exceed the license conditions or WAC. The contract with the RPCDF will include:

1) A dispute resolution procedure to resolve analytical discrepancies.
2) Charges and procedures for handling non-complying wastes, ranging from treatment options to the return of loaded cars.

Waste exceeding the RPCDF's WAC will be either recycled for further processing or sent directly to the NTS, depending on the extent and nature of the deviation. At this time, it is expected that the RPCDF and the Nevada Test Site can accept waste generated by OU1's waste pit remedial action project.

SECTION 6

TRANSPORT AND DISPOSAL AT THE NEVADA TEST SITE

6.1 Facility Overview

The NTS is located in Nye County, Nevada, about 65 miles northwest of Las Vegas. The NTS encompasses about 1350 square miles and is surrounded on three sides by public access exclusion areas. NTS has been the primary location for testing the nation's nuclear weapons since January 1951. Since 1978, NTS has also served as a major LLRW disposal facility for several DOE sites. Off-site waste from other DOE sites must be packaged to meet NTS criteria (DOE *et al.* 1992).

6.2 NTS Waste Acceptance Criteria

Material that cannot be treated to meet the RPCDF's WAC will be disposed of at the NTS. Before any waste material leaves the FEMP, the waste will be analyzed to ensure compliance with the NTS WAC (NVO-325)(DOE *et al.* 1992). A partial list of NTS WAC is presented in Table 6-1. (Note: The criteria presented in Table 6-1 are not all inclusive. Refer to NVO-325 for the complete list of criteria.) Prior to shipment of OU1 material to the NTS, the FEMP will submit the appropriate application for DOE approval.

The NTS process for application approval, waste characterization, waste certification, exemption requests, and waste transfer, is thoroughly explained in its document, NTS Defense Waste Acceptance Criteria, Certification and Transfer, NVO-325 (Rev. 1). This document states that bulk waste containers must be approved by the Department of Energy-Nevada (DOE-NV). Further, bulk waste containers being returned to the shipper must be decontaminated sufficiently to meet NTS' off-site release limits.

To comply with the Off-site Rule for CERCLA waste (40 CFR 300.440), the DOE will conduct an audit of the disposal facility prior to shipping waste to confirm the facility's status and compliance history. The review will be conducted annually throughout the term of the remediation project. In the event the compliance status of the disposal facility changes, the DOE will suspend waste shipments until the actions/requirements for regaining acceptability status under the policy are implemented and the facility is designated as acceptable.

6.3 Truck Transport

Current FEMP procedures for shipment of LLRW to the NTS specify the use of disposable metal containers transported by truck. For disposal of small limited quantities of material, use of disposable

Table 6-1 - Excerpts from the NTS Waste Acceptance Criteria

Packaging for radioactive waste must meet DOT (49 CFR 173) and NRC (10 CFR 71) requirements for LSA, Type A, and Type B packages.

Only low activity LLRW will be accepted in bulk. Bulk waste will be contained such that personnel can unload waste without contaminating personnel and equipment. Bulk waste must meet the requirements of 49 CFR 173.425. Bulk waste containers may be returned to the waste generator.

The quantity of radioactive material in a package shall be limited to the extent that the effects of nuclear decay heat will not adversely affect the physical integrity of a package or (its contents) . . . (49 CFR 173.442)

The package closure shall not be breached under normal handling conditions and shall not be the weakest structural element in the package.

Packages shall be capable of supporting a uniform distributed load of 4,000 psf on any of the surfaces. (Sea/land containers, steel drums and bulk waste are exempt.)

All waste packages shall be provided with permanently attached . . . auxiliary lifting devices to allow handling by means of forklifts, cranes, or similar equipment. . . . lifting devices on the package must not inhibit stacking of the packages. Lifting devices must have a 5:1 safety factor . . .

DOE-NV recommends that 4 ft by 4 ft by 7 ft or 4 ft by 2 ft 7 ft (width, height, length) boxes or 55-gallon steel drums be used. Other size containers are acceptable with approval of DOE-NV.

NTS imposes limits of 9,000 lbs. per box and 1,200 lbs. per drum. Packages exceeding these limits . . . (need approval) and must be shipped in . . .(certain types of) trailers.

Waste packages shall utilize package volume in such a fashion . . . (to maximize packing) efficiency.

Use of Type A packaging not evaluated under the DOE Type A Package Certification Program will not be permitted.

Radioactive gases shall be . . . so that pressure does not exceed 1.5 atmosphere at 20 degrees C. Compressed gases (49 CFR 173.300) will not be accepted.

The external radiation levels for packages shall not exceed 200 mrem/hour on contact (49 CFR 173.441). DOT regulatory exceptions will be acceptable on a case by case basis. Type B containers that require remote handling will be addressed on a case by case basis.

All packages shall be marked with a unique package identifier. Bar coding denoting shipment, package, and waste stream identification is required. Bulk waste shipments must be accompanied by appropriate waste identification documentation.

Fine particulate waste shall be immobilized so that the package contains no more than 1 per cent (by weight) of less than 10-micron diameter particles or 15 percent (by weight) of less than 200-micron diameter particles. When immobilization is impractical, the package shall include a sealed liner and be over-packed.

Table 6-1 - Excerpts from the NTS Waste Acceptance Criteria (Continued)

Radioactive-contaminated asbestos capable of giving off friable asbestos dust must be wetted with water and surfactant and stored in double plastic bags having a combined wall thickness of at least 6 mil . . . must be overpacked in leak-resistant metal or wood containers. Sea/land containers containing radioactive asbestos will be considered on a case by case basis. Any regulated asbestos waste must be segregated into a separate stream.

Each waste package shall be prepared for shipment so as to minimize damage during transit. Preshipment storage shall be controlled to avoid adverse effects of weather . . . The accumulation of moisture on or in the packages . . . shall be avoided. Each waste container shall be provided with tamper indication devices once all certification actions have been taken.

Minor liquid residue . . . (is) acceptable. In no case shall free liquid content exceed 0.5 percent (by volume). May use Method 9095 (Paint Filter Test) to demonstrate compliance.

LLRW containing pathogens, infectious wastes, or other etiologic agents (49 CFR 173.386) will not be accepted.

LLRW containing chelating or complexing agents at concentrations greater than 1 percent (by weight) will not be accepted.

containers is practical. However, for bulk quantities of material, the metal containers would be emptied at the disposal cell and returned for repeated use. Transport to the NTS is by truck, along existing routes, in accordance with existing procedures. The maximum net cargo weight for truck load is about 20 tons. Therefore, for terms of economy, large 20-ton containers are assumed.

Currently, NTS does not accept bulk waste from off-site generators. However, NTS does dispose of bulk waste generated internally. In recent discussions, NTS has indicated a willingness to accept bulk waste from the FEMP for disposal at NTS Area 3 following approval of an application from the shipper. Before selection of the specific bulk container, NTS personnel will be consulted regarding their logistical requirements and handling capabilities.

The logistics of loading large bulk containers at the FEMP are under development. It is assumed no road upgrades are necessary along the FEMP access roads to support a single loaded truck. However, if there is a substantial amount of truck traffic, road upgrades would be necessary. At this time, no road improvements are considered necessary to support the anticipated level of truck traffic, an occasional truck.

The FEMP process for shipments to the NTS is well-established and documented in the FEMP procedures. The FEMP has been shipping LLRW to the NTS since 1986. The FEMP's long and excellent record of full compliance with NTS shipping procedures has been cited by the NTS as a model for others to follow. Truck routes are planned in accordance with normal FEMP procedures.

An intermodal option is being evaluated. This would involve originating rail shipments of containers on flat cars at the FEMP, and transhipping the containers to trucks at an intermodal facility to be located.

SECTION 7

EMERGENCY RESPONSE PLANNING AND TRAINING

This section describes the existing emergency response infrastructure to provide assistance to any rail transportation incident, except for the FEMP plans, which are under development.

7.1 Process For Plan Development

Federal regulations and DOE orders require the FEMP (as shipper), the DOE, and the carriers to have emergency plans and procedures in place to respond to transportation accidents. Existing emergency plans and procedures must be reviewed and revised, as necessary, or new plans and procedures must be created to provide a quick response to any emergency or non-routine condition that could arise from these rail shipments. Abnormal rail incidents, that could occur either on-site or off-site, could include the following:

1) Removal of a single railcar for unplanned maintenance to correct a safety or mechanical problem from the unit train
2) Derailment of one or more intact and upright railcars
3) Finding external contamination on a railcar while on a siding
4) One or more overturned cars, with a partial or complete loss of contents on land
5) Release of material into a public water supply

Currently, the FEMP has a *Transportation Emergency Plan* (FERMCO 1995a) and associated emergency preparedness procedures that cover only truck transport incidents. Before initiation of OU1 shipments, the existing plan and procedures will be revised to include rail transport accidents. In addition, the DOE will offer emergency training to first responders in the nearby communities and will participate, as requested, in periodic training programs sponsored by the railroad and other organizations responsible for emergency planning (DOE 1995a). As part of emergency response preparations, the DOE is committed to contact and work with representatives from Ohio, Utah, and transited states prior to the first waste shipment to brief them on shipment plans.

7.2 Overview Of Involved Organizations

In the event of an emergency, there are at least six different generic organizations involved in responding, as shown on Figure 7-1. All the organizations are prepared and trained to provide support and assistance to the On-Scene Commander, as requested. Briefly, the functions of the six organizations are identified below and are further elaborated upon in the following sections:

1) Train crews are trained to make an initial notification and assessment of the emergency.

2) Railroad companies have contingency plans, technical and communications personnel, and remediation contractors in place to respond to transportation incidents.

3) Local authorities at the scene of the accident serve as the on-scene incident commander. All other parties support the on-scene commander.

4) States have emergency response organizations and personnel for monitoring and administrative functions. These may include state police and national guard, state departments of transportation, health (State Radiation Control Programs), and environmental protection.

5) The DOE has a network of regional Radiological Assistance Teams that can respond to support local response agencies.

6) The FEMP's existing emergency response program will be revised to support the management of off-site rail emergencies, and to support the railroad and on-scene commander with both technical and communication personnel.

Depending on the actual location of the radiological accident, specific organizations will respond. The responsibility matrix presented on Figure 7-2, illustrates the various organizations that will respond as a function of the location of the emergency, depending on the particular state and the railroad involved. Additionally, two other resources, independent of location of the emergency, are available: the FEMP and the DOE-Headquarters (DOE-HQ).

7.3 Train Crew

DOT regulations (49 CFR 172) require classroom training for transportation personnel, who are subsequently tested on their knowledge of regulations and emergency procedures. Thus, considerable operational training is imparted to train crews, which typically consist of an engineer, who operates the train, and a conductor, who is in charge. For each train, the following information is supplied to the conductor:

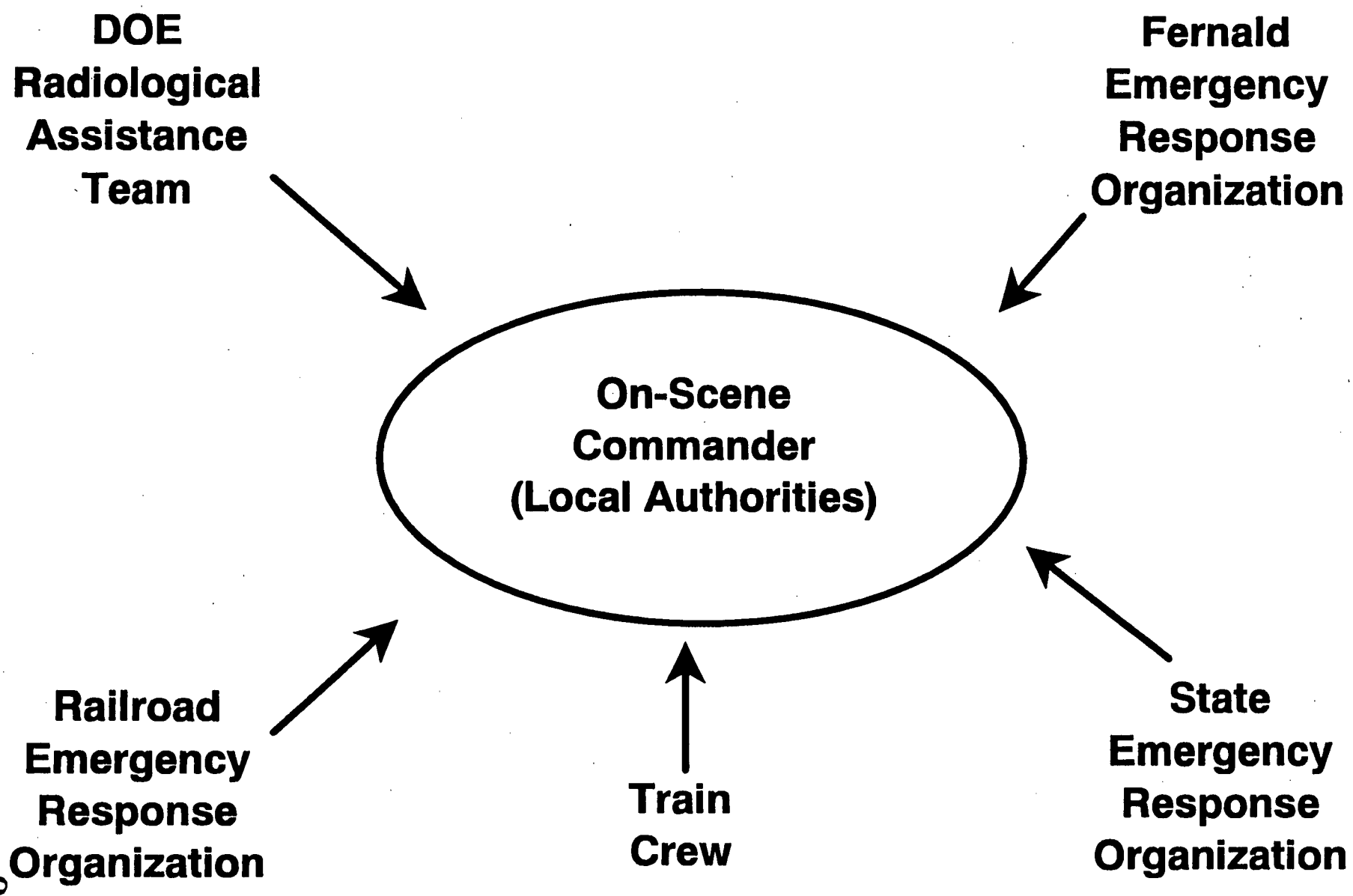

Figure 7-1 - Organizations Responding to a Transportation Incident

RAIL TRANSPORTATION INCIDENT RESPONSIBILITY MATRIX/COVERAGE

FERNALD TO ENVIROCARE

STATE:	OHIO	INDIANA	ILLINOIS	MISSOURI	KANSAS	NEBRESKA	WYOMING	UTAH
State Agencies:	Emergency Management Agency Department of Health	Emergency Management Agency Board of Health	Emergency Management Agency Department of Nuclear Safety	Emergency Management Agency Bureau of Radiological Health	Emergency Management Agency Department of Health and the Environment	Emergency Management Agency Department of Health	Highway Patrol Office	Public Safety Department
Railroad:	CSX Transportation, Inc. Jacksonville, FL			Union Pacific Railroad Company Omaha, NE				
Railroad Regional Emergency Response Offices:	Cincinnati			St. Louis	Kansas City, MO	North Platte	Cheyenne	
Possible Railroad Remediation Contractors:	OHM Remedial Services			OHM Remedial Services			Flint Eng'g & Construction	
Fernald	FERMCO & DOE - FN							
DOE Regional Coordinating Head Office:	Chicago			Oak Ridge	Albuquerque	Chicago	Idaho	
DOE Headquarters:	Env. Restoration & Waste Management/Technology Development (Transportation & Emergency Management Programs)							
USEPA Region/Location:	5 (Chicago)			7 (Kansas City)			8 (Denver)	
Possible USEPA Emergency Response Cleanup Contractors:	OHM Remedial Services			REIDEL Environmental Services				

Note: EPA is not the lead federal agency for radioactive materials accidents.

Figure 7-2 - Rail Transportation Incident Responsibility Matrix/Coverage

1) Special Instructions
2) Train Switchlist and Consist
3) Emergency Handling Precautions
4) Notice of Cars Containing Explosives A and/or poison gas (not applicable)
5) Waybills

The Special Instructions printout lists the complete DOT shipping descriptions for each hazardous material (such as radioactive material) on the train, and the relative position of the car from the engine. The Consist identifies each car on the train by position, cargo and provides basic emergency response information. It includes the train schedule and telephone numbers for incident notification. The hard copy is carried on the train and the file is remotely available on the railroads' computer systems.

The train crew is provided with emergency handling precautions for each hazardous material on the train. In addition, the crew has Waybills that include the following information for each car in the train:

1) Car initial and number

2) Shipper's name and address

3) Consignee's name and address

4) Commodity shipping description, which for a hazardous material includes the proper DOT shipping name, hazard class, four-digit UN or NA identification number, placard notation, and the total weight of the commodity

5) Placard endorsement in the upper left hand corner (for most, but not all, hazardous materials)

6) Emergency Response Telephone Number

Furthermore, the railcar's hazardous material contents can be identified by DOT required placards displayed on each side and each end of the railroad cars or containers. Placement of these "RADIOACTIVE" and other placards, as appropriate, on each railcar is the responsibility of the shipper (the FEMP), not the carrier (49 CFR 173.415(b) and (c)), although packages of LSA material are exempt from labeling requirements (49 CFR 173.425(b)).

Railroad crews use the DOT *1993 Emergency Response Guidebook* (DOT 1993) for first responders, which details the safe handling of released hazardous materials and the proper response to an incident. The crew's primary responsibility is to notify their railroad of the accident, and to make an initial assessment of the extent of the accident and to report on their findings. It should be noted that the train

crews do not require detailed radiological training as they function only as observers and reporters at the initial stage of the incident.

7.4 Railroad Emergency Response Personnel

CSXT and UPRR have an established emergency response infrastructure to respond rapidly to hazardous materials incidents. After receiving an accident notification, the rail carrier will make other required notifications (to the FEMP, the DOE, state agencies) and initiate immediate response. On call around the clock, professional railroad staff members are strategically located throughout the rail system to provide prompt and effective response to incidents involving hazardous materials or environmentally sensitive chemicals. Those on call would have the authority to authorize the mobilization and response of clean-up firms (see Figure 7-3), who are experts in spill response and cleanup. The railroad's HAZMAT personnel would report to the scene of the accident to support cleanup efforts as required. CSXT, for example, has an emergency response person assigned to Cincinnati. After an emergency is considered contained by the on-scene commander in accordance with guidance in the Emergency Response Guidebook, the rail carrier is responsible for subsequent cleanup activities.

The CSXT emergency response hotline is (800) 593-6188.

The UPRR emergency response hotline is (800) 726-1099.

Railroads frequently present hazardous materials training programs to emergency response groups along their rail systems and to state/federal agencies and private industry groups. The railroads' professional staff has training in hazardous materials and draws upon strong backgrounds in chemistry, environmental engineering, biology, geology and industrial hygiene. In the event of a hazardous materials incident (regardless of severity), the hazardous materials group will notify all state and federal agencies as required/planned.

The railroad and its remediation contractors have primary responsibility for cleaning up the accident scene and restoring the rail line to a safe and functioning condition. The accident site would be independently inspected and verified by state officials when remediated.

7.5 Local Authorities

Initially, the local fire or police authority will assume the role of on-scene incident commander. Every state has an organization and procedures in place to respond to transportation emergencies. All other organizations support the efforts of local emergency officials to mitigate the immediate consequences of an emergency and monitor cleanup efforts conducted by railroad contractors.

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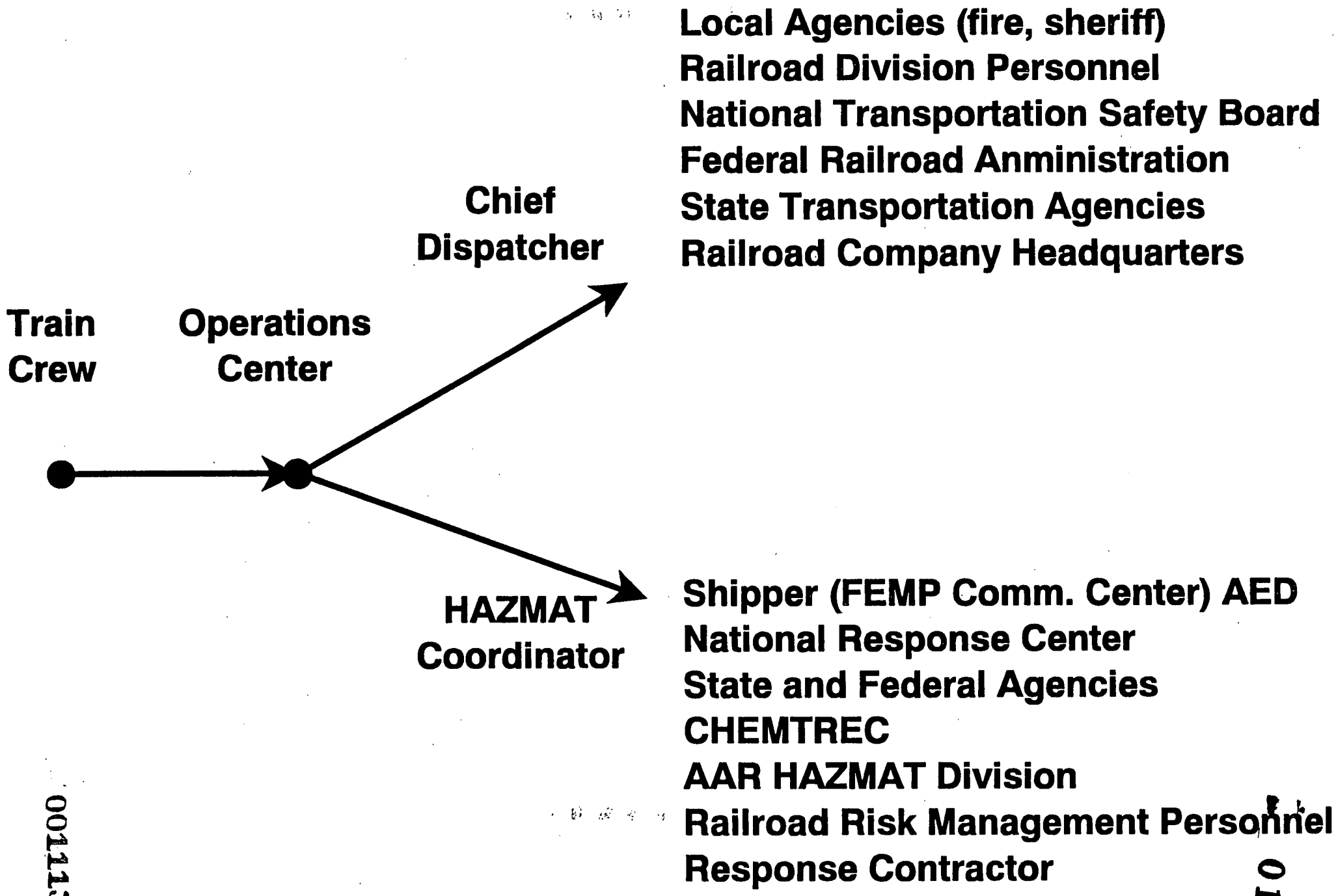


Figure 7-3 - Emergency Notification

The local authorities should coordinate its local emergency plan to be compatible with the state's plan. The local emergency plan should specify the respective roles and responsibilities of federal, state, local and private organizations. The local authorities, probably its law enforcement or fire fighting department, will most likely be the first responder. Its primary responsibilities are as follows:

1) Administer emergency measures to save lives and attend to the injured.
2) Determine if radioactive or other hazardous materials are present and obtain information regarding its potential hazards.
3) Notify appropriate authorities to obtain radiological expertise (state, federal, shipper).
4) Determine the action required to prevent further damage to life or property.

(FEMA 1992)

Before initiation of OU1 rail shipments, the FEMP will offer first responders in nearby communities to opportunity participate in emergency preparedness training, specifically involving the transport of FEMP materials. This topic is discussed further in Section 7.8.

7.6 State Agencies

State or county emergency management agencies and local emergency planning committees have the primary responsibility to protect the public health and welfare in the event of a transportation accident. The state emergency plan should coordinate the activities of all state, county or local agencies for emergency response within each community, assisted by FERMCO, the DOE, or the railroad carrier as necessary. The state has the primary responsibility of protecting its citizens from any unwarranted radiation exposure and thus for managing the containment and control of the potential hazards resulting from an accident. In particular, the state emergency plan should complete the following actions:

1) Take responsibility for developing a radiological response plan, assigning responsibilities to various agencies, and identifying resources
2) Officially designate an emergency radiological response team
3) Coordinate a communications system of federal, state, and local involved agencies
4) Negotiate agreements with contiguous states addressing responses to incidents in close proximity to a common border and a mutual assistance pact
5) Prepare and assist other agencies in the development, distribution and implementation of procedures for the supporting agencies to use to carry out their assigned responsibilities
6) Sponsor periodic drills and exercises to test and "fine-tune" the emergency response system

(FEMA 1992)

Each state has a radiological health agency responsible for the assessment of radiological events within the state and for taking the appropriate actions to protect the public health and safety upon notification of an incident. Appendix C presents a list of State Radiation Control contacts. In most situations, state radiation control programs can provide the most prompt radiological assistance at the scene of an accident, and they are prepared to assess all types of radioactivity. In most states, the radiation control program is responsible for, at a minimum, the initial radiological assessment of transportation accident.

7.7 DOE

The DOE is the lead federal agency for responding to a transportation radiological accident, if it is requested to so by state or local authorities. The DOE's mechanism for providing assistance is through the network of regional radiological assistance teams, which offers technical guidance, communications assistance, and radiological assessment to the on-scene commander.

7.7.1 Regional

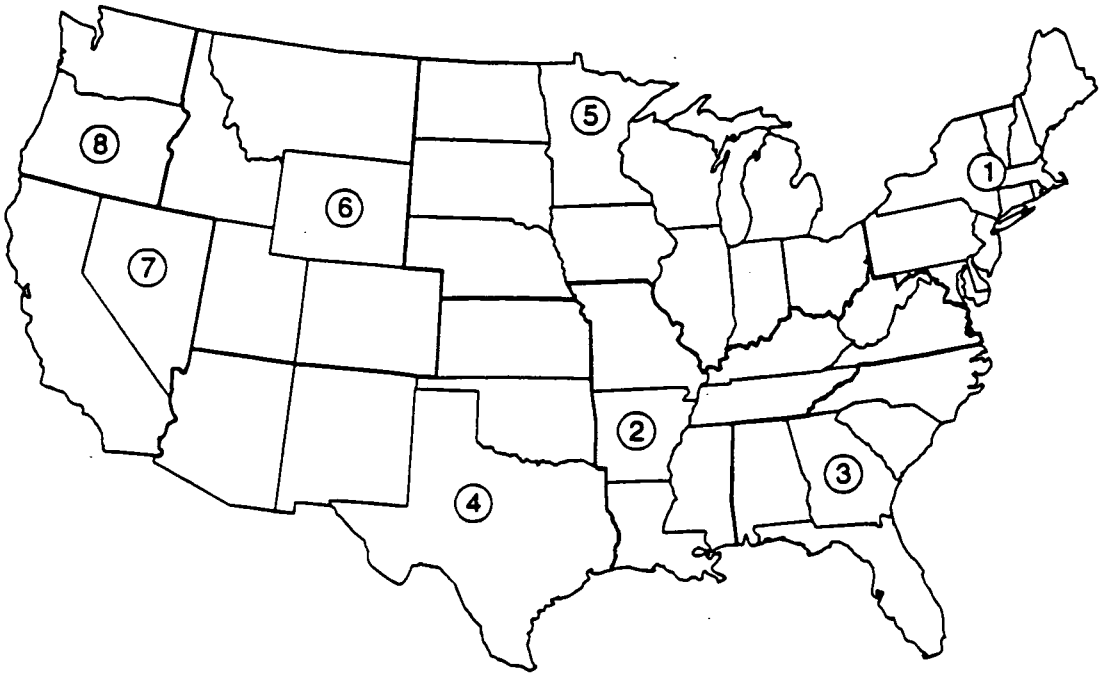
To assist in mitigating radiological incidents, The DOE provides assistance to state and local agencies through a nationwide network of regional Radiological Assistance Teams, as shown on Figure 7-4 with their telephone numbers. Regional DOE Radiological Assistance Teams provide radiological monitoring, communications, and information coordination during an emergency. An additional mission is to coordinate all efforts for the restoration of public services and expedite recovery following an incident. These teams are made up of DOE and contractor personnel with expertise in health physics, public information and communications. A DOE employee serves as the response coordinator and ensures communications back to the regional office.

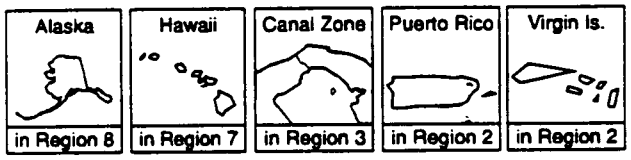
When deployed, these teams support field responders and are not intended to direct actions at the incident scene. As with other responders, the DOE response coordinator reports to the local incident commander. (Note: Only in an incident involving a nuclear weapon or Special Nuclear Material does the DOE have authority to take direct command and control.)

7.7.2 DOE Headquarters

At DOE-HQ, the Director of the Office of Environmental Management (EM) is responsible for DOE-HQ emergency response for EM facilities, operations, or activities, including related transportation operations. The Fernald Area Office (FN) reports directly to EM. The DOE-Ohio Field Office receives notification of the event. The DOE-HQ is still the primary contact point for emergency events and still coordinates federal response efforts.

EM's Operational Emergency Management Teams can be activated to perform the following functions:





(Region #) Regional Coordinating Office	(1) Brookhaven Area Office	(2) Oak Ridge Field Office	(3) Savannah River Fld. Office	(4) Albuquerque Field Office	(5) Chicago Field Office	(6) Idaho Field Office	(7) San Francisco Field Office	(8) Richland Field Office
Post Office Address	Upton, L.I. New York 11973	P.O. Box 2001 Oak Ridge, TN 37831	P.O. Box A Aiken, S.C. 29808	P.O. Box 5400 Albuquerque NM 87115	9800 S. Cass Ave. Argonne, IL 60439	785 DOE Place Idaho Falls, ID 83402	1333 Broadway Oakland, CA 94612	825 Jadwin Ave. Richland, WA 99352
Telephone for Assistance	(516) 282-2200	(615) 576-1005	(803) 725-3333	(505) 845-4667	Duty Hrs: (708) 252-4800 Off Hrs. (708) 252-5731	(208) 526-1515	(510) 273-4237	(509) 373-3800

Figure 7-4 - Regional Coordinating Offices for Radiological Assistance

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1) Monitor and support the FEMP response to an emergency
2) Provide overall management and direction of the DOE emergency response
3) Inform and keep DOE-HQ senior management updated on emergency status
4) Notify and coordinate with other DOE elements and federal agencies
5) Coordinate and authorize deployment of DOE emergency response assets outside the area of responsibility of the FEMP
6) Coordinate response on a federal level

In the event of an accident involving OU1 material, the DOE will ensure that any material released while in transit from the FEMP to the disposal site is cleaned up to background levels. To ensure achieving such a cleanup standard, the DOE is committed to preparing a contingency plan for additional remedial activities at the accident site. (DOE 1995a) This contingency plan will be developed in accordance with the Remedial Action Work Plan.

In the unlikely event of a major disaster requiring the full resources of the federal government (*i.e.*, exceeding the capability of the DOE Radiological Assistance Teams), the state Radiation Control Program Director has the authority to call the Federal Radiological Monitoring and Assessment Center (FRMAC) for assistance. The FRMAC is a federal interagency group formed specifically to manage and coordinate the vast resources of many federal agencies in case of a major radiological event. (FRMAC was organized as a direct result of the lessons learned from the Three Mile Island experience.)

The U.S. Nuclear Regulatory Commission (NRC) will provide technical advice, assistance with communications, and a radiological assessment team if requested by the principal state or local responder. While, the NRC has the principal federal responsibility for regulating commercial nuclear power and for those radioactive materials licensed by the NRC, the NRC is not a primary responder nor primary resource for radiological assessment of transportation accidents. In case of a major accident where the services of NRC personnel were required, it would be managed and coordinated through the FRMAC.

7.8 FEMP

As shipper of the material leaving the FEMP, FERMCO is required by DOT regulations (49 CFR 172.604) to provide a 24-hour emergency response telephone number on all shipping papers, to have information available regarding the nature of material being transported, and to have back-up personnel available to support the railroad at the accident scene. In addition, DOE Order 5500.3A requires the FEMP to perform, prior to shipment, a hazard assessment analyzing the full spectrum of transportation accident scenarios. The FEMP's emergency plan will be revised to meet these requirements before initiation of rail shipments. Its emergency phone number (513 648-4444) is answered by the Fernald Communications Center, which is staffed 24 hours per day, in the event of a

transportation incident. The FEMP's Emergency Operations Center (EOC) is activated, if determined to be appropriate, to provide information and technical/communications personnel to the scene of the accident as required. The shipment-specific technical information may include source terms, hazard and consequence assessment, health and safety impacts, and recommended protective actions. The FEMP personnel and the DOE would participate in an advisory function in the mitigation of accident conditions and any subsequent cleanup required. The DOE-FN has the authority to activate the DOE regional Radiological Response Team to provide requested assist at the accident scene. The FEMP, as shipper shares responsibility with the railroad for coordinating, arranging, and ensuring cleanup and site restoration of the accident site involving FEMP waste. (FERMCO 1995a) In revising the existing FEMP Transportation Emergency Plan to include rail accidents, the FEMP will coordinate revisions with the railroads.

FEMP emergency preparedness procedures require a transportation hazard assessment before off-site shipments. The assessment will examine various accident scenarios and analyze the resulting potential health impacts to workers and members of the public. A result of the analysis is to recommend measures to mitigate the consequences of the accident and/or reduce the probability of accidents. Another benefit of this hazard assessment is that documentation of the hazards involved is on file and readily available to the FEMP emergency personnel to relay timely and critical information to the accident scene. Hazard assessments, performed in accordance with DOE Orders 5481.1B, 5630.11 and 5500.3A, provide the technical basis for emergency management programs.

The FEMP Transportation Emergency Plan specifies that Butler and Hamilton Counties, the State of Ohio, the DOE-HQ EOC, and the DOE-FN Duty Officer must be notified within 15 minutes of declaring an on-site or near-site emergency. When the EOC is operational, responsibility for assuring proper notifications are made is transferred to the Deputy Emergency Director and the response management group in the EOC. The response management group is lead by the Deputy Emergency Director, who may assign specific notification responsibilities to the members of the support group. Whenever a categorization/classification level is escalated or de-escalated, all parties originally notified must be re-notified. The local communities would mobilize their emergency response personnel based on these notifications. In the event of a distant transportation accident, the primary responsibility of the FEMP is to provide specific technical information regarding the contents of the shipment and the associated worker and public hazards pertaining to its clean-up.

On July 18, 1995, the FEMP took a significant step toward honoring the DOE commitment with respect to emergency planning, training, and assistance the local communities. The FEMP awarded a $1 million contract to the International Association Fire Fighters (IAFF) for its assistance as experts in the field of "Hazardous Material Emergency Response Training." The scope of work entails development of a custom-tailored hazardous material (including radioactive materials) emergency response training program, specifically based on the hazardous materials from the FEMP (including OU1 waste), Mound, and West Valley. The program is directed toward first responders located near these DOE facilities and

along the transportation routes to be traveled by their waste shipments. This two-year contract involves development of a fully accredited Hazardous Material Emergency Response Training Program, including development of site-specific lesson plans, student work books, reference manuals, audio-visual teaching aids, tests and answer keys. This training program will include consideration of OU1's shipping campaign. The IAFF will conduct "Train the Trainer" training sessions, where the trainees learn to become the trainers for future courses. (FERMCO 1995c)

7.9 Incident Scenario

The scenario of how the emergency preparedness organizations would respond to a major transportation incident (*e.g.*, railcar derailment) is outlined below. Note that, due to the nature of OU1's waste material (it is neither explosive nor flammable) and the isolation from other hazardous substances afforded by the unit train concept, a railcar derailment (and loss of contents) would not initiate an immediate "acute" threat (*i.e.*, fire or explosion) resulting from the OU1 material, itself. The OU1 material is classified as Low Specific Activity material, which is the least hazardous classification for radioactive materials, *i.e.*, a minimal hazard. Thus, containment and cleanup operations could begin immediately as personnel and equipment arrive on the scene.

7.9.1 Evaluation and Notification

The crew's first indication of a major non-collision incident would be activation of the automatic air brakes. The crew's first step is immediate radio notification of the railroad dispatcher, so that oncoming trains are re-routed or stopped. Then, the crew's responsibilities are to walk the length of the train, conduct an inspection (cognizant of their own safety), and notify their dispatcher. This second notification would note what cars are involved using the train Consist. At the end of this process, the railroad's Operations Center and its Hazardous Materials Department will be provided the following information:

1) Exact location of incident

2) Time incident occurred

3) Car numbers and types

4) Commodities involved

5) Status of cars (loaded/empty)

6) Disposition of cars, including damage to car, evidence of leakage (*e.g.*, spill on car or ground), location of leakage (*e.g.*, bottom, dome), and estimate rate of leakage (*e.g.* one pound per minute, car only leaks when moved, *etc.*)

7) Environmental concerns, such as threatened waterways, culverts, drainage ditches

8) Prevailing weather conditions (rain, hail, wind direct and speed, etc.)

9) Public exposure potential (nearest habitation)

10) Nature and extent of any injuries

11) Action taken (leaking car isolated, *etc.*)

12) Name, title, and call back number of the person making the report

When the first response personnel arrive at the scene, the train crew provides the first responders the Consist and shipping papers that identify suggested responses and precautions for the surrounding community. In addition, the responders will be in contact with the railroads' headquarters emergency response personnel and the shipper (FEMP).

The emergency notification sequence from the train crew to the FEMP is illustrated on Figure 7-3. The current emergency notification sequence through the FEMP emergency preparedness organization to the local stakeholders and public is shown on Figure 7-5. The typical sequence of notification within the railroad is: Dispatcher, Division Chief Dispatcher, railroad Operations Center, local railroad office (trainmaster and roadmaster), railroad emergency response, local and county, and state officials and other federal emergency organizations such as the National Response Center, the National Transportation Safety Board and the Federal Railroad Administration. The determination of the appropriate local/county authority to notify would be based on the location of the nearest track milepost to the accident scene. The Division Chief Dispatcher's Office maintains a comprehensive list of agencies and 24-hour telephone numbers for each community within the Division's geographical area of responsibility. A parallel notification would be provided to the Fernald Communications Center, which, in turn, would notify designated DOE-FN, DOE-HQ, and FEMP personnel.

The railroads would expect the availability of a representative of FEMP management (FERMCO and/or the DOE) and a FEMP emergency response professional as on-scene advisor to the railroads' cleanup contractor(s) in performing the remediation. The FEMP is preparing plans to provide FERMCO and DOE representatives at off-site incidents.

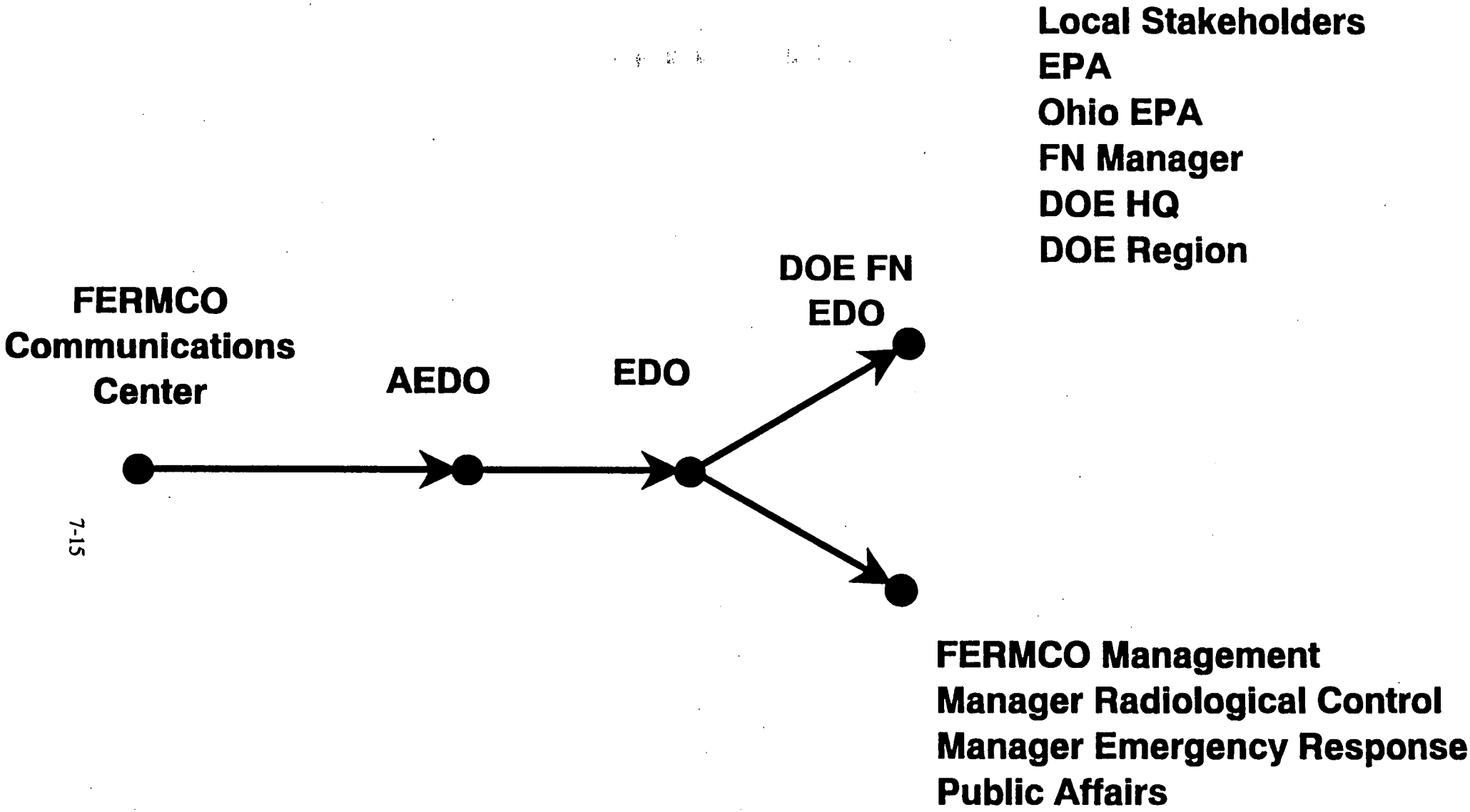

Figure 7-5 - Emergency Notification (Pathway Within the FEMP)

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7.9.2 Overview

The DOT *1993 Emergency Response Guidebook*, Guide 62, provides the appropriate actions by firefighters, police, and other emergency services personnel who may be the first responders to a transportation accident involving LSA material (See Figure 7-6). The primary concern of the first responder arriving at the site of a railroad accident is safety of those persons involved. The following immediate actions at an accident would be undertaken if necessary and safe:

1) Rescue the injured
2) Provide initial medical attention
3) Evacuate threatened personnel
4) Secure the perimeter to prevent unauthorized access
5) Set up an incident command post
6) Extinguish fires
7) Take steps to limit the spread of contamination without waiting for a radiological survey
8) Promptly provide additional reports to other agencies involved

Under the direction of the on-scene commander, he would coordinate the activities of involved local, state and federal agencies to evaluate, monitor, control and administratively stabilize the situation. The radiological assessment group(s) would survey the accident scene and would delineate the extent of the contamination. The On-Scene Commander will determine the need to take protective action by the public, but it is not expected due to the inherently low hazardous nature of the OU1 material. Then, the railroad's cleanup contractor and railroad emergency response personnel, with advice from the DOE and FEMP personnel, will commence to contain and remove the waste material and complete cleanup of the accident site and the affected environment. The need for subsequent monitoring and remediation will be determined by the appropriate agencies.

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POTENTIAL HAZARDS

HEALTH HAZARDS

Radiation presents minimal risk to lives of persons during transportation accidents.

Low radiation hazard when material is inside container. If material is released from package or bulk container, hazard will vary from little to moderate, depending on the type and amount of radioactivity,the kind of material it is in, and/or the surface it is on.

Full-load shipments and packages often do not have "RADIOACTIVE" labels.

Occasionally, packages may have a "RADIOACTIVE" label and a second hazard label; usually the second hazard is greater than the radiation hazard.

Some radioactive materials cannot be detected by commonly available instruments.

Spilled radioactive materials usually will be visible if packaging fails.

Runoff from control of cargo fire may cause low-level pollution.

FIRE OR EXPLOSION

Some of these materials may burn, but most do not ignite readily.

Radioactivity does not change flammability or other properties of the materials.

EMERGENCY ACTION

Priority response actions may be performed before taking radiation measurements.

Priorities are life saving, control of fire and other hazards, and first aid.

Isolate hazard area and deny entry. Notify Radiation Authority of accident conditions.

Keep unnecessary people at least 150 feet upwind of spill; greater distances may be necessary for people downwind, or if advised by Radiation Authority.

Uninjured persons or equipment with suspected contamination should be detained or isolated; delay cleanup until instructions are received from Radiation Authority.

Positive pressure self-contained breathing apparatus (SCBA) and structural firefighters' protective clothing will provide adequate protection.

CALL EMERGENCY Response Telephone Number on Shipping Paper first. If Shipping Paper not available or no answer, CALL CHEMTREC AT 1-800-424-9300.

If water pollution occurs, notify the appropriate authorities.

FIRE

Do not move damaged packages; move undamaged packages out of fire zone.

Small Fires: Dry chemical, CO_2, water spray or regular foam.

Large Fires: Water spray, fog or regular foam.

SPILL OR LEAK

Do not touch damaged containers or spilled material.

Small Liquid Spills: Cover with sand, earth or other noncombustible absorbent material.

Dike to collect large liquid spills or cargo fire control water.

Cover powder spill with plastic sheet or tarp to minimize spreading.

FIRST AID

Use first aid treatment according to the nature of the injury.

If persons have contacted released material, use standard hazmat procedures for care of contaminated persons, for transport of the injured, and for notifications to authorities.

Figure 7-6 - Initial Emergency Response Actions for LSA Material

SECTION 8

PRE-SHIPMENT NOTIFICATION

This section addresses the federal, FEMP, and state pre-shipment notification requirements.

8.1 Requirements

Under DOT regulations, LLRW, such as the OU1 remediation wastes, are regulated and shipped as hazardous materials. Packaging and shipment of radioactive wastes is also regulated by the NRC. These federal agencies do not require prior notification of intent to ship LLRW. For shipments to the RPCDF, the states of Ohio, Utah, and transited states do not require prior notification and there are no known corresponding local requirements.

The DOT and the NRC, through their rule making process and related studies, have determined what prenotification (including information, documentation and certification) requirements are necessary for the safe transportation of radioactive materials. These agencies have determined prenotification to affected states is only required for the transport of radioactive materials shipped in highway route controlled quantities, such as spent nuclear fuel and high level radioactive waste (10 CFR 71.97; 49 CFR 173.22). Prior notification is not required for LLRW. State and local provisions requiring prenotification, which are inconsistent with federal regulations, have been determined to be incompatible with the national need for uniform transport regulations; consequently, these state and local regulations are preempted (50 FR 20872; 52 FR 13000; 55 FR 36736).

DOE Order 1540.1A, "Materials Transportation and Traffic Management," requires that a shipment plan be submitted to the DOE-HQ (EM-561) for all shipping campaigns 45 days in advance of such shipment.

8.2 FEMP Initiatives

Currently, the FEMP does not provide advance notification of specific truck shipments to stakeholders. However, reports that address aggregate projected and completed shipments are prepared and distributed to stakeholders. Recognizing the interest of Fernald stakeholders in rail transportation issues, the FEMP will present plans prior to shipment for waste shipment by rail to interested members of the public or interested stakeholders. These plans will include the following information:

1) Time frames over which waste shipment will occur
2) The number of shipments anticipated
3) Quantities and types of waste planned

The FEMP intends to continue to work with interested stakeholders. Public information sessions will be held to address concerns regarding shipment and staging of these wastes prior to transport. Feedback will be incorporated in the development of detailed transportation plans. Any public notification given for rail shipments leaving the FEMP would be coordinated with the rail carrier.

The FEMP will contact representatives from Ohio, Utah, Nevada, and transited states, prior to the first waste shipment, to brief them on overall shipment plans. This information will allow states to prepare, as necessary, for any potential emergency response activities involving FEMP wastes and ensure that potential first responders are aware of the transport of these wastes.

8.3 States

OU1 wastes, *en route* from Ohio to disposal sites in Nevada or Utah, will transit a number of states that have authority to regulate the following:

1) Certain safety aspects of transportation (*e.g.*, vehicle weight on certain state roadways).

2) Transportation of radioactive materials within their borders as an additional level of regulation without preempting federal regulations or interfere with interstate commerce. Most state requirements apply to truck shipments of high level and route-restricted quantities of radioactive materials. However, certain states address low-level radioactive materials.

The following is the current status of pre-notification requirements for truck and rail shipments.

8.3.1 Colorado

Notification is not required nor requested by Colorado for rail shipment of LLRW. A hazardous materials permit is required for placarded loads transported by truck.

8.3.2 Illinois

Notification is not required nor requested by Illinois.

8.3.3 Indiana

Notification is not required nor requested by Indiana.

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8.3.4 Kansas

Notification is not required nor requested by Kansas.

8.3.5 Missouri

Notification is not required nor requested by Missouri.

8.3.6 Nebraska

The state of Nebraska requests a courtesy notification to the Hazardous Materials Coordinator, Nebraska State Patrol, before truck shipments enter the state.

8.3.7 Nevada

Nevada requires a Hazardous Material Permit from the Nevada Highway Patrol for truck shipments. Nevada also requires that vehicles transporting radioactive materials be inspected. A minimum of 4 hours and a maximum of 72 hours advance notification is required before entering the State with radioactive materials. DOE's subcontractor at the NTS must also be notified of incoming shipments prior to arrival.

However, Nevada's rules governing radioactive waste transportation are under revision; this issue must be reviewed before shipment of LLRW to the NTS.

Notification is not required nor requested for shipments of LLRW by rail.

8.3.8 Ohio

The State of Ohio requires highway transporters of radioactive waste to register with the Ohio Public Utilities Commission prior to transport.

8.3.9 Utah

Notification is not required nor requested by Utah.

8.3.10 Wyoming

Wyoming requires a permit to be obtained from the Wyoming Department of Transportation as well as the payment of an emergency response fee for shipment of radioactive materials by truck. There is no equivalent permit for rail.

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APPENDIX A

DOT REQUIREMENTS FOR SHIPMENT OF OU1 WASTE *via* RAIL

Fernald Environmental
FERMCO
Restoration Management Corporation

INTEROFFICE MEMORANDUM

To:	Bob Fellman, MS52-1	Date:	May 16, 1995
Location:	Fernald	Reference:	N/A
From:	Diane Zdelar-Bush, MS52-1	FERMCO #:	M:CRU1:95-0030
Location:	Fernald	Client:	DOE DE-AC24-92OR21972
Extension:	738-6288	Subject:	Department of Transportation Requirements For Shipment of OU1 Waste Via Rail

c: Connie Aragon, MS42
Wm. Benson, MS52-1
Ken Beyma, MS50
File Record Storage Copy 106.4.15
Elaine Blakely, MS52-1
Dave Gilbert, MS42
Terry Hagen, MS65-2
Mike Jannelli, MS52-1
Thurle Moss, MS52-1
Gerry Motl, MS50
Wm. Weddendorf, MS52-1

SUMMARY

Operable Unit 1 material complies with Department of Transportation (DOT) regulations such that fully loaded, lined, covered gondola cars may be used for transportation.

DISCUSSION

The selected remedy for Operable Unit I as presented in the Final Operable Unit 1 Record of Decision is excavation of the waste pit contents, waste processing and treatment by thermal drying, and off-site disposal at a permitted commercial disposal facility. The current operational scenario for off-site shipment includes packaging the dried waste into lined gondola cars (polyethylene-type bag liners) and the application of a hard cover to the gondolas.

Concerns related to transportation of OU1 material have been identified during preliminary design planning. One primary concern has been whether OU1 waste meets the DOT definition of low specific activity (LSA) material; this designation directly effects the type of packaging that may be used for transport and the permissible quantity of material per package. Packaging and quantity requirements must be defined prior to designing operational storage

and loading facilities on-site; and preparing for shipment off-site and off-loading.

The following has been prepared to identify the Department of Transportation requirements associated with shipment of OU1 material via rail. Steps 1 through 3 address the designation of OU1 material as low specific activity (LSA). The remaining items have been identified as items which must be considered during design and operation; however, items 1 through 3 must have concurrence prior to addressing items 4 through 10.

The Hazardous Materials Transportation Act (HMTA) and amendments are the major transportation related statutes affecting the DOE. Hazardous materials regulations are subdivided by function into four basic areas: (1) procedures and/or policies - 49 CFR 101, 106-7; (2) material designations - 49 CFR Part 172; (3) packaging requirements - 49 CFR 173, 178-180; and (4) operational rules - 49 CFR Parts 171, 173-7. Ten steps [Lion Technologies, Inc. Hazardous Materials Transportation: Mandates, Strategies, and Options, 1991] to consider for transporting hazardous materials in accordance with these requirements are shown below. Steps 1 through 3 address the LSA concern described above. Steps 4 through 9 identify additional requirements to consider during remedial design planning, and Step 10 discusses anticipated changes in future DOT requirements.

<u>KEY ITEMS: LSA ISSUES</u>

1. Classification - Is it a hazardous material? 49 CFR 171.8

   Radioactive materials (even if they are mixed wastes) are hazard class 7 as defined under 49 CFR 172.101. Likewise, OU1 materials are considered hazard class 7. (see 49 CFR 173.403 for definition of radioactive material)

2. Naming - 49 CFR 172.101 provides information on selecting a proper shipping name for the material. Part 172 lists and classifies those materials which the DOT has designated as hazardous materials for transportation. Part 172 also prescribes the requirements for shipping papers, package markings, labeling, and transport vehicle placarding applicable to the shipment and transportation of those

Fernald Environmental
FERMCO
Restoration Management Corporation

INTEROFFICE MEMORANDUM

hazardous materials.

The proper shipping name for OU1 material is "Radioactive material, low specific activity, n.o.s." or "Radioactive material, LSA, n.o.s.".

3. Packaging - 49 CFR 173, Subpart I provides requirements for packaging radioactive shipments; 49 CFR 178 Specifications for Packagings; and 49 CFR 179 Specifications for Tank Cars

The requirements for meeting the definition of LSA are provided in 49 CFR 173.403 (Attachment 1). Attachment 2 presents the calculations used to support the designation of OU1 material as LSA. Part of the LSA requirement is calculation of the "sum-of-the-factions"; that is, for each radionuclide present in the waste, the summation of all radionuclides divided by the LSA limit for each radionuclide (as defined in 49 CFR 173.403(n)) must be less than or equal to one. Attachment 2 includes the sum-of-the-fractions calculations for each waste pit using both current and proposed A2 values. (A2 values are given in 49 CFR 173.435. Proposed changes to DOT regulations include revisions to some of the promulgated A2 values) Based on the analyses presented in Attachment 2, all waste pit material meets the sum-of-the-fractions requirement both for current and proposed A2 values.

Once a material has been designated LSA, 49 CFR 173.425 identifies three potential methods for containerization: 1) DOT Type 7A containers; 2) strong tight containers; or 3) bulk unpackaged. The requirements for each of these methods are included as Attachment 4. A lined gondola car with a hard cover, the currently planned shipment mode for OU1 waste material, is consistent with the strong tight container option defined in 49 CFR 173.425(b) and the Special Handling Requirements for Class 7 (radioactive) materials in 49 CFR 174.700.

ADDITIONAL STEPS TO CONSIDER

4. Marking and Labeling - 49 CFR 172.300/.400 - Marking requirements, general markings, additional markings, hazard class labels, additional labeling

5. Preparing Shipping Papers - 49 CFR 172.200 - General entries, basic

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		DOT descriptions, additional descriptions, certifications
6.	Providing and Using Placards -	49 CFR 172.500 - Applicability of Placarding Requirements
7.	Loading, Moving and Unloading -	49 CFR 174-177, Carriers (Part 174 - Rail) - Hazardous materials carriers' rules

Part 174 identifies the general operating requirements for shipment of hazardous materials via rail. These operating requirements include handling and loading procedures, placarding, inspections, etc. Part 174, Subpart K specifically outlines requirements for shipment of radioactive materials via rail.

8.	Incidents & Emergencies -	49 CFR 172.600, 49 CFR 171.15-.16, 40 CFR 302 - Emergency Preparedness, DOT written reports, DOT emergency reports, EPA reports
9.	Reliefs and Exemptions -	49 CFR 106-107 - Limited quantity and rule exclusions, applications for and party to exemption

<u>REVISIONS TO DOT REGULATIONS</u>

10. Keeping up With Changes.

Discussions with DOT suggest that to maintain compliance with transportation regulations, current and future, DOT and International Atomic Energy Agency (IAEA) standards should always be considered when planning for radioactive material shipments. A draft revision of the IAEA regulations has been published for review and comment; and DOT revisions are anticipated in the Spring of 1996.

DLZ:rjd:djw
Attachments

ATTACHMENT 1

(n) Low specific activity material (LSA) means any of the following:

(1) Uranium or thorium ores and physical or chemical concentrates of those ores.

(2) Unirradiated natural or depleted uranium or unirradiated natural thorium.

(3) Tritium oxide in aqueous solutions provided the concentration does not exceed 5.0 millicuries per milliter.

(4) Material in which the radioactivity is essentially uniformly distributed and in which the estimated average concentration of contents does not exceed:
[48 FR 31214, July 7, 1983, effective July 1, 1983]

(i) 0.0001 millicurie per gram of radionuclides for which the A↓2 quantity is not more than .05 curie;

(ii) 0.005 millicurie per gram of radionuclides for which the A↓2 quantity is more than .05 curie, but not more than 1 curie; or

(iii) 0.3 millicurie per gram of radionuclides for which the A↓2 quantity is more than 1 curie.

(5) Objects of nonradioactive material externally contaminated with radioactive material, provided that the radioactive material is not readily dispersible and the surface contamination, when averaged over an area of 1 square meter, does not exceed 0.0001 millicurie (220,000 disintegrations per minute) per square centimeter of radionuclides for which the A↓2 quantity is not more than .05 curie, or 0.001 millicurie (2,200,000 disintegrations per minute) per square centimeter for other radionuclides.
[48 FR 13431, March 31, 1983]

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ATTACHMENT 2

WASTE PIT 1	Step 1	Step 1	Step 2	Step 3	Step 4
ISOTOPE	A2 Value	LSA Limit (mCi/g)	Max Hit * (pCi/g)	Max Hit (mCi/g)	Sum of Fractions
Cesium-137	10	0.3	1.1	0.0000000011	0.0000000037
Neptunium-237	0.005	0.0001	0	0	0
Plutonium-238	0.003	0.0001	0	0	0
Plutonium-239/40	0.002	0.0001	0	0	0
Radium-226	0.05	0.0001	100	0.0000001	0.001
Radium-228	0.05	0.0001	41	0.000000041	0.00041
Ruthenium-106	7	0.3	0	0	0
Strontium-90	0.4	0.005	7.7	0.0000000077	0.00000154
Technetium-99	25	0.3	15	0.000000015	0.00000005
Thorium-228	0.008	0.0001	790	0.00000079	0.0079
Thorium-230	0.003	0.0001	5500	0.0000055	0.055
Thorium-232	unlimited	0.3	490	0.00000049	0.0000016333
Uranium-234	0.1	0.005	1200	0.0000012	0.00024
Uranium-235	0.2	0.005	260	0.00000026	0.000052
Uranium-238	unlimited	0.3	16000	0.000016	0.0000533333
					0.0646585603 Step 5

WASTE PIT 1	Step 1	Step 1	Step 2	Step 3	Step 4
ISOTOPE	Proposed A2 Value	LSA Limit (mCi/g)	Max Hit * (pCi/g)	Max Hit (mCi/g)	Sum of Fractions
Cesium-137	13.5	0.3	1.1	0.0000000011	0.0000000037
Neptunium-237	13.5	0.3	0	0	0
Plutonium-238	0.0054	0.0001	0	0	0
Plutonium-239/40	0.0054	0.0001	0	0	0
Radium-226	0.54	0.005	100	0.0000001	0.00002
Radium-228	1.08	0.3	41	0.000000041	0.0000001367
Ruthenium-106	5.4	0.3	0	0	0
Strontium-90	2.7	0.3	7.7	0.0000000077	0.0000000257
Technetium-99	24.3	0.3	15	0.000000015	0.00000005
Thorium-228	0.0108	0.0001	790	0.00000079	0.0079
Thorium-230	0.0054	0.0001	5500	0.0000055	0.055
Thorium-232	unlimited	0.3	490	0.00000049	0.0000016333
Uranium-234	0.027	0.0001	1200	0.0000012	0.012
Uranium-235	0.027	0.0001	260	0.00000026	0.0026
Uranium-238	unlimited	0.3	16000	0.000016	0.0000533333
					0.0775751827 Step 5

* U.S. Department of Energy, 1994c, "Remedial Investigation Report for Operable Unit 1," FEMP, DOE, FFO, Fernald, Ohio, Tables 4-1.1 to 4-1.8.

Step 1: Determine the A2 value for each radionuclide (49 CFR 173.435)
Determine the LSA limit for each radionuclide (49 CFR 173.403(n)(4))
Step 2/3: Calculate net weight in grams; calculate mCi/gram
Step 4: Perform "Sum of the Fractions" by dividing mCi/g by LSA limit for each radionuclide
Step 5: Add all answers from Step 4;
If less than or equal to 1.0 == LSA
If greater than 1.0, == NOT LSA

WASTE PIT 2	Step 1	Step 1	Step 2	Step 3	Step 4
ISOTOPE	A2 Value	LSA Limit (mCi/g)	Max Hit * (pCi/g)	Max Hit (mCi/g)	Sum of Fractions
Cesium-137	10	0.3	3.6	0.0000000036	0.000000012
Neptunium-237	0.005	0.0001	0	0	0
Plutonium-238	0.003	0.0001	0.1	1.000000E-10	0.000001
Plutonium-239/40	0.002	0.0001	0.6	0.0000000006	0.000006
Radium-226	0.05	0.0001	950	0.00000095	0.0095
Radium-228	0.05	0.0001	440	0.00000044	0.0044
Ruthenium-106	7	0.3	11	0.000000011	0.0000000367
Strontium-90	0.4	0.005	4	0.000000004	0.0000008
Technetium-99	25	0.3	620	0.00000062	0.0000020667
Thorium-228	0.008	0.0001	700	0.0000007	0.007
Thorium-230	0.003	0.0001	1800	0.0000018	0.018
Thorium-232	unlimited	0.3	340	0.00000034	0.0000011333
Uranium-234	0.1	0.005	18000	0.000018	0.0036
Uranium-235	0.2	0.005	8800	0.0000088	0.00176
Uranium-238	unlimited	0.3	18000	0.000018	0.00006
					0.0443310487 Step 5

WASTE PIT 2	Step 1	Step 1	Step 2	Step 3	Step 4
ISOTOPE	Proposed A2 Value	LSA Limit (mCi/g)	Max Hit * (pCi/g)	Max Hit (mCi/g)	Sum of Fractions
Cesium-137	13.5	0.3	3.6	0.0000000036	0.000000012
Neptunium-237	13.5	0.3	0	0	0
Plutonium-238	0.0054	0.0001	0.1	1.000000E-10	0.000001
Plutonium-239/40	0.0054	0.0001	0.6	0.0000000006	0.000006
Radium-226	0.54	0.005	950	0.00000095	0.00019
Radium-228	1.08	0.3	440	0.00000044	0.0000014667
Ruthenium-106	5.4	0.3	11	0.000000011	0.0000000367
Strontium-90	2.7	0.3	4	0.000000004	0.0000000133
Technetium-99	24.3	0.3	620	0.00000062	0.0000020667
Thorium-228	0.0108	0.0001	700	0.0000007	0.007
Thorium-230	0.0054	0.0001	1800	0.0000018	0.018
Thorium-232	unlimited	0.3	340	0.00000034	0.0000011333
Uranium-234	0.027	0.0001	18000	0.000018	0.18
Uranium-235	0.027	0.0001	8800	0.0000088	0.088
Uranium-238	unlimited	0.3	18000	0.000018	0.00006
					0.2932617287 Step 5

* U.S. Department of Energy, 1994c, "Remedial Investigation Report for Operable Unit 1," FEMP, DOE, FFO, Fernald, Ohio, Tables 4-1.1 to 4-1.8.

Step 1: Determine the A2 value for each radionuclide (49 CFR 173.435)
Determine the LSA limit for each radionuclide (49 CFR 173.403(n)(4))
Step 2/3: Calculate net weight in grams; calculate mCi/gram
Step 4: Perform "Sum of the Fractions" by dividing mCi/g by LSA limit for each radionuclide
Step 5: Add all answers from Step 4;
If less than or equal to 1.0 == LSA
If greater than 1.0, == NOT LSA

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WASTE PIT 3	Step 1	Step 1	Step 2	Step 3	Step 4
ISOTOPE	A2 Value	LSA Limit (mCi/g)	Max Hit* (pCi/g)	Max Hit (mCi/g)	Sum of Fractions
Cesium-137	10	0.3	0	0	0
Neptunium-237	0.005	0.0001	2.1	0.0000000021	0.000021
Plutonium-238	0.003	0.0001	0.98	0.000000001	0.0000098
Plutonium-239/40	0.002	0.0001	14	0.000000014	0.00014
Radium-226	0.05	0.0001	450	0.00000045	0.0045
Radium-228	0.05	0.0001	240	0.00000024	0.0024
Ruthenium-106	7	0.3	0	0	0
Strontium-90	0.4	0.005	5.2	0.0000000052	0.00000104
Technetium-99	25	0.3	1100	0.0000011	0.0000036667
Thorium-228	0.008	0.0001	820	0.00000082	0.0082
Thorium-230	0.003	0.0001	12000	0.000012	0.12
Thorium-232	unlimited	0.3	400	0.0000004	0.0000013333
Uranium-234	0.1	0.005	990	0.00000099	0.000198
Uranium-235	0.2	0.005	52	0.000000052	0.0000104
Uranium-238	unlimited	0.3	1700	0.0000017	0.0000056667
					0.1354909067 Step 5

WASTE PIT 3	Step 1	Step 1	Step 2	Step 3	Step 4
ISOTOPE	Proposed A2 Value	LSA Limit (mCi/g)	Max Hit* (pCi/g)	Max Hit (mCi/g)	Sum of Fractions
Cesium-137	13.5	0.3	0	0	0
Neptunium-237	13.5	0.3	2.1	0.0000000021	0.000000007
Plutonium-238	0.0054	0.0001	0.98	0.000000001	0.0000098
Plutonium-239/40	0.0054	0.0001	14	0.000000014	0.00014
Radium-226	0.54	0.005	450	0.00000045	0.00009
Radium-228	1.08	0.3	240	0.00000024	0.0000008
Ruthenium-106	5.4	0.3	0	0	0
Strontium-90	2.7	0.3	5.2	0.0000000052	0.0000000173
Technetium-99	24.3	0.3	1100	0.0000011	0.0000036667
Thorium-228	0.0108	0.0001	820	0.00000082	0.0082
Thorium-230	0.0054	0.0001	12000	0.000012	0.12
Thorium-232	unlimited	0.3	400	0.0000004	0.0000013333
Uranium-234	0.027	0.0001	990	0.00000099	0.0099
Uranium-235	0.027	0.0001	52	0.000000052	0.00052
Uranium-238	unlimited	0.3	1700	0.0000017	0.0000056667
					0.138871291 Step 5

* U.S. Department of Energy, 1994c, "Remedial Investigation Report for Operable Unit 1," FEMP, DOE, FFO, Fernald, Ohio, Tables 4-1.1 to 4-1.8.

Step 1: Determine the A2 value for each radionuclide (49 CFR 173.435)
Determine the LSA limit for each radionuclide (49 CFR 173.403(n)(4))
Step 2/3: Calculate net weight in grams; calculate mCi/gram
Step 4: Perform "Sum of the Fractions" by dividing mCi/g by LSA limit for each radionuclide
Step 5: Add all answers from Step 4;
If less than or equal to 1.0 == LSA
If greater than 1.0, == NOT LSA

WASTE PIT 4	Step 1	Step 1	Step 2	Step 3	Step 4
ISOTOPE	A2 Value	LSA Limit (mCi/g)	Max Hit * (pCi/g)	Max Hit (mCi/g)	Sum of Fractions
Cesium-137	10	0.3	0	0	0
Neptunium-237	0.005	0.0001	0.4	0.0000000004	0.000004
Plutonium-238	0.003	0.0001	0.5	0.0000000005	0.000005
Plutonium-239/40	0.002	0.0001	0.4	0.0000000004	0.000004
Radium-226	0.05	0.0001	50	0.00000005	0.0005
Radium-228	0.05	0.0001	140	0.00000014	0.0014
Ruthenium-106	7	0.3	0	0	0
Strontium-90	0.4	0.005	140	0.00000014	0.000028
Technetium-99	25	0.3	230	0.00000023	0.0000007667
Thorium-228	0.008	0.0001	2500	0.0000025	0.025
Thorium-230	0.003	0.0001	1800	0.0000018	0.018
Thorium-232	unlimited	0.3	840	0.00000084	0.0000028
Uranium-234	0.1	0.005	4100	0.0000041	0.00082
Uranium-235	0.2	0.005	930	0.00000093	0.000186
Uranium-238	unlimited	0.3	42000	0.000042	0.00014
					0.0460905667 Step 5

WASTE PIT 4	Step 1	Step 1	Step 2	Step 3	Step 4
ISOTOPE	Proposed A2 Value	LSA Limit (mCi/g)	Max Hit * (pCi/g)	Max Hit (mCi/g)	Sum of Fractions
Cesium-137	13.5	0.3	0	0	0
Neptunium-237	13.5	0.3	0.4	0.0000000004	0.0000000013
Plutonium-238	0.0054	0.0001	0.5	0.0000000005	0.000005
Plutonium-239/40	0.0054	0.0001	0.4	0.0000000004	0.000004
Radium-226	0.54	0.005	50	0.00000005	0.00001
Radium-228	1.08	0.3	140	0.00000014	0.0000004667
Ruthenium-106	5.4	0.3	0	0	0
Strontium-90	2.7	0.3	140	0.00000014	0.0000004667
Technetium-99	24.3	0.3	230	0.00000023	0.0000007667
Thorium-228	0.0108	0.0001	2500	0.0000025	0.025
Thorium-230	0.0054	0.0001	1800	0.0000018	0.018
Thorium-232	unlimited	0.3	840	0.00000084	0.0000028
Uranium-234	0.027	0.0001	4100	0.0000041	0.041
Uranium-235	0.027	0.0001	930	0.00000093	0.0093
Uranium-238	unlimited	0.3	42000	0.000042	0.00014
					0.0934635013 Step 5

* U.S. Department of Energy, 1994c, "Remedial Investigation Report for Operable Unit 1," FEMP, DOE, FFO, Fernald, Ohio, Tables 4-1.1 to 4-1.8.

Step 1: Determine the A2 value for each radionuclide (49 CFR 173.435)
Determine the LSA limit for each radionuclide (49 CFR 173.403(n)(4))
Step 2/3: Calculate net weight in grams; calculate mCi/gram
Step 4: Perform "Sum of the Fractions" by dividing mCi/g by LSA limit for each radionuclide
Step 5: Add all answers from Step 4;
If less than or equal to 1.0 == LSA
If greater than 1.0, == NOT LSA

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WASTE PIT 5	Step 1	Step 1	Step 2	Step 3	Step 4
ISOTOPE	A2 Value	LSA Limit (mCi/g)	Max Hit * (pCi/g)	Max Hit (mCi/g)	Sum of Fractions
Cesium-137	10	0.3	78	0.000000078	0.00000026
Neptunium-237	0.005	0.0001	46	0.000000046	0.00046
Plutonium-238	0.003	0.0001	4.4	0.0000000044	0.000044
Plutonium-239/40	0.002	0.0001	13	0.000000013	0.00013
Radium-226	0.05	0.0001	150	0.00000015	0.0015
Radium-228	0.05	0.0001	39	0.000000039	0.00039
Ruthenium-106	7	0.3	3.3	0.0000000033	0.000000011
Strontium-90	0.4	0.005	31	0.000000031	0.0000062
Technetium-99	25	0.3	3000	0.000003	0.00001
Thorium-228	0.008	0.0001	44	0.000000044	0.00044
Thorium-230	0.003	0.0001	8500	0.0000085	0.085
Thorium-232	unlimited	0.3	55	0.000000055	0.0000001833
Uranium-234	0.1	0.005	1300	0.0000013	0.00026
Uranium-235	0.2	0.005	79	0.000000079	0.0000158
Uranium-238	unlimited	0.3	1200	0.0000012	0.000004
					0.0832604543 Step 5

WASTE PIT 5	Step 1	Step 1	Step 2	Step 3	Step 4
ISOTOPE	Proposed A2 Value	LSA Limit (mCi/g)	Max Hit * (pCi/g)	Max Hit (mCi/g)	Sum of Fractions
Cesium-137	13.5	0.3	78	0.000000078	0.00000026
Neptunium-237	13.5	0.3	46	0.000000046	0.0000001533
Plutonium-238	0.0054	0.0001	4.4	0.0000000044	0.000044
Plutonium-239/40	0.0054	0.0001	13	0.000000013	0.00013
Radium-226	0.54	0.005	150	0.00000015	0.00003
Radium-228	1.08	0.3	39	0.000000039	0.00000013
Ruthenium-106	5.4	0.3	3.3	0.0000000033	0.000000011
Strontium-90	2.7	0.3	31	0.000000031	0.0000001033
Technetium-99	24.3	0.3	3000	0.000003	0.00001
Thorium-228	0.0108	0.0001	44	0.000000044	0.00044
Thorium-230	0.0054	0.0001	8500	0.0000085	0.085
Thorium-232	unlimited	0.3	55	0.000000055	0.0000001833
Uranium-234	0.027	0.0001	1300	0.0000013	0.013
Uranium-235	0.027	0.0001	79	0.000000079	0.00079
Uranium-238	unlimited	0.3	1200	0.0000012	0.000004
					0.099448841 Step 5

* U.S. Department of Energy, 1994c, "Remedial Investigation Report for Operable Unit 1," FEMP, DOE, FFO, Fernald, Ohio, Tables 4-1.1 to 4-1.8.

Step 1: Determine the A2 value for each radionuclide (49 CFR 173.435)
Determine the LSA limit for each radionuclide (49 CFR 173.403(n)(4))
Step 2/3: Calculate net weight in grams; calculate mCi/gram
Step 4: Perform "Sum of the Fractions" by dividing mCi/g by LSA limit for each radionuclide
Step 5: Add all answers from Step 4;
If less than or equal to 1.0 == LSA
If greater than 1.0, == NOT LSA

WASTE PIT 6	Step 1	Step 1	Step 2	Step 3	Step 4
ISOTOPE	A2 Value	LSA Limit (mCi/g)	Max Hit * (pCi/g)	Max Hit (mCi/g)	Sum of Fractions
Cesium-137	10	0.3	31	0.000000031	0.0000001033
Neptunium-237	0.005	0.0001	3.6	0.0000000036	0.000036
Plutonium-238	0.003	0.0001	1.4	0.0000000014	0.000014
Plutonium-239/40	0.002	0.0001	15	0.000000015	0.00015
Radium-226	0.05	0.0001	4.9	0.0000000049	0.000049
Radium-228	0.05	0.0001	190	0.00000019	0.0019
Ruthenium-106	7	0.3	0	0	0
Strontium-90	0.4	0.005	5.1	0.0000000051	0.00000102
Technetium-99	25	0.3	160	0.00000016	0.0000005333
Thorium-228	0.008	0.0001	1.7	0.0000000017	0.000017
Thorium-230	0.003	0.0001	62	0.000000062	0.00062
Thorium-232	unlimited	0.3	1.2	0.0000000012	0.000000004
Uranium-234	0.1	0.005	5300	0.0000053	0.00106
Uranium-235	0.2	0.005	1800	0.0000018	0.00036
Uranium-238	unlimited	0.3	29000	0.000029	0.0000966667
					0.0043043273 Step 5

WASTE PIT 6	Step 1	Step 1	Step 2	Step 3	Step 4
ISOTOPE	Proposed A2 Value	LSA Limit (mCi/g)	Max Hit * (pCi/g)	Max Hit (mCi/g)	Sum of Fractions
Cesium-137	13.5	0.3	31	0.000000031	0.0000001033
Neptunium-237	13.5	0.3	3.6	0.0000000036	0.000000012
Plutonium-238	0.0054	0.0001	1.4	0.0000000014	0.000014
Plutonium-239/40	0.0054	0.0001	15	0.000000015	0.00015
Radium-226	0.54	0.005	4.9	0.0000000049	0.00000098
Radium-228	1.08	0.3	190	0.00000019	0.0000006333
Ruthenium-106	5.4	0.3	0	0	0
Strontium-90	2.7	0.3	5.1	0.0000000051	0.000000017
Technetium-99	24.3	0.3	160	0.00000016	0.0000005333
Thorium-228	0.0108	0.0001	1.7	0.0000000017	0.000017
Thorium-230	0.0054	0.0001	62	0.000000062	0.00062
Thorium-232	unlimited	0.3	1.2	0.0000000012	0.000000004
Uranium-234	0.027	0.0001	5300	0.0000053	0.053
Uranium-235	0.027	0.0001	1800	0.0000018	0.018
Uranium-238	unlimited	0.3	29000	0.000029	0.0000966667
					0.0718999497 Step 5

* U.S. Department of Energy, 1994c, "Remedial Investigation Report for Operable Unit 1," FEMP, DOE, FFO, Fernald, Ohio, Tables 4-1.1 to 4-1.8.

Step 1: Determine the A2 value for each radionuclide (49 CFR 173.435)
Determine the LSA limit for each radionuclide (49 CFR 173.403(n)(4))
Step 2/3: Calculate net weight in grams; calculate mCi/gram
Step 4: Perform "Sum of the Fractions" by dividing mCi/g by LSA limit for each radionuclide
Step 5: Add all answers from Step 4;
If less than or equal to 1.0 == LSA
If greater than 1.0, == NOT LSA

Burn Pit	Step 1	Step 1	Step 2	Step 3	Step 4
ISOTOPE	A2 Value	LSA Limit (mCi/g)	Max Hit * (pCi/g)	Max Hit (mCi/g)	Sum of Fractions
Cesium-137	10	0.3	0	0	0
Neptunium-237	0.005	0.0001	0.6	0.0000000006	0.000006
Plutonium-238	0.003	0.0001	0.5	0.0000000005	0.000005
Plutonium-239/40	0.002	0.0001	0.4	0.0000000004	0.000004
Radium-226	0.05	0.0001	39	0.000000039	0.00039
Radium-228	0.05	0.0001	10	0.00000001	0.0001
Ruthenium-106	7	0.3	0	0	0
Strontium-90	0.4	0.005	0.5	0.0000000005	0.0000001
Technetium-99	25	0.3	64	0.000000064	0.0000002133
Thorium-228	0.008	0.0001	900	0.0000009	0.009
Thorium-230	0.003	0.0001	4500	0.0000045	0.045
Thorium-232	unlimited	0.3	410	0.00000041	0.0000013667
Uranium-234	0.1	0.005	1700	0.0000017	0.00034
Uranium-235	0.2	0.005	100	0.0000001	0.00002
Uranium-238	unlimited	0.3	2000	0.000002	0.0000066667
					0.0548733467 Step 5

Burn Pit	Step 1	Step 1	Step 2	Step 3	Step 4
ISOTOPE	Proposed A2 Value	LSA Limit (mCi/g)	Max Hit * (pCi/g)	Max Hit (mCi/g)	Sum of Fractions
Cesium-137	13.5	0.3	0	0	0
Neptunium-237	13.5	0.3	0.6	0.0000000006	0.000000002
Plutonium-238	0.0054	0.0001	0.5	0.0000000005	0.000005
Plutonium-239/40	0.0054	0.0001	0.4	0.0000000004	0.000004
Radium-226	0.54	0.005	39	0.000000039	0.0000078
Radium-228	1.08	0.3	10	0.00000001	0.0000000333
Ruthenium-106	5.4	0.3	0	0	0
Strontium-90	2.7	0.3	0.5	0.0000000005	0.0000000017
Technetium-99	24.3	0.3	64	0.000000064	0.0000002133
Thorium-228	0.0108	0.0001	900	0.0000009	0.009
Thorium-230	0.0054	0.0001	4500	0.0000045	0.045
Thorium-232	unlimited	0.3	410	0.00000041	0.0000013667
Uranium-234	0.027	0.0001	1700	0.0000017	0.017
Uranium-235	0.027	0.0001	100	0.0000001	0.001
Uranium-238	unlimited	0.3	2000	0.000002	0.0000066667
					0.0720250837 Step 5

* U.S. Department of Energy, 1994c, "Remedial Investigation Report for Operable Unit 1," FEMP, DOE, FFO, Fernald, Ohio, Tables 4-1.1 to 4-1.8.

Step 1: Determine the A2 value for each radionuclide (49 CFR 173.435)
Determine the LSA limit for each radionuclide (49 CFR 173.403(n)(4))
Step 2/3: Calculate net weight in grams; calculate mCi/gram
Step 4: Perform "Sum of the Fractions" by dividing mCi/g by LSA limit for each radionuclide
Step 5: Add all answers from Step 4;
If less than or equal to 1.0 == LSA
If greater than 1.0, == NOT LSA

Clearwell	Step 1	Step 1	Step 2	Step 3	Step 4
ISOTOPE	A2 Value	LSA Limit (mCi/g)	Max Hit * (pCi/g)	Max Hit (mCi/g)	Sum of Fractions
Cesium-137	10	0.3	450	0.00000045	0.0000015
Neptunium-237	0.005	0.0001	2.2	0.0000000022	0.000022
Plutonium-238	0.003	0.0001	0.49	0.0000000005	0.0000049
Plutonium-239/40	0.002	0.0001	0.54	0.0000000005	0.0000054
Radium-226	0.05	0.0001	170	0.00000017	0.0017
Radium-228	0.05	0.0001	26	0.000000026	0.00026
Ruthenium-106	7	0.3	3.1	0.0000000031	0.0000000103
Strontium-90	0.4	0.005	26	0.000000026	0.0000052
Technetium-99	25	0.3	700	0.0000007	0.0000023333
Thorium-228	0.008	0.0001	56	0.000000056	0.00056
Thorium-230	0.003	0.0001	5600	0.0000056	0.056
Thorium-232	unlimited	0.3	39	0.000000039	0.00000013
Uranium-234	0.1	0.005	1100	0.0000011	0.00022
Uranium-235	0.2	0.005	370	0.00000037	0.000074
Uranium-238	unlimited	0.3	1600	0.0000016	0.0000053333
					0.058860807 Step 5

Clearwell	Step 1	Step 1	Step 2	Step 3	Step 4
ISOTOPE	Proposed A2 Value	LSA Limit (mCi/g)	Max Hit * (pCi/g)	Max Hit (mCi/g)	Sum of Fractions
Cesium-137	13.5	0.3	450	0.00000045	0.0000015
Neptunium-237	13.5	0.3	2.2	0.0000000022	0.0000000073
Plutonium-238	0.0054	0.0001	0.49	0.0000000005	0.0000049
Plutonium-239/40	0.0054	0.0001	0.54	0.0000000005	0.0000054
Radium-226	0.54	0.005	170	0.00000017	0.000034
Radium-228	1.08	0.3	26	0.000000026	0.0000000867
Ruthenium-106	5.4	0.3	3.1	0.0000000031	0.0000000103
Strontium-90	2.7	0.3	26	0.000000026	0.0000000867
Technetium-99	24.3	0.3	700	0.0000007	0.0000023333
Thorium-228	0.0108	0.0001	56	0.000000056	0.00056
Thorium-230	0.0054	0.0001	5600	0.0000056	0.056
Thorium-232	unlimited	0.3	39	0.000000039	0.00000013
Uranium-234	0.027	0.0001	1100	0.0000011	0.011
Uranium-235	0.027	0.0001	370	0.00000037	0.0037
Uranium-238	unlimited	0.3	1600	0.0000016	0.0000053333
					0.0713137877 Step 5

* U.S. Department of Energy, 1994c, "Remedial Investigation Report for Operable Unit 1," FEMP, DOE, FFO, Fernald, Ohio, Tables 4-1.1 to 4-1.8.

Step 1: Determine the A2 value for each radionuclide (49 CFR 173.435)
Determine the LSA limit for each radionuclide (49 CFR 173.403(n)(4))
Step 2/3: Calculate net weight in grams; calculate mCi/gram
Step 4: Perform "Sum of the Fractions" by dividing mCi/g by LSA limit for each radionuclide
Step 5: Add all answers from Step 4;
If less than or equal to 1.0 == LSA
If greater than 1.0, == NOT LSA

ATTACHMENT 3

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§173.425 Transport requirements for low specific activity (LSA) radioactive materials.

In addition to other applicable requirements specified in this subchapter, low specific activity (LSA) materials shall be transported in accordance with paragraph (a) of this section, or if transported as exclusive-use may be transported in accordance with paragraph (b) or (c) of this section.

(a) DOT Specification 7A (§173.350 of this subchapter) Type A package. The requirements of §173.412(a), (b), (d), and (n) do not apply.

(b) Packaged shipments of LSA material consigned as exclusive use shall either be in accordance with paragraph (a) of this section or shall comply with the following in which case they are excepted from specification packaging, marking and labeling:

(1) Materials must be packaged in strong, tight packages so that there will be no leakage of radioactive material under conditions normally incident to transportation.

(2) Packages must not have any significant removable surface contamination (see §173.443).

(3) External radiation levels must comply with §173.441.

(4) Shipments must be loaded by consignor and unloaded by consignee from the conveyance or freight contained in which originally loaded.

(5) There must be no loose radioactive material in the conveyance.

(6) Shipment must be braced so as to prevent shifting of lading under conditions normally incident to transportation.

(7) Except for shipments of unconcentrated uranium or thorium ores, the transport vehicle must be placarded with the placards prescribed in accordance with Subpart F of Part 172 of this subchapter, as appropriate.

(8) The exterior of each package must be stenciled or otherwise marked "Radioactive--LSA". Packages, with a capacity of 110 gallons or less, that contain a hazardous substance, must be stenciled or otherwise marked with the letters "RQ" in association with the above description. For vessel transportation, packages that contain a marine pollutant must be marked in accordance with §172.322 of this subchapter.
[54 FR 39506, Sept. 26, 1989; 57 FR 52940, Nov. 5, 1992, effective Jan. 1, 1993]

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(9) Specific instructions for maintenance of exclusive use shipment controls must be provided by the shipper to the carrier. Such instructions must be included with the shipping paper information. Approved by the Office of Management and Budget under OMB control number 2137-0536

(10) Transportation by aircraft is prohibited.

(c) Unpackaged (bulk) shipments of LSA materials shall be transported only in exclusive use closed transport vehicles and shall comply with the following:

(1) Authorized materials are limited to the following:

(i) Uranium or thorium ores and physical or chemical concentrates of those ores.

(ii) Uranium metal or natural thorium metal, or alloys of these materials.

(iii) Materials of low radioactive concentration, if the average estimated radioactivity concentration does not exceed 0.001 millicurie per gram and the contribution from materials with an A↓2 value (see §173.435) of less than 0.05 curie does not exceed one percent of the total radioactivity.

(iv) Objects of nonradioactive material externally contaminated with radioactive material, if the radioactive material is not readily dispersible and the surface contamination, when averaged over one square meter, does not exceed 0.0001 millicurie per square centimeter or radionuclides for which the A↓2 value is less than 0.05 or 0.001 millicurie per square centimeter of other radionuclides. Such objects must be suitably wrapped or enclosed.

(2) Bulk liquids must be transported in the following: (i) Specification 103CW, 111A60W7 (§§179.200, 179.201, 179.202 of this subchapter) tank cars. Bottom openings in tanks prohibited.

(ii) Specification MC 310, MC 311, MC 312, or MC 331 (§§178.343 or 178.337 of this subchapter) cargo tanks. Authorized only where the radioactivity concentration does not exceed 10 percent of the specified low specific activity levels (see §173.403)(n)). The requirements of §173.412(n) do not apply to these cargo tanks. Bottom fittings and valves are not authorized. Trailer-on-flat-car service is not authorized.

(3) External radiation levels must comply with §173.441(b).

(4) Shipments must be loaded by the consignor, and unloaded by the consignee from the conveyance or freight container in which

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originally loaded.

(5) Except for shipments of unconcentrated uranium or thorium ores, the transport vehicle must be placarded with the placards prescribed in Subpart F of Part 172 of this subchapter, as appropriate.

(6) There must be no leakage of radioactive materials from the vehicle.

(7) Specific instructions for maintenance of exclusive use shipment controls must be provided by the shipper to the carrier. Such instructions must be included with the shipping paper information. Approved by the Office of Management and Budget under OMB control number 2137-0534

(8) Transportation by aircraft is prohibited.
[49 FR 38134, Sept. 27, 1984]

(d) Except for transportation by aircraft, low specific activity material that conforms with the provisions specified in 10 CFR 20.306 is excepted from all requirements of this subchapter pertaining to radioactive materials when offered for transportation for disposal or recovery. A material which meets the definition of another hazard class is subject to the provisions of this subchapter relating to that hazard class.
[50 FR 23812, June 6, 1985]

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APPENDIX B

TRANSPORTATION DRIVERS

APPENDIX II
TRANSPORTATION DRIVERS

Although many such stipulations are involved, this section addresses those of particular interest.

1.0 SUMMARY

The interstate transportation of radioactive material via highway or railroad is a highly regulated activity. The Department of Transportation (DOT) is the primary regulator of radioactive material transportation. However, state and local government agencies also regulate certain aspects of radioactive material transportation regarding safety and emergency response. In addition to federal, state and local requirements, the transportation of Department of Energy (DOE) radioactive material is also regulated on a programmatic level through various DOE Orders.

Through federal, state, local requirements and DOE Orders, every aspect of radioactive material transportation is regulated. This section provides a preliminary regulatory overview of the requirements pertaining to the transportation of radioactive material, generated from the remediation of OU1, to potential disposal sites in Utah (Envirocare) and Nevada (NTS) via highway and railroad.

DOT has pre-emptive authority to regulate hazardous materials transportation which includes the transportation of radioactive materials. Pursuant to this regulatory authority, DOT has promulgated regulations for the transportation of hazardous material (i.e. radioactive material) by railroad and public highway. Further, this statute preempts any state or local requirements that is found inconsistent with the DOT regulations. DOT regulations for hazardous materials transportation include provisions for the selection of proper shipping names and material classification, packaging of materials, marking and labeling material packaging, training of hazardous material personnel, placarding transportation vehicles, material handling, routing of highway vehicles, shipping papers, emergency response and reporting, inspections, and material transfers regarding transportation via highway and rail. These comprehensive

regulations ensure that hazardous materials are transported in a manner which protects the environment and the safety, welfare and property of the public.

Certain state and local government agencies also provide additional requirements relating to the transportation of radioactive materials which generally are concerned with transportation safety and include pre-notification and emergency response provisions, vehicle weight restrictions, and local routing and bridge and tunnel restrictions.

The transportation of DOE radioactive material is further subject to programmatic requirements relating to radioactive materials transportation contained in various DOE Orders. Requirements contained within DOE Orders include provisions for the loading and unloading of radioactive materials, inspections, emergency response procedures and incident reporting. These requirements do not replace federal, state and local requirements, but add an additional level of requirements to the transportation of DOE radioactive materials.

2.0 SCOPE AND ASSUMPTIONS

This section addresses:

- Radioactive material defined by DOT regulations to include material with a specific activity greater than 0.002 microcurie/gram [49 CFR 173.3(y)].

- Low level radioactive waste which is material not classified as high-level waste, transuranic waste, spent nuclear fuel, or by-product material such as uranium or thorium tailings and waste.

- Low specific activity material (LSA) which, per 49 CFR 173.3(n), means any of the following:
  - Uranium or thorium ores and physical or chemical concentrates of those ores.
  - Un-irradiated natural or depleted uranium or un-irradiated natural thorium.
  - Tritium oxide in aqueous solutions provided the concentration does not exceed 5.0 millicuries per milliliter.
  - Material in which the radioactivity is essentially uniformly distributed and in which the estimated average concentration of contents does not exceed:
  - 0.0001 millicurie per gram of radionuclides for which the A_2 quantity is not more than .05 curie;
  - 0.005 millicurie per gram of radionuclides for which the A_2 quantity is more than .05 curie, but not more than 1 curie; or

- 0.3 millicurie per gram of radionuclides for which the A_2 quantity is more than 1 curie.
- Objects of nonradioactive material externally contaminated with radioactive material, provided that the radioactive material is not readily dispersible and the surface contamination, when averaged over an area of 1 square meter, does not exceed 0.0001 millicurie (220,000 disintegrations per minute) per square centimeter of radionuclides for which the A_2 quantity is not more than .05 curie, or 0.001 millicurie (2,200,000 disintegrations per minute) per square centimeter for other radionuclides.

This regulatory overview is based upon the assumption that the FEMP OU1 material is defined as radioactive material and that transportation will be by both highway and railroad. It is further assumed that the OU1 material can be classified as LSA material based upon DOT regulations under Title 49 of the Code of Federal Regulations, Section 173.3(n). Under certain conditions (49 CFR 173.425), LSA material can either be shipped in approved DOT packaging (strong and tight or Type A) or in unpackaged bulk shipments.

3.0 DEPARTMENT OF TRANSPORTATION (DOT)

The DOT is the primary regulator of hazardous material transportation, including radioactive materials. The Hazardous Materials Transportation Act (HMTA) gives DOT broad authority to promulgate and enforce hazardous materials regulations for transportation by rail and public highway. The goal of HMTA is to protect against the risks to life and property which are inherent in the transportation of hazardous materials by establishing uniform national transportation standards.

The DOT regulates all aspects of hazardous materials transportation regarding hazard classification, packaging, hazard communication, handling, routing, and package manufacture, testing and maintenance under Title 49 of the Code of Federal Regulations (CFR). These DOT regulations establish a uniform national system to identify hazardous materials, package them safely, communicate hazards, and handle the packages safely during transportation. In addition to DOT, certain states also have limited jurisdiction concerning the transportation of radioactive materials including transporter permit requirements, routing restrictions and notification requirements. It should be noted that DOT is currently revising the hazardous materials regulations concerning the transportation of radioactive material. Final revised

regulations are expected sometime in 1994. However, for the most part, these regulations will revise the terminology used in the DOT radioactive materials transportation regulations to be consistent with international regulations.

The DOT regulations governing the transportation of hazardous materials are all encompassing regarding the protection of public safety and highly regulate all aspects of hazardous materials transportation including: training; proper shipping names; marking; labeling; shipping papers; placarding; and handling/loading. A hazardous material is defined pursuant to DOT regulations as a substance or material, including a hazardous substance, which has been determined by the Secretary of Transportation to be capable of posing an unreasonable risk to health, safety, and property when transported in commerce, and which has been so designated. Radioactive materials are included under the definition of hazardous materials. The DOT definition of a hazardous substance is any material, including its mixtures and solutions but excluding petroleum, that is listed under the appendix to 49 CFR 172.101 which is in a quantity, in one package, which equals or exceeds the reportable quantity (RQ) listed in the appendix to 49 CFR 172.101. For mixtures of radionuclides, DOT regulations provide methods for determining if a package contains an RQ of a hazardous substance.

3.1 Shipping Names

Prior to shipping radioactive material, a proper shipping name for the material must be selected. The proper shipping name is chosen from the hazardous materials table (HMT) under 49 CFR 172 and must be the listed name that most accurately describes the material. The proper shipping name will determine the appropriate hazard class for the material. Pursuant to DOT regulations, radioactive materials are assigned to Hazard Class 7 (Class 7 material) which includes material with specific activity greater than .002 microcurie/gram. Material less than this concentration is not considered radioactive for transportation purposes. Class 7 material is further classified by the type of material and the specific activity of the material under 49 CFR 173.3.

Once a proper shipping name has been selected, the HMT will direct management of the material including any restrictions on transportation, hazard class identification, ID number, packing group, labels, special provisions, specification packaging, quantity limitations and storage requirements which are in addition to the requirements for general management of hazardous materials.

3.2 Packaging

DOT regulates the packaging requirements associated with the transportation of low level radioactive materials, including LSA material. These DOT regulations provide detailed requirements for packaging design and performance to ensure safety during radioactive materials transportation from general design requirements applicable to all radioactive materials transportation packaging to specific design and performance standards and specifications for packaging associated with the transportation of specific types of radioactivity. No other state requirements concerning radioactive material packaging have been identified.

Packaging is established based on the hazard class of the material. Only approved methods for packaging a particular material may be utilized for transportation. The following discussion concerns the DOT packaging requirements for OU1 radioactive material.

3.2.1 Packaging for LSA Material

When packaged in a Type A package, transport of LSA material is permitted. When packaged in a "strong and tight" package, LSA material must be transported under exclusive-use conditions. Unpackaged (bulk) shipment of LSA material is permitted under exclusive conditions only for certain concentrations (< 1 microCurie/gram of LSA material, 49 CFR 173.425).

3.2.2 Bulk Shipments

LSA material which is transported in bulk unpackaged shipments must meet the DOT regulations which require that this material be shipped in exclusive use closed transport vehicles which meet specified requirements. These requirements include a limitation on the

type of material which is authorized to be transported, the physical form in which the material may be transported, limitations on the external radiation levels, loading and unloading restrictions, requirements of no leakage of radioactive material from the vehicles, placarding requirements and requirements for the maintenance of exclusive use shipment controls which must be included with the shipping papers. These requirements ensure that LSA material is transported in a safe manner that ensures the safety of the public from any hazards associated with this material.

Safety is ensured by the requirement for the use of "exclusive use" vehicles. "Exclusive use" means the sole use of a conveyance by a single consignor and for which all initial, intermediate, and final loading and unloading are carried out in accordance with the direction of the consignor or consignee. Any loading or unloading must be performed by personnel having radiological training and resources appropriate for safe handling of the consignment. As referenced above, specific instructions for maintenance of exclusive-use shipment controls must also be issued in writing and include with the shipping paper information provided to the carrier by the consignor. These exclusive use requirements place limitations the personnel authorized to handle LSA material and ensure that only properly designated properly trained personnel are involved with the handling, loading and unloading of LSA material shipments from the time the material is loaded for shipment until the time the material is unloaded at the specified destination which ensures that LSA material is handled in a safe manner by trained, experienced personnel familiar with the safe handling of this material. These requirements also help to ensure that any hazards associated with mishandling of this material are eliminated to the extent possible.

The reference to "closed transport vehicles" means a transport vehicle equipped with a securely attached exterior enclosure that during normal transportation restricts the access of unauthorized persons to the cargo space containing the radioactive materials and must limit access from the top, sides and ends. This "closed transport vehicle" requirement further ensures that unauthorized personnel access is limited and further ensures that only authorized, trained personnel can access the LSA material further protecting public safety. Also, there must be no leakage of radioactive material from the vehicle. External radiation

levels for bulk shipments must also meet DOT specified levels under 49 CFR 173.441(b) to further ensure public safety.

3.2.3 Containers

LSA material may also be shipped in DOT approved containers. Two types of containers are authorized for LSA material under specific circumstances: 1) DOT Specification 7A Type A package; and 2) DOT "strong tight" packages.

All radioactive materials packaging must meet DOT general design requirements under 49 CFR 173.411 which include the following:

- Packages must be designed to be easily handled and properly secured in or on a conveyance during transport
- External surfaces must be easily decontaminated to the extent practicable
- Outer layers of packaging must be designed to avoid, as far as practicable, pockets or crevices where water might collect

In addition to the above general design requirements for radioactive materials packaging, Type A packages must be designed to meet the following additional design requirements:

- The outside of the packaging must incorporate a feature, such as a seal, that is not readily breakable, and that, while intact, is evidence that the package has not been opened; in the case of exclusive use closed transport vehicles, the cargo compartment may be sealed instead of the individual packages
- External surfaces must free of protrusions and must be designed and finished to be easily decontaminated
- Containers must be able to withstand the effects of any acceleration, vibration or vibration resonance that may arise during normal transportation, without any deterioration of the effectiveness of the packaging
- Must include a containment system securely closed by a positive fastening device that cannot be opened unintentionally or by pressure within the package during normal transportation
- Packaging must be physically and chemically compatible with the material

- Design account for radiolytic decomposition of materials and the generation of gas by chemical reaction
- The containment system must retain radioactive contents under a reduction of ambient pressure to .25 kilograms per square centimeter
- When subjected to the performance tests under 49 CFR 173.465 including the water spray test, free drop test, compression test, and penetration test, the package will prevent loss or dispersal of radioactive contents any significant increase of radiation at the external surfaces
- Must not exceed the A_2 levels as specified in 49 CFR 173.435 or 173.433

LSA material can also be packaged in strong tight packages so that there is no leakage of radioactive material under conditions normally incident to transportation under the following conditions:

- Packages must not have any significant removable surface contamination
- External radiation levels must comply with 49 CFR 173.441
- Shipments must be loaded by consignor and unloaded by consignee from the conveyance or freight contained in which originally loaded
- No loose radioactive material in the conveyance
- Shipments must be braced to prevent shifting of lading under conditions normally incident to transportation
- Transport vehicle must be placarded pursuant to 49 CFR 172 Subpart F
- The exterior of each package must be stenciled or otherwise marked "Radioactive-LSA" and packages containing 110 gallons must be marked "RQ"
- Specific instructions for maintenance of exclusive use shipments must be provided to the carrier and included with the shipping paper information.

3.2.4 Packaging for Other Class 7 Radioactive Material

Other radioactive material from the FEMP site, which does not meet the definition of LSA material, must be packaged in Type A containers. Type A containers which meet the general packaging requirements as well as the additional requirements applicable to Type A containers. Material that exceeds the A_2 activity (49 CFR 173.435) for Type A containers

must be packaged in Type B containers. However, with the exception of the contents of the silos, it is not anticipated that any material requiring Type B containers will be transported from FEMP. The NRC regulates Type B packaging standards under 10 CFR 71.

3.3 Other Requirements

Marking - DOT regulations also require shipments of radioactive material to be marked with information identifying the material. Markings must be durable, in English, and affixed to or printed on the package, label or tag. Marking information includes proper shipping name, ID number, RQ, name and address of consignor/consignee, any additional information (i.e. direction arrows, pressure warnings), and any DOT exemption numbers. Shipments of radioactive material must also be labeled pursuant to DOT regulations under 49 CFR 172.3 which prescribes specific labels for packages based on transport index and radiation level at the surface of the package. DOT labels are diamond-shaped. Radioactive materials must be labeled with a DOT Class 7 radioactive materials label.

Training - DOT regulations require that anyone performing a function associated with the transportation of radioactive materials must be trained to ensure that transportation activities are conducted in compliance with applicable DOT regulations. Furthermore, it is illegal to ship radioactive material without complying with all applicable regulations and it is illegal for transporters to accept radioactive materials in noncompliance with applicable regulations. Civil and criminal penalties can be enforced for violations of DOT regulations.

Requirements for Transportation by Highway - In addition to the labeling and packaging requirements discussed above the transportation of radioactive materials by highway must meet the following requirements.

Placarding - Vehicles used to transport radioactive materials must be properly placarded pursuant to 49 CFR 172.505. Placarding allows for the identification of the particular hazard of the material from outside the transport vehicle.

Handling - Radioactive materials must also be handled in compliance with handling and loading requirements found under 49 CFR 177 Subpart B. The number of packages of radioactive material in any motor vehicle must be limited so that the total transport index number does not exceed 50 unless it is an exclusive use shipment. The transport index is defined as the dimensionless number placed on a label of a package to designate the degree of control to be exercised by the carrier during transportation which is determined by the maximum radiation level in millirem per hour at one meter from the external surface of the package. Packages must not be placed in a motor vehicle or in any place closer than the prescribed distances from areas which may be continuously occupied by passengers or employees.

Routing - All shipments of radioactive material must be transported via routes that minimize radiological risk considering accident rates, transit time, population density and activities, and the time of day and the day of the week that transportation will occur. An Interstate system bypass or Interstate system beltway around a city should be used, when available, rather than a preferred route through a city, unless the state routing agency has designated an alternative route. However, no designated routes or route restrictions for the states through which the material at issue potentially transported have been identified.

No formal routing restrictions exist for LSA material. Routing restrictions do exist for "Highway controlled quantities" and Type B packages which do not apply to OU1 material.

Driver Training - Drivers of vehicles transporting radioactive materials on public highways must be trained pursuant to 49 CFR 172 Subpart H and driver training requirements under 49 CFR 177.816. These requirements include general awareness/familiarization training, function specific training safety training, OSHA training and pre trip safety inspection vehicle equipment and emergency equipment operation training, vehicle operation training and associated hazards, procedures for tunnels, bridges, railroad crossings, and loading and unloading procedures. A copy of all training records must be in the immediate possession of the driver.

Shipping Papers - All shipments of radioactive materials must be accompanied by shipping papers (49 CFR 177.817) which document the quantity and type of material shipped. The papers must be maintained by the carrier in a readily accessible (e.g. in the driver's side door, on the driver's seat when parked, or within the reach of the driver). Shipping papers are the key documents used by emergency responders in case of an accident. DOT regulations require emergency response information to be included in the shipping papers. First response information must include:

- The basic description and technical name of the hazardous material
- Immediate hazards to health
- Risks of fire or explosion
- Immediate precautions to take in the event of an accident or incident
- Immediate methods for handling
- Initial method for handling spills or leaks
- Preliminary first aid measures

In addition to the above, an emergency response telephone number must be provided on the shipping paper. The telephone number must be manned at all times during transportation of the shipment by a person who is knowledgeable in the hazards of the material shipped and can give additional information to emergency responders.

Emergency Response - In the event of an accident or incident of spill release or other emergency occurring during the course of transportation, loading, unloading or temporary storage, the DOT must be immediately notified along with the emergency response agencies of the state in which the emergency occurs. The DOT should be notified at the earliest practicable moment by telephone (800) 424-8802 or (202) 267-2675 notice must include name of reporter, name and address of carrier phone number where reporter can be contacted, date, time and location of incident, extent of any injuries, type of incident, and classification, name and quantity of materials involved in compliance with 49 CFR 171.15. The carrier must also submit a detailed hazardous materials incident report within 30 days after the incidents discovery in compliance with 49 CFR 171.16. In addition to these notification and reporting requirements, the carrier should also notify the shipper at the earliest practicable moment following an incident involving leakage, breakage, spillage, or suspected radioactive contamination regarding Class 7 materials. Any vehicles, buildings, areas or

equipment in which Class 7 material has been spilled cannot be returned to service until the radiation dose rate at any accessible surface is 0.5 millirems per hour or less and there is no significant removable surface contamination. Any spilled materials should be segregated from personnel contact until handled by qualified persons. DOE should be contacted for any technical assistance.

Transportation By Rail - The DOT regulates the transportation of hazardous materials, including radioactive materials by rail. These regulations are found under 49 CFR 174 et seq. Although states can also regulate rail transportation of hazardous material, the state regulations must be consistent with DOT regulations and cannot pre-empt DOT regulations. The DOT regulations cover all aspects of transporting radioactive material by rail throughout the United States including general operating requirements, general handling and loading requirements, requirements for placarding rail cars, transport vehicles and freight containers, and detailed requirements for Class 7 radioactive materials.

Labeling, Placarding and Shipping Papers - The shipment of radioactive materials by rail must also meet the labeling, placarding and shipping paper requirements discussed above for transportation of radioactive materials by highway. The information on the shipping papers should be included on all switching orders, waybills, and other billings. The train crew must have a document indicating the position in the train of the loaded placarded cars containing radioactive material. The train crew must also have in possession a copy of the shipping papers for the radioactive material. Loading and unloading must meet the requirements for blocking and bracing as described in 49 CFR 174.81 and meet the requirements generally applicable as discussed for highway transportation.

Packaging - LSA material can be transported either in bulk unpackaged form, "strong tight" packaging, or in Type A packaging as discussed in Section 2.2.1 for highway transportation packaging. Other low level radioactive material, classified as Class 7 radioactive material, will be packaged in Type A containers. Any material which exceeds the A_2 quantity for Type A packaging must be packaged in Type B. However, it is not anticipated that any material requiring Type B packaging will be generated at the FEMP OU1 site.

Training - The DOT regulations require training for transportation personnel pursuant to 49 CFR 172 Subpart H.

Inspections - The DOT regulations also provides for inspection by DOT of packaging and storage of radioactive material transported by rail. Each loaded placarded rail car and each car adjacent to must be inspected at any point where a train is required to be inspected. Cars may not continue unless the inspection indicates that the cars are in a safe condition for transportation. Cars that demonstrate evidence of rough handling must be inspected before the car is permitted to proceed to an interchange. All shipments of radioactive material offer by a connecting carrier must include the placard notation and endorsement on any billing document.

Freight Transfer - Each origin carrier, including the freight forwarder, must have a copy of the shipper's certified shipping papers on file. A carrier is required to forward shipments of radioactive material within 48 hours (Saturdays, Sundays, and holidays excluded) after acceptance at the originating point or receipt at any yard, transfer station, interchange point, except where biweekly or weekly service only is performed, the shipment must be forwarded on the first available train. The shipper must remove material from the carrier within 48 hours of receiving notice of arrival has been sent or given (excluding Saturdays, Sundays, and holidays).

Handling - The DOT regulations also provide detailed procedures which must be followed during switching of rail cars which contain radioactive materials. Except for exclusive use shipments, the number of packages containing Class 7 material in any rail car cannot exceed the transport index of 50. The position of cars containing radioactive materials must be separated from locomotive, occupied caboose, or undeveloped film containing car by at least one unplacarded car and must be positioned in accordance with the requirements of 49 CFR 174.85(d). Each package of Class 7 radioactive material must not be placed closer than 1 meter to an area which may be continuously occupied by any passenger, rail employee or shipment of animals nor closer than 4.5 meters to any shipment of undeveloped film. If more

than one package is present, the distance must be computed from the table under 49 CFR 174.700 on the basis of the transport index.

Flat cars can be used for transport of radioactive materials in containers weighing 6,805 kg or more and gondola cars, other than a drop bottom car may be used for the following: Class 7 materials weighing 2,268 kg or more; strong wooden boxes with inside containers of Class 7 material, securely braced and cushioned. Personnel must not unnecessarily remain in cars containing Class 7 material.

Packages shipped exclusively which have external radiation levels in excess of 200 millirem per hour at the package surface must meet the requirements of a closed transport vehicle, packages must be secured so that their position remains fixed within the rail cars, and radiation level should not exceed 2 millirems per hour in any normally occupied position in the transport vehicle or adjacent railroad cars.

Each rail car must be surveyed for radiation after each use. Vehicles may not be returned to service until the radiation dose levels at any accessible surface is 0.5 millirems per hour or less and there is no significant removable radioactive surface contamination. This requirement does not apply to rail cars used exclusively for radioactive material shipments if a survey of the interior of the car shows a radiation dose rate that does not exceed 10 millirems per hour at the interior surface, or 2 millirems at 1 meter from any interior surface. These cars must also be stencilled with the words "FOR RADIOACTIVE MATERIALS USE ONLY" in lettering at least 8 cm high in a conspicuous place on both sides of the exterior car and cars must be kept closed at all times except for loading and unloading.

Emergency Response - Any radioactive material incident must be reported as required in the notification requirements for highway transportation pursuant 49 CFR 171.15 and 171.16 discussed in Section 2.5.6. In addition to these notification and reporting requirements, the carrier should also notify the shipper at the earliest practicable moment following an incident involving leakage, breakage, spillage, or suspected radioactive contamination regarding Class 7 materials. Any vehicles, buildings, areas or equipment in which Class 7 material has been

spilled cannot be returned to service until the radiation dose rate at any accessible surface is 0.5 millirems per hour or less and there is no significant removable surface contamination. Any spilled materials should be segregated from personnel contact until handled by qualified persons. The DOE should be contacted for any technical assistance.

Other Requirements - In addition to the DOT requirements, the railroad carriers may also have requirements pertaining to the transport of radioactive material. However, based on information received from DOT, it does not appear that railroads generally refuse to accept radioactive material or impose requirements which render radioactive material transportation by rail prohibitive.

4.0 FEDERAL RAILROAD ADMINISTRATION (FRA)

The facility and infrastructure aspects of railroad transportation are regulated by 49 CFR Parts 200 through 268.

5.0 DEPARTMENT OF ENERGY

DOE has issued Orders establishing policies/responsibilities for the transportation of radioactive materials which supplement DOT's hazardous (i.e., not necessarily hazardous waste as defined by EPA) materials regulations pertaining to radioactive material and specific state requirements. The most relevant DOE orders for OU1 material, described below, do not include those addressing higher activity material.

5.1 DOE 1540.1A - Materials Transportation and Traffic Management

This order addresses the following:

- General
  - Shipments must conform with all applicable laws, regulations and transportation industry guidance.
- Loading
  - Adequate blocking and bracing of freight to avoid shifting.
  - Tie-down of load to ensure stability of the shipment.
  - Gross vehicle weight must not exceed authorized capacity.
- Inspection
  - Of material prior to loading to ensure transportability .

- Prior to release of loaded vehicle.
- In transit.
- Upon receipt for any damage or leakage.
- Implement decontamination procedures in cases of leakage.

- Emergency response
  - DOE's national radiological assistance plan addresses transportation releases; DOE will advise/assist as needed to protect public health and safety.

- Reporting
  - Carriers of radioactive materials must report leakages or suspected contamination to DOT and DOE Headquarters.

5.2 DOE 1540.2A - Hazardous Material Packaging for Transport

This order approves the use of DOT specification packages provided that all provisions of the DOT specifications and applicable quality assurance requirements are met.

5.3 DOE Order 1540.3A Base Technology for Radioactive Material Transportation Packaging Systems

This order establishes DOE policies and responsibilities for coordinating and planning base technology for radioactive material transportation packaging systems.

5.4 DOE Order 5500.3A

This Order, "Planning and Preparedness for Operational Emergencies", outlines the general requirements for an emergency management program.

5.5 DOE Order 5820.2A

This Order, "Radioactive Waste Management", concerns the management of radioactive and mixed waste at contaminated facilities.

6.0 INTERSTATE COMMERCE COMMISSION

The ICC regulates "published" transportation rates. However, the Staggers (deregulation) Act, allows contract rates to be negotiated between railroads and shippers.

7.0 LOCAL REGULATIONS

Certain local governmental jurisdictions have the authority to regulate certain aspects of hazardous material transportation within their jurisdiction, but must not pre-empt federal DOT requirements or restrict interstate commerce. These may be in the form of local route directives in the form of bridge and tunnel restrictions. Due to the amount of local jurisdictions involved in transporting material from Ohio to either Utah or Nevada, a comprehensive listing of these requirements is beyond the scope of this review; the detailed planning for implementing this project must address such stipulations

8.0 FEMP PROCEDURES

Prior to the commencement of physical work, detailed plans and procedures will be developed to conduct on-site remediation activities and those directed at the staging, loading, monitoring and release of rail shipments of waste. These plans will be reviewed with the public.

APPENDIX C

STATE RADIATION CONTROL PROGRAMS

STATE RADIATION CONTROL PROGRAM ASSISTANCE FOR INCIDENTS INVOLVING RADIOACTIVE MATERIALS

CRCPD Notes of February 1995

State	State Radiation Control Program: Emerg. Response Section Leader	Voice Phone	Telefax	24-Hour or After Hours[A]: Voice Phone	Agency	Assistance at Rad. Control or (*) only at the 24-Hr. Phone: Locate Shipper	Locate Experts	Conf. Calls	Tech. Info.	Radiol. Survey	Federal Region: DOE	NRC	Date of This Info.
ALABAMA■	Bernis Hannah	**205/613-5391**	205/613-5387	205/242-4378	SP	Yes	Yes	Yes	Yes	Yes	III	II	14 Feb.'95
ALASKA	(none)			907/465-4000	SP	Yes	Yes	Yes	No	No	VIII	IV	13 Feb.'95
ARIZONA■	John Lutton	602/255-4845	602/437-0705	602/223-2212[A]	SP	Yes	Yes	Yes	Yes	Yes	IV	IV	9 Feb.'95
ARKANSAS■	Bernard Bevill	**501/661-2301**	501/661-2468	501/661-2136	RCP	Yes	Yes	Yes	Yes	Yes	II	IV	13 Feb.'95
CALIFORNIA■	Donald Bunn	916/323-2756	916/324-3610	**916/262-1621**	EM	Yes	*Yes	Yes	Yes	Yes	VII	IV	14 Feb.'95
COLORADO■	Martin Hanrahan	303/692-3030	303/782-5083	303/756-4455[A]	EM	Yes	Yes	Yes	Yes	Yes	VI	IV	13 Feb.'95
CONNECTICUT	Denny Galloway	**203/424-3029**	203/566-6032	203/566-3333	RCP	Yes	Yes	Yes	Yes	Yes	I	I	14 Feb.'95
DELAWARE	Al Tapert	302/739-3787	302/739-3839	**302/834-4531**	EM	Yes	Yes	*Yes	Yes	No	I	I	14 Feb.'95
D.C.	Philip Sumner	202/727-7218	202/727-7780	**202/727-6161**	EM	No	No	*Yes	No	No	VII	I	10 Feb.'95
FLORIDA■	Harlan Keaton	**407/297-2095**	407/297-2085	904/413-9911	EM	Yes	Yes	*Yes	Yes	Yes	III	II	9 Feb.'95
GEORGIA■	James Hardeman	404/362-2675	404/362-2653	800/241-4113[A]	RCP	Yes	Yes	Yes	Yes	Yes	III	II	13 Feb.'95
HAWAII	Russell Takata	808/586-4700	808/586-4729	808/734-2161	EM	Yes	Yes	Yes	Yes	Yes	VII	IV	9 Feb.'95
IDAHO	Steven Oberg	208/334-0436	208/334-0429 In-state ->	**208/334-4570** **800/632-8000**	EM	No	Yes	Yes	Yes	Yes	VI	IV	9 Feb.'95
ILLINOIS■	Tim Runyon	**217/785-0600**[24]	217/786-7223	217/785-0600	RCP	Yes	Yes	Yes	Yes	Yes	V	III	14 Feb.'95
INDIANA	Rex Bowser	317/383-6150	317/383-6154	317/383-6144[A]	RCP	No	Yes	Yes	Yes	Yes	V	III	14 Feb.'95
IOWA■	Don Flater	515/281-3478	515/242-6284	**515/281-3231**	EM	Yes	Yes	Yes	Yes	Yes	V	III	9 Feb.'95
KANSAS■	Harold Spiker	913/296-1561	913/296-0984	**913/296-3176**	EM	Yes	Yes	Yes	Yes	Yes	IV	IV	9 Feb.'95
KENTUCKY■	John Volpe	502/564-3700	502/564-6533	502/564-7815[A]	RCP	Yes	Yes	*Yes	Yes	Yes	II	II	14 Feb.'95
LOUISIANA■	Stan Shaw	504/765-0140	504/926-1903	**504/765-0160**	RCP	Yes	Yes	Yes	Yes	Yes	II	IV	13 Feb.'95
MAINE■	Jay Hyland	**207/287-5676**	207/287-4172	207/624-7000 Page Health Eng.	SP	Yes	Yes	Yes	Yes	Yes	I	I	14 Feb.'95
MARYLAND■	Carl Trump	410/631-3300	410/631-3198	410/243-8700[A]	RCP	Yes	Yes	Yes	Yes	Yes	I	I	13 Feb.'95
MASSACHUSETTS	Bob Hallisey	617/727-6214	617/727-2098	**617/727-9710**	RCP	Yes	Yes	Yes	Yes	Yes	I	I	14 Feb.'95
MICHIGAN	Dennis Hahn	517/335-8200	517/335-8706	517/336-6100[A]	SP	Yes	Yes	Yes	Yes	Yes	V	III	10 Feb.'95
MINNESOTA	Alice Dolezal-Hennigan	612/627-5071	In-state ->
612/627-5075	800/422-0798 **612/649-5451**	EM	Yes	Yes	Yes	Yes	Yes	V	III	9 Feb.'95
MISSISSIPPI■	Bob Bell	601/354-6657	601/354-6167	**601/352-9100**	EM	Yes	Yes	Yes	Yes	Yes	II	II	9 Feb.'95

■ NRC Agreement State. Bold Phone preferred for first report. [24] a 24-Hr. phone [A] After hours only * Service available only from the 24-Hr. phone.

Agency for after hours or 24-hour calls: EM = Emergency management, SP = State police, RCP = Radiation control program, usually the main department switchboard.

Locate Shipper / Export means that staff will undertake to identify and notify the shipper / enlist experts on the cargo. Technical information refers here only to radioactive materials.

Conference Call means, here, the capability to dial and connect together three or more numbers e.g. shipper, expert and fire fighters at the accident.

Radiological Survey means staff and equipment for evaluation of all types of ionizing radiation as well as airborne radioactivity at an accident scene.

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STATE RADIATION CONTROL PROGRAM ASSISTANCE FOR INCIDENTS INVOLVING RADIOACTIVE MATERIALS

CRCPD Notes of February 1995

State	State Radiation Control Program: Emerg. Response Section Leader	Voice Phone	Telefax	24-Hour or After Hours[A]: Voice Phone	Agency	Assistance at Rad. Control or (*) only at the 24-Hr. Phone: Locate Shipper	Locate Experts	Conf. Calls	Tech. Info.	Radiol. Survey	Federal Region: DOE	NRC	Date of This Info.
MISSOURI	Gary McNutt	314/751-6160	314/526-6946	314/751-2748[A]	EM	Yes	Yes	Yes	Yes	Yes	II	III	14 Feb.'95
MONTANA	Adrian Howe	**406/444-3671**	406/444-5275	406/444-6965	EM	No	*Yes	No	Yes	Yes	VI	IV	14 Feb.'95
NEBRASKA■	Harold Borchert	**402/471-2168**	402/471-0169	402/471-4545	SP	Yes	Yes	Yes	Yes	Yes	V	IV	13 Feb.'95
NEVADA■	Stan Marshall	702/687-5394	702/687-5751	**702/687-5300**	SP	Yes	Yes	Yes	Yes	Yes	VII	IV	13 Feb.'95
NEW HAMPSHIRE■	Diane Tefft	603/271-4588	603/225-2325	603/271-3636[A]	SP	Yes	Yes	*Yes	Yes	Yes	I	I	10 Feb.'95
NEW JERSEY	John Feeney	609/987-6365	609/987-6390	**609/292-7172**	RCP	Yes	Yes	*Yes	Yes	Yes	I	I	14 Feb.'95
NEW MEXICO■	William Floyd	505/827-4358	505/827-4361	**505/827-9329**	RCP	Yes	*Yes	*Yes	Yes	Yes	IV	IV	9 Feb.'95
NEW YORK■	Adela Salame-Alfie	518/458-6451	518/458-6434	**518/457-2200**	EM	Yes	Yes	*Yes	Yes	Yes	I	I	10 Feb.'95
NEW YORK CITY■	Richard Borri	718/643-7967	718/643-4616	212/340-4494[A]	RCP	Yes	Yes	No	Yes	Yes	I	I	10 Feb.'95
NORTH CAROLINA■	Johnny James	919/571-4141	919/571-4148	**919/733-3861**	SP	Yes	Yes	Yes	Yes	Yes	III	II	14 Feb.'95
NORTH DAKOTA■	Ken Wangler	701/328-5188	701/328-5200	**701/328-2121**	SP	Yes	Yes	No	Yes	Yes	V	IV	9 Feb.'95
OHIO	Robert Owen	**614/644-2727**[24]	614/644-1909	614/644-2727	RCP	Yes	Yes	Yes	Yes	Yes	V	III	14 Feb.'95
OKLAHOMA	Mike Broderick	**405/271-5338**	405/271-8425	**800/522-0206**[A]	RCP	Yes	Yes	Yes	Yes	Yes	IV	IV	13 Feb.'95
OREGON■	Nick Goevelinger	503/731-4014[24]	503/731-4081	503/731-4014	RCP	Yes	Yes	Yes	Yes	Yes	VIII	IV	14 Feb.'95
PENNSYLVANIA	Barbara Conrad	717/787-2480	717/783-8965	**717/783-8150**	EM	Yes	Yes	Yes	Yes	Yes	I	I	14 Feb.'95
RHODE ISLAND■	(none)	401/277-2438	401/277-6953	**401/421-7333**	EM	*Yes	No	*Yes	No	No	I	I	13 Feb.'95
SOUTH CAROLINA■	Sandra Threatt	803/896-4095	803/896-4110	803/253-6488[A]	RCP	Yes	Yes	Yes	Yes	Yes	III	II	14 Feb.'95
SOUTH DAKOTA	Mike Pochop	605/773-3351	605/773-4068	**605/773-3231**	EM	Yes	Yes	*Yes	Yes	Yes	V	IV	10 Feb.'95
TENNESSEE■	Elizabeth Flanagan	615/532-0360	615/532-7938	**615/741-0001**	EM	No	Yes	*Yes	Yes	Yes	II	II	9 Feb.'95
TEXAS■	Brad Caskey	512/834-6688	512/834-6690	**512/458-7460**	RCP	Yes	Yes	Yes	Yes	Yes	IV	IV	13 Feb.'95
UTAH■	Dane Finerfrock	801/536-4250	801/533-4097	**801/536-4123**	RCP	Yes	Yes	Yes	Yes	Yes	VI	IV	14 Feb.'95
VERMONT	Paul Clemons	802/865-7730	802/865-7745	**802/244-8727**	SP	Yes	Yes	Yes	Yes	Yes	I	I	13 Feb.'95
VIRGINIA	Leslie Foldesi	804/786-5932	804/786-6979	**804/674-2400**	EM	Yes	Yes	No	Yes	Yes	II	II	10 Feb.'95
WASHINGTON■	Robert Mooney	206/464-7274	206/464-7081	**206/NUCLEAR**	RCP	Yes	Yes	Yes	Yes	Yes	VIII	IV	9 Feb.'93
WEST VIRGINIA	Beattie DeBord	304/558-0696	304/558-0691	304/558-5380	EM	Yes	Yes	Yes	Yes	Yes	II	II	14 Feb.'95
WISCONSIN	Paul Schmidt	608/267-4792	608/267-4799	**800/943-0003**	EM	Yes	Yes	Yes	Yes	Yes	V	III	13 Feb.'95
WYOMING	Chuck Fraley (EM)	307/777-7197	307/635-6017	307/777-4321	SP	*Yes	No	*Yes	No	No	VI	IV	13 Feb.'95

■ NRC Agreement State. **Bold** Phone preferred for first report. [24] a 24-Hr. phone [A] After hours only * Service available only from the 24-Hr. phone.

Agency for after hours or 24-hour calls: EM = Emergency management, SP = State police, RCP = Radiation control program, usually the main department switchboard.

Locate Shipper / Export means that staff will undertake to identify and notify the shipper / enlist experts on the cargo. Technical information refers here only to radioactive materials.

Conference Call means, here, the capability to dial and connect together three or more numbers e.g. shipper, expert and fire fighters at the accident.

Radiological Survey means staff and equipment for evaluation of all types of ionizing radiation as well as airborne radioactivity at an accident scene.

APPENDIX D

DESIGN AND OPERATIONAL BASIS FOR PROPOSED OPERABLE UNIT 1 TRANSPORTATION INFRASTRUCTURE

APPENDIX D

DESIGN AND OPERATIONAL BASIS FOR PROPOSED OPERABLE UNIT 1 TRANSPORTATION INFRASTRUCTURE

D-1 FEMP Railcar and Trackage Requirements

D-1.1 Purpose

Pursuant to the Remedial Design Work Plan for Remedial Actions at Operable Unit 1, this document provides:

- The layout drawing showing the rail upgrades and the construction to support on-site operations.
- A description of the logistics associated with receiving, loading, storing, and moving full and empty gondola railcars to support the Operable Unit 1 (OU1) production operation.

Although this is a deliverable requirement of the Site Improvement Plan, it is also appended to the Transportation and Disposal Plan to facilitate review.

D-1.2 Current FEMP Rail Facilities

From Figure D-1, FEMP railcars travel north along a 24-mile Branch Line to Cottage Grove, Indiana in order to access CSXT Transportation, Inc.'s (CSXT's) main line rail system. The Branch Line is owned by CSXT which provides rail service to the FEMP. CSXT's inactive Shandon Yard, directly northwest of the FEMP, is the origination point of the CSXT spur which services the FEMP. The track is constructed from heavy-duty rail. After entering DOE-owned property, the track is considered to be the Main FEMP Spur and continues east across an unfenced access corridor. After crossing Paddys Run Road, DOE's track successively enters: (1) the contiguous portion of the FEMP property, and (2) the fenced, access-restricted, FEMP Controlled Area. The Main FEMP Spur continues into the former process area where it bifurcates into two light-duty rail parallel tracks (FEMP Tracks 1 and 2), with crossovers. The east and west sections of these tracks are in the Contaminated Area; the center has been downposted to a Controlled Area.

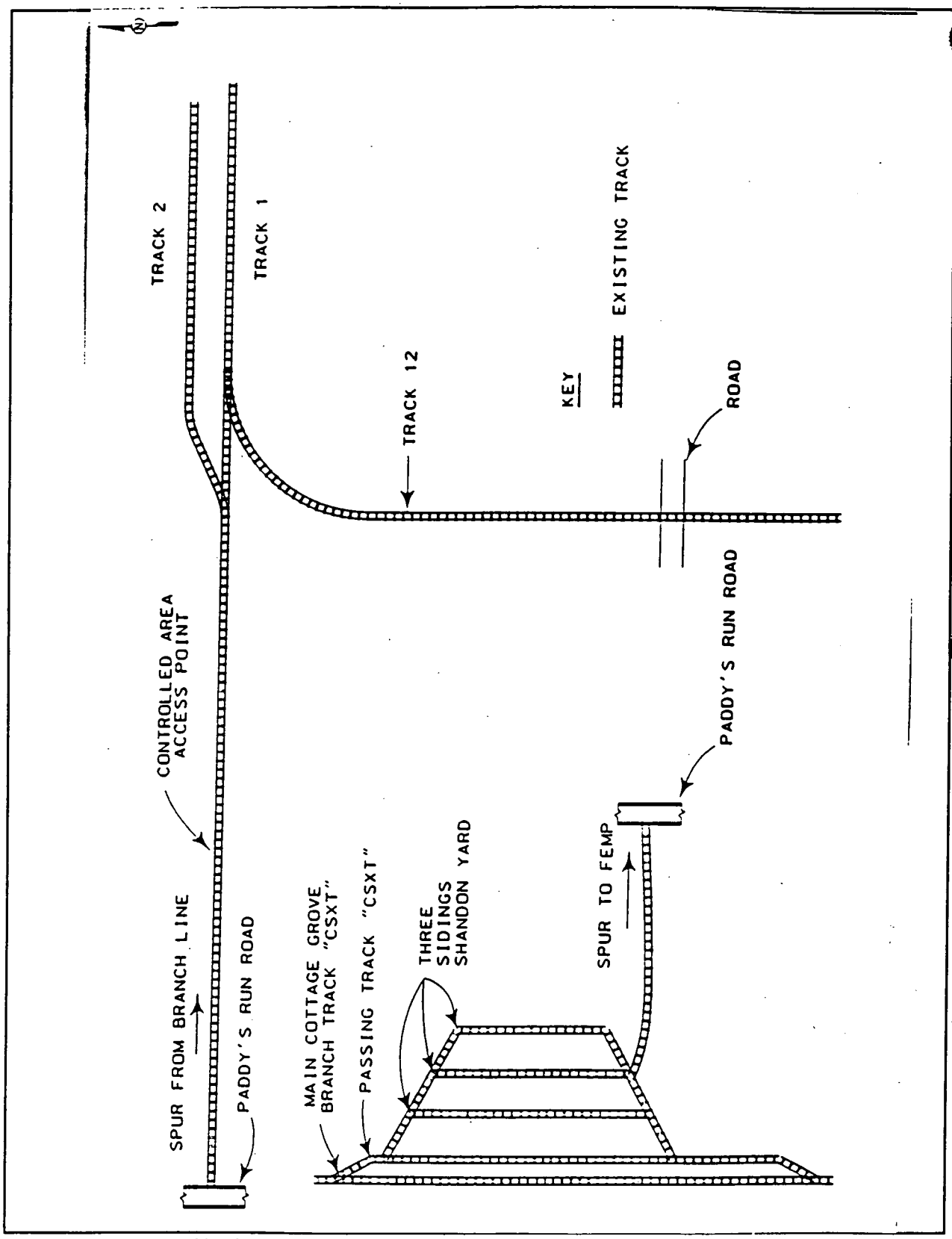

Figure D-1 - FEMP Site Showing Existing Trackage

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This trackage supports five unused light-duty FEMP yard spurs, which are in uncertain condition. In addition, the radius of curvature of these tracks is too severe to support substantial rail traffic. These tracks are in the area to be remediated by Operable Unit 3, and their future viability is unknown. However, FEMP Track 12 (which originates from Track 1, and curves around the west side of the former process area and extends south) is constructed of heavy-duty rail, and appears to be in excellent condition.

Heavy-duty rail weighs about 131 pounds per linear yard, and will handle the weight of OU1's loaded gondola cars. However, Tracks 1 and 2 are constructed with 80 pound per yard light-duty rail. A contact at the US Department of Transportation's Volpe National Transportation Systems Center has indicated that 80 pound per yard rail is unacceptable for loaded cars.[1] This does not preclude use of Tracks 1 and 2 for storage of empty cars.

D-1.3 Spatial and Traffic Constraints

To comply with commitments to the public, CSXT's Shandon Yard is not used in any manner. As a result of environmental and locational considerations, the only areas available at the FEMP for the construction of new track at the FEMP are parallel to, and:

- South of Track 1.

  Construction of the FEMP Railyard, for storage of filled and empty cars, in this area requires the permanent blockage of "B" Street.

- East and west of Track 12.

  The existing grade crossing of Track 12, between the Low and High Nitrate Tanks, becomes part of the FEMP's primary waste haul road. OU3 has assumed the responsibility to construct the roadbed and the warning devices necessary to cross OU1's track structure. It is preferable to have no new tracks crossing the road.

The area south of Track 1 is selected for construction of the FEMP Railyard.

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1 Hay, W. "Assessment of Ability of 80 Pound Rail Section to Withstand Loads from a 100-Ton Hopper Car", Railroad Engineering.

D-1.4 Design and Operational Constraints

This section presents the design basis for the additional FEMP trackage required for loading and storage of railcars. After completion of the on-site rail upgrade illustrated by Figure D-2, the FEMP rail system can be described as follows:

- The FEMP has sufficient track to:

    - o Store all of the railcars on-site in the event that operations are temporarily stopped.

    - o Commence unit train operations with a full inventory of stored cars; i.e., not be "carbound".

- Under normal production operations, the FEMP originates and receives unit trains using on-site trackage in a timely manner.

  Due to public input:

    - o The maximum time, that railcars are on the section of the Main FEMP Spur outside of the Controlled Area, is about 36-hours.

    - o CSXT does not use its Branch Line trackage, in the vicinity of the FEMP, for switching operations in order to deliver and remove unit trains of empty and filled cars on the same day. Therefore, empty cars arrive at least one day after a unit train of filled cars has departed. This involves "deadhead" (i.e., without cars) CSXT locomotive traffic along the Branch Line.

  The FEMP achieves these mandates by using a "wye"[2] to allow a small locomotive to rapidly transfer railcars from the FEMP Railyard tracks to the Main FEMP Spur and vice-versa. The wye includes the new curve, connecting the main FEMP Spur and Track 12 and the existing curve.

- From the preceding section:

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[2] A triangular track system with three curved legs and three switches.

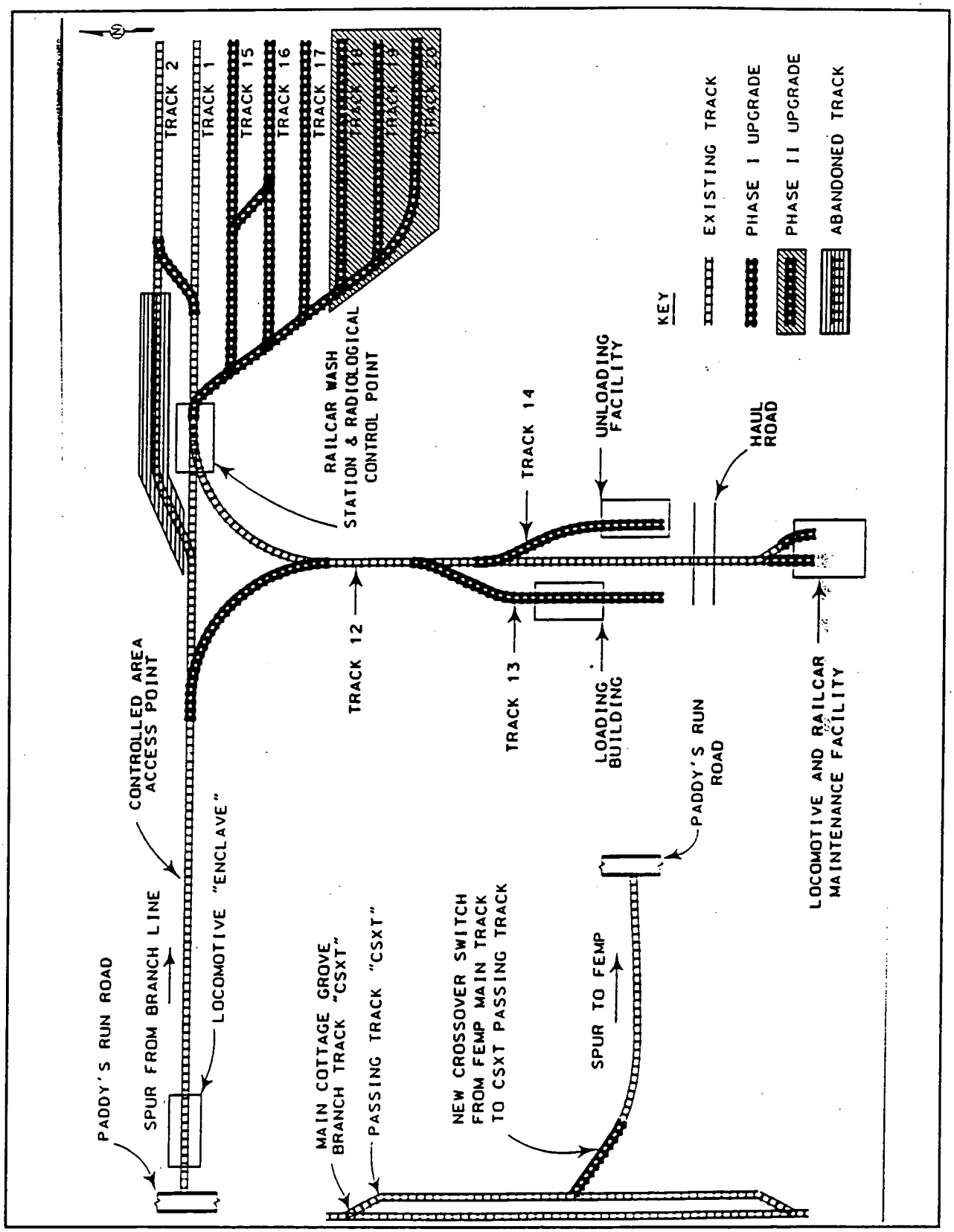

Figure D-2 - Proposed FEMP Railroad Facilities

- o Existing Tracks 1 and 2 are dedicated for empty cars.
- o All new track is constructed from heavy-duty rail.

- New parallel tracks (Numbers 15 *et.seq.*), adjacent to and south of, Track 1, serve to accumulate loaded cars. These tracks are constructed in two phases in order to accommodate the:

  - o Start of production in FY 1998 (Tracks 15, 16 and 17), and
  - o Anticipated production increase in FY 2001 (Tracks 18, 19 and 20).

- The FEMP railcar loading facility is served by a new spur, Track 13, accessed by a switch at the north end of existing Track 12, immediately south of the new wye. Track 13 is west of, and parallel to, Track 12, and is long enough to allow three cars to project out of either the north and south ends of the Loading Building.

- A similar track (Number 14), tentatively located on the east side of Track 12 is used in the event that it is necessary to unload railcars. This need arises if a loaded car is rejected by FEMP or Representative Permitted Disposal Facility (RPCDF) Quality Assurance (QA). As currently configured, Track 14 is accessed by a switch south of the one for Track 13.

- The new FEMP trackage is constructed in accordance with the following guidelines:

  - o New switches are limited to those absolutely necessary.

  - o Crossovers, between the railcar storage tracks, are not recommended as operation becomes more complicated, and the potential for derailments increases.

The first step in the design process is to determine the number of required railcars. Then, trackage needs to support the planned operation are determined. Although operational details in this paper reflect initial planning and are subject to change, the trackage layout is sufficiently flexible to accommodate the needs of OU1. However, this document does not address possible rail transportation requirements of other FEMP operable units, and revisions may be necessary if any such needs are defined.

D-1.4.1 Density

For purposes of this plan, the as-loaded density of the material is 80 pounds per cubic foot.

D-1.4.2 Railcars

Due to commitments made in public meetings, railcars are fitted with hard covers which are only removed to install liners and load the cars.

DOE's Fernald Field Office has informally accepted FERMCO's suggestion that standard, medium-wall height gondola cars be acquired. Depending upon the manufacturer, these cars have interior box dimensions of 52½ feet (L) x 9½ feet (W) x 5½ feet (H)[3]. An average one-foot freeboard is the minimum achievable by a production loading operation. As the wall of the recommended car type is one-foot higher than that of common low-wall units, about 90 tons (2240 cubic feet) of material can be loaded.

The coupler-to-coupler 57 foot length of the recommended gondola cars is the primary factor in determining trackage needs for railcar storage at the FEMP. Shorter "high-wall" gondola cars would require less FEMP trackage, but their internal wall supports prevent compliance with the commitment that the railcars be lined.

D-1.4.3 Minimum Number of Railcars per Unit Train

CSXT, the originating railroad, requires that a unit train's "consist"[4] be at least 40 cars. In addition, pursuant to the requirements of 49 CFR 174.85, a spacer car is necessary to limit exposure to the train crews. The railroads require that the spacer car be loaded to prevent it from derailing. Thus, an inert one-time load of cargo will have to be obtained for such cars. For example, the cargo could consist of absorbent material for use, if necessary, by Envirocare in treating any loads found to have free liquids upon arrival at the site.

D-1.4.4 Maximum Number of Railcars per Unit Train

The length of the train is limited by the FEMP's trackage for originating trains. As the Shandon Yard is not available, the trains must be made up along the Main FEMP Spur up to the point-of-switch for Track 2, as currently configured. Thus, allowing space for access of two CSXT line-haul locomotives and a spacer car, a maximum of about 53-gondola railcars can be dispatched by the FEMP at one time.

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[3] Fernald Environmental Restoration Management Corporation, July 31, 1995, "OU1 Transportation Mode Options Analysis - Direct Rail Shipment from the FEMP to a Permitted Commercial Disposal Facility Versus Intermodal Transfer".

[4] Number and/or type of cars comprising a freight train.

D-1.4.5 Production Rate

This section is based upon the anticipated production rates between FY 1998 through FY 2004. The corresponding average daily railcar production rates (275 operating days per fiscal year) are tabulated below:

Table D-1. Anticipated Daily Railcar Production

Fiscal Year:	1998	1999	2000	2001	2002	2003	2004
Average Railcars Produced per Day (275 Operating Days per Year):	2.2	3.2	3.0	6.0	6.3	6.2	6.7
Maximum Railcars per Unit Train:	42	45	42	48	50	50	53
Days to Produce Unit Train:	19	14	14	8	8	8	8

From this table, the rationale for the recommended rail design is as follows:

- The 6.7 cars per day generation rate in FY 2004 is considered as the upper limit as this high production level only exists for one year. No contingency is added for more production, as additional funding is not be expected to be received.

- The "base load" railcar generation rate is the three cars per day forecasted in FY 2000. Sufficient additional railcars will be obtained to afford production flexibility in response to possible short-notice funding increases which would allow the plant to operate at a higher rate and/or more than 275 days per year.

- The railcars should be procured, by lease or purchase, in two phases to accommodate the increased production rate at the start of FY 2001. Similarly, the rail infrastructure should be completely designed for both phases. However, construction of the second phase should be delayed until the purchase decision for the second batch of railcars.

- As noted in Section D-1.6.2.1, varying the number of railcars per unit train allows production increases (up about 25 per cent of the baseload) without impacting the overall unit train schedule. Significant production fluctuations will necessitate revision of the unit train cycle and/or number.

D-1.5 Scheduling

D-1.5.1 Analytical Hold Periods

Two days are scheduled for completion of preliminary quality assurance testing of the material loaded into railcars. An additional four days are necessary to receive analytical data for the estimated 10 percent of the cars which may fail the preliminary tests.

D-1.5.2 Railroad Transit Time

CSXT has quoted a unit train round trip transit time of 11 days for the representative PCDF.[5]

D-1.5.3 PCDF Turn-Around Time

A four day cycle (Day 6 through Day 9 of the aggregate 15 day off-site time) affords time for: (1) waste acceptance, (2) unloading, and (3) train make-up. FEMP scheduling must insure that two unit trains are not at the PCDF at the same time.

D-1.5.4 FEMP Turn-Around Time

One day is provided for the unit train to be assembled at the FEMP, and another day is afforded for break-down of the unit train of returned empty cars. Furthermore, as noted in Section D-1.4, the public opposes unit trains arriving and departing on the same day.

D-1.6 Operation of Multiple Unit Trains

D-1.6.1 Production Start-Up

As noted in Table D-2, prior to the release of approved loaded cars, the following reserves must be filled:

- Two days of railcar production are loaded and certified as "quality assured" at the start of the third working day to provide a production reserve. This affords spare cars in the event that:
    - The last batches of cars to be included in the out-bound unit train are rejected by quality assurance.
    - CSXT refuses to accept a car due to a maintenance problem.

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[5] Johnson, R. July 6, 1994 letter, CSX Transportation, Inc.

- The third and fourth days of production satisfy the holding requirements for initial QA testing.

- A reserve of empty cars is maintained to accommodate 10 percent of four days' production that may fail the initial QA tests. The need for this reserve will be periodically reviewed during the course of the project.

Table D-2. Unit Train "Consist" and Trackage Requirements.

Fiscal Years:	1999 & 2000		2001, 2002, 2003 and 2004	
Planning Basis For Railcar Utilization:	Minimum Rate with 130 Cars	Maximum Rate with 130 Cars	Minimum Rate with 190 Cars	Maximum Rate with 190 Cars
Production Rate, Cars/Day:	3.0[6]	3.8	5.00	6.7[7]
Unit Trains:	2	2	3	3
Cars/Unit Train with Pit Material:	42	53	40	53
Total Unit Train Cars for Pit Material:	84	106	120	159
Maximum Working Reserve Cars:	12	12	10	[illegible]
Production Reserve Cars (2-days):	6	0	10	0
1st Analytical Reserve Cars (2-days):	6	8	10	13
2nd Analytical Reserve Cars (10%; 4-days):	1	2	2	3
Production Surge Spare Cars:	19	0	35	0
FEMP Spacer Cars:	2	2	3	3
TOTAL NUMBER OF RAILCARS NEEDED:	**130**	**130**	**190**	**190**
TOTAL FEET OF STORAGE TRACK REQUIRED:	**7,426**		**10,854**	
Storage track needed if the following tracks are used:				
Tracks 1/2 (3,200'):	4,226		7,654	
Tracks 1/2 and Track 12 (1,250'):	2,976		6,404	

[6] Production rate for FY 2000.

[7] Production rate for FY 2004, the last year of the project.

When the production reserve is drawn down, it must be replenished by increasing daily production. A reserve must be maintained when the unit trains are at, or near, the 40-car minimum; the reserve is not mandatory when longer trains are shipped.

D-1.6.2 Unit Train Operations

D-1.6.2.1 Operating Flexibility

FERMCO has established that rail options, involving DOE-owned/leased cars and unit trains, offer increased safety and security over use of the railroads' regularly scheduled freight service in which cars:

- Sit unattended on sidings waiting for next train.
- Are switched from one train to another in various yards while transiting to and from the PCDF.
- Are scattered across the country, and subject to unauthorized appropriation to other service in the event of local car shortages.

In addition, unit train service reduces the project cost due to:

- o A discount afforded to this type of traffic by the railroads.
- o Faster transit time which maximizes utilization of railcars.

From an operating perspective, the primary disadvantages are that:

- Scheduling problems will "ripple" through the transportation system. The ripple effect may increase over time and distance from the source, particularly with multiple unit trains.
- Production surges must be accommodated.

These problems may be addressed by varying the trains': (1) scheduling and/or (2) consist. The first method involves constantly changing the schedule for unit train departures. CSXT has evinced a willingness to be somewhat flexible in this matter, but will require a one-week advance notice of schedule changes. The recommended solution is to establish a unit train operating schedule for the lowest anticipated production rate and respond to surges by increasing the number of cars. As noted in Section D-1.7, the FEMP's rail system is designed such that 53-car unit trains could be originated.

D-1.6.3 Total Number of Railcars Required

Table D-2 summarizes railcar and track requirements for various production scenarios.

As noted in Section D-1.4.5, the FY 2000 production rate is a minimum rate case, and accommodation would be necessary for production surges. The FY 2004 production is considered as an upper "cap". Table D-2 is the basis for recommending that railcars be procured in two phases:

- Phase I: Lease/purchase 130 railcars (valued at $7.2 million on the basis of a unit cost of $55,000[8]) for delivery in the first quarter of FY 1998.

- Phase II: If funding materializes to support a substantial production increase, lease/purchase an additional 60 cars to be received in the last quarter of FY 2000.

Cost reduction efforts include:

- Performing a lease versus purchase analysis for new cars, and

- Preparing a solicitation to determine the availability of a uniform fleet of used railcars in good condition.

D-1.7 FEMP Storage Track Requirements

The installation of new storage sidings (Tracks 15 *et.seq.*) is subject to the constraint that the FEMP have sufficient track to store all railcars in the event that operations were to be suspended due to:

- Funding problems, or
- Seasonal weather disruptions.

In addition, car storage on the Main FEMP Spur is impractical, as this would block the FEMP's ability to originate unit trains upon resumption of production.

Sidings derived from, and parallel to Track 1, are configured as a "ladder track" (*i.e.*, a series of switches which provide access to several parallel dead-end yard tracks. If all of these stub tracks

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[8] FERMCO, July 1995, Draft OU1 Transportation Mode Options Analysis - Direct Rail Shipment from the FEMP to a Permitted Commercial Disposal Facility versus Intermodal Transfer.

terminate at a common boundary, such as the on-site cell, each successive stub will be shorter than the previous one. For Number 8 turnouts:

- The offset distance between the points of switch for successive spurs is 112 feet.
- The closest point of approach of a railcar on a spur to the point of switch is 112 feet, due to offset requirements to eliminate interferences between railcars on adjacent tracks. Furthermore, the usable length is further reduced by a 50-foot minimum buffer space at the far end of the track.

On the basis of Table D-2, Table D-3 presents the FEMP's FY 2004 storage track needs if the 4,450 feet of track afforded by existing Tracks 1, 2 and 12 are used.

Table D-3. Proposed Minimum New FEMP Spur Tracks for FY 2004 Production Rate (Car Storage on Tracks 1, 2 and 12)

Track No.	Spur Total Length, Feet	Usable Trackage, Feet	Additional Required Footage
			6,404
15	1,650	1,488	4,916
16	1,538	1,376	3,540
17	1,426	1,264	2,276
18	1,314	1,152	1,124
19	1,202	1,040	84
20	1,090	928	0

In view of funding uncertainties, this is an excessive amount of storage track to construct at one time. Accordingly, it is recommended that the FEMP embark on a two-phase program to procure railcars and install the required track as follows:

- Phase I FY 1998 through FY 2000 production (Tracks 15-17).
- Phase II FY 2001 through FY 2004 output (Tracks 18-20).

Table D-4 presents the trackage requirements for Phase I if Tracks 1, 2 and 12 are used.

Table D-4. Proposed New Phase I FEMP Spur Tracks
for FY 1998-2000 Production Rate
(Car Storage on Tracks 1, 2 and 12)

Track No.	Spur Total Length, Feet	Usable Trackage, Feet	Additional Required Footage
			2,976
15	1,650	1,488	1,488
16	1,538	1,376	112
17	1,426	1,264	0

Tracks 15 and 16 almost satisfy the minimum FEMP railcar needs. Track 17 is needed for storage of cars held for analytical clearance. The origination of 53-car unit trains will require a crossover, as discussed in Section 3.2.3.1.

In addition to the above-noted track, Phase I also involves:

- Inspection of the Main FEMP Spur and the FEMP trestle (upgrading, if necessary).
- Inspection, upgrading, and east extension, of Tracks 1 and 2.
- Construction of the new curve to connect the Main FEMP Spur with Track 12.
- Construction of Tracks 13 and 14.
- "Upfront cost" (to be credited) for rebuilding CSXT Shandon Yard switches.
- Construction of support facilities noted in Section D-2.

Cost reduction efforts focus on availability/procurement of:

- Heavy-duty "relayer" rail, at favorable pricing, from CSXT's former Shandon Yard.

- Rail from the abandoned southern section of Track 12 for the construction of the new curve-in from the Main FEMP Spur to the north end of Track 12.

- The car bumpers, at the ends of abandoned FEMP stub spurs, for "recycling" via emplacement at the end of each new spur track constructed.

D-2 SUPPORT FACILITIES

D-2.1 Loading Building

This building and the following facilities are not included in this program as they are considered to comprise the processing plant "package" to be designed by PARSONS:

- Railcar mover.
- Railcar scale.
- Computer and software for automated shipping document preparation.
- Railcar washing and spent fluid management.
- Radiological monitoring and analytical equipment for determining railcar:
    - o Total fixed and removable contamination.
    - o Removable contamination.
- Dust control.

D-2.2 Railcar Unloading

This area is supported by Track 14. The facility affords access for equipment to remove material from a railcar and load the waste into a container or truck for return to the OU1 processing area. The entire working area, including the track, is hard surfaced. No other provisions are included.

D-2.3 Radiological Control Point and Final Car Wash

This structure, having a length slightly longer than one railcar, is similar to the enclosure over the main vehicular access point to the FEMP Controlled Area. No provisions are included in the scope of this work package for laboratory facilities involving radiological detection/counting instrumentation.

If time-consuming tests are required, prior to the release of the loaded railcars, the radiological personnel will have to "field perform" the required monitoring/sampling of cars on Tracks 15 and 16.

The railcar wash station is a simple facility, exposed to the elements, and allows for optional spraying

of railcar undercarriage, sides and cover as the cars are moved slowly through the structure by means of the locomotive. Water is collected in a diked area underneath the tracks; additional liquid handling is beyond the scope of this package. This facility is sited on Track 1, east of the northeast wye switch.

D-2.4 Locomotive and Railcar Maintenance Building

A three-bay building is constructed with two adjacent bays having parallel tracks along their entire length. This structure houses the FEMP locomotive(s) and affords simple maintenance services (e.g., lubrication as opposed to engine overhauls). In addition, space is available for scheduled contract-maintenance of the leased gondola railcars. A primary function of the facility is repairing railcar covers. To accomplish this, a railcar with a "bad order" cover is spotted in the center bay. The cover is removed by an overhead crane and placed on a dolly in the adjacent non-rail bay for work or transport outside the building. The new cover is moved from temporary laydown on the tracks of the other bay and placed on the car. This procedure may also used to successively move covers, stacked on flat cars used for shipping from the vendor's plant, onto DOE's gondola cars.

The building includes: an overhead crane of appropriate capacity for the locomotive, a fueling facility and a heated trailer with telephone and toilet facilities. Tools and other "shop" provisions are excluded from this package. An outside paved yard, with a two-ton capacity simple overhead crane, stores covers and additional components. The crane traverses three stored covers, the dolly area outside the bay and a laydown area for a cover removed from a car.

D-2.5 Fencing

The scope of this project includes:

- Chain link fencing around:
  - The Main FEMP spur from the Controlled Area to Paddys Run Road.
  - A 200-foot minimum length CSXT locomotive "enclave", east of Paddys Run Road, with sliding gates at each end, to isolate CSXT's equipment and crew from the site. A small heated shelter with a chemical toilet is provided for FEMP security personnel awaiting the arrival/departure of a train.
- Radiological control fencing around Tracks 1, 2 15, 16, 17 and the rest of the Main FEMP Spur.

D-3 LOGISTICS

D-3.1 Unit Train Management During Production Operations

With respect to train origination, the number of cars released from QA must equal a pre-determined "average" number of cars per day. A uniform production rate is not necessary, but the number of cars generated each day must be an integer.

The illustrative basis for this discussion is Figure D-3 on page D-18, which depicts the operating cycle from point of start-up (after all of the analytical and production car reserves have been established) for the FY 2000 production rate of 3 cars per day. Under this scenario, which is considered to be the Base Load Case for track design purposes, fourteen days are required to generate each of two minimum length unit trains (i.e., 42-cars). The following daily schedule for railcar management, based upon a selected starting point on Day 15, complements the schedule for railcar movements described by Section D-3.2.3.1:

- Days 15-27: QA releases cars designated for Train 2.
- Day 28: QA releases last cars assigned to Train 2 which is made-up on this day along the Main FEMP Spur.
- Day 29: Train 2 departs, and first set of cars, allocated to Train 1, is released by QA. First three cars from the "Working Reserve" are loaded and placed into analytical hold.
- Day 30: Three more empty cars from the Working Reserve are loaded. QA releases cars, filled two days previously, which are assigned to Train 1.
- Day 31: Three more Working Reserve railcars are filled. QA releases cars loaded two days previously, which are assigned to Train 1. Train 1 arrives and is broken down. At end of day, Working reserve cars are replenished from Train 1 cars.
- Day 32: Three cars are QA-approved and join the nine cars released on Days 29-31, assigned to Train 1.
- Day 42: Train Number 1 is made-up on Main FEMP Spur using previously released assigned cars and three provided by QA that day. Three empty

STATUS AT DAY END

DAY	CARS FROM QA/QC	TRAIN 1	TRAIN 2	TRAIN 3	CAR SOURCE TRAIN	CAR SOURCE "WORKING" RESERVE	TOTAL QA/QC CARS	EMPTY "WORKING" RESERVE CARS
0	0	ARRIVE			0			
1	3	3 3			3	0	0	9
2	3	3 6			3	0	0	9
3	3	3 9			3	0	0	9
4	3	3 12			3	0	0	9
5	3	3 15			3	0	0	9
6	3	3 18			3	0	0	9
7	3	3 21			3	0	0	9
8	3	3 24			3	0	0	9
9	3	3 27			3	0	0	9
10	3	3 30			3	0	0	9
11	3	3 33			3	0	0	9
12	3	3 36			3	0	0	9
13	3	3 39			3	0	0	9
14	3	3 42	ARRIVE		3	0	0	9
15	3	LEAVE	3 3		3	0	0	9
16	3	1	3 6		3	0	0	9
17	3	2	3 9		3	0	0	9
18	3	3	3 12		3	0	0	9
19	3	4	3 15		3	0	0	9
20	3	5	3 18		3	0	0	9
21	3		3 21		3	0	0	9
22	3		3 24		3	0	0	9
23	3		3 27		3	0	0	9
24	3		3 30		3	0	0	9
25	3	10	3 33		3	0	0	9
26	3	11	3 36		3	0	0	9
27	3	12	3 39		3	0	0	9
28	3	13	3 42		3	0	0	9
29	3	14	LEAVE		0	3	3	6
30	3	15	1		0	3	6	3
31	3	ARRIVE	2		0	3	9	0
32	3	12 12	3		12	0	0	9
33	3	3 15	4		3	0	0	9
34	3	3 18	5		3	0	0	9
35	3	3 21			3	0	0	9
36	3	3 24			3	0	0	9
37	3	3 27			3	0	0	9
38	3	3 30			3	0	0	9
39	3	3 33	10		3	0	0	9
40	3	3 36	11		3	0	0	9
41	3	3 39	12		3	0	0	9
42	3	3 42	13		3	0	0	9
43	3	LEAVE	14		0	3	3	6
44	3	1	15		0	3	6	3
45	3	2	ARRIVE		0	3	9	0
46	3	3	12 12		12	0	0	9
47	3	4	3 15		3	0	0	9
48	3	5	3 18		3	0	0	9
49	3		3 21		3	0	0	9
50	3		3 24		3	0	0	9
51	3		3 27		3	0	0	9
52	3		3 30		3	0	0	9
53	3	10	3 33		3	0	0	9
54	3	11	3 36		3	0	0	9
55	3	12	3 39		3	0	0	9
56	3	13	3 42		3	0	0	9
57	3	14	LEAVE		0	3	3	6
58	3	15	1		0	3	6	3

Dark shading indicates days when trains are in transit; solid shading shows days at PCDF.

Figure D-3 - Operating Schedule for 2 x 42-Car Unit Trains (14 day Cycle) at Minimum Supportable Production Rate of 3.0 Cars (270 Tons) Per Day

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cars from the "Working Reserve" are loaded. QA releases cars filled two days previously which are assigned to Train 1.

- Day 43: Train 1 departs and Working Reserve is "tapped" as a source of cars to be loaded. Three cars are released from QA and assigned to Train 2.

Usually, a repeatable cycle is developed after all of the trains have made one trip. However, a review of Figures D-5 and D-6, respectively on pages D-21 and D-22, shows that the train is at the PCDF for five days, rather than the minimum of four days. This avoids having the first train leave on the same day that the second arrives, and is the basis for the "staggered unit concept" in which time elapses between the departure of one unit train and the arrival of the next. This is mandated because the Shandon Yard cannot be used for train origination.

Using the same unit train cycle, Figure D-4 on page D-20, shows that production surges up to 26 per cent (3.8 cars per day) can be accommodated by increasing the cars in the train up to a maximum of 53. For this scenario, an additional nine to twelve cars are required as a working reserve to accommodate the loading of three to four cars per day during the three day intervals between unit trains.

Similarly, Figures D-5 and D-6 illustrate the operation of three unit trains, operating on an eight day cycle. Increasing the number of cars from 40 to 53, provides the means to support the maximum production rate of 6.74 cars per day in FY 2004.

D-3.2 FEMP Track Utilization

D-3.2.1 On-Site Storage of 130 Railcars

This section presents the plan for storing all of the railcars on the site during Phase I if operations are temporarily halted.

The method for putting all FEMP cars into storage is for the site locomotive to pull/push successive strings of inbound cars onto:

- Existing Tracks 1 and 2.
- New Tracks 15 through 17.

Track 17 will be used in lieu of Track 12. The locomotive will then proceed into the new maintenance structure at the south end of Track 12.

STATUS AT DAY END

DAY	CARS FROM QA/QC	TRAIN 1	TRAIN 2	TRAIN 3	CAR SOURCE TRAIN	CAR SOURCE "WORKING" RESERVE	TOTAL QA/QC CARS	EMPTY "WORKING" RESERVE CARS
0	0	ARRIVE			0			
1	3	3 3			3	0	0	9
2	3	3 6			3	0	0	9
3	3	3 9			3	0	0	9
4	4	4 13			4	0	0	9
5	4	4 17			4	0	0	9
6	4	4 21			4	0	0	9
7	4	4 25			4	0	0	9
8	4	4 29			4	0	0	9
9	4	4 33			4	0	0	9
10	4	4 37			4	0	0	9
11	4	4 41			4	0	0	9
12	4	4 45			4	0	0	9
13	4	4 49			4	0	0	9
14	4	4 53	ARRIVE		4	0	0	9
15	3	LEAVE	3 3		3	0	0	9
16	3	1	3 6		3	0	0	9
17	3	2	3 9		3	0	0	9
18	4	3	4 13		4	0	0	9
19	4	4	4 17		4	0	0	9
20	4	5	4 21		4	0	0	9
21	4		4 25		4	0	0	9
22	4		4 29		4	0	0	9
23	4		4 33		4	0	0	9
24	4		4 37		4	0	0	9
25	4	10	4 41		4	0	0	9
26	4	11	4 45		4	0	0	9
27	4	12	4 49		4	0	0	9
28	4	13	4 53		4	0	0	9
29	3	14	LEAVE		0	3	3	6
30	3	15	1		0	3	6	3
31	3	ARRIVE	2		0	3	9	0
32	4	13 13	3		13	0	0	9
33	4	4 17	4		4	0	0	9
34	4	4 21	5		4	0	0	9
35	4	4 25			4	0	0	9
36	4	4 29			4	0	0	9
37	4	4 33			4	0	0	9
38	4	4 37			4	0	0	9
39	4	4 41	10		4	0	0	9
40	4	4 45	11		4	0	0	9
41	4	4 49	12		4	0	0	9
42	4	4 53	13		4	0	0	9
43	3	LEAVE	14		0	3	3	6
44	3	1	15		0	3	6	3
45	3	2	ARRIVE		0	3	9	0
46	4	3	13 13		13	0	0	9
47	4	4	4 17		4	0	0	9
48	4	5	4 21		4	0	0	9
49	4		4 25		4	0	0	9
50	4		4 29		4	0	0	9
51	4		4 33		4	0	0	9
52	4		4 37		4	0	0	9
53	4	10	4 41		4	0	0	9
54	4	11	4 45		4	0	0	9
55	4	12	4 49		4	0	0	9
56	4	13	4 53		4	0	0	9
57	3	14	LEAVE		0	3	3	6
58	3	15	1		0	3	6	3

Dark shading indicates days when trains are in transit; solid shading shows days at PCDF.

Figure D-4 - Operating Schedule for 2 x 53-Car Unit Trains (14-Day Cycle) at Maximum Supportable Production Rate of 3.78 Cars Per Day

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STATUS AT DAY END

DAY	CARS FROM QA/QC	TRAIN 1	TRAIN 2	TRAIN 3	CAR SOURCE TRAIN	CAR SOURCE "WORKING" RESERVE	TOTAL QA/QC CARS	EMPTY "WORKING" RESERVE CARS
0	0	ARRIVE			0			
1	5	5 5			5	0	0	10
2	5	5 10			5	0	0	10
3	5	5 15			5	0	0	10
4	5	5 20			5	0	0	10
5	5	5 25			5	0	0	10
6	5	5 30			5	0	0	10
7	5	5 35			5	0	0	10
8	5	5 40	ARRIVE		5	0	0	10
9	5	LEAVE	5 5		5	0	0	10
10	5	1	5 10		5	0	0	10
11	5	2	5 15		5	0	0	10
12	5	3	5 20		5	0	0	10
13	5	4	5 25		5	0	0	10
14	5	5	5 30		5	0	0	10
15	5		5 35		5	0	0	10
16	5		5 40	ARRIVE	5	0	0	10
17	5		LEAVE	5 5	5	0	0	10
18	5		1	5 10	5	0	0	10
19	5		2	5 15	5	0	0	10
20	5	11	3	5 20	5	0	0	10
21	5	12	4	5 25	5	0	0	10
22	5	13	5	5 30	5	0	0	10
23	5	14		5 35	5	0	0	10
24	5	15		5 40	5	0	0	10
25	5	16		LEAVE	0	5	5	5
26	5	ARRIVE		1	0	5	10	0
27	5	15 15		2	15	0	0	10
28	5	5 20	11	3	5	0	0	10
29	5	5 25	12	4	5	0	0	10
30	5	5 30	13	5	5	0	0	10
31	5	5 35	14		5	0	0	10
32	5	5 40	15		5	0	0	10
33	5	LEAVE	16		0	5	5	5
34	5	1	ARRIVE		0	5	10	0
35	5	2	15 15		15	0	0	10
36	5	3	5 20	11	5	0	0	10
37	5	4	5 25	12	5	0	0	10
38	5	5	5 30	13	5	0	0	10
39	5		5 35	14	5	0	0	10
40	5		5 40	15	5	0	0	10
41	5		LEAVE	16	0	5	5	5
42	5		1	ARRIVE	0	5	10	0
43	5		2	15 15	15	0	0	10
44	5	11	3	5 20	5	0	0	10
45	5	12	4	5 25	5	0	0	10
46	5	13	5	5 30	5	0	0	10
47	5	14		5 35	5	0	0	10
48	5	15		5 40	5	0	0	10
49	5	16		LEAVE	0	5	5	5
50	5	ARRIVE		1	0	5	10	0
51	5	15 15		2	15	0	0	10
52	5	5 20	11	3	5	0	0	10
53	5	5 25	12	4	5	0	0	10
54	5	5 30	13	5	5	0	0	10
55	5	5 35	14		5	0	0	10
56	5	5 40	15		5	0	0	10
57	5	LEAVE	16		0	5	5	5
58	5	1	ARRIVE		0	5	10	0

Dark shading indicates days when trains are in transit; solid shading shows days at PCDF.

Figure D-5 - Operating Schedule for 3 x 40-Car Unit Trains (8-Day Cycle) at Minimum Supportable Production Rate of 5.0 Cars (450 Tons) Per Day

DAY	CARS FROM QA/QC	TRAIN 1	TRAIN 2	TRAIN 3	STATUS AT DAY END: CAR SOURCE TRAIN	STATUS AT DAY END: CAR SOURCE "WORKING" RESERVE	STATUS AT DAY END: TOTAL QA/QC CARS	STATUS AT DAY END: EMPTY "WORKING" RESERVE CARS
0	0	ARRIVE			0			
1	6	6 6			6	0	0	12
2	6	6 12			6	0	0	12
3	6	6 18			6	0	0	12
4	7	7 25			7	0	0	12
5	7	7 32			7	0	0	12
6	7	7 39			7	0	0	12
7	7	7 46			7	0	0	12
8	7	7 53	ARRIVE		7	0	0	12
9	6	LEAVE	6 6		6	0	0	12
10	6	1	6 12		6	0	0	12
11	6	2	6 18		6	0	0	12
12	7	3	7 25		7	0	0	12
13	7	4	7 32		7	0	0	12
14	7	5	7 39		7	0	0	12
15	7		7 46		7	0	0	12
16	7		7 53	ARRIVE	7	0	0	12
17	6		LEAVE	6 6	6	0	0	12
18	6		1	6 12	6	0	0	12
19	6		2	6 18	6	0	0	12
20	7	11	3	7 25	7	0	0	12
21	7	12	4	7 32	7	0	0	12
22	7	13	5	7 39	7	0	0	12
23	7	14		7 46	7	0	0	12
24	7	15		7 53	7	0	0	12
25	6	16		LEAVE	0	6	6	6
26	6	ARRIVE		1	0	6	12	0
27	6	18 18		2	18	0	0	12
28	7	7 25	11	3	7	0	0	12
29	7	7 32	12	4	7	0	0	12
30	7	7 39	13	5	7	0	0	12
31	7	7 46	14		7	0	0	12
32	7	7 53	15		7	0	0	12
33	6	LEAVE	16		0	6	6	6
34	6	1	ARRIVE		0	6	12	0
35	6	2	18 18		18	0	0	12
36	7	3	7 25	11	7	0	0	12
37	7	4	7 32	12	7	0	0	12
38	7	5	7 39	13	7	0	0	12
39	7		7 46	14	7	0	0	12
40	7		7 53	15	7	0	0	12
41	6		LEAVE	16	0	6	6	6
42	6		1	ARRIVE	0	6	12	0
43	6		2	18 18	18	0	0	12
44	7	11	3	7 25	7	0	0	12
45	7	12	4	7 32	7	0	0	12
46	7	13	5	7 39	7	0	0	12
47	7	14		7 46	7	0	0	12
48	7	15		7 53	7	0	0	12
49	6	16		LEAVE	0	6	6	6
50	6	ARRIVE		1	0	6	12	0
51	6	18 18		2	18	0	0	12
52	7	7 25	11	3	7	0	0	12
53	7	7 32	12	4	7	0	0	12
54	7	7 39	13	5	7	0	0	12
55	7	7 46	14		7	0	0	12
56	7	7 53	15		7	0	0	12
57	6	LEAVE	16		0	6	6	6
58	6	1	ARRIVE		0	6	12	0

Dark shading indicates days when trains are in transit; solid shading shows days at PCDF.

Figure D-6 - Operating Schedule for 3 x 53-Car Unit Trains (8-Day Cycle) at Maximum Supportable Production Rate of 6.7 Cars Per Day

D-3.2.2 Start-Up of Production

The loading cycle involves removing stored cars from Tracks 16, 15 and 17 in succession. After filling, the first day's production is pushed out to the limits of the FEMP Controlled Area. More cars are added over time. Before the motive capacity of the locomotive is exceeded, the string of cars is pushed out to the east limit of the enclave near Paddys Run road, where it awaits the departure of the first unit train. Then, the storage tracks for filled cars (Numbers 15 and 16) should be sufficiently cleared of empty cars, so that loaded cars can be accepted. As the number of cars on-site decreases, the production and analytical reserves are established, and a regular unit train schedule is developed to match the production rate.

D-3.2.3 FEMP Track Logistics During Production Operations

This section conceptualizes possible FEMP yard operations for accomplishing these railcar movements in order to ensure that the track design will serve its purpose. Modest refinements of the design may be expected. The on-site operations involve the cycling of empty cars from Tracks 1 and 2, to:

- Track 13 for loading.
- Track 17 for analytical hold.
- Track 14 for unloading, if necessary.
- Tracks 15 and 16 for storage.

During the make-up of a unit train, the FEMP locomotive moves cars from Tracks 15/16 to the Main FEMP Spur for pickup by CSXT's locomotives.

This section is based upon Figures D-1 and D-2 which depict the upgraded FEMP track system and the southern portion of the former Shandon Yard. CSXT traffic on the Fernald-Cottage Grove Branch Line travels along the main Branch Line which is the westernmost track. About ¾ mile north of the FEMP Spur, somewhat south of New Haven Road, CSXT's Passing Track is accessed by a switch (the North Branch Line Switch). The Passing Track is immediately east of the main line. About ½ mile south of the FEMP Spur, the Passing Track rejoins the Main Branch Line at a switch (the South Branch Line Switch). The balance of the parallel tracks is the unused Shandon Yard. After removal of the Shandon Yard, the western end of CSXT's spur will be connected directly to the Passing Track. The involved switch will be referred to as "the Spur Switch".

A wye, which enables a switching locomotive to turn cars around by a series of movements (similar to the "K-turn" used by automobiles), is constructed using the following as the legs:

- Existing curve from the Main FEMP Spur to Track 12 (the East Leg).
- New curve between the Main FEMP Spur and Track 12 (the West Leg).
- Main FEMP Spur (the Top Leg)

The following switches will be referenced:

- The Northeast Switch accessing Tracks 1, 2, 15, 16 and 17.
- The Northwest Switch leading to the Main FEMP Spur.
- The South Wye Switch on Track 12.

D-3.2.3.1 Train Origination at the FEMP

This description of the operational scenario for train make-up involves the following steps for a production rate of three cars per day:

- The selected starting point for this example is Day 27 as shown by Figure D-3:

  1) At the start of the day's operation, three cars are pulled out of Tracks 1 or 2, and travel west through the car wash and the radiological check point. Either, or both, of the facilities are activated if necessary. The cars continue west across the Top Leg past the Northwest Switch and onto the Main FEMP Spur. The locomotive reverses direction and shoves the cars south along the West Leg to Track 12, and then onto Track 13 for loading. The loading operation is detailed later in this section.

  2) Then, about ten QA-approved cars (the estimated maximum number of loaded cars that the FEMP locomotive can move), followed by an empty spacer car, are pulled out of Track 16. They move through the car wash and radiological control point for a pre-departure check. The locomotive pulls the cars south, along the East Leg, onto Track 12. After the South Wye Switch is cleared, the cars are pushed north, across the West Leg, and onto the Main FEMP Spur. The cars are stopped immediately east of the fence currently delineating the Controlled Area.

  3) Near the end of the loading shift, the cars on the Main FEMP Spur are pushed out to just east of the locomotive enclave at the west end of the Main FEMP Spur.

4) At the end of the loading shift, decontamination and radiological checking of the three cars ("spotted" at the start of the day in Step 1) continues in the Loading Building.

- Day 28:

5) The first priority of each day's rail operations is to remove the radiologically-surveyed three cars from Track 13, and pull them north along the West Leg onto the Main FEMP Spur. After all cars clear the Northwest Switch, the cars are shoved east across the Top Leg and onto Track 17 to begin the analytical hold period. At some time during each day, a string of QA-released filled railcars are removed from their hold point on Track 17 and moved onto Tracks 15 or 16.

6) Step 1, from Day 27, is repeated to position and load the next set of three cars on Track 13.

7) CSXT is contacted by 8:00 a.m. to provide the standard 24-hour advance notice that a unit train shipment will be ready. This notice confirms the 7-day notice provided earlier.

8) Three empty cars, removed from Tracks 1 or 2, are pre-positioned at the south end of Track 12. Except for a maximum of 19-spare cars for production surges, in order to originate unit trains longer than 42-cars (refer to Table D-2), Tracks 1 and 2 are essentially empty of cars.

9) The combined capacity of Tracks 15 and 16 is about 50-filled cars. During the balance of the shift, successive strings of about ten cars are pulled west out of Tracks 15 and 16. For reasons addressed later, Track 16 is cleared of cars before Track 15. En-route to the East Leg, each string passes through the car wash and radiological survey point. After clearing the South Wye Switch, the locomotive pushes the cars north, along the West Leg and onto the Main FEMP spur. Each string is pushed out to, and coupled with, the cars staged east of the locomotive enclave. After the train is completed, using the cars released that day by QA, FEMP personnel perform a preliminary inspection of brakes, etc.

10) If the departing unit train substantially exceeds 42 cars, it will block the wye, and the last string of cars cannot be placed as detailed in Step 9. It is then necessary for:

- o Track 16 to be cleared of cars, and

- o The locomotive to:

  * Pull the last ten cars remaining on Track 15 to its west end so that they clear the crossover between Tracks 15 and 16.

  * Travel east on Track 16, past the crossover switch. Upon reversing direction, the locomotive moves northwest onto Track 15.

  * Push the last string of cars west onto the Top Leg of the wye. After the string passes the Northeast Switch and is coupled with the rest of the cars, the locomotive reverses direction.

  * After clearing the Northeast Switch, the locomotive changes direction, and moves south on the East Leg to Track 12.

- Day 29 (Shipment):

  11) Step 5, from Day 28, cannot be executed as there may not be sufficient room on the Main FEMP Spur, west of the Northwest Switch, for the string of three radiologically-surveyed cars to be removed from Track 13. Instead, the cars are pulled north across the East Leg of the wye onto Track 16, where the cars are temporarily spotted after clearing the switch accessing the spur. The locomotive proceeds east. After clearing the crossover switch on Track 16, the locomotive reverses, crosses over to Track 15, moves east, and then south along the East Leg to return to the south end of Track 12. The three cars, pre-positioned via Step 8 from Day 28, are then pulled north. After clearing the Track 13 switch, the cars are pushed south into the Loading Building.

  12) About one to two hours after transmitting a position notification at the Cottage Grove Yard, CSXT's locomotives arrive on the FEMP spur, stopping just west of Paddys Run Road.

13) The west sliding gate of the FEMP enclave is opened by Security personnel who then stop traffic on the road. CSXT's locomotives cross over Paddys Run Road and enter the enclave. The west gate is closed, the east sliding gate is opened, and the locomotives proceed a few feet east into the FEMP area in order to couple with the string of loaded outbound cars. The CSXT crew is provided with shipping papers for the train. This operation should only require a few minutes, and CSXT's crew remains in the locomotive.

14) The west gate is opened, automotive traffic is blocked, and CSXT's locomotives pull the unit train of filled cars across Paddys Run Road and north onto the passing track where the CSXT crew performs the brake and safety inspection. CSXT accepts the unit train and departs. The fifteen day off-site cycle commences on Day 30. FEMP Security personnel close all gates and retire.

D-3.2.3.2 Receipt of Empty Cars

Continuing with the example, empty cars are received at the FEMP as follows:

- Day 30 (One day prior to receipt):

  15) A 24-hour advance notice of the cars' arrival is obtained on the basis of car tracking information, and/or receipt of notice from CSXT. This completes the 15-day off-site cycle.

- Day 31 (Receipt of inbound cars):

  16) One hour after FEMP's receipt of telephoned advance notice of the train's imminent arrival, CSXT's locomotives pull 40 cars south from the Main Branch Line, onto the passing track via the North Branch Line Switch, and stop immediately north of the Spur Switch accessing the Main FEMP Spur where they are met by FEMP Security personnel. The cars are uncoupled and temporarily "staged" on the Passing Track, under supervision of FEMP Security.

  17) This step, and Steps 18, 19 and 20, allow CSXT's locomotives to "runaround" the empty cars.

  CSXT's locomotives proceed south on the Passing Track, and stop just north of the South Branch Line Switch which is then manipulated.

18) CSXT's locomotives traverse the switch, and move south onto the Main Branch Line. The South Branch Line Switch is positioned to access the Main Branch Line.

19) CSXT's locomotives move north on the Main Branch Line and just clear the North Branch Line Switch.

20) The locomotives cross the switch, move south onto the Passing Track, and couple with the string of empty cars.

21) The empties are shoved onto the Main FEMP Spur and into the site as described in Steps 13 and 14 from Day 29. The cars are uncoupled just east of the locomotive enclave.

22) CSXT's locomotives move out to the passing track and depart.

23) Strings of 10 to 20 empty cars are pulled east on the Main FEMP Spur by the FEMP locomotive, and south onto Track 12.

24) The cars are pushed north and then east onto Tracks 1 and 2.

D-3.2.3.3 Loading

Loading operations commence after Step 1, from Day 27, is completed:

- Each day:

25) The FEMP locomotive moves empty cars onto Track 13 until they can be attached to the car mover serving the Loading Building.

26) The car mover pulls the string of cars through the building until all cars, except the north car, extend south of the Loading Building.

27) During the day, the cars are loaded and pulled north of the Loading Building.

28) At the conclusion of each day's operation, Steps 4 and 5, from Day 28, are initiated.

- At some time each day, the QA-approved cars are moved from the analytical hold track to Tracks 15 and 16.