3387

SILOS 1 AND 2 ACCELERATED WASTE RETRIEVAL PROJECT

DRAFT FINAL

REMEDIAL DESIGN PACKAGE

NOVEMBER 2000

FERNALD ENVIRONMENTAL MANAGEMENT PROJECT

VOLUME 1

SILOS 1 AND 2 ACCELERATED WASTE RETRIEVAL PROJECT REMEDIAL DESIGN PACKAGE

TABLE OF CONTENTS

VOLUME 1

SECTION	PAGE No.
1 INTRODUCTION	1
2 DETAILED DESCRIPTION OF PROCESS OPERATIONS	
2.1 PROCESS DESCRIPTION	9
2.2 PROCESS CONTROL SUMMARY	29
3 SAMPLING PLAN	52
4 BERM EXCAVATION PLAN	92
5 OPERATIONAL ENVIRONMENTAL CONTROL PLAN	111
5.1 ARAR COMPLIANCE MATRIX	125
5.2 RCS PERFORMANCE CALCULATION	147
5.3 STORMWATER DRAINAGE PLAN	187
5.4 WASTE HANDLING WORK PLAN	216
5.5 SILOS PROJECTS ENVIRONMENTAL MONITORING PLAN	231
6 HEALTH AND SAFETY CONTROLS	247
7 CONTINGENCY PLAN	253
8 SILO PENETRATION PLAN (removed)	
APPENDICES	
APPENDIX A – PROCESS FLOW DIAGRAMS	319
APPENDIX B – GENERAL ARRANGEMENT DRAWINGS	365
APPENDIX C – HEAT AND MATERIAL BALANCES	385
VOLUME 2 – SUPPORTING INFORMATION	
APPENDIX D – SYSTEM DESIGN DESCRIPTION	395
APPENDIX E – PIPING AND INSTRUMENTATION DIAGRAMS	482
APPENDIX F – EASILY MANIPULATED MECHANICAL ARM (EMMA)	536
APPENDIX G – PROCESS CONTROL PLAN (BALANCE OF PLANT)	585
APPENDIX H – PROCESS CONTROL PLAN (RADON CONTROL SYSTEM)	620

1.0 INTRODUCTION

The Silos 1 and 2 Accelerated Waste Retrieval (AWR) project is one of the initial steps in the remediation of Silos 1 and 2 within Operable unit 4 (OU4) at the Fernald Environmental Management Project (FEMP). A revised Feasibility Study/Proposed Plan for Silos 1 and 2 has been issued evaluating alternatives for treatment of the Silos 1 and 2 material. Following completion of the public involvement process, and subsequent issuance and approval of a Record of Decision (ROD) Amendment, a contract will be placed for implementation of the selected treatment remedy. The primary purpose of the AWR Project is to retrieve the material from Silos 1 and 2 and transfer it to a newly constructed Transfer Tank Area (TTA) for safe interim storage pending final treatment and disposal. The project also includes construction of a Radon Control System (RCS) to provide mitigation of radon emissions from the Silos, the TTA, and from the future Silos 1 and 2 Full-scale Remediation Facility. Fluor Fernald, Inc. has placed a contract with Foster Wheeler Environmental Corporation (FWENC) for the design, construction, startup, testing and operation of the systems and facilities required for implementation of the AWR Project

1.1 Purpose

The content of this Remedial Design (RD) Package is consistent with the *Silos 1 and 2 Accelerated Waste Retrieval Project Design Deliverables Schedule* which was submitted to the United States Environmental Protection Agency (USEPA) and the Ohio Environmental Protection Agency November 19, 1999. The intent of the RD package is to provide USEPA and OEPA with substantive information from the detailed engineering, design, and operations documentation. This information is to provide the Agencies with an understanding of the proposed design, retrieval, operation, and environmental controls necessary to ensure protection of the workers, public, health, safety, and the environment.

1.2 Scope

Site preparation construction activities for the AWR Project were detailed in the AWR Project Site Preparation Package. The Site Preparation Package was approved by the OEPA and the USEPA in May 2000. The work scope implemented under the approved Site Preparation Package was comprised of the following activities:

- Set up of office trailers and construction facilities
- Installation of erosion controls, storm water management facilities and temporary fencing
- Building of access roads and gravel parking areas
- Utility installation
- Site Grading and preparation of lay down areas
- Excavation, subgrade preparation, sump installation, and other preparation for foundations
- Placement of concrete mat foundations for the TTA, and RCS

This RD Package documents the remainder of the design for the AWR Project. The principle design elements detailed in the package include

- Design of the TTA
- Design of the RCS
- Design of the Silo Waste Retrieval System, including installation of the Silo superstructure
- Design of the Full-scale Mockup System at Silo 4
- Excavation and disposition of the Silo berm material in support of both the Silo superstructure installation and Silo waste retrieval operation
- Design of the Decant Sump Waste Retrieval and TTA Waste Retrieval Systems
- Characterization and disposition of secondary wastes generated during construction and operation activities
- Environmental controls for air emissions, wastewater, and storm water generated during construction and operation activities
- Sampling and analysis and process controls

The documents contained in the RD Package to address these design elements are described in the following sections.

Following receipt of U.S. EPA and OEPA approval of this RD Package, a Final Design Report will be prepared documenting the detailed, Certified for Construction (CFC) design. Any changes to the design will be documented, reviewed, and approved through a formal change control process. Design Change Notices (DCNs) documenting proposed changes which impact the approved RD package will be provided to OEPA and USEPA for review and approval.

1.3 AWR Project RD Package – Summary of Significant Changes

The draft RD Package for the AWR Project was originally submitted to U.S. EPA and OEPA for review in June 2000. Revisions to the RD package were necessary to incorporate responses to comments (see Appendix I) received from U.S. EPA (August 29, 2000) and OEPA (August 28, 2000). In addition to these changes in response to U.S. EPA and OEPA comments, some changes to the documentation contained in the RD package were necessary due to evolution of the AWR design during the period since the June 2000 draft RD Package was submitted. The significant changes to each section of the June 2000 draft RD Package are summarized below.

Table of Contents

- Updated to reflect format and content of November 2000 revised draft.
- Added references to RD Package page numbers.

Section 1.0 Introduction

- Minor revisions to incorporate comments and to reflect current format of RD Package.

Section 2.1 Process Description

- Added new Section 2.4 to provide detail on water management during waste retrieval operations.
- Deleted specific discussion of Silo residue sampling; details to be submitted as part of Remedial Action Work Plan for Waste Retrieval Operation.

Section 2.2 Process Control Plan

- Revised Key Parameters/Setpoint Table to provide additional detail on alarm responses per EPA comments.
- Detail on headspace pressure control now included in Section 2.2 of the Process Control Summary.

Section 3.0 Sampling Plan

- Minor revisions to incorporate U.S. EPA /OEPA comments.
- Deleted discussion of Silo residue sampling; detail to be provided in Remedial Action Work Plan for Waste Retrieval Operation.

Section 4.0 Berm Excavation Plan

- Incorporated revised WAC verification monitoring approach (Section 1.4)
- Added clarification of height differential between berm soil and residues
- Referenced detail on stormwater drainage and erosion control during berm excavation, now included in Stormwater Drainage Plan (RD Package section 5.3)

Section 5.0 Operational Environmental Control Plan

- Minor revisions to incorporate U.S. EPA/OEPA comments
- Radon emission data revised based upon revised based upon Revision 2 of RCS Performance Calculation.
- Stormwater Drainage Plan submitted as part of Site Preparation Package has been updated to reflect completed site preparation work and depict controls for facility construction, berm excavation and waste retrieval operations. Now included as RD Package Section 5.3

Section 5.1 ARAR Compliance Matrix

- Formerly Section 5.3 of June 2000 draft RD Package.

Section 5.2 RCS Performance Calculation

- Formerly included as part of Section 5.1, "environmental ALARA Report in June 2000 draft RD Package.
- Calculation revised to reflect revised Dynamic Adsorption Coefficient assumptions.

Section 5.3 Stormwater Drainage Plan

- Added in response to OEPA comments

Section 5.4 Waste Handling Work Plan

- Formerly Section 5.2 of June 2000 Draft RD Package
- Revised to incorporate U.S. EPA/OEPA Comments

Section 5.5 Silos Projects Environmental Monitoring Plan
- Formerly Appendix E of June 2000 draft RD package
- Minor revisions in response to OEPA comments.

Section 6.0 Health and Safety Controls
- No changes

Section 7.0 Contingency Plan
- No changes

Section 8.0 Silo Penetration and Riser Installation Plan
- Section removed; to be revised and submitted as part of the Remedial Action Work Plan for FSMS and RCS Phase 1 Operation.

Appendix A Process Flow Diagrams
- "Voided" drawings included in the June 2000 draft RD package to show changes from the previous draft have been removed.
- Current revisions of PFD's applicable to the current design have been included.

Appendix B General Arrangement Drawings
- "Voided" drawings included in the June 2000 draft RD package to show changes from the previous draft have been removed.
- Current revisions of General Arrangement drawings applicable to the current design have been included.

Appendix C Heat and Material Balances
- Calculations reviewed and revised as necessary to correct discrepancies.
- Current revisions of Heat and material balances applicable to the current design have been included.

Appendix D System Design Descriptions
- Deleted discussion of Silo residue sampling; detail to be provided in Remedial Action Work Plan for Waste Retrieval Operation.
- Added additional detail regarding water management and disposition of Decant Sump Waste (section 4.3)

Appendix E Piping and Instrumentation Drawings
- Current revisions of Piping and Instrumentation Diagram (P&ID) drawings applicable to the current design have been included for information.

Appendix F Easily Manipulated Mechanical Arm (EMMA) Information
- No changes

Appendix G Process Control Plan (Balance of Plant)
- No changes

Appendix H Process Control Plan (Radon Control System)

- Added additional detail describing control philosophy for control of airflow and headspace pressure.

1.4 Remedial Design Documentation

1.4.1 Detailed Description of Process Operations

1.4.1.1 Process Description

The Process Description document provides an overview of each of the systems that comprise the Accelerated Waste Retrieval process. The functions of these systems are to retrieve, transfer and store the K-65 residue for final remediation. Also these systems treat the radon and particulate emission. The systems consist of the following:

- Silo Waste Retrieval System (SWRS)
- Decant Waste Retrieval System (DWRS)
- Radon Control System (RCS)
- Transfer Tank Area (TTA)
- Full Scale Mock-Up System (FSMS)
- Transfer Tank Waste Retrieval System (TWRS)

The narrative descriptions presented in the document are intended to provide a guide to the more detailed information in the System Design Description and the PFD's.

1.4.1.2 Process Control Plan

The Process Control Plan describes the three control systems for the Easily Manipulated Mechanical Arm (EMMA), RCS, and balance of process systems. The Process Control Plan describes how these three control system interface and function.

1.4.2 Sampling Plan

This plan describes the sampling and analysis effort associated with the AWR project. These efforts are summarized as followed:

- Ensure that the periodic discharge of excess water from the AWR project meets the waste acceptance (WAC) prior to being transferred to the site Advance Waste Water Treatment Facility.
- Ensure that the air emissions associated with the AWR project, meet the applicable regulatory and site standards; and

1.4.3 Berm Excavation Plan

This plan provides a summary of the construction and operational interfaces related to the excavation and removal of silo berm material. The Berm Excavation Plan emphasizes the excavation methods employed to mitigate the impact on silo structural integrity throughout the AWR project.

1.4.4 Operational Environmental Control Plan

The Operational Environmental Control Plan (ECP) describes the methods and controls that are to be incorporated into the design and operation of the Accelerated Waste Retrieval (AWR) Project to minimize the impacts of operation activities on the environment. These methods and controls are intended to minimize the environmental impacts of air emissions, dust, wastewater, storm water, erosion, and secondary waste generation resulting from AWR Project activities. Controls implemented to minimize the environmental impact of site preparation construction activities were documented in the Pre-operational Environmental Control Plan, submitted and approved as part of the AWR Project Site Preparation Package in May 2000.

ARAR Compliance Summary

Applicable or Relevant and Appropriate Requirements (ARARs) and to-be-considered (TBC) requirements for the AWR Project were identified in the July 13, 2000, Record of Decision (ROD) Amendment for Operable Unit 4 (OU4) Remedial Actions at the Fernald Environmental Management Project (FEMP). The ARARs Compliance Strategy identifies each ARAR and TBC requirement, the strategy used by the AWR Project to meet the requirement, and provides a cross-reference to the documentation within the RD Package where compliance with the ARAR is documented.

Radon Control System Performance Calculation

To support the evaluation of air emissions in the Environmental Control Plan, the Radon Control System Performance Calculation provides a detailed analysis of projected radon emissions during each phase of the AWR project. Projected emissions of radon, the effectiveness of radon control provided by the RCS and the estimated impact of radon emissions on both onsite and offsite radon concentrations are evaluated for each of the following phases of the AWR Project:

- Phase 1 – Silo 1 and 2 headspace reduction
- Phase 2A – Silo 1 waste retrieval
- Phase 2B – Silo 2 waste retrieval
- Phase 2C – TTA ventilation

Stormwater Drainage Plan

The Stormwater Drainage Plan describes the stormwater management philosophy for the various phase of the Accelerated Waste Retrieval project. The Stormwater Management Plan defines the process for handling stormwater during the construction of the Silo Waste Retrieval system and during the operational phases of the project.

Waste Handling Work Plan

The Waste Handling Work Plan identifies the plans for management and disposition of each of the types of secondary waste generated during implementation of the AWR project. For each secondary waste stream, the Waste Handling Work Plan identifies the projected amount to be generated, anticipated characterization, and proposed disposition of the waste.

Silos Projects Environmental Monitoring Plan

The current focus of environmental monitoring at the Fernald Environmental Management Project is the implementation of site-wide environmental monitoring and project-specific environmental monitoring. Site-wide environmental monitoring is addressed in the Integrated Environmental Monitoring Plan (IEMP) while project-specific requirements are addressed within the environmental control plans, process control plans, and other design documents which constitute the project's remedial design package. For the Silo 3 Stabilization Project and the Silos 1 and 2 Accelerated Waste Retrieval Project (AWR Project), modifications to the site-wide environmental program are necessary to support project activities. Therefore, the focus of this plan is to establish the integrated environmental monitoring requirements for Operable Unit 4 (OU4) during the conduct of both projects.

1.4.5 Description of Health and Safety Controls

The Health and Safety Control section describes the overall process for the development of the safety documentation for the AWR project. This section is an upper-tier summary that identifies the specific AWR documentation that details the preventative measures safety controls and action to be taken to mitigate the consequences of occupational, public and environmental hazards associated with the operational phase of the AWR project.

1.4.6 Contingency Plan

The Contingency Plan provides instruction for the AWR personnel in response to unusual and emergency events with the project area. The Contingency Plan is the interface document between the AWR project and the FEMP emergency organization, as identified in the FEMP Emergency Plan. The Contingency Plan describes the appropriate action for spill control, decontamination, emergency response and evacuation in the event of an unusual or emergency conditions.

1.4.7 Process Flow Diagrams

Appendix A contains the Process Flow Diagrams for all systems associated with the AWR Project.

1.4.8 General Arrangement Drawings

Appendix B contains the General Arrangement Drawings for all systems associated with the AWR Project.

1.4.9 Heat and Material Balance

Appendix C contains the Heat and Material Balance for all systems associated with the AWR Project.

1.4.10 System Description

Appendix D contains the System Description document. This document provides a detailed description of each system that supports the AWR project. This detail discussion defines the systems, the system functions and the interface between the systems. This appendix was included as a reference.

1.4.11 Piping and Instrumentation Diagrams

Appendix E contains the Piping and Instrumentation Diagrams for all systems associated with the AWR Project. This appendix was included for reference.

1.4.12 Easily Manipulating Mechanical Arm (EMMA) General Information

Appendix F contains the System description of the Easily Manipulated Mechanical Arm and supporting drawings of the EMMA system. This appendix was included for reference.

1.4.13 Process Control Plan (Balance of Plant)

Appendix G contains the Process Control Plan (Balance of Plant). This document provides a detail description of control logic and control functions of the Balance of Plant process controller. This appendix was included for reference.

1.4.14 Process Control Plan (Radon Control System)

Appendix H contains the Process Control Plan (Radon Control System). This document provides a detail description of control logic and control functions of the RCS process controller. This appendix was included for reference.

REMEDIAL DESIGN PACKAGE
PROCESS DESCRIPTION

FOR THE

SILOS 1 & 2 ACCELERATED WASTE RETRIEVAL (AWR)
PROJECT

NOVEMBER 2000

ACRONYMS AND ABBREVIATIONS

AC	alternating current
ADSS	Arm Deployed Sluicing System
ALARA	as low as reasonably achievable
API	American Petroleum Institute
AWR	Accelerated Waste Retrieval
AWS	American Welding Society
AWWT	Advanced Wastewater Treatment
BRS	Bulk Retrieval System
CATS	Conditioning and Transfer System
CCTV	closed circuit television
CFC	Certified for Construction
Cfm	cubic feet per minute
CPU	central processor unit
DC	direct current
DCS	distributed control system
DOE	U.S. Department of Energy
DOF	degree of freedom
DRS	Debris Retrieval System
DWRS	Decant Waste Retrieval System
EDT	EMMA™ Deployment Tower
EMMA™	Easily Manipulated Mechanical Arm™
FDS	Facility Decontamination System
FEMP	Fernald Environmental Management Project
Fps	feet per second
FSM	Full-Scale Mock-Up
FSMS	Full-Scale Mock-Up System
FSS	Fixative Spray System
GEE	Gripping End-Effector
GEES	Gripping End-Effector System
GFE	government-furnished equipment
Gpm	gallons per minute
HEPA	high efficiency particulate air
HMI	human-machine interface
Hp	Horsepower
HVAC	heating, ventilating, and air conditioning
I/O	input/output
ICAT	Integrated Construction Acceptance Test
ISO	International Standards Organization
MEES	master equipment enable switch
MOV	motor-operated valves
NEMA	National Electrical Manufacturers Association
NIS	not in scope
NPSH	net positive suction head
PLC	programmable logic controller
PPE	personal protective equipment
Profibus	Process Field Bus

ACRONYMS AND ABBREVIATIONS

3387

Psi	pounds per square inch
RH	relative humidity
RCS	Radon Control System
Rpm	revolutions per minute
SAIE	Silo-Arm Interface Enclosure
SDRS	Silo Debris Retrieval System
SFC	Sequence Function Chart
SOT	System Operability Test
SPSA	Sample Preparation and Storage Area
SREE	Silo Retrieval End-Effector
SSC	systems, structures, and components
SWRS	Silo Waste Retrieval System
TEFC	totally enclosed, fan-cooled
TRD	Technical Requirements Document
TTA	Transfer Tank Area
TWRS	Transfer Tank Area Waste Retrieval System
UF	ultra-filtration
UPS	Uninterruptible Power Supply
V	Volt
VitPP	Vitrification Pilot Plant
WAC	waste acceptance criteria
WG	water gauge
WT%	weight percent

000010

000013

1.0 GENERAL OVERVIEW

1.1 Project Scope:

Silos 1 and 2 contain K-65 material, a residue that contains radionuclides, including radium (the primary radiological contaminant of concern), generated from the processing of high-grade uranium ores. The purpose of the Accelerated Waste Retrieval (AWR) Project is to retrieve the material from Silos 1 and 2, segregate discrete objects, and transfer the residue to transfer tanks for staging before final remediation. The project also includes the installation and operation of a Radon Control System (RCS) to reduce the radon concentration in each of the silos' headspace, and provide radon control during retrieval, material storage, and future operation of the final remediation facility. The final stage involves the gross decontamination of the silos, and equipment for system closure, and handling of secondary waste generated during the AWR Project.

As the contractor, Foster Wheeler Environmental Corporation (FWENC) is designing, constructing, testing, and directing the operation and maintenance of the AWR Project. Fluor Fernald, Inc. is providing labor for operations and maintenance. The Project consists of five functional stages:

Stage 1: Radon Control System (RCS) Installation, Operation, and Maintenance to reduce the radon concentration of each of the silos headspace before construction around silos and silo retrieval operations;

Stage 2: Demonstration of the Full-Scale Mock-Up System (FSMS) and residue retrieval from the Transfer Tank Area (TTA) to support final remediation;

Stage 3: Residue material retrieval from the silos and decant sump tank, material segregation, transfer of residue to the TTA, and placement of discrete objects in drums for processing by others;

Stage 4: Staging and storage of the residue in the TTA; and

Stage 5: Perform gross decontamination and apply fixative to the silo interior structure. Also perform gross decontamination of the decant sump tank and contaminated process equipment.

1.2 Document Purpose

The purpose of the Remedial Design Package Process Description document is to provide a summary description of the AWR process. Additional detail is provided in the FWENC System Design Descriptions document contained in Appendix D and the AWR Process Control Plans in Appendices G and H.

1.3 Systems Identification

To accomplish the 5 functional stages of the AWR Project seven major systems listed below were defined.

Radon Control System (RCS), Phase 1 and 2. RCS Phase 1 controls and reduces radon concentrations in the silo headspace. RCS Phase 2 ensures radon control during retrieval, transfer, and storage of the silos material.

Full Scale Mock-Up System (FSMS). A Full-Scale Mock-Up Integrated Construction Acceptance Test (ICAT)/System Operability Test (SOT) is to be performed with the Silo 4 Full Scale Mock-Up System (FSMS). FWENC will incorporate the lessons learned from the FSM ICAT/SOT into the AWR Project before beginning operations and use the FSMS for training and troubleshooting during SWRS operations.

Silos Waste Retrieval System (SWRS). The SWRS retrieves material from the silos; transfers residues, BentoGrout™, and heel material to the transfer tanks; retrieves and packages discrete objects; and performs gross decontamination of the silos.

Decant Sump Waste Retrieval System (DWRS). The DWRS retrieves waste from the decant sump tank (approximately 1,000 gallons of residue/solids in a heel), segregates and transfers/packages material, and performs gross decontamination of the decant sump.

Transfer Tank Area (TTA). The TTA consists of transfer tanks to be used as a storage area for K-65 Material/BentoGrout™ slurry for future remediation activity. Provisions will be made for sampling and sample storage.

Transfer Tank Waste Retrieval System (TWRS). The TWRS will retrieve the K-65 Material/BentoGrout™ slurry from the TTA and transfer it for processing at a future waste treatment facility that is not in the scope (NIS) of the AWR Project.

Facilities Decontamination System (FDS). The Facilities Decontamination System (FDS) functions to remove gross contamination from the silos, the decant sump tank, and contaminated process equipment as part of facility demobilization and closure. Two categories of gross decontamination activities are provided by the FDS. First, the gross decontamination of silos, decant sump tank, and process equipment, as well as permanent facilities erected during the project is part of the FDS. The second type is decontamination of temporary tools, equipment, and facilities used on the project.

2.0 RADON CONTROL SYSTEM (RCS) (PHASE 1 AND PHASE 2)

The RCS as depicted in Exhibit 2-1 is a treatment system that employs air conditioning, dehumidification, activated carbon, and HEPA filtration to control and monitor emission of radon and other contaminants. The RCS System receives gas streams from the following sources:

- Silo 1 and Silo 2
- Silo Waste Retrieval System

- Decant Sump Waste Retrieval System
- TTA System
- Transfer Tank Area Waste Retrieval System, and
- Final Remediation Facility

The RCS is operated in two phases. Phase 1 is a recycle loop used to treat the Silo 1 and 2 radon concentration prior to any activity on or near the silos. Phase 2 of the RCS is a once-through system to support the waste retrieval activities.

The RCS is designed to remove radon-laden air from the various system components, provide Best Available Technology (BAT) control of our radon emission to the atmosphere, detect and measure releases to the atmosphere, and mitigate system upsets. Ventilation from the sources described above is drawn through the RCS by redundant centrifugal fans (FAN-20-001A and FAN-20-001B). The fans, ducting system, and automated process controls are designed to prevent over or under pressurization of the silos and transfer tanks. Additional details on the controls of pressure in the silo headspace is provided in Process Control Plan (Radon Control System) in appendix H. The ducting system recirculates process air through the system or discharges through the exhaust stack, while maintaining the required silo and tank pressures. The ducting system is balanced using a redundant programmable logic control (PLC) system. The fans are located downstream of the carbon beds to maintain an induced draft in the carbon beds. The ducting arrangement, in conjunction with the automated monitoring and damping system, prevents backflow of contaminated gases to the atmosphere.

The total design flowrate for the RCS is 1,000 cubic feet per minute (cfm). The ventilation rate for each source listed above is dependent upon which operational phase is in effect for the RCS. The ventilation gas from each source is withdrawn and transferred to the RCS Building where the treatment equipment is located. Ventilation air from each source is combined into a 10-inch insulated, carbon steel, common duct header. The 10-inch header connects to redundant 95%-efficient roughing filters (FLT-20-001A and FLT-20-001B) for particulate removal. Filters will be operated with one online at a time dependent upon which train is in operation.

Upon exiting a roughing filter, the ventilation air enters one of the redundant desiccant drying systems (DDS-20-001A and DDS-20-001B) at 90° F and 100% relative humidity (RH) where the air stream is cooled and dehumidified to 36°F and 15% RH. The gas is cooled and dehumidified to enhance the dynamic adsorption capacity of the activated carbon. A condensate pump located within the desiccant drying system transfers condensed liquids from the desiccant drying system to one of two 3,000-gallon carbon steel hold-up tanks (TNK-20-002A and TNK-20-002B). The condensate holdup storage tanks are vented to the RCS and automatic dampers will open to relieve pressure. These tanks are equipped with vacuum control valves to let air into tanks when the vacuum setpoint is reached. The liquid is held for as much as 40 days in the condensate holdup tanks to allow for radon decay. Subsequently, transfer pumps disposition the liquid in one of two ways:

- Transfer to the filtrate tanks in the TTA building for subsequent distribution to one of the four Transfer Storage Tanks or use by the high-pressure pumps.
- Transfer to the FEMP Advanced Wastewater Treatment (AWWT) facility after characterization indicates the condensate meets the waste acceptance criteria (WAC).

The chilled/dehumidified ventilation air stream exiting the desiccant drying systems flows to the carbon adsorption units (CBD-20-001A, CBD-20-001B, CBD-20-002A, and CBD-20-002B) via a 10-inch carbon steel duct header. The carbon adsorption system consists of four insulated carbon steel vessels, approximately 16-feet by 11-feet by 11-feet, which contains a total of 160,000 pounds of carbon (40,000 pounds per vessel). The four carbon beds are operated in parallel splitting the flow equally.

Each carbon bed is connected to the 10-inch main duct headers by 8-inch branch duct connections on both the inlet and outlet of the beds. Each bed is aligned with a dedicated inlet and outlet damper for flow control and isolation. Modulating dampers and flow elements provided on the inlet of each bed allow flow to each bed to be reduced or increased on the basis of operations. Each carbon adsorption vessel is capable of treating up to 500 cfm.

The treated gas stream flows from the carbon adsorption units through 8-inch branch connections to the 10-inch duct header to the redundant high-efficiency particulate air (HEPA) filtration units (FLT-20-002A and FLT-20-002B). Filters will be rated at 1,000 cfm each and operated with one online at a time. Air from the carbon beds, makeup air, and fan recycle combine before entering the HEPA filters.

Quantities of makeup air, fan recycle air, and stack exhaust will be based upon maintaining a certain static pressure at the discharge of the fan. These flows will be closely controlled so that the air discharged to the exhaust stack will be minimized to maintain the appropriate negative pressure and flow through the system. After exiting the operating HEPA filter unit, the treated air stream enters the operating recirculation fans (FAN-20-001A and FAN-20-001B) for redistribution to the silos, TTA tanks, or exhaust through the monitored stack (STK-20-001).

The stack (STK-20-001) is a 150-foot tapered carbon steel stack that is approximately 6 feet 4 inches at the base and tapers to approximately 3 feet at the top. The maximum airflow through the stack is 12,000 cfm. The stack has connections for a 10-inch carbon steel RCS process duct and a 34-inch carbon steel building ventilation duct. The stack is provided with an isokinetic sampling system and will include continuous monitoring for both particulate radionuclides and continuous monitoring for radon. Additional detail on air emissions is provided in the Operational Environmental Control plan, section 5.0 of the RD package.

Radon Control System (RCS)

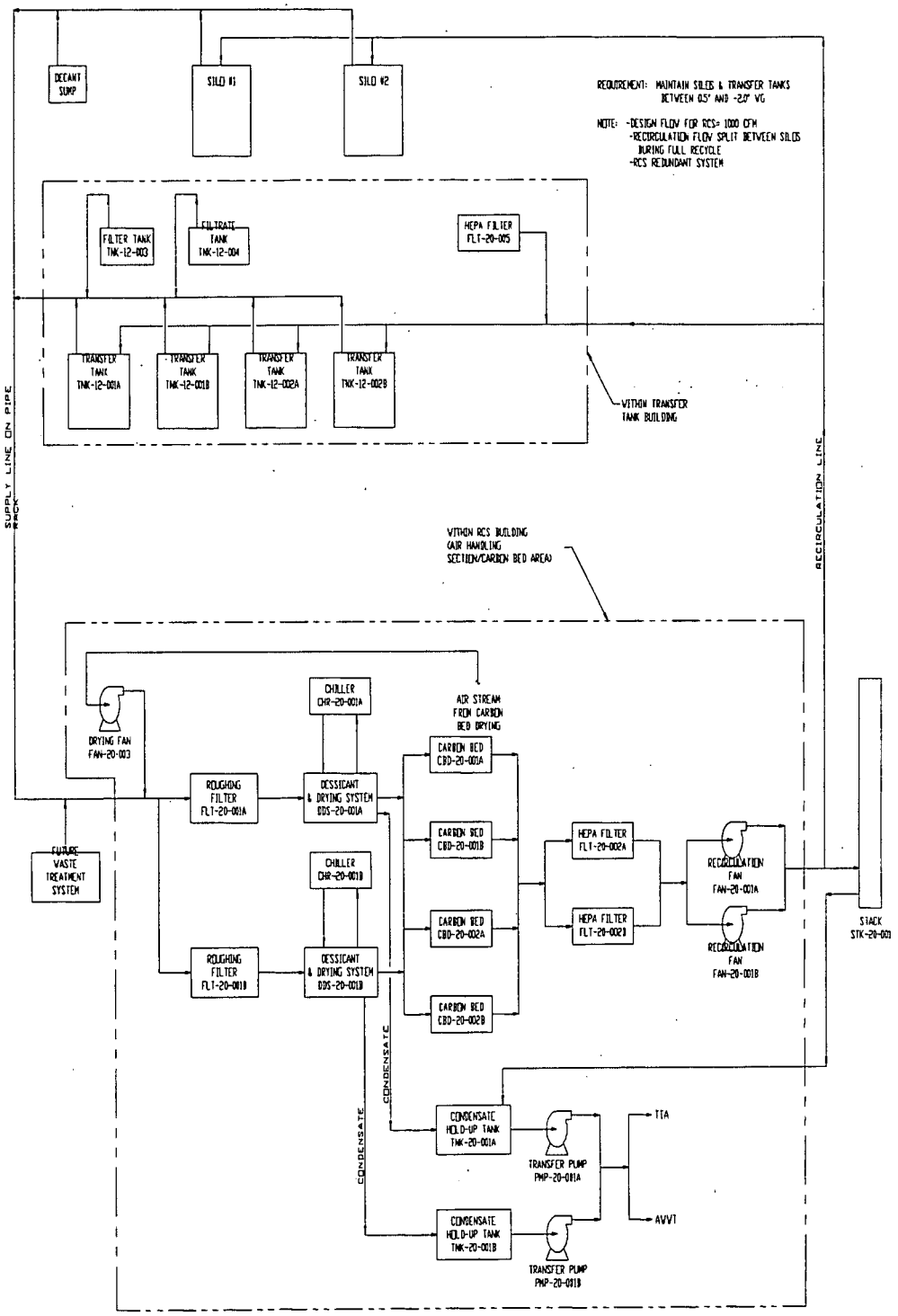

EXHIBIT 2-1

3.0 FULL-SCALE MOCK-UP SYSTEM(FSMS)

The Full-Scale Mock-Up System (FSMS) is designed to provide the equipment at Silo 4 for the operator training and proof of principle testing of the AWR systems. This testing includes the removal and transfer of K-65 silo surrogate material and debris. The testing will be performed in a nonradioactive environment using Silo 4 and modified Silo 4 superstructure facilities. FSMS refers to the specific systems, structures, and components (SSCs) that are installed at the Silo 4 facility. Full-Scale Mock-Up (FSM) refers to the integrated overall AWR mockup system including the FSMS. The FSMS tie-ins to the AWR system will be removed at the completion of the FSM Integrated Construction Acceptance Test (ICAT) and System Operability Test (SOT). The FSMS will remain as a stand-alone system ensuring continued availability for training, system optimization and troubleshooting throughout the AWR operations phase. The FSMS will utilize the exact model of equipment used in the SWRS, TWRS, and TTA to gain the most accurate testing and training.

4.0 SILOS WASTE RETRIEVAL SYSTEM (SWRS)

4.1 Overview

The purpose of the Silos Waste Retrieval System is as follows:

- Bulk Material (K-65 residue and BentoGrout™) waste retrieval and transfer to the transfer tanks
- Heel material retrieval and transfer to the transfer tanks
- Discrete object retrieval and packaging

4.2 Bulk Retrieval System

The bulk retrieval system depicted on Exhibit 4-1 is a sluicing system based on past practices. The main components of the bulk retrieval system are as follows:

- Sluicer Module – contains sluicing nozzle, which is used to convert the silo contents into a slurry.
- Slurry Pump Module – pumps the slurry from the silos to the transfer tank area.
- Supernate Pump Module – pumps the decanted supernate water from the transfer tanks to the sluicer module and slurry pump. The decanted supernate water is the main water supply for the sluicer module and slurry pump.

4.3 Bulk Waste Retrieval Strategy

The sluicing module and the slurry pump module are used for sluicing the bentonite cap and K-65 waste material. Initially, the sluicing stream is directed as close to the pump inlet as possible to induce a small, localized slurry pool. Additionally, the slurry pump module has the capability to operate in reverse, using sluice water, to assist in making a slurry pool. The slurry pump module also has a high-pressure water jet ring at the pump suction, which can blast hard material into a pumpable slurry. A key objective of this waste retrieval activity is to minimize, and closely monitor, the inventory of water added to the silos. Details on management of water during waste retrieval activities are provided in the next section. The slurry pump module is designed to withstand occasional impact by the sluicer module jet stream during operation.

Upon creating the cavity, the sluicer module cuts a canyon for slurry to flow though to the slurry pump module. The canyon will progress in depth and length toward the sluicer module. The slurry pool size at the slurry pump module suction will be minimized to minimize free water in the silo. The sluicer module will "push" the slurry towards the slurry pump module for retrieval. This type of operation occurs as long as it is effective. The width of the canyon will increase with priority being given to increasing the depth of the canyon, and the slurry pump module is periodically lowered (remotely) further into the silos, until it reaches the bottom. The sluicer module nozzle is also lowered periodically further into the silos. If the sluicer module nozzle is inadequate to break up a waste agglomeration, the EMMA™ assists with the small arm-based sluicing nozzle. This allows a focused stream to be applied close to the waste.

The waste stream is monitored to determine the point at which solids loading in the waste stream are the same as the return supply supernatant. Upon a determination that effective sluicing is complete, the bulk waste retrieval operation will be completed and waste retrieval using the Conditioning and Transfer System (CATS) mode will be used. The sluicer module will be retracted back into its containment housing above the silo on the platform. The slurry pump system will be retracted back into its containment housing and modified for CATS mode operation (See Section 4.4).

To minimize the secondary waste water, the slurry water is supplied by a supernate pump module installed into the Transfer Storage Tank. Section 6.0 will further describe the Transfer Tank system. The supernate water could also be processed through the ultra-filtration skids for use by the high-pressure pumps for the heel removal and back flushing. In support of the silo waste retrieval activities, the silo berm will be lowered in stages as defined in the Berm Excavation Plan to minimize the load on the silo wall. To ensure containment in the unlikely event of a failure of the silo walls, the level of the berm will be maintained at least five feet above the level of residue inside the silos.

Silo Waste Retrieval (SWRS)

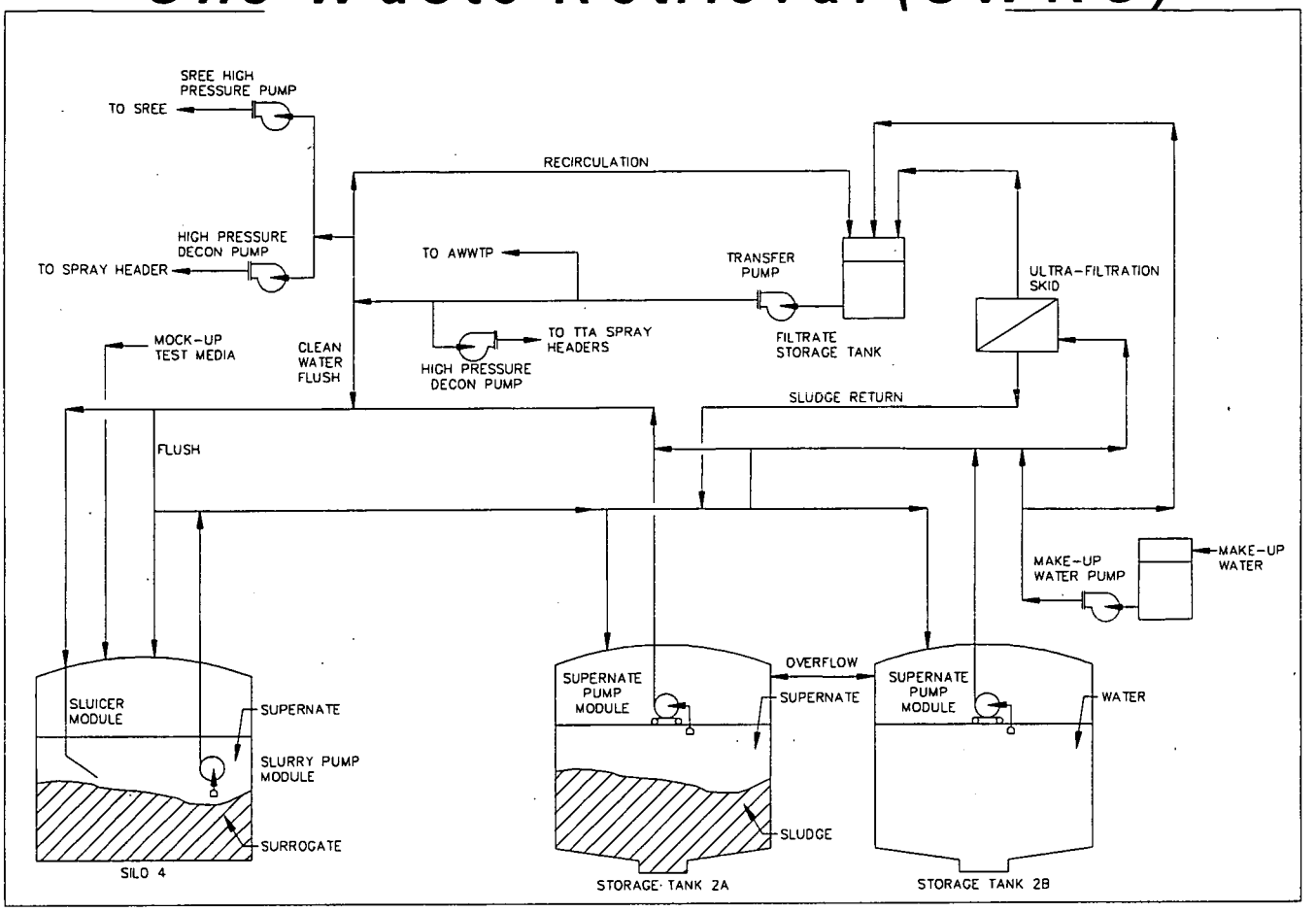

EXHIBIT 4-1

4.4 Water Management Strategy

One of the objectives of the AWR Project is to minimize the secondary waste generated, particularly the wastewater given the limitation of the FEMP Advance Waste Water Treatment (AWWT) facility. Therefore, it is very important that the AWR Project have a water management strategy, which will closely monitored secondary wastewater generation. The slurry water needed for the Silo Waste Retrieval operation will be supplied by recycling the sluicing water through the supernate pump module within the Transfer Storage Tanks. To meet the high-pressure water quality requirements the decanted sluicing water will be processed through the Ultrafiltration Skid prior to being supplied to the high-pressure pumps. These recycling steps reduce the water dispositioned to the AWWT. The water to the AWWT consists of the condensate water from the Radon Control System Phase 1 operation. The condensate water from the RCS operation in the latter phases will be recycled to the TTA system.

The key to the successful management of water usage during the AWR Project is to effectively account for the water throughout the systems. To minimize potential for release of wastewater the following water management strategy will be employed:

- The quantity of water into and out of the silos will be closely monitored throughout the silo waste retrieval activities. Alarm limits are set such that if the water flow into the silos is 25% greater that the water flow out of the silos, the Silo Waste Retrieval operation will be stopped until the water can be accounted for and corrective action taken.

- The Bulk Waste Retrieval Strategy will utilize a localized slurry pool. The size of the slurry pool will be minimized to the amount required to support the slurry pump operation.

- The K65 Decant Sump Tank located between the silos (reference drawing #05FMD010 Rev 3 "Misc Facilities General Arrangement Key Plan" will have level instrumentation for continually monitoring the infiltrate liquid level and calculating the infiltrate liquid flow rate into the decant sump tank. The flow of the liquid infiltrate into the K-65 Decant Sump Tank will be monitored and recorded both on operator roundsheets and on the automated process control system. When the action limits discussed below require removal of the liquid from the decant sump tank, a submersible pump will be used to pump the liquid to a tanker truck for transfer to a holding tank for sampling prior to disposition. A maximum of 8 hours is estimated to hook-up the tanker truck and initiate pumping:

  (Note: The current K-65 Decant Sump Tank Maintenance Action Work Plan specifies that the decant sump tank will be pumped out when the level reaches 70% capacity. Historically this criteria requires the pumping of the decant sump tank once every 6 to 12 months)

A. If the flow of liquid into the Decant Sump Tank exceeds the baseline flow rate based on historical data the following action is required:
   - Increase monitoring and document the waste retrieval operation and silo area conditions at time of alarm.
   - Then pump out the tank when the level reaches 60% of its capacity and analyze content for increased levels of K-65 materials.
   - Maintain increased monitoring.

B. If the flow exceeds 5gpm, the following action is required:

   Note: The Action Limit of 5 gpm was calculated based on the assumption that if the tank is 50% full, then the 5gpm infiltration would only fill the tank to 75% capacity, during the 8 hours required to hook-up the tanker truck and initiate liquid removal. The 5 gpm infiltration rate would add 2400 gallons (25%) to the decant sump tank during the 8 hour period.

   - Stop addition of sluicing water and transfer the slurry pool to the TTA. Suspend waste retrieval activity and note the conditions of waste retrieval operations and silo area.
   - Then pump out the tank when the level reaches 60% of its capacity and analyze content for increased levels of K-65 materials.

C. If flow limits are not exceeded, the tank level limit established in the Maintenance Action Work Plan are to be maintained which requires the decant sump tank to be pumped out at 70% capacity.

- During Berm excavation activities, the berm soil will be sampled for presence of K-65 material which may have leaked out of the silos.

4.5 Heel Removal (Conditioning and Transfer) CAT System

Heel removal follows the bulk sluicing activities. The heel is defined as the slurry, supernate, and K-65 material located on the silo bottom left after the bulk sluicing. The heel removal operation as depicted on Exhibit 4-2 consists of the following major components:

- EMMA™ - EMMA™ is used to place the Silo Retrieval End Effector and other equipment in various locations where heel is present. (Not depicted on Exhibit 4-2)
- Slurry Pump Module – Pump slurry from heel waste surge tank to the Transfer StorageTanks
- Silo Retrieval End Effector – The SREE consists of three rotating jets that are used to locally slurry material. The SREE jet nozzles operate at up to a maximum of 10,000 psi. Water to SREE comes from the SREE high-pressure pump. (detail of CATS Mode not depicted on Exhibit 4-2)
- Jet Pump – Used to vacuum the slurry out of SREE and transfer the slurry to the heel waste surge tank. (detail of CATS Mode not depicted on Exhibit 4-2)
- Heel Waste Surge Tank – located under the slurry pump module to create a reservoir from which the slurry pump can operate. (detail of CATS Mode not depicted on Exhibit 4-2)

Silo Waste Retrieval (CATS MODE)

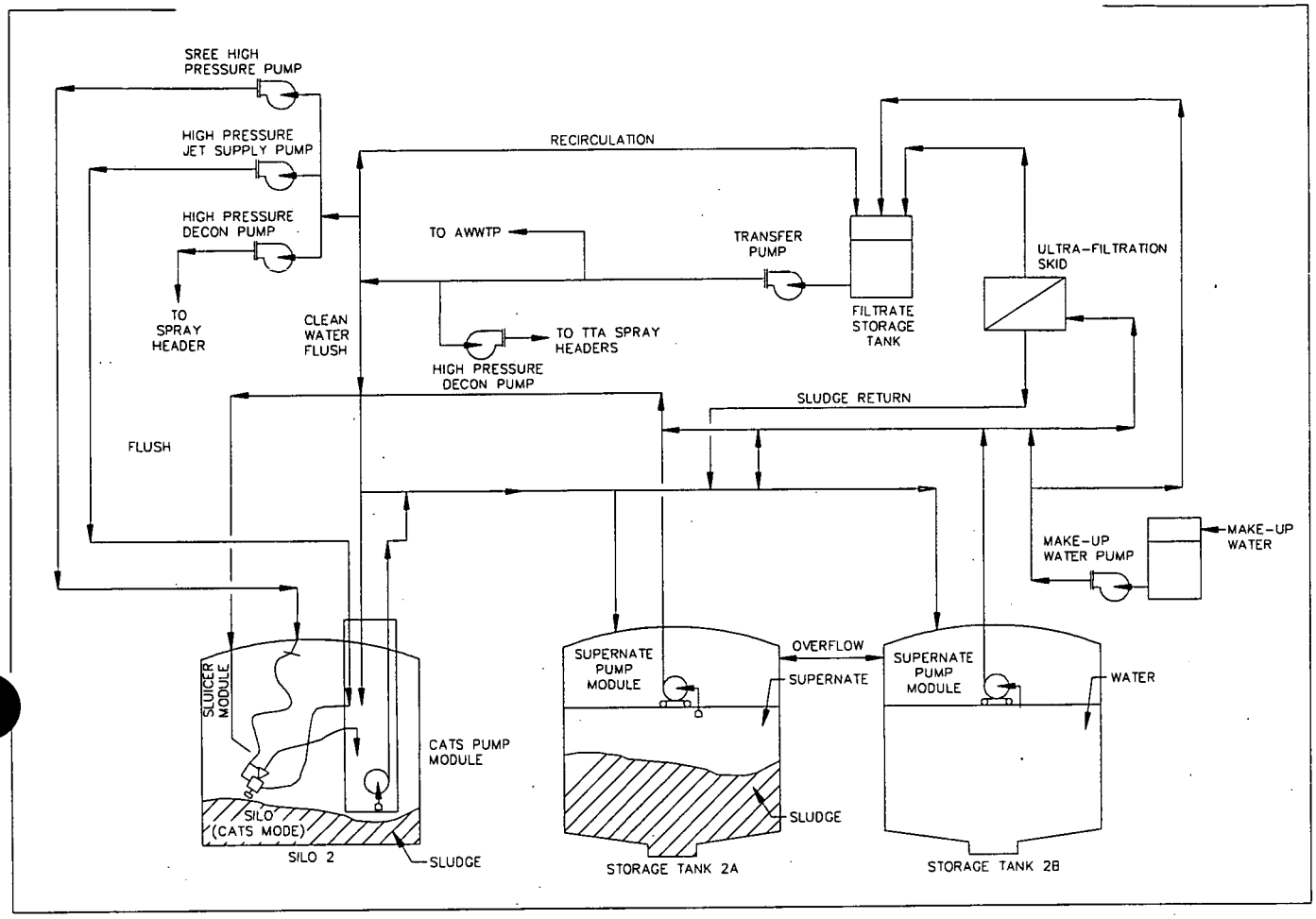

EXHIBIT 4-2

4.6 Heel Removal Strategy

The Conditioning and Transfer System (CATS) is lowered to the silo floor from the slurry pump module by a hoist. Then the EMMA™ grasps and maneuvers the SREE in the tank to where heel is present.

When the SREE inlet is placed over heel and submerged in liquid, the jet pump can remove up to 100 gpm of motive water and liquid. When the inlet begins to pump air, the overall retrieval rate is decreased significantly. However, the system is able to continue to vacuum the bottom of the silo floor. Both the SREE and the jet pump require filtered water for the small nozzles that are used. Filtered water is supplied by the ultrafiltration skid. The slurry from the SREE inlet port is sucked into the three jets and it is pressurized and "pushed" through the jet pump discharge nozzle and into the Heel Waste Surge Tank. The slurry in the Heel Waste Surge Tank is then pumped by the slurry pump module to the Transfer StorageTank.

4.7 Debris Removal

A simple basket system design allows the debris that remains at the bottom of the tank to be removed and packaged for disposal. The basket is lowered through the same riser used by the Sluicer Module during Bulk Waste Retrieval activities. The basket is lowered from the containment housing at the top of the platform by a cable and winch system. EMMA™ uses the gripper to collect and place debris into the basket until the basket is either full or all the reachable debris has been placed into the basket. The basket is raised back into the containment housing where it is placed in a drum to allow for removal from the bridge and disposition by Fluor Fernald, Inc.

4.8 Waste Retrieval Support

The EMMA™ is used to support all activities within the silos. EMMA™ features include:

- Deploying the high-pressure Arm Deployed Sluicing System (ADSS) nozzles to mobilize the BentoGrout™ layer and force the dislodged material toward the slurry pump;
- Forcing the waste and debris away from the slurry pump module and Silo Retrieval End-Effector (SREE) to facilitate continuous operations;
- Supporting the camera and lighting system, inspection and cleaning of all wall-mounted silo sampling ports;
- Cleaning the in-silo cameras and lights to ensure optimum visibility for remote operations;
- Transferring debris to different locations in the silo before removal to minimize retrieval obstructions;
- Performing wall washing and inspection operations as the headroom within the silo is increased (eliminates need for high-pressure water cannon on walls and minimizes the potential for silo damage caused by high-pressure wall washing activities);
- Forming debris piles for size reduction and removal activities;
- Strategically placing the debris size reduction tool off-center from the riser location near debris piles and providing a flat surface under the silo riser for placement of the debris collection and transport basket;
- Transferring debris from the pile to the size reduction tool to the retrieval basket;

- Providing close visual inspection capabilities throughout operations and final inspection;
- Employing the ADSS for fixative application; and
- Employing the Gripper End-Effector System (GEES) camera and lighting system to assist in initial and final wall, floor, and ceiling inspection activities.

5.0 DECANT SUMP WASTE RETRIEVAL SYSTEM (DWRS)

The Decant Sump Waste Retrieval System (DWRS) will retrieve the waste from the K-65 Decant Sump Tank located within the silo area. During SWRS operation a submersible pump with level indicator will be lowered into the K-65 Decant Sump Tank. This submersible pump and level indicator will be utilized for water management during SWRS activities. If the K-65 Decant Sump Tank needs to be emptied during the Silo Waste Retrieval System operation, a tanker truck will be mobilized and the liquid will be pumped from the K-65 Decant Sump Tank into the tanker truck, sampled, analyzed, and dispositioned. See section 4.4 for water management strategy. The DWRS system will also be utilized to remove the sludge located within the K-65 Decant Sump Tank after the SWRS activities are completed. A flanged mounted sluicer will inject filtered water into the K-65 Decant Sump Tank to create a slurry. An air-operated pump will retrieve the slurry and transfer the slurry to the Transfer Storage Tanks via a double-contained hose system. (Reference Drawing # 14FMD002 Rev 3)

6.0 TRANSFER STORAGE TANK AREA (TTA)

The TTA System is provided to store residues received from Silos 1 and 2, and the Decant Sump. The TTA consists of a building that provides shielding and containment for the Transfer Storage Tanks, a water makeup system, and a piping network for receiving and transferring residues from the silos to a future remediation facility. The TTA System communicates with and supports the following systems:

- Silo Waste Retrieval System (SWRS)
- Decant Waste Retrieval System (DWRS)
- TTA Waste Retrieval System (TWRS)
- Full Scale Mock-Up System (FSMS), and
- Radon Control System (RCS).

6.1 SWRS and DWRS Support

The TTA System supports SWRS and DWRS by receiving the slurry from the waste retrieval activity into the transfer storage tank. The slurry waste will settle and the supernate will be decanted and used as sluice water supply. The system is designed to allow the slurry feed tank and sluice water supply tank to change roles to allow for settling and minimize water usage.

During heel removal activities the CATS mode is utilized (see figure 4-2). The CATS mode requires high-pressure water that is provided by the high-pressure pumps located near the bridge. The supply to the high-pressure pumps is from the TTA Filtrate Transfer Pumps that transfer water from the TTA Filtrate Storage Tank. Level in the TTA Filtrate Storage Tank is maintained by water transferred from the sluice water header to the Ultra-Filtration Skid via the filter process tank (ref drawing #12FMD026 Rev2). Makeup water for the TTA Filtrate Storage Tank is also available from the Makeup Water Tank. The slurry from heel removal is transferred to Transfer Storage Tank for settling and decanting. The sluice water is supplied

from another Transfer Storage Tank where the settling activity is complete and supernate is available.

6.2 FSMS Support

The TTA System supports the Full Scale Mock-Up System (FSMS) in the same manner as the SWRS and TWRS. The FSMS is the system that will test the SWRS and TWRS equipment with surrogate material prior to the Silos 1&2 waste retrieval activities.

6.3 TWRS Support

During operation of the TWRS, the K-65/BentoGrout™ is slurried from the TTA tanks to the remediation facility in a similar fashion as it was removed from the silos except two sluicer modules are deployed in the storage tank being emptied, and the CATS system and EMMA™ are not required (Reference figure 7-1). The storage tank bottoms are sloped to a center sump to facilitate heel removal. The Slurry Pump is deployed in the center tank nozzle. When one tank is completely emptied, instrumentation, cameras, pumps, and sluicers are moved to the next tank. The operation is repeated until all four tanks are emptied.

6.4 Radon Control System (RCS) Interface

The Transfer Storage Tanks are vented to the RCS to control the build-up of radon in the tanks.

6.5 Sampling System

The Silo Project is currently evaluating the needs and requirements for archive samples from the AWR Project. Upon determining the appropriate sampling requirements the AWR Project will design, build and operate the sampling system. The sampling system requirements and design information will be presented in the AWR Waste Retrieval Remedial Action Work Plan.

6.6 Transfer Storage Tanks

Four Transfer Storage Tanks are provided for storage of residues from Silos 1 and 2, and from the K-65 Decant Sump Tank (reference drawing #05FMD010 Rev 3). The K-65 material and BentoGrout™ from Silo 1 are stored in two of the four tanks, and the K-65 material and BentoGrout™ from Silo 2 is stored in the other two tanks. The residue in the K-65 Decant Sump Tank is transferred to the storage tanks assigned for receipt of wastes from Silo 2.

The carbon steel Transfer Storage Tanks each have a capacity of 750,000 gallons and are constructed in accordance with American Petroleum Institute API-650 standard. The tank volume was selected to allow for a maximum storage level of 90% of total capacity, although the tanks are designed for filling to their maximum capacity. The tanks are 66-feet in diameter, have a straight side dimension of 30 feet, and are provided with 1/4-inch corrosion allowance. The exterior surfaces of the tanks are painted. The tank roofs are dome shaped and are supported by rafters to minimize the overall height to 33-feet, 6-inches (excluding nozzle risers) from the top of their concrete foundations. The tank bottoms are sloped to a center sump to facilitate residue removal during TWRS.

7.0 TRANSFER TANK WASTE RETRIEVAL SYSTEM (TWRS)

The TWRS as depicted in Exhibit 7-1 is designed to access, mobilize, and transfer residue stored in the TTA System. The TWRS is comprised of the TTA System and support features included within the future remediation facility. Sluicer Modules, Slurry Pump Modules and equipment used for the SWRS are also deployed for the TWRS.

The function of the TWRS is to provide the capability to retrieve and transfer the entire inventory of waste from the TTA Transfer Storage Tanks (TTA tanks) to a future remediation facility for final treatment and disposal. The same equipment used for the SWRS will also be deployed by the TWRS with one major design enhancement. The TTA storage tanks will have two opposing sluicer modules per tank with a central slurry pump module, thereby eliminating the need for heel removal. All of the equipment will be of the same design and fully interchangeable. Thereby, the sluicer module used in the silos will be the same as the sluicer module used in the TTA storage tanks. The two-sluicer modules and the central slurry pump module will permit a "swirl" movement of the waste within the tank as the waste is removed. This will result in providing a more uniform mix of waste material.

Equipment is provided for the transfer of stored residues from one TTA tank at a time. Connections are provided for connecting slurry and sluice water piping to and from the future remediation facility. Sluice water for TWRS operations is supplied from the future remediation facility. The TTA System provides piping and valves between the future remediation facility interface point and each of the four TTA storage tanks. The two Sluicer modules and the Slurry Pump module are connected to the storage tank being emptied.

Transfer Tank Waste Retrieval System (TWRS)

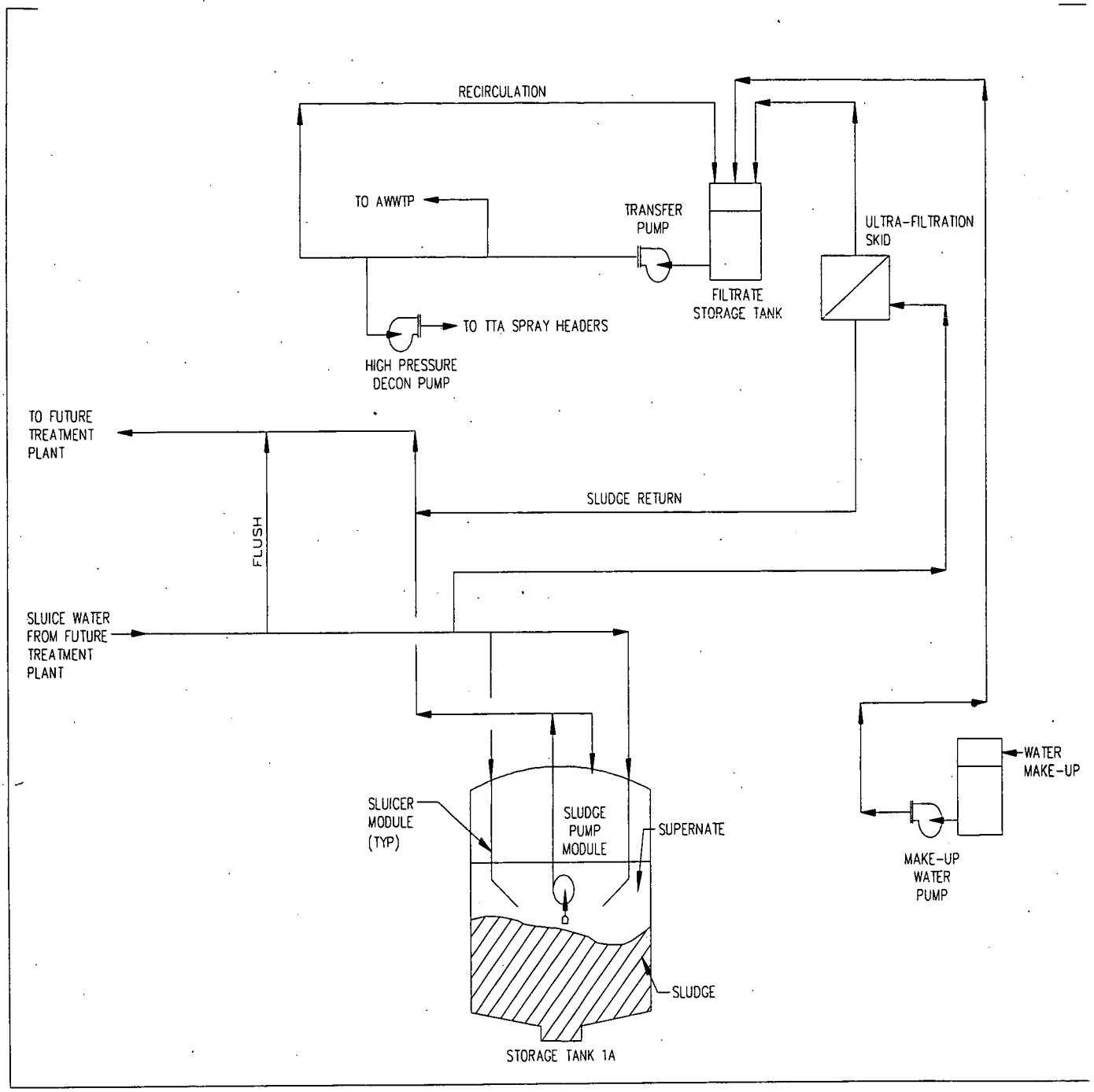

EXHIBIT 7-1

8.0 FACILITIES DECONTAMINATION

The Facilities Decontamination removes gross contamination from the silos, the decant sump tank, and contaminated process equipment as part of facility demobilization and closure. There are two categories of gross decontamination activities. First, is gross decontamination of silos, decant sump tank and process equipment, as well as permanent facilities erected during the project, especially those left behind for management of the waste and radon effluent until the time that the waste is remediated. The second type of gross decontamination is the processing of temporary tools, equipment, and facilities used on the project.

8.1 Silos Decontamination and Fixative Application

Gross decontamination of permanent facilities includes decontamination of the internal surfaces of the silos. The Fixative Spray System (FSS) is used after the internal surfaces of the silos are accessed and decontaminated to remove all visible loose contamination, as verified by closed-circuit television (CCTV) inspection. The FSS applies a fixative to the walls and floors of the silos after completion of waste and debris removal to prevent any radionuclides in the concrete surfaces from becoming airborne. The fixative is a water-based, paint-like liquid material that has properties that allows it to contain radioactive contamination under the fixative layer after it dries. More than one layer of fixative may be applied as necessary to achieve the necessary level of sealing of the silo walls. The FSS consists of pump, hose, nozzle, and small, positive-displacement pump and uses EMMA™ to reach all points within the silos.

8.2 Decontamination, Packaging, and Staging of Contaminated Materials and Equipment

Decontamination of discrete objects and failed equipment will be performed in a portable, truck-mounted decontamination facility. It provides for cleaning of equipment and the collection of water and abrasive cleaning media used in the cleaning process. The survey of material for unrestricted release (that precedes making the material available to Fluor Fernald, Inc. for verification survey) is done in an area within a facility reserved for this function where background radiation level is low enough to achieve the desired instrument sensitivity. This facility is located in the southwest section of the project site.

9.0 EASILY MANIPULATED MECHANICAL ARM (EMMA™) SYSTEM

The EMMA™ System is a major component of the Silo Waste Retrieval System (SWRS), and is critical to the success of the Accelerated Waste Retrieval (AWR) program. Two EMMA systems are planned for delivery to the Fernald site. These systems will be used for the AWR operations on Silos 1 and 2, and the Full-Scale Mock-Up (FSM) testing activities planned for Silo 4.

The EMMA™ System is designed to assist in all mining and silo closure operations for BentoGrout™ removal through final inspection and fixative application activities. The proposed mining strategy will be achieved through effective employment of the EMMA™. The EMMA™ will facilitate operations from initial entrance into the silo through final clean out, inspection, and closure acceptance.

9.1 System Features

The EMMA™ manipulator is a 52.5-foot long, 30-inch diameter (maximum), cylindrical serpentine manipulator composed of five independent stages and a wrist assembly. Stages 1 through 3 are single degree of freedom (1 DOF) stages, capable of bending only in a vertical direction (pitch). Stages 4 and 5 are two degrees of freedom (2 DOF) stages, and provide pitch and yaw capability, which allows the stages to bend both in vertical and horizontal directions. The 2 DOF wrist at the end of the manipulator provides local dexterity in support of silo waste retrieval activities. The manipulator's length ensures access to the complete working envelope within the silo. The dexterity offered by the five discrete manipulator stages and wrist assembly enables the manipulator to move effectively around in-silo obstacles such as the SREE umbilical, the sluicer module, and the slurry pump module.

9.2 Equipment Safety and Survival

The EMMA™ manipulator system design incorporates unique coupling and cable systems that will allow the manipulator to safely sustain in-silo rigors associated with operation and decontamination activities. The design also specifies robust materials of construction that will provide a 10-year operating life.

Several redundant systems have been included to ensure that control of the EMMA™ can always be maintained and that collision or loading of the silo does not occur. The system sensors will alert the operator to situations that could potentially damage the silo integrity, or cause a manipulator system failure. Programmed software controls will not allow the manipulator system to process forward movement or configuration commands should the manipulator encroach the designated safety space by the wall. Additional safety controls will be incorporated into the operating system to meet all operating requirements set forth by the AWR environment and operating requirements.

9.3 Detail Design

Reference Appendix F for further details regarding the EMMA™ system.

10.0 PROCESS CONTROL

Process Control of the RCS, EMMA™, Waste Retrieval activities will be accomplished by three distributed control systems at HMI stations in the control trailer. The Process Control Plan will provide further discussion on these controls.

11.0 SILO PENETRATION

To deploy the various equipment and system into the Silos the existing manways need to be enlarged. The Silo Penetration Plan which will be submitted with the AWR Radon Control System Phase I Remedial Action Work Plan will provide further discussion on how the Silo Penetration activity is done.

Section 2.2
Process Ctrl Summary

Accelerated Waste Retrieval Project Process Control Summary

1.0 INTRODUCTION

1.1 Objective

The objective of this document is to provide a general overview of the Accelerated Waste Retrieval Project controls, operating parameters, and alarms. The Accelerated Waste Retrieval process control systems are designed to support the treatment of radon, waste retrieval, full-scale mock-up testing and staging of waste in the TTA.

1.2 Overview

The AWR project consists of several separate phases and activities that require different process controls. The AWR Radon Control System is required to operate continually throughout the waste retrieval operation, prior to any construction activities around and on the silos and during the staging of silo material in the TTA tanks. The silo waste retrieval activities are batch processes which require controls to start, stop and periodically control operation. To accomplish these multiple functions and activities the AWR Process Control Philosophy is to use three independent control systems. These systems are as follows:

- Balance of Plant (BOP) Control System
- Radon Control System (RCS) Control System
- Easily Manipulated Mechanical Arm (EMMA) Control System

The three independent control systems are integrated through a fiber optic cable link and the Siemans Profibus operating system. The primary plant operating system is the BOP Control System, which is responsible for control of plant operations such as Silo material conveyance and storage, water supply, and filtration systems. The RCS and EMMA systems are provided with independent control systems and do not directly communicate with each other except through their common link to the BOP Control System as depicted in Exhibit 1-1. Key alarms, their setpoints, and alarm responses are summarized in Exhibit 1-2.

The BOP Control System receives and log status and alarm signals from both the RCS and EMMA control systems. The BOP system can initiate appropriate actions on the systems under its control (e.g. shut slurry transfer) in response to alarm signals from the RCS and EMMA control systems. In the case of alarm or status signal from the BOP system

CONTROL INTERFACE DIAGRAM

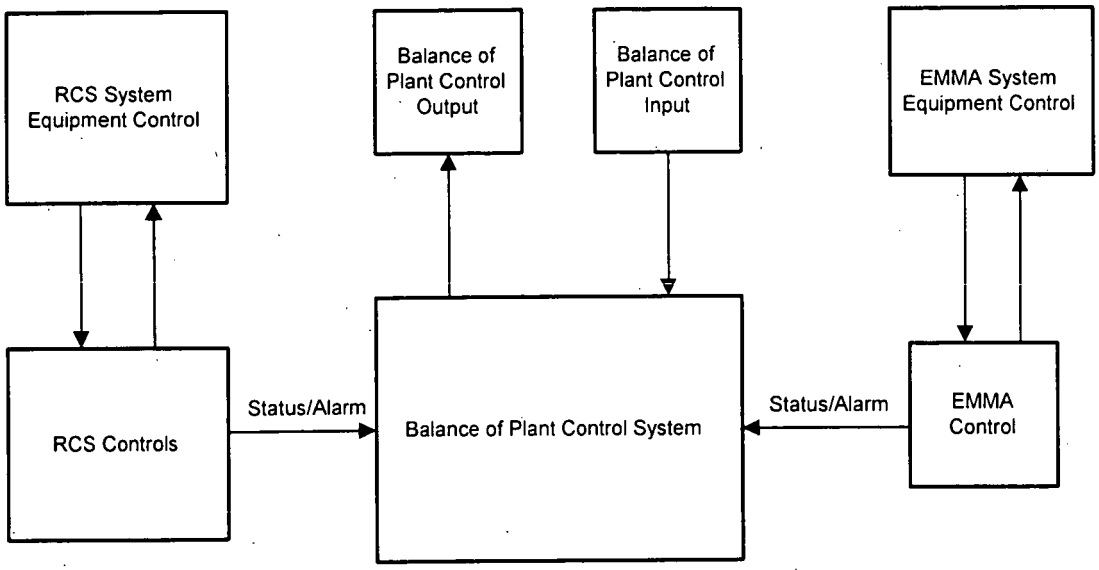

EXHIBIT 1-1

Exhibit 1-2. Summary of Key Alarms, Key Alarm Setpoints, and Alarm Responses

TAG NO.	FUNCTION	INSTRUMENT RANGE	L-SP	H-SP	ALARMS	RESPONSE	P & ID
PDIT-SILO-20-002	MONITOR AND CONTROL SILO PRESSURE	-5 TO 5 " WATER GAUGE (W.G.)	-2.0" W.G.	0.5" W.G.	YES	Damper modulation to regain operating setpoint: System shutdown on unrelieved pressure conditions	20FMD012
FE/FIT-SILO-20-001	MONITOR FLOW FROM SILO 1	0-1000 ACFM	N/A	500 ACFM	YES	Measurement of flow from silo	20FMD013
FE/FIT-SILO-20-002	MONITOR FLOW FROM SILO 2	0-1000 ACFM	N/A	500 ACFM	YES	Measurement of flow from silo	20FMD013
LVR-20-001	CONTROL SILO PRESSURE	0 TO 100%	N/A	N/A	N/A	Opposed blade damper actuated by silo pressure	20FMD013
LVR-20-002	CONTROL SILO PRESSURE	0 TO 100%	N/A	N/A	N/A	Opposed blade damper actuated by silo pressure	20FMD013
LVR-20-003	CONTROL SILO PRESSURE	0 TO 100%	N/A	N/A	N/A	Opposed blade damper actuated by silo pressure	20FMD013
LVR-20-004	CONTROL SILO PRESSURE	0 TO 100%	N/A	N/A	N/A	Opposed blade damper actuated by silo pressure	20FMD013
PDIT-SILO-20-001	MONITOR AND CONTROL SILO PRESSURE	-5 TO 5" W.G.	-2.0" W.G.	0.5" W.G.	YES	Damper modulation to regain operating setpoint: System shutdown on unrelieved pressure conditions	20FMD013
FE/FIT-CBD-20-001A	CONTROL FLOW ACROSS CARBON BED 1A	0 TO 1000 ACFM	100 ACFM	500 ACFM	YES	Supply damper modulation to alleviate reduction in bed performance or bed isolation by closing exhaust damper on bed	20FMD016
FE/FIT-CBD-20-001B	CONTROL FLOW ACROSS CARBON BED 1B	0 TO 1000 ACFM	100 ACFM	500 ACFM	YES	Supply damper modulation to alleviate reduction in bed performance or bed isolation by closing exhaust damper on bed	20FMD016
FE/FIT-CBD-20-002A	CONTROL FLOW ACROSS CARBON BED 2A	0 TO 1000 ACFM	100 ACFM	500 ACFM	YES	Supply damper modulation to alleviate reduction in bed performance or bed isolation by closing exhaust damper on bed	20FMD016
FE/FIT-CBD-20-002B	CONTROL FLOW ACROSS CARBON BED 2B	0 TO 1000 ACFM	100 ACFM	500 ACFM	YES	Supply damper modulation to alleviate reduction in bed performance or bed isolation by closing exhaust damper on bed	20FMD016
LVR-20-005	MODULATES FLOW THOUGH CARBON BED 2B	0 TO 100%	N/A	N/A	N/A	Opposed blade damper actuated by individual radon monitor	20FMD016
LVR-20-006	MODULATES FLOW THOUGH CARBON BED 2A	0 TO 100%	N/A	N/A	N/A	Opposed blade damper actuated by individual radon monitor	20FMD016
LVR-20-017	MODULATES FLOW THOUGH CARBON BED 1A	0 TO 100%	N/A	N/A	N/A	Opposed blade damper actuated by individual radon monitor	20FMD016
LVR-20-021	MODULATES FLOW THOUGH CARBON BED 1B	0 TO 100%	N/A	N/A	N/A	Opposed blade damper actuated by individual radon monitor	20FMD016
ME/MT-CBD-20-001	MONITORS MOISTURE PRIOR TO CARBON BEDS	0 TO 100% RH	N/A	15%	YES	Changeover of operating train	20FMD016
ME/MT-CBD-20-002	MONITORS MOISTURE AFTER CARBON BEDS	0 TO 100% RH	N/A	N/A	N/A	Moisture loading on bed	20FMD016
PDIT-CBD-20-001A	INDICATING DIFFERENTIAL PRESSURE ACROSS CARBON BED 1A	0 TO 20" W.G.	4" W.G.	15" W.G.	YES	Indicates reduced airflow and alerts operation of possible problems	20FMD016
PDIT-CBD-20-001B	INDICATING DIFFERENTIAL PRESSURE ACROSS CARBON BED 1B	0 TO 20" W.G.	4" W.G.	15" W.G.	YES	Indicates reduced airflow and alerts operation of possible problems	20FMD016
PDIT-CBD-20-002A	INDICATING DIFFERENTIAL PRESSURE ACROSS CARBON BED 2A	0 TO 20" W.G.	4" W.G.	15" W.G.	YES	Indicates reduced airflow and alerts operation of possible problems	20FMD016
PDIT-CBD-20-002B	INDICATING DIFFERENTIAL PRESSURE ACROSS CARBON BED 2B	0 TO 20" W.G.	4" W.G.	15" W.G.	YES	Indicates reduced airflow and alerts operation of possible problems	20FMD016
RE/RQIT-CBD-20-001A	MONITORS RADIATION BREAKTHROUGH OF CARBON BED 1A	0 TO 1,000,000 pCi/L	N/A	H-130,000 pCi/L HH-250,000 pCi/L	YES	Redistribution of air flow upon high alarm: bed shutdown on high/high alarm Adjustable over	20FMD016

3387

AG NO.	FUNCTION	INSTRUMENT RANGE	L-SP	H-SP	ALARMS	RESPONSE	P & ID
						operating phases	
RE/RQIT-CBD-20-001B	MONITORS RADIATION BREAKTHROUGH OF CARBON BED 1B	0 TO 1,000,000 pCi/L	N/A	H-130,000 pCi/L HH-250,000 pCi/L	YES	Redistribution of air flow upon high alarm: bed shutdown on high/high alarm Adjustable over operating phases	20FMD016
RE/RQIT-CBD-20-002B	MONITORS RADIATION BREAKTHROUGH OF CARBON BED 2A	0 TO 1,000,000 pCi/L	N/A	H-130,000 pCi/L HH-250,000 pCi/L	YES	Redistribution of air flow upon high alarm: bed shutdown on high/high alarm Adjustable over operating phases	20FMD016
RERQIT-CBD-20-002A	MONITORS RADIATION BREAKTHROUGH OF CARBON BED 2B	0 TO 1,000,000 pCi/L	N/A	H-130,000 pCi/L HH-250,000 pCi/L	YES	Redistribution of air flow upon high alarm: bed shutdown on high/high alarm Adjustable over operating phases	20FMD016
TE/TT-CBD-20-001	MONITORS TEMPERATURE ENTERING CARBON BEDS	0 TO 100°F	N/A	40F	YES	Changeover of operating train	20FMD016
TE/TT-CBD-20-002	MONITORS TEMPERATURE EXITING CARBON BEDS	0 TO 100°F	N/A	40F	YES	Alerts operations of possible loss of environmental control in carbon bed rooms and/or carbon bed problems	20FMD016
FE/FIT-AWT-20-001	MEASURES FLOW TO ADVANCE WASTEWATER TREATMENT (AWWT)	0 TO 50 GPM	N/A	5 and 25 GPM	N/A	Monitors flow to AWWT	20FMD017
LE/LIT-TNK-20-002A	INDICATING WATER LEVEL IN HOLDUP TANK 002A	0 TO 10 FT	N/A	N/A	N/A	Cycles operating trains and initiates pump operation and/or termination	20FMD017
LE/LIT-TNK-20-002B	INDICATING WATER LEVEL IN HOLDUP TANK 002B	0 TO 10 FT	N/A	N/A	N/A	Cycles operating trains and initiates pump operation and/or termination	20FMD017
LE/LSH-SMP-20-001	DETECTS LIQUID IN SUMP	N/A	0.5 FT	2 FT.	YES	Alert operations and begin corrective action and cleanup	20FMD017
LSHH-TNK-20-002A	MONITORS HOLDUP TANK 002A LEVEL HIGH-HIGH	N/A	N/A	6.5 FT	YES	Alert operations and changes to different operating train	20FMD017
LSHH-TNK-20-002B	MONITORS HOLDUP TANK 002B LEVEL HIGH-HIGH	N/A	N/A	6.5 FT	YES	Alert operations and changes to different operating train	20FMD017
TNK-20-002A	MONITORS HOLDUP TANK 002A LEVEL LOW-LOW	N/A	0.5 FT	N/A	YES	Terminates condensate transfer pump operations	20FMD017
LSLL-TNK-20-002B	MONITORS HOLDUP TANK 002B LEVEL LOW-LOW	N/A	0.5 FT	N/A	YES	Terminates condensate transfer pump operations	20FMD017
PDIT-TNK-20-002A	MONITORS PRESSURE IN TANK	-5 TO 5 "W.G.	-1.0" W.G.	0.1" W.G.	YES	Monitors pressure in condensate holdup tanks	20FMD017
PDIT-TNK-20-002B	MONITORS PRESSURE IN TANK	-5 TO 5 "W.G.	-1.0" W.G.	0.1" W.G.	YES	Monitors pressure in condensate holdup tanks	20FMD017
RE/RQIT-RCS-20-001	BUILDING ROOM MONITOR	0 TO 10,000 pCi/L	N/A	100 pCi/L	YES	Shutdown and assess ventilation supply and exhaust systems	20FMD017
GA-CHR-20-001A	MONITORS CHILLER PKG GENERAL ALARMS/INPUT	N/A	OUT OF PARAMETER CONDITIONS	OUT OF PARAMETER CONDITIONS	YES	Changeover of operating train	20FMD018
GA-CHR-20-001B	MONITORS CHILLER PKG GENERAL ALARMS/INPUT	N/A	OUT OF PARAMETER CONDITIONS	OUT OF PARAMETER CONDITIONS	YES	Changeover of operating train	20FMD018
GA-DDS-20-001A	MONITORS DESICCANT DRYING PKG GENERAL ALARM/INPUT	N/A	OUT OF PARAMETER CONDITIONS	OUT OF PARAMETER CONDITIONS	YES	Changeover of operating train	20FMD018
GA-DDS-20-001B	MONITORS DESICCANT DRYING PKG GENERAL ALARM/INPUT	N/A	OUT OF PARAMETER CONDITIONS	OUT OF PARAMETER CONDITIONS	YES	Changeover of operating train	20FMD018
LSHH-DDS-20-001A	MONITORS CHILLER UNIT 001A WATER LEVEL HIGH-HIGH	0 TO 6 FT	N/A	2 FT.	YES	Alerts operation and changeover if required	20FMD018
LSHH-DDS-20-001B	MONITORS CHILLER UNIT 001B WATER LEVEL HIGH-HIGH	0 TO 6 FT	N/A	2 FT.	YES	Alerts operation and changeover if required	20FMD018
ME/MT-TOT-20-001	MONITORS TOTAL MOISTURE GOING INTO DESICCANT UNITS	0 TO 100% RH	N/A	N/A	NO	Feedback to Programmable Logic Controller (PLC) for capacity control of chiller units	20FMD018
PDIT-DDS-20-001A	MONITORS PRESSURE ACROSS DESICCANT DRYER UNIT	0 TO 10" W.G.	N/A	4" W.G.	YES	Changeover of operating train	20FMD018
PDIT-DDS-20-001B	MONITORS PRESSURE ACROSS DESICCANT DRYER UNIT	0 TO 10" W.G.	N/A	4" W.G.	YES	Changeover of operating train	20FMD018

3387

TAG NO.	FUNCTION	INSTRUMENT RANGE	L-SP	H-SP	ALARMS	RESPONSE	P & ID
DDS-20-002	MONITORS PRESSURE TO CARBON BEDS	0 TO 20" W.G.	N/A	15" W.G.	YES	Alert operations of blockage and possible shutdown for protection of desiccant dryers	20FMD018
PDIT-FLT-20-001A	MONITORS PRESSURE ACROSS ROUGHING FILTER	0 TO 5" W.G.	1.0" W.G.	2.5" W.G.	YES	Alerts operations and operating train changeover if required filter replacement Low setpoint refers to loading of roughing filter located in front of high efficiency particulate accumulator (HEPA) (low setpoint is high for roughing filter).	20FMD018
PDIT-FLT-20-001B	MONITORS PRESSURE ACROSS ROUGHING FILTER	0 TO 5" W.G.	1.0" W.G.	2.5" W.G.	YES	Alerts operations and operating train changeover if required filter replacement Low setpoint refers to loading of roughing filter located in front of HEPA (low setpoint is high for roughing filter).	20FMD018
PDIT-SILO-20-003	MONITOR TOTAL DIFFERENTIAL PRESSURE FROM BOTH SILO 1 & 2	0 TO 20" W.G.	N/A	10" W.G.	YES	Alerts operations of static pressure and flow from both silos	20FMD018
FE/FIT-TOT-20-001	MONITORS AIR FLOW TO DRYING SYSTEM	0 TO 1000 ACFM	N/A	N/A	N/A	Feedback to PLC for capacity control of chiller units	20FMD018
TE/TT-TOT-20-001	MONITOR AIR TEMPERATURE INTO DESICCANT DRYING UNITS	0 TO 200 F	N/A	150F	YES	Feedback to PLC for capacity control of chiller units	20FMD018
FE/FIT-FAN-20-001A/B	MONITORS FLOW DISCHARGE FROM FAN-20-001A/B TO STACK	0 TO 1500 ACFM	N/A	N/A	N/A	Required for dose calculations System shutdown on double failure	20FMD019
FE/FIT-FAN-20-001R	MONITORS FLOW DISCHARGE FROM FAN-20-001A/B TO SUCTION SIDE (RECIRC.)	0 TO 1500 ACFM	N/A	N/A	N/A	Operational control	20FMD019
FE/FIT-FLT-20-004	MONITORS FLOW FRESH AIR INLET	0 TO 1000 ACFM	N/A	N/A	N/A	Operational control and measures the amount of makeup air added into system	20FMD019
K-20-001	STACK ISOKENITIC SAMPLER AND RADON MONITOR	Particulate - 0 - 10E-12 uCi/mL Radon: 0-20,000 pCi/L	Particulate - 1E-12 uCi/mL Radon: 2,000 pCi/L	Particulate - 5E-12 uCi/mL Radon: 6,000 pCi/L	YES	High measurements alerts operations to assess and correct RCS; At high-high system shutdown	20FMD019
LE/LSH-STK-20-001	EXHAUST STACK SUMP LEVEL SWITCH HIGH	N/A	N/A	0.5 FT	YES	Alarms to alert operations personnel	20FMD019
LVR-20-015	CONTROLS INTAKE FLOW RATE	0 TO 100%	N/A	N/A	N/A	Opposed blade damper actuated by fan discharge pressure	20FMD019
LVR-20-016	CONTROLS EXHAUST FLOW RATE TO STACK	0 TO 100%	N/A	N/A	N/A	Opposed blade damper actuated by fan discharge pressure	20FMD019
LVR-20-020	CONTROLS RECIRC FLOW RATE	0 TO 100%	N/A	N/A	N/A	Opposed blade damper actuated by fan discharge pressure	20FMD019
PDIT-FAN-20-001A/B	MONITORS FAN-20-001A/B DISCHARGE PRESSURE	0 TO 15" W.G.	N/A	7" W.G.	YES	Controls stack exhaust and makeup air dampers located at fan; Adjustable over operations	
PDIT-FLT-20-002A	MONITORS DIFFERENTIAL PRESSURE ACROSS FILTER TRAIN A	0 TO 10" W.G.	2.0" W.G.	4.0" W.G.	YES	Alerts operations and operating train changeover if required filter replacement Low setpoint refers to loading of roughing filter located in front of HEPA (low setpoint is high for roughing filter).	20FMD019
PDIT-FLT-20-002B	MONITORS DIFFERENTIAL PRESSURE ACROSS FILTER TRAIN B	0 TO 10" W.G.	2.0" W.G.	4.0" W.G.	YES	Alerts operations and operating train changeover if required filter replacement Low setpoint refers to loading of roughing filter located in front of HEPA (low setpoint is high for roughing filter).	20FMD019
PDIT-FLT-20-004	MONITORS DIFFERENTIAL PRESSURE ACROSS FILTER	0 TO 10" W.G.	1.0" W.G.	2.0" W.G.	YES	Alerts operations and operating train changeover if required filter replacement Low setpoint refers to loading of roughing filter located in front of HEPA (low setpoint is high for roughing filter).	20FMD019

TAG NO.	FUNCTION	INSTRUMENT RANGE	L-SP	H-SP	ALARMS	RESPONSE	P & ID
QIT-RCS-20-002	MONITORS RADIATION IN THE RCS BUILDING	0 TO 10,000 pCi/L	N/A	100 pCi/L	YES	Shutdown and assess ventilation supply and exhaust systems	20FMD019
FQI-TOT-51-002	INDICATE TOTAL FLOW FROM POTABLE WATER SUPPLY	0 TO 50 gpm	N/A	N/A	N/A	Totalizes water used by system	51FMD002
PDI-FLT-77-002A	INDICATES DIFFERENTIAL PRESSURE ACROSS FILTER	0 TO 5" W.G.	2.0" W.G.	4.0" W.G.	YES	Alerts operations and operating train changeover if required filter replacement Low setpoint refers to loading of roughing filter located in front of HEPA (low setpoint is high for roughing filter).	77FMD006
PDI-FLT-77-002B	INDICATES DIFFERENTIAL PRESSURE ACROSS FILTER	0 TO 5" W.G.	2.0" W.G.	4.0" W.G.	YES	Alerts operations and operating train changeover if required filter replacement Low setpoint refers to loading of roughing filter located in front of HEPA (low setpoint is high for roughing filter).	77FMD006
PDIT-FLT-77-001	MONITORS DIFFERENTIAL PRESSURE ACROSS RCS BUILDING FRESH AIR FILTER	0 TO 5" W.G.	1.0" W.G.	2.0" W.G.	YES	Alerts operations and operating train changeover if required filter replacement Low setpoint refers to loading of roughing filter located in front of HEPA (low setpoint is high for roughing filter).	77FMD006
PDIT-RCS-77-001	MONITORS DIFFERENTIAL PRESSURE IN RCS BUILDING	-5 TO 5 "W.G.	N/A	0" W.G.	YES	Shutdown and assess ventilation supply and exhaust systems	77FMD006
PDIT-RCS-77-003	MONITORS DIFFERENTIAL PRESSURE IN CARBON BED 001A BUILDING	-5 TO 5 "W.G.	N/A	0" W.G.	YES	Adjust damper positions	77FMD006
PDIT-RCS-77-004	MONITORS DIFFERENTIAL PRESSURE IN CARBON BED 001B BUILDING	-5 TO 5 "W.G.	N/A	0" W.G.	YES	Adjust damper positions	77FMD006
-RCS-77-005	MONITORS DIFFERENTIAL PRESSURE IN CARBON BED 002A BUILDING	-5 TO 5 "W.G.	N/A	0" W.G.	YES	Adjust damper positions	77FMD006
PDIT-RCS-77-006	MONITORS DIFFERENTIAL PRESSURE IN CARBON BED 002B BUILDING	-5 TO 5 "W.G.	N/A	0" W.G.	YES	Adjust damper positions	77FMD006
FE/FIT-FAN-77-001A/B	MONITORS FLOW DISCHARGE FROM FAN-77-001A OR B	0 TO 15,000 ACFM	N/A	N/A	N/A	Required for dose calculations	77FMD008
PDIT-FLT-77-002A	MONITORS DIFFERENTIAL PRESSURE ACROSS RCS BUILDING A FILTER	0 TO 10" W.G.	2.0" W.G.	4.0" W.G.	YES	Alerts operations and operating train changeover if required filter replacement Low setpoint refers to loading of roughing filter located in front of HEPA (low setpoint is high for roughing filter).	77FMD008
PDIT-FLT-77-002B	MONITORS DIFFERENTIAL PRESSURE ACROSS RCS BUILDING B FILTER	0 TO 10" W.G.	2.0" W.G.	4.0" W.G.	YES	Alerts operations and operating train changeover if required filter replacement Low setpoint refers to loading of roughing filter located in front of HEPA (low setpoint is high for roughing filter).	77FMD008
RE/RQIT-RCS-77-001	MONITORS RADIATION IN THE RCS BUILDING	0 TO 2,000 pCi/L	N/A	100 pCi/L	YES	Shutdown and assess ventilation supply and exhaust systems	77FMD008
PDIT-SILO-10-001	MONITORS PRESSURE IN SILO 4	-5 TO 5 "W.G.	-2.0" W.G.	0.5" W.G.	NO	Mockup System	10FMD004
FE/FIT-FLT-10-001	MONITORS FRESH AIR FLO INLET FOR SILO 4	0 TO 1500 ACFM	N/A	N/A	NO	Mockup System	10FMD005
FE/FIT-SILO-10-001	MONITORS SUPPLY AIR FLOW TO SILO 4	0 TO 1500 ACFM	N/A	N/A	NO	Mockup System	10FMD005
FE/FIT-SILO-10-002	MONITORS RETURN AIR FLOW FROM SILO 4	0 TO 1500 ACFM	N/A	N/A	NO	Mockup System	10FMD005
LVR-10-003	CONTROL FRESH AIR INLET	0 TO 100%	N/A	N/A	NO	Mockup System	10FMD005
I VR-10-004	CONTROL EXHAUST TO STACK	0 TO 100%	N/A	N/A	NO	Mockup System	10FMD005
10-005	CONTROL RECIRCULATION AIR	0 TO 100%	N/A	N/A	NO	Mockup System	10FMD005
PMP-11-301P	MONITOR DISCHARGE PRESSURE	0 TO 500 psig	N/A	250 psig	YES	Alerts operations of out of potential problems	11FMD011

TAG NO.	FUNCTION	INSTRUMENT RANGE	L-SP	H-SP	ALARMS	RESPONSE	P & ID
						(clogged slurry line)	
F...-PMP-11-301S	MONITOR DISCHARGE PRESSURE	0 TO 500 psig	N/A	250 psig	YES	Alerts operations of out of potential problems (clogged slurry line)	11FMD011
PIT-SP-001	MONITORS PRESSURE IN TRANSFER LINE	0 TO 500 psig	N/A	250 psig	YES	Alerts operations of out of potential problems (clogged slurry line)	11FMD012
PIT-SP-002	MONITORS PRESSURE IN TRANSFER LINE	0 TO 500 psig	N/A	250 psig	YES	Alerts operations of out of potential problems (clogged slurry line)	11FMD012
PIT-SP-003	MONITORS PRESSURE IN TRANSFER LINE	0 TO 500 psig	N/A	250 psig	YES	Alerts operations of out of potential problems (clogged slurry line)	11FMD012
PIT-SS-001	PRIMARY SLURRY LINE PRESSURE INDICATION	0 TO 500 psig	N/A	250 psig	YES	Alerts operations of out of potential problems (clogged slurry line)	11FMD012
PIT-SS-002	SPARE SLURRY LINE PRESSURE INDICATION	0 TO 500 psig	N/A	250 psig	YES	Alerts operations of out of potential problems (clogged slurry line)	11FMD012
PIT-SS-003	PRIMARY SLURRY LINE PRESSURE INDICATION	0 TO 500 psig	N/A	250 psig	YES	Alerts operations of out of potential problems (clogged slurry line)	11FMD012
AE/AT-PMP-12-200/201	MONITORS DENSITY/FLOW IN SLUICE WATER	300 GPM / 1.2 SG	N/A	1.2 S.G.	YES	Alerts operations of out of parameter sluice water concentrations	11FMD014
LT/LC-TNK-12-001A	MONITORS WATER LEVEL & SLUDGE LEVEL IN TTA TANK 1A	0 TO 40 FT	1 FT (DELTA)	26.5 FT	YES	Termination of decant pump operations	12FMD010
LT/LC-TNK-12-001B	MONITORS WATER LEVEL & SLUDGE LEVEL IN TTA TANK 1B OR 2B	0 TO 40 FT	1 FT (DELTA)	26.5 FT	YES	Termination of decant pump operations	12FMD011
LT/LC-TNK-12-002A	MONITORS WATER LEVEL & SLUDGE LEVEL IN TTA TANK 1A OR 2A	0 TO 40 FT	1 FT (DELTA)	26.5 FT	YES	Termination of decant pump operations	12FMD012
LT/LC-TNK-12-002B	MONITORS WATER LEVEL & SLUDGE LEVEL IN TTA TANK 1B OR 2B	0 TO 40 FT	1 FT (DELTA)	26.5 FT	YES	Termination of decant pump operations	12FMD013
C-TNK-14-001	MONITORS WATER LEVEL & INFILTRATION INTO DECANT SUMP	0 TO 10 FT		HIGH LEVEL - 5 FT LEVEL CHANGE- 1 IN/MIN	YES	Alarms on high setpoint and high infiltration and alerts operation to shutdown SWRS activities.	14FMD011
RQIT-TTA-20-001	TTA AREA RADIATION MONITOR	0 TO 10,000 pCi/L	N/A	100 pCi/L	YES	Shutdown and assess ventilation supply and exhaust systems	20FMD014
FE/FIT-FLT-20-005	MONITORS INTAKE AIR FLOW TO TTA	0 TO 1000 ACFM	N/A	N/A	N/A	Measurement of flow to TTA tank	20FMD015
FE/FIT-TNK-12-001A	MONITOR TANK FLOW	0 TO 1000 ACFM	N/A	500 ACFM	YES	Measurement of flow from TTA tank	20FMD015
FE/FIT-TNK-12-001B	MONITOR TANK FLOW	0 TO 1000 ACFM	N/A	500 ACFM	YES	Measurement of flow from TTA tank	20FMD015
FE/FIT-TNK-12-002A	MONITOR TANK FLOW	0 TO 1000 ACFM	N/A	500 ACFM	YES	Measurement of flow from TTA tank	20FMD015
FE/FIT-TNK-12-002B	MONITOR TANK FLOW	0 TO 1000 ACFM	N/A	500 ACFM	YES	Measurement of flow from TTA tank	20FMD015
LVR-20-007	CONTROL PRESSURE IN TANK	0 TO 100%	N/A	N/A	N/A	Opposed blade damper actuated by silo pressure	20FMD015
LVR-20-008	CONTROL PRESSURE IN TANK	0 TO 100%	N/A	N/A	N/A	Opposed blade damper actuated by silo pressure	20FMD015
LVR-20-009	CONTROL PRESSURE IN TANK	0 TO 100%	N/A	N/A	N/A	Opposed blade damper actuated by silo pressure	20FMD015
LVR-20-010	CONTROL PRESSURE IN TANK	0 TO 100%	N/A	N/A	N/A	Opposed blade damper actuated by silo pressure	20FMD015
LVR-20-011	CONTROL PRESSURE IN TANK	0 TO 100%	N/A	N/A	N/A	Opposed blade damper actuated by silo pressure	20FMD015
LVR-20-012	CONTROL PRESSURE IN TANK	0 TO 100%	N/A	N/A	N/A	Opposed blade damper actuated by silo pressure	20FMD015
LVR-20-013	CONTROL PRESSURE IN TANK	0 TO 100%	N/A	N/A	N/A	Opposed blade damper actuated by silo pressure	20FMD015
LVR-20-014	CONTROL PRESSURE IN TANK	0 TO 100%	N/A	N/A	N/A	Opposed blade damper actuated by silo pressure	20FMD015
PDIT-FLT-20-005	MONITORS DIFFERENTIAL PRESSURE ACROSS TTA TANK FRESH AIR FILTER	0 TO 5" W.G.	1.0" W.G.	2.0" W.G.	YES	Sweep air across TTA tanks	20FMD015
PDIT-TNK-12-001A	MONITOR AND CONTROL TANK PRESSURE	-5 TO 5 "W.G.	-2.0" W.G.	0.5" W.G.	YES	Damper modulation to regain operating setpoint	20FMD015

3387

TAG NO.	FUNCTION	INSTRUMENT RANGE	L-SP	H-SP	ALARMS	RESPONSE	P & ID
PDIT-TNK-12-001B	MONITOR AND CONTROL TANK PRESSURE	-5 TO 5 "W.G.	-2.0" W.G.	0.5" W.G.	YES	Damper modulation to regain operating setpoint	20FMD015
PDIT-TNK-12-002A	MONITOR AND CONTROL TANK PRESSURE	-5 TO 5 "W.G.	-2.0" W.G.	0.5" W.G.	YES	Damper modulation to regain operating setpoint	20FMD015
PDIT-TNK-12-002B	MONITOR AND CONTROL TANK PRESSURE	-5 TO 5 "W.G.	-2.0" W.G.	0.5" W.G.	YES	Damper modulation to regain operating setpoint	20FMD015

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requiring action from the RCS or EMMA control system, the operator will operate the appropriate Human Machine Interface (HMI) screen to initiate the necessary action.

2.0 CONTROL SYSTEM DESCRIPTIONS

2.1 Balance of Plant Control System

The BOP Control System controls all plant operations except the RCS and EMMA operations. It includes PLC controls and redundant Human Machine Interface (HMI) consoles for the K-65 conveyance and storage system, water supply, and the filtration system. The HMI consoles are located in the AWR Project control trailer and are capable of accessing status and alarm information from the RCS and EMMA systems. Each subsystem in the BOP can be operated locally through the PLC with safety interlocks to prevent inadvertent operation of equipment. The BOP Control System provides several key operational control functions as noted in the Process Control Key Parameters/Set-point Table Exhibit 1-2. Specifically the BOP control system is responsible for controlling the flow rates, operating pressures and solids concentrations during sluicing operations. Details of the Balance of Plant (BOP) Process Control philosophy are included in Appendix H Process Control Plan of the Balance of Plant. This appendix includes detailed discussion of control sequences, alarm responses, and auto and manual control features.

2.2 RCS Process Control System

The Radon Control System (RCS) is a treatment system that employs air conditioning, dehumidification, activated carbon, and HEPA filtration to provide Best Available Technology for control of radon emissions and other radionuclides to the environment. The RCS will be operated in compliance with ARARs and TBC requirements identified in Section 5.0 of the Remedial Design Package. The RCS provides treatment of emissions from the following sources:

- Silos 1 and 2 headspace (including during decontamination of the silos),
- Silos 1 and 2 Waste Retrieval System,
- Decant Sump Tank Waste Retrieval System,
- Transfer Tank Area (TTA) System,
- TTA Waste Retrieval System, and
- Future Full-Scale Remediation and Support Facilities.

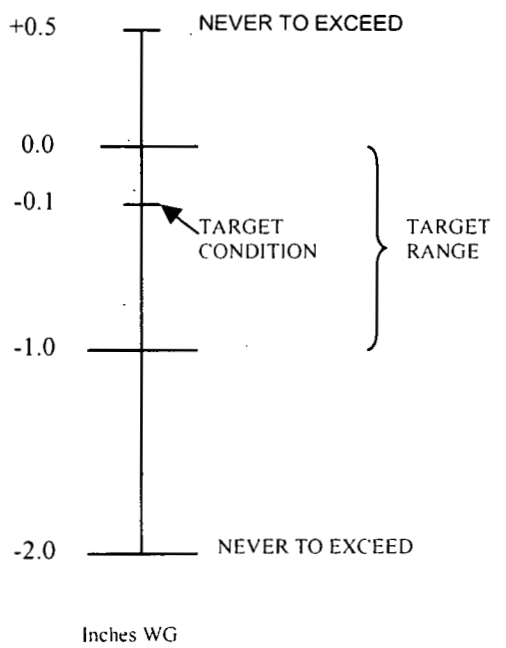
The philosophy for operation of the RCS focuses upon controlling two key process parameters: system operating pressure and radon emissions. Based upon the phase of the Silos 1 and 2 remediation activities, the configuration of the RCS and thus the mechanics for controlling the system operating pressure and radon emissions will vary.

The process flow for the RCS is depicted on Figure 2-1. Alarm setpoints and responses are summarized in the Key Parameters and Setpoint Table (Exhibit 1-2). Additional detail on process control for the RCS, including description of the instrumentation and control equipment, is provided in the Process Control Plan (Radon Control System, Document No-624-P622-36A, Appendix H of this Remedial Design Package).

The following sections describe the methods for controlling the RCS operating pressure and radon emissions. In addition to providing radon control during the two phases of AWR Operations (Phase 1, Silo Headspace Reduction, and Phase 2, Silo Waste Retrieval), the RCS is designed to provide control of radon emissions during the subsequent TTA storage and future waste remediation periods.

2.2.1 Pressure Control in the Silos 1 and 2 Headspace

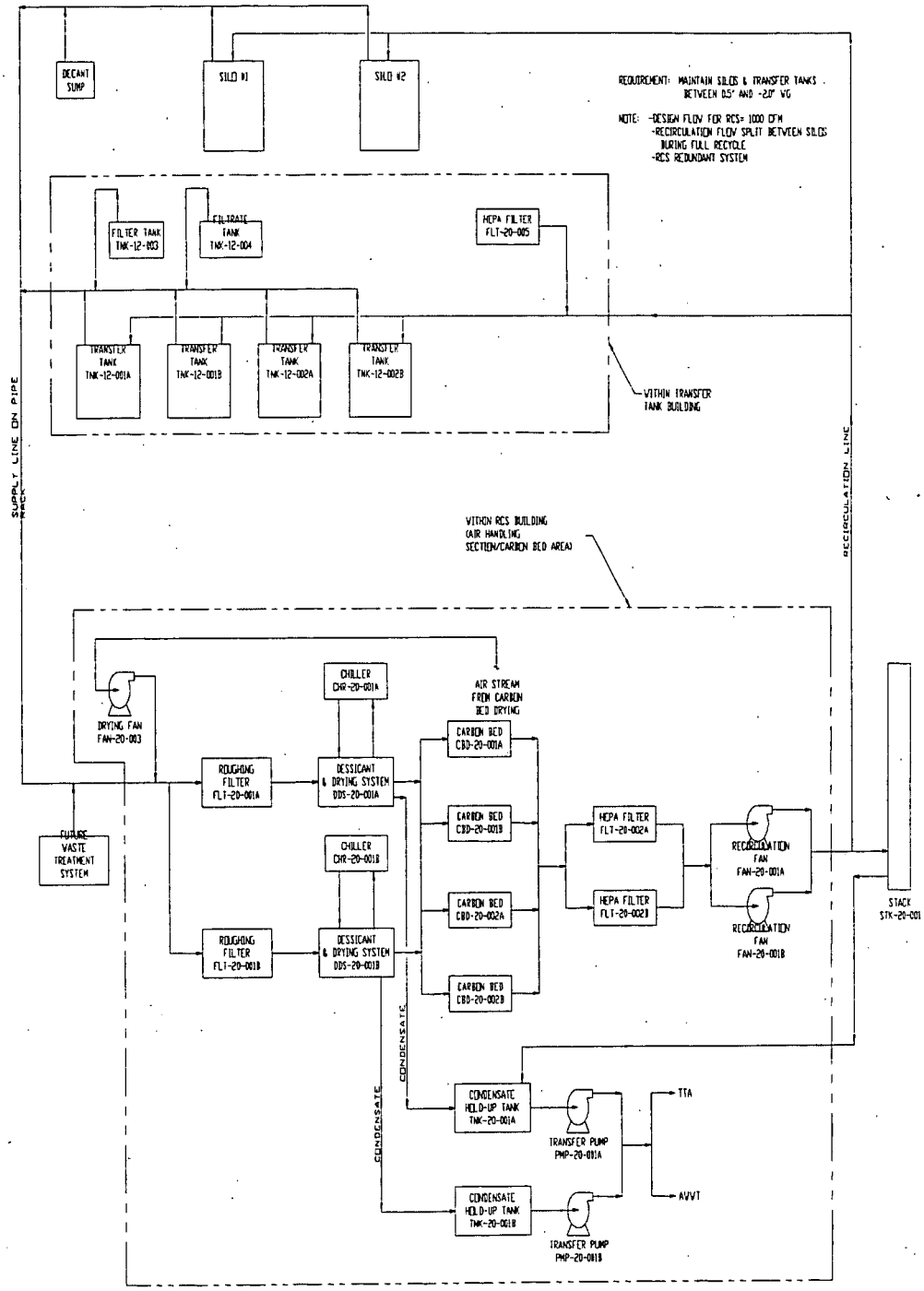
The Silos 1 and 2 headspace will be protected from an out-of-parameter pressure condition. Over-pressurization conditions are addressed by the master/slave operation of the supply and exhaust damper system on each silo. In the event that a positive pressure spike remains unmitigated by initial damper adjustment, the supply of air to the silo headspace is terminated and the system briefly goes into return-only or exhaust mode to dampen the spike. Subsequently, the supply is bled back online and the desired condition is restored. Additionally, a pressure/vacuum relief device protects the silos by providing the final relief from over and under-pressurization. In an under-pressurization condition, the pressure/vacuum relief device allows ambient air in and thus relieves the condition. Such events are considered upset conditions and are not intended for normal operation. Subsequent to such an event, the prevailing system conditions are analyzed to determine the causative factors so that operational adjustments can be identified and implemented.



Target Headspace Pressure

As shown above, based upon silo integrity, the allowable pressure range for the silo headspaces is between 0.5 and −2.0 inches WG. The targeted operating pressure range for operation in the silos is from 0.0 to −1.0 inch WG. The normal operating target pressure during Phase 1 will be −0.1 inches WG. The target pressure may be adjusted to a setpoint nearer atmospheric pressure if the structural nature of the silos (large crack areas = high infiltration rate) necessitates. The control system will respond to maintain the targeted pressure condition. Normal operations will occur within the targeted range.

FIGURE 2-1 Radon Control System



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Excursions beyond the targeted range are mitigated as discussed below. The control devices, control strategy, and the relief mechanism ensure the "never-to-exceed" values of 0.5 and −2 inches WG. Targeted setpoints for the subsequent phases of operation (Phases 2A, 2B, 2C, and 3) will be optimized based testing during the Full-scale Mock-up System activities conducted on Silo 4 during Phase 1 RCS operations.

During Phase 1, the headspace air is withdrawn from Silos 1 and 2 and transferred to the RCS for treatment. The desired pressure condition is maintained by using an induced-draft, automatically, controlled fan and damper system.

A ventilation air stream from Silo 1 or Silo 2 is exhausted into an 8-inch main duct header to the RCS Building. Upon entering the building, the air is treated through one of two process trains. After the air is treated and leaves the fan, it flows to a 10-inch duct header whose branch supply lines exhaust air to the stack, the Silos, and in subsequent phases to the TTA tanks, as needed.

The dampers associated with pressure control for Silos 1 and 2 are modulating opposed blade dampers. These dampers and the associated instrumentation are depicted on Figure 2-2. The primary dampers consist of a silo supply damper (LVR-20-003), a silo exhaust damper (LVR-20-004), a make-up air damper (LVR-20-015), and an exhaust stack damper (LVR-20-016). A pressure differential transmitter provides pressure indication inside the silos to the HMI. A redundant pressure differential transmitter will be provided to ensure proper pressure is detected and maintained in the silos.

During normal pressure operations (range ≅ 0 to −1.0 inches WG), flow from the silos through the silo exhaust damper will be monitored against the desired setpoint for the flow transmitter. The exhaust stack and make-up air dampers will operate to provide a constant flow to the silos by maintaining a setpoint pressure in the 10-inch fan exhaust header. The pressure differential transmitter will measure the pressure in the exhaust header and will control the make-up air and exhaust dampers to maintain required header pressure. If the exhaust air header pressure reaches the high setpoint, then the exhaust stack damper will automatically begin to open to alleviate this condition. When the transmitter detects the low setpoint, the make-up air damper will automatically start to open to allow more air to flow into the RCS system to maintain the desired pressure in the exhaust air header. The difference between the high and low setpoints will be approximately 0.5 inches w.g.

This offset flow control method will ensure that the exhaust flowrate from the silos will be greater than the supply flowrate, which will maintain a negative pressure within the silos. Offset flow control will be overridden in the event of pressures outside the operating range, either high or low. If the pressure exceeds the high set point or low set points for normal operating pressure range then associated opposed blade dampers for silos supply and silos exhaust will be controlled by the silo pressure differential transmitter control loop.

If the pressure in the silo exceeds the high end of the operating range, the RCS will begin to operate using a master/slave pressure control scheme. Pressure in the silos will be relieved, as required, by the supply dampers acting as the masters and exhaust dampers acting as the slaves. Pressure differential transmitters will control the dampers.

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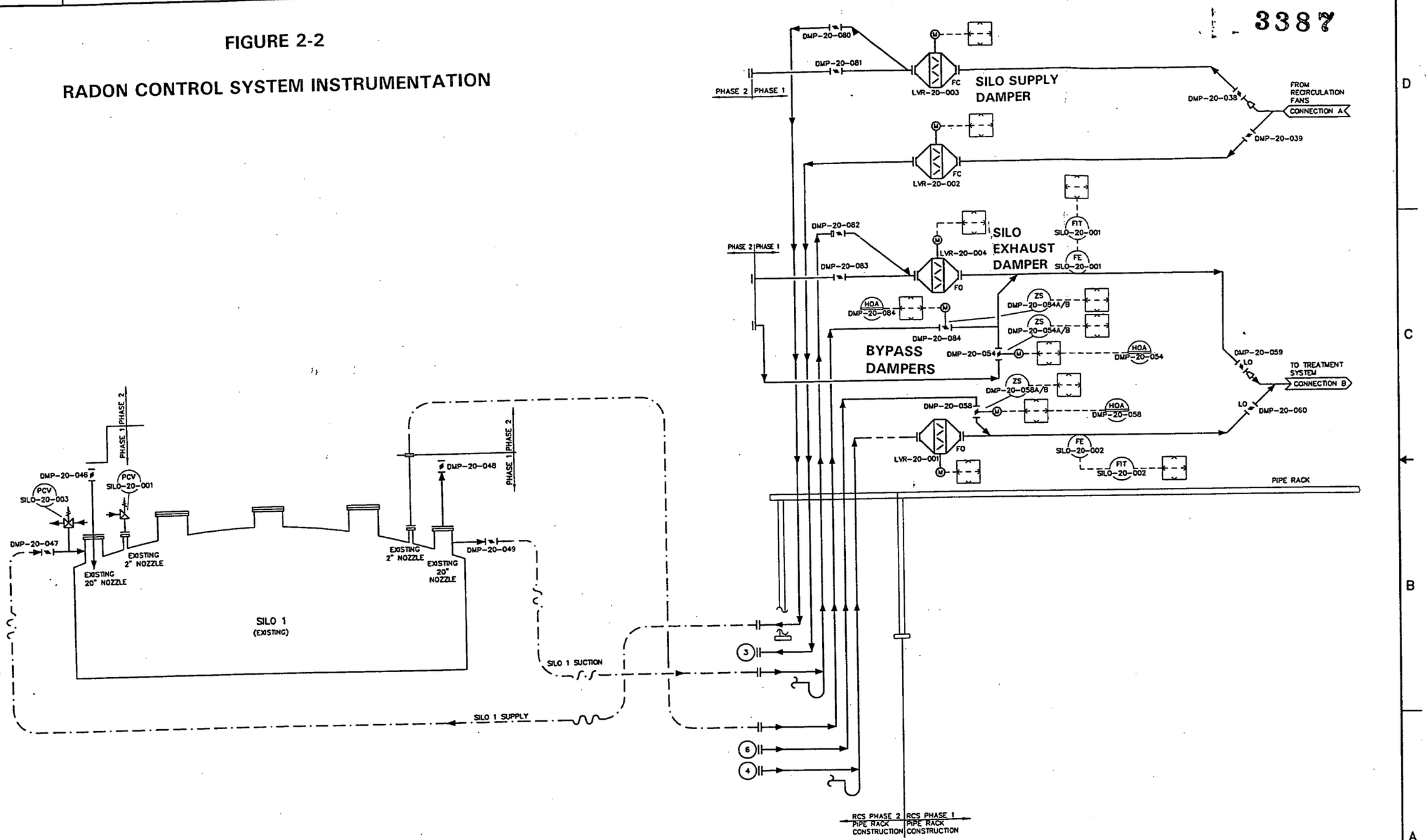
FIGURE 2-2

RADON CONTROL SYSTEM INSTRUMENTATION



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TITLE	
RADON CONTROL SYSTEM PHASE 1 SCHEMATIC	
SIZE D	SCALE: NONE
DWG. NO. SKFMD046	

FILENAME: SKFMD046.DWG

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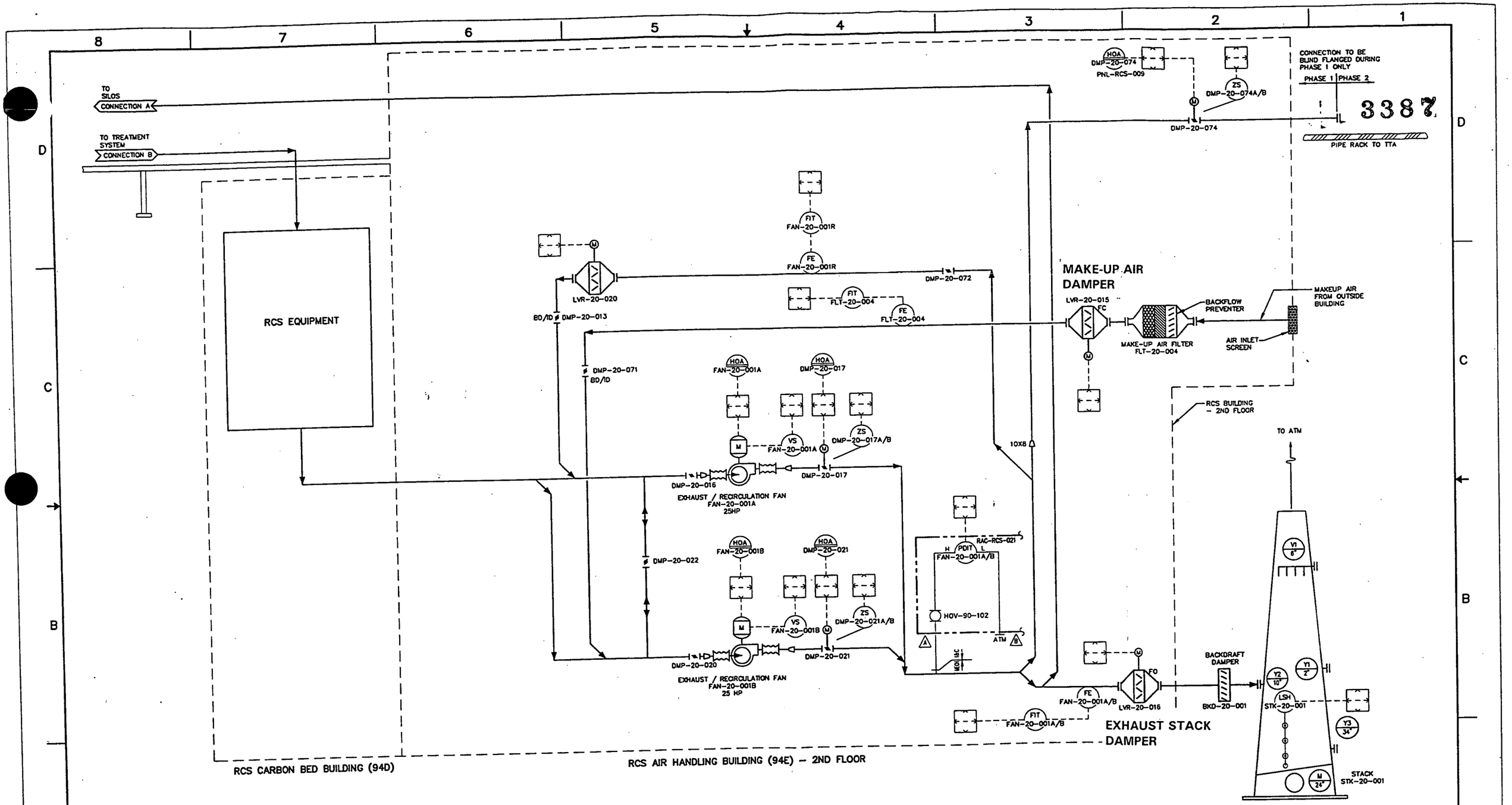

FIGURE 2-2

RADON CONTROL SYSTEM INSTRUMENTATION

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TITLE		
RADON CONTROL SYSTEM PHASE 1 SCHEMATIC		
SIZE D	SCALE NONE	DWG. NO. SKFMD047

FILENAME: SKFMD047.DWG

When a positive pressure is detected in the silo, the silo supply damper will begin to close immediately. If unrelieved pressure outside of the operating range remains after complete closure of the silo supply damper, the silo exhaust damper will open until the operating range is recovered. If the pressure reaches or exceeds the high-high set point for the pressure differential transmitter (> 0.20 inches WG), then bypass dampers will open fully to provide pressure relief

The RCS will be automatically shutdown if the pressure inside the silo exceeds 0.45 inches WG. In the event of a shutdown of the RCS, opposed blade-modulating dampers for silo exhaust and exhaust stack will receive a signal from the PLC to open to 100% to allow for diffusion through the RCS to the stack. The make-up air damper and the silo supply damper will receive a signal to close upon system shutdown.

A recycle duct containing a damper around the fan is provided to maintain the fan at a working level close to optimal conditions. Also exhaust air can be recycled around the fan on high pressure in the silos and gradually bled back into the system upon reaching normal operating conditions.

If the pressure in the silos decreases below the low end of the operating range (-1 inch WG), the RCS will again operate using a master/slave pressure control scheme. If a negative pressure below −1 inch WG occurs, then the silo supply damper will begin to open to 100% capacity. If unrelieved vacuum outside of operating range remains after complete opening of the silo supply damper, the silo exhaust damper will begin to close until the operating range is recovered.

Additionally, an emergency vacuum/pressure relief device is provided for the silos. If a vacuum pressure beyond −2 inches WG occurs in the silo, it will result in the opening of a vacuum relief valve that is located on the silo. Likewise, if a positive pressure of 2 inches WG occurs in the silo, it will result in the immediate opening of a pressure relief valve to mitigate this condition.

When normal operating pressures within the silos have been re-established following a pressure upset, control of the RCS will be returned to the offset flow control system.

The TTA tanks undergoing recirculation will be controlled using the same methods described for the silos using their respective dampers. The TTA tanks that are ventilated during the subsequent phases of RCS operation will be normally ventilated as a once through system by pulling atmospheric air through a backdraft-dampered, HEPA-filtered opening into an air supply header that branches to feed the TTA tanks. The ability to recirculate air from the RCS to the TTA tanks is included in the design for subsequent phases of operation of the RCS.

Once the Phase 1 operations have been successful in reducing the activity levels within the silos, construction will begin on the bridge and other systems. During this construction process, the pipe rack will be extended to its final termination point near the pivot point of the bridge. Three rigid duct spool pieces will be installed on the completed pipe rack that will run from the dampered, blinded-off connections to a final termination point on the bridge in preparation for Phase 2A operation.

To address the tightness of the silos that will be required for the subsequent phases of operation of the RCS, a tyvek or heavy mil plastic cover may be used to cover the dome and sides of the silos. This cover may be used to minimize the amount of in-leakage or infiltration through cracks.

For subsequent Phases 2A and 2B, the ducting for the silo being mined will be routed on the new bridge and connected to the RCS ducting on the pipe rack. RCS ducting on the pipe rack will be sloped to the RCS Building while ductwork on the bridge will slope to the silo being mined.

For Phase 2A operations, the bridge will be positioned over Silo 1. Both the RCS supply and suction connections on Silo 1 dampers will be connected to rigid ducting, mounted on the bridge, by means of a short piece of flexible hose. The supply and suction ducting is routed on the new bridge and connected to the RCS ducting on the pipe rack by means of spool pieces.

2.2.2 Radon Control in the Silo Headspace – Phase 1 Operation

During Phase 1, the ventilation air is withdrawn from Silos 1 and 2 and transferred to the RCS for treatment. The treated ventilation air is returned to the silos for "sweep ventilation" purposes. The RCS will operate in this mode to reduce radon concentration levels inside the silo headspaces to levels that will allow safe access for work activities in the silo area. The design flowrate for the ducting system for the ventilation of Silos 1 and 2 is based upon exhausting up to 500 cfm from each silo during Phase 1 operations. The RCS design also includes the flexibility to reduce flow from one silo for a short period of time in order to increase the amount of air exhausted from the other silo in service. This capability may be used during silo penetration and riser installation. During initial penetration of the dome of one of the silos, the flows will be adjusted as necessary to assure the necessary negative pressure is maintained in the silo being penetrated.

During Phase 1, the RCS suction lines from Silos 1 and 2 will be flexible hoses routed over the berm with a low-point condensate trap. This trap is equipped with a level alarm to notify operations personnel of excess water in the trap. When the excess water is drained, a portable collection pan (e.g., volume $\geq$ 5 gallons) will be placed under the connection. The excess condensate (approximately 2 gallons) will be collected in a container and characterized for discharge to the AWWT facility. A ventilation stream from each silo through an existing opening in silo risers is exhausted through manual dampers into 6-inch flexible hoses that connect to a 6-inch rigid steel duct that extends up the pipe rack and connects to two dampers that feed an 8-inch main duct header to the RCS. Upon entering the building, the air is treated through on of two process trains. After the air is treated, it flows to an 8-inch duct header that supplies the silos. This duct header connects to two dampers that feed back to the flexible hoses routed over the berm, which connect to the silos by manual dampers.

Start-up of silo ventilation will be initiated by enabling the silo control loops on the HMI. Opposed blade dampers will be controlled by flow indicating transmitters. The initial flow set point for exhaust flow from the silos will be 0 cfm. Airflow exiting the silos at this point will be greater than 0 cfm based on in-leakage or the automatic opening of pressure control valves due to increased vacuum pressure in the silos. Flow set points for the silos

will be gradually increased in ≅50 cfm increments until flow rate exiting silos are ≅500 cfm each.

2.2.3 Radon Control during Material Transfer – Phase 2A and 2B Operation

When hydraulic mining activities begin in Silo 1, the RCS moves from Phase 1 to Phase 2A. During this phase, recirculation air to Silo 1 is discontinued and the ventilation air is pulled into the silo through the three enclosures on the pivoting bridge that are used for waste retrieval from Silo 1. The capability to shutoff the enclosure louver intakes and place the silo in recirculation mode is still available if needed. While hydraulic mining activities occur in Silo 1, Silo 2 continues to operate as before in Phase 1 mode.

The design flowrate for the ducting system for the ventilation of Silos 1 and 2 is based upon exhausting up to 500 cfm from each silo for Phase 2A operations. The design also includes the flexibility to discontinue flow from one silo for a short period of time to increase the amount of air exhausted from the other silo in service.

In addition to airflow from Silos 1 and 2, two of the TTA tanks TNK-12-001A and TNK-12-001B will be in operation during Phase 2A. In Phase 2A, the TTA is connected into the RCS. The flow to the various major TTA components is controlled individually at each component. Air is drawn into the TTA through a single manifold and distributed to the transfer tanks by modulating dampers. The filter and filtrate storage tanks are vented to the RCS and a damper will be open to relieve pressure. These tanks are equipped with pressure/vacuum control valves to let air into the tanks at the vacuum set point or to remove air at the pressure setpoint. During Phase 2A, only two of the four waste storage tanks are in service (TNK-12-001A and TNK-12-001B). After Phase 2A, the flow to these tanks can be reduced but not eliminated.

The design flowrate for the ducting system for the ventilation of TTA tanks is based upon exhausting up to 250 cfm from each TTA tank (TNK-12-001A and TNK-12-001B) for Phase 2A operations. Flow to and from these two tanks is controlled using the same methods as those described for the silos.

Before mining starts in Silo 1, the connections of the rigid ductwork on the bridge to the silo and to the duct header on the pipe rack must be verified. To begin Phase 2A operations, airflow must be established through the ductwork on the bridge. The dampers associated with Phase 2A operations will be opened and the dampers associated with Phase 1 operation will be closed. Once airflow is established through the ductwork on the bridge, the flexible hoses associated with Phase 1 operations for Silo 1 can be disconnected and removed. A blind flange will be installed over the opening associated with the hose removal to provide additional sealing.

At the start of Phase 2A operations, the damper in the supply air duct to Silo 1 (the first silo to be emptied) begins closing upon opening of the automatic dampers on the

enclosures. Inlet air for Silo 1 is provided directly through the three enclosures used in this phase for:

- Sluicing,
- Slurry transfer, and
- EMMA™ operations.

Each enclosure is served by a secondary containment that is attached to the silo penetration using a seal arrangement that avoids placing any load on the silo dome. The moveable bridge that is positioned first over Silo 1, and subsequently over Silo 2, structurally supports the enclosures. Each of the three enclosures has an air inlet equipped with a roughing filter, HEPA filter, automatic damper, and flow meter. Access to the enclosures is through air-locked doors that limit additional flow during entry and exit. Flexible seals are used to minimize the free space around equipment passing through the enclosure opening into the silo below.

Ventilation of Silo 1 will be discontinued after hydraulic mining and interior decontamination activities are completed and before the application of the fixative to the inside surfaces of the silo. The dampers that were opened for initiation of mining activities listed earlier are now closed. Spool pieces are removed and the bridge is repositioned over Silo 2. Once in position the spool pieces are reconnected to their original connections. The ventilation strategy of Silo 2 during retrieval activities is identical to that of Silo 1. During Phase 2B, there is an increase in the availability of ventilation air caused by stopping flow to the empty Silo 1. This increases the capability of the RCS to control radon from other sources by increasing the amount of air that can be exhausted from the remaining sources.

When hydraulic mining activities begin in Silo 2, the RCS moves from Phase 2A to Phase 2B. During this phase, recirculation air to Silo 2 is discontinued and the ventilation air is pulled into the silo through the three enclosures on the pivoting bridge that are used for waste retrieval from Silo 2. The capability to shutoff the enclosure louver intakes and place the silo in recirculation mode is still available if needed.

The design flowrate for the ducting system for the ventilation of Silo 2 is based upon exhausting up to 500 cfm from each silo for Phase 2B operations. In addition to the airflow from Silo 2, the two remaining TTA tanks will be placed in operation during Phase 2B. The airflow to the various major TTA components is controlled individually at each component. Air is drawn into the TTA through a single manifold and distributed to the waste transfer tanks by modulating dampers. The filter and filtrate storage tanks are vented to the RCS and will be open to relieve pressure. These tanks are equipped with pressure/vacuum control valves to let air into tanks at the vacuum set point or to remove air at the pressure setpoint. During Phase 2B, all four waste storage tanks are in. After Phase 2B, the airflow to these tanks can be reduced but not eliminated.

The design flowrate for the ducting system for the ventilation of TTA tanks is based upon exhausting up to 250 cfm from each TTA tank for Phase 2B operations. Flow to and from these two tanks is controlled using the same methods as those described for the silos.

Before hydraulic mining starts in Silo 2, the connections of the rigid ductwork on the bridge to the silo and to the duct header on the pipe rack must be verified. In Phase 2B, the dampers associated with Silo 1 control shall be used to control pressures in Silo 2 to minimize the number of specialized spool pieces required for movement of the bridge. To begin Phase 2B operations, airflow must be established through the ductwork on the bridge. The dampers associated with Phase 2B operation will be reopened and the dampers associated with Phase 2A operation will be closed. Once airflow is established through the ductwork on the bridge, the flexible hoses associated with Phase 1 operations for Silo 2 can be disconnected and removed. A blind flange shall be installed over the opening associated with the hose removal to provide additional sealing.

During material retrieval activities of Silo 2, the active waste storage tanks are TNK-12-002A and TNK-12-002B while TNK-12-001A and TNK-12-001B are ventilated at a lower rate. The majority of the TTA flow is committed to tanks TNK-12-002A and TNK-12-002B. After mining and decontamination activities are complete and before the application of the fixative to the inside surfaces of the silo, ventilation of Silo 2 will be discontinued. The dampers that were opened for initiation of mining activities listed earlier are now closed.

After completion of Phase 2B, decant sump waste retrieval begins. This method for this activity is currently under development. Because of the transient nature of this operation, steady-state material balances were not required but RCS ventilation is balanced accordingly.

2.2.4 Radon Control during Interim Storage – Phase 2C

At the conclusion of the material retrieval campaigns from Silos 1 and 2, the operation of the RCS moves from Phase 2B to Phase 2C. During this phase, the RCS ventilates various TTA components as required. Limited airflow can be maintained through TTA components during this phase. The RCS has the flexibility to recycle treated air back through the TTA manifold, or exhaust it through the stack. During the interim waste storage period, the waste storage tanks each have approximately a 2-foot layer of water on top of the material for attenuating the release of radon to the TTA headspace.

The design flowrate for the ducting system for the ventilation of TTA tanks is based upon exhausting up to 125 cfm from each tank for Phase 2C RCS operations. Airflow to and from these tanks is controlled using the same methods as those described for the silos.

2.2.5 Radon Control during Full-Scale Remediation - Phase 3

During Phase 3, the RCS can accommodate a design airflow rate of up to 500 cfm from the future full-scale treatment facility and its support facilities. In addition, the design supports an airflow rate of up to 500 cfm from the TTA tanks. Dampers would again control the balance between the two inputs. If desired, the system can be operated in the recycle mode so that air from the TTA would pass through the carbon beds and return to the TTA, in much the same way the air is to be recycled through the silos during Phase 1.

Airflow through TTA waste storage tanks would be discontinued after transfer of contents from that tank to the future full-scale treatment facility is complete.

2.2.6 Process Control of Carbon Beds

The carbon adsorption system consists of four insulated carbon steel vessels, approximately 16-feet by 11-feet by 11-feet, which contains a total of 160,000 pounds of carbon (40,000 pounds per vessel). Each carbon adsorption vessel is capable of treating up to 500 cfm. Each carbon bed is physically isolated in an individual room.

The four carbon beds are operated in parallel, connected to the 10-inch main duct headers by 8-inch branch duct connections on both the inlet and outlet of the beds. Each bed is aligned with a dedicated inlet and outlet damper for flow control and isolation. Modulating dampers and flow elements provided on the inlet of each bed allow flow to each bed to be reduced or increased on the basis of operations.

The treated air stream from each carbon bed is monitored by radon monitors downstream of the carbon bed discharge dampers. In the event that out-of-parameter high alarm conditions is detected downstream of a carbon bed, the adjusting of the opposed blade damper set point on the inlet side of the carbon bed may reduce the airflow through the affected bed. If the performance of the bed continues to degrade and an out-of-parameter high-high alarm from the HMI occurs, the affected carbon bed damper will automatically close and cannot be re-opened until associated radon high-high alarm has been cleared. Closing of the damper will force the opposed blade damper of the affected carbon bed to also close. The opposed blade damper will be locked in the closed position until the associated damper is reset. The airflow will be redistributed evenly through the other carbon beds.

Pressure across each carbon bed is monitored and displayed on the HMI screen. The HMI will alarm if less than low set point or greater than high set point is exceeded on any active carbon bed.

Moisture levels entering and exiting the carbon bed are indicated on the HMI screen. High-high set point exiting will alarm on the HMI screen to alert the operator of an out-of-parameter condition.

Temperature levels entering and exiting the carbon bed are indicated on the HMI screen. High-high set point entering and exiting will alarm on the HMI screen to alert the operator of an out-of-parameter condition.

In the event a carbon bed needs to be dried to regain carbon bed performance, the RCS has the capability to isolate the individual bed from the others. A take-off stream ranging between 125 and 250 cfm from the recirculation fans will be heated using an inline process heater and passed through the affected carbon beds using an induced draft fan. From this fan the drying air stream is transferred to the RCS for treatment in the carbon beds that remain on line or if the bed is allowed to sit until the radon has decayed adequately, there exists the capability to discharge through the HEPA filters.

2.2.7 Emission Control

The treated gas stream flows from the carbon adsorption units through 8-inch branch connections to the 10-inch duct header to the redundant HEPA filtration units. Filter housings for the HEPA filters are stainless steel, side access, "bag-in/bag-out" type housings with in-place test sections. The HEPA filtration system employs bag-in and bag-out features to minimize the potential of releases during filter changes. Filters will be rated at 1,000 cfm each and operated with one online at a time. Air from the carbon beds, makeup air, and fan recycle combine before entering the HEPA filters. Differential pressure transmitters monitor differential pressure across each filter. The HMI will alarm if less than low set point or greater than high set point is exceeded when filter is in service.

A connection into the flow path before the exhaust fans provides makeup air to the closed air system through opposed blade damper LVR-20-015. Opposed blade damper LVR-20-020 allows recycled air back to the active fan. This configuration allows the fan to run near its rated speed (in rpm) to reduce strain and thus potential maintenance on the system. A connection into the flow path after the exhaust fans allows excess air to exit the system to the stack through opposed blade damper LVR-20-016.

This configuration allows the flow path of the air to:

- Return to the silos or TTA tanks,
- Be exhausted to the stack,
- Be modulated to reduce total flow through the entire system, and
- Allow fresh air makeup to take place.

Quantities of makeup air, fan recycle air, and stack exhaust will be based upon maintaining a certain static pressure at the discharge of the fan. After exiting the operating HEPA filter unit the treated air stream enters the operating recirculation fan for redistribution to the silos, TTA tanks, or exhaust through the monitored stack.

Air from the recirculation fans can be recirculated to the silos, TTA tanks, or exhausted through the stack is sent through a common duct header. Air recirculated back to the silos or the TTA is sent through a duct located on the pipe rack that branches to each of the areas and further branches to the individual silos and tank sources to supply the recirculated air to each one. The distribution of air being exhausted versus the amount of air being recirculated to the different sources is controlled by using modulating dampers LVR-20-016, LVR-20-015, and LVR-20-020 which will be controlled based upon pressure in the fan discharge line. The pressure in the fan discharge line will be affected by the pressure in the silos and TTA tanks, each of which has modulating dampers on the inlet and outlet lines of the silos and TTA tanks for pressure control within each source vessel. Also, a closed position for the supply dampers on the silos and TTA tanks provide a signal to the exhaust damper for the stack which allows air to be exhausted. The amount of air exhausted is based upon the flow measured by the flow meters in the respective exhaust suction lines of the sources with a closed supply damper.

The stack (STK-20-001) is a 150-foot tapered carbon steel stack that is approximately 6 feet 4 inches at the base and tapers to approximately 3 feet at the top. The maximum airflow through the stack is 12,000 cfm. The stack has connections for a 10-inch carbon steel RCS process duct and a 34-inch carbon steel building ventilation duct. The stack is provided with an isokinetic sampling system and will include monitoring for both particulate radionuclides and continuous monitoring for radon. The isokinetic sampling system is housed in enclosures that are environmentally conditioned on the equipment pad close to the stack to minimize the horizontal run of the sampling line. Minimization of the horizontal run and sharp bends or turns of the sample line are requirements to reduce particulate fallout in the sample line. A sampling rake for collection of the sample from the stack is inserted into the stack and is attached to a sampling line. The sampling line is located at approximately 61 feet in elevation. This corresponds to roughly eight stack diameters downstream from the last flow disturbance into the stack. Also, the tapered transition from the 6 feet 4 inch base section of the stack to the smaller diameter section is located at approximately an elevation of 75 feet, which corresponds to about 2 stack diameters downstream of the sampling rake. These elevations were used to obtain a representative sample of the air stream being exhausted. In the event that an out-of-parameter condition is detected, an alarm is enunciated and appropriate action is taken, such as switching the HEPA filters being used, recirculating the process flow to the silos, reducing the airflow in the RCS, or shutting down the RCS. In addition to the automatic actions taken by the control system, the system calls—using telemetry—a designated number to alert the on-call responsible person that an out-of-parameter condition exists.

2.3 EMMA Control System

The EMMA Control system is used to control the EMMA manipulator system. The EMMA system is normally operated using the HMI located in the AWR Project control trailer. Should a need arise the EMMA may also be operated at the local HMI located at the EMMA tower. The EMMA Control System is responsible for the complete operation of the EMMA arm. The control system continuously maps and logs the position and speed of the arm as well as being responsible for all arm movement.

The key control parameters controlled by the EMMA Controller are listed in the Process Control Key Parameters/Set-point Table Exhibit 2-1.

Details of the EMMA Process Control philosophy are included in Appendix G EMMA System Description. This appendix includes detailed discussion of control sequences alarm responses and auto and manual control features.

3387

FOSTER WHEELER

FOSTER WHEELER ENVIRONMENTAL CORPORATION

SAMPLING PLAN

DOCUMENT NO.
624-P621-13, Rev. 0

FOR THE

SILOS 1 AND 2
ACCELERATED WASTE RETRIEVAL
PROJECT

SUBMITTED TO:

FLUOR FERNALD, INC.

CONTRACT NO. FSC 624

November 16, 2000

FOSTER WHEELER ENVIRONMENTAL CORPORATION

SAMPLING PLAN
Revision 0

Recommended by:

Foster Wheeler Engineering Manager

11/28/00
Date

Approved by:

G.H. Mackay (FOR)
Foster Wheeler Project Manager

11/28/00
Date

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000056

3387

TABLE OF CONTENTS

1.0 INTRODUCTION 1
1.1 Background 1
1.2 Scope and Purpose of Plan 1
1.3 Organization of Plan 2
2.0 DATA QUALITY OBJECTIVES AND QUALITY CONTROL 3
2.1 DQOs and Intended Use of Acquired Data 3
2.1.1 Wastewater 3
2.1.2 Air Emissions 3
2.1.3 Silo Residues 4
2.2 Elements of Quality Control (QC) 4
2.2.1 Laboratory Control Sample (LCS) 4
2.2.2 Internal Standards (IS) 5
2.2.3 Method Blank 5
2.2.4 Field Duplicate 5
2.2.5 Matrix Spike/Matrix Spike Duplicate (MS/MSD) 5
2.2.6 Analytical Methods 6
2.3 Supplies and Consumables 6
3.0 SAMPLING MEDIA AND SOURCES 7
3.1 Wastewater 7
3.1.1 RCS Condensate Tanks 7
3.1.2 Filtrate Storage Tank 7
3.2 Air Emissions 7
3.2.1 RCS Stack 8
3.2.2 Process Monitoring of Radon Concentrations 8
4.0 SAMPLING AND ANALYTICAL METHODS 9
4.1 Wastewater 9
4.1.1 Sample Collection and Screening Methods 9
4.1.2 CSL Radiological Analytical Methods 11
4.1.3 Remaining CSL Analytical Methods 11
4.2 Air Emissions 12
4.2.1 Stack Monitoring 12
4.2.2 Radon Process Monitoring 14
5.0 DOCUMENTATION AND RECORDKEEPING 16
5.1 Field Logbook 16
5.2 Sample Container Labeling 16
5.3 Sample Packaging and Shipping 16
5.4 Chain-of-Custody (COC) 17
5.5 Records Storage 17
5.6 Analytical Data 18
5.6.1 Wastewater Samples 18
5.6.2 Air Emissions Samples 18
6.0 WASTE MANAGEMENT PLAN 19
6.1 Wastewater 19
6.2 Consumables 19
7.0 REFERENCES 20

000053

000057

3387

APPENDICES

APPENDIX A	Advanced Wastewater Treatment (AWWT) Facility Waste Acceptance Criteria (WAC) for the Accelerated Waste Retrieval (AWR) Project
APPENDIX B	Summary of Analytical Procedures, Containers, Preservatives, and Holding Time Requirements for Wastewater Samples
APPENDIX C	Wastewater Sample Collection Guideline
APPENDIX D	Typical Analytical Methods for Air Emissions Analyses
APPENDIX E	Air Emissions Monitoring – Radon Control System (RCS) Stack Sampling Guideline
APPENDIX F	Manual Chain-of-Custody (COC) Guideline

000054

3387

ACRONYM AND ABBREVIATIONS

ALARA	as low as reasonably achievable
ANSI	American National Standards Institute
ASL	analytical support level
AWR	Accelerated Waste Retrieval
AWWT	Advanced Wastewater Treatment
Bq	Becquerel
CAA	Clean Air Act
CAM	continuous air monitor
CERCLA	Comprehensive Environmental Response, Compensation and Liability Act
CFR	Code of Federal Regulations
COC	chain-of-custody
CSL	Contract Services Laboratory
DOE	U.S. Department of Energy
DOT	U.S. Department of Transportation
DQO	Data Quality Objective
EML	Environmental Measurements Laboratory
EPA	U.S. Environmental Protection Agency
ES&H	environmental safety and health
FAT&LC	Fernald Atomic Trades and Labor Council
FEMP	Fernald Environmental Management Project
Fluor Fernald	Fluor Fernald, Inc.
FWENC	Foster Wheeler Environmental Corporation
gpd	gallons per day
gpm	gallons per minute
HASL	Health and Safety Laboratory
HASP	Health and Safety Plan
kg/day	kilograms per day
lb/day	pounds per day
LCS	Laboratory Control Sample
MeV	million electronvolts
MSCC	Material Segregation and Containerization Criteria
MS/MSD	Matrix Spike/Matrix Spike Duplicate
NPDES	National Pollutant Discharge Elimination System
OAC	Ohio Administrative Code
OEPA	Ohio Environmental Protection Agency
pCi/L	picocuries per liter
PM	Project Manager
PPE	personal protective equipment
ppm	parts per million
PWID	Project Waste Identification and Disposition
QA	quality assurance
QA/QC	quality assurance/quality control
QC	quality control
RCS	Radon Control System
SOP	Standard Operating Procedure
TEDE	total effective dose equivalent
TRD	Technical Requirements Document
TSS	total suspended solids
TTA	Transfer Tank Area
WAC	waste acceptance criteria
WL	working levels

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1.0 INTRODUCTION

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This Sampling Plan addresses the requirements for the collection and analysis of wastewater and air emission samples associated with the Accelerated Waste Retrieval (AWR) Project at the U.S. Department of Energy (DOE) Fernald Environmental Management Project (FEMP) site near Cincinnati, Ohio. This Plan has been developed and shall be executed in accordance with the *Sitewide Comprehensive Environmental Response, Compensation and Liability Act (CERCLA) Quality Assurance Project Plan* (FD-1000) prepared by Fluor Fernald, Inc. (Fluor Fernald).

1.1 Background

The source of contamination for the AWR Project is the radioactive waste stored in Silos 1 and 2. The AWR Project will involve the safe and effective removal of radioactive decay gases, K-65 residues and bentonite, and other debris contained in Silos 1 and 2 and the Decant Sump Tank. Accumulated concentration of radon gas in the silo headspaces is reduced through the operation of the Radon Control System (RCS). This system will operate on a 24-hour basis and will generate a condensate requiring discharge to the FEMP's Advanced Wastewater Treatment (AWWT) facility.

The bulk of the solid waste is transferred with the addition of water through a sluicing device and pumped as slurry through the transfer line to the shielded Transfer Tank Area (TTA). This process may generate wastewater in the form of filtrate during the latter stages of the AWR Project when the TTA storage capacity is expected to be limited. Wastewater (i.e., condensate and filtrate) and air emissions from the RCS stack produced during the AWR Project require the generation of characterization data in accordance with the data quality objectives (DQOs) described in Document No. 624-P621-12, *Data Quality Objectives*, and therefore, require sampling and analysis in accordance with this Sampling Plan. (Note: Wastewater from the Decant Sump Tank will be transferred to the TTA and managed from that point similar to the filtrate. Therefore, water to be sent to the AWWT facility will come from either the RCS condensate tanks or the TTA filtrate tanks).

1.2 Scope and Purpose of Plan

The purpose of this Sampling Plan is to describe the sampling and analysis efforts associated with the DQOs for the AWR Project. These efforts are generally twofold in scope, as summarized below:

- Ensure that the periodic discharge of excess water from the AWR Project meets waste acceptance criteria (WAC) prior to being transferred to the FEMP's AWWT facility; and
- Ensure that the air emissions associated with the AWR Project meet the applicable regulatory and FEMP site standards.

An additional sample collection effort is required for the AWR Project that relates to obtaining archive samples of silo residues for future use. Since DQOs and related analytical requirements are to be determined by Fluor Fernald, the specific sampling methodology is under development for the silo residues, and therefore, is not provided in this Sampling Plan.

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1.3 Organization of Plan

This Sampling Plan has been prepared to address the requirements of the AWR Contract, specifically paragraph 3.1.13 of the *Technical Requirements Document* (TRD), Fluor Fernald No. 40710-RP-0001, February 3, 1999, Revision 1. This Sampling Plan and its implementation will comply with the *FEMP Sitewide CERCLA Quality Assurance Project Plan* (FD-1000) and applicable local, state, and federal regulatory requirements.

Section 1 of this Sampling Plan provides an introduction including AWR Project background and the purpose and scope of this Plan. Section 2 describes the DQOs and quality control (QC) associated with the sampling and analysis activities for the AWR Project. Section 3 describes the sampling media and sources, while Section 4 provides an overview of the field sampling procedures. Section 5 discusses the appropriate documentation and recordkeeping related to sampling for the AWR Project, including chain-of-custody (COC) and records management. Section 6 provides an overview of the waste management requirements associated with sampling activities for the AWR Project, and finally, Section 7 lists the references used in the preparation of this Plan. In addition to the text of this Sampling Plan, supporting technical information is provided in several appendices to this Plan, as listed below:

Appendix A	AWWT WAC for the AWR Project;
Appendix B	Summary of Analytical Procedures, Containers, Preservatives, and Holding Time Requirements for Wastewater Samples;
Appendix C	Wastewater Sample Collection Guideline;
Appendix D	Typical and Alternative Analytical Methods for Air Emissions Analyses;
Appendix E	Air Emissions Monitoring – RCS Stack Sampling Guideline; and
Appendix F	Manual COC Guideline.

The guidelines presented in the appendices relating to sample collection methods will be used in the development of detailed AWR Project procedures. Detailed sampling procedures will be prepared as part of the operational procedures associated with the RCS and the TTA. Specifically, the sampling/monitoring associated with the condensate tanks, carbon beds, and stack will be addressed in the *RCS Phase 1 and 2 Standard Operating Procedures (SOPs),* which are AWR Project Submittals 624-P633-01 and 624-P636-01. The sampling of the filtrate storage tank will be addressed in the *AWR SOPs* (Submittal No. 624-P6315-01). This approach was approved by Fluor Fernald in response to Foster Wheeler's "Request for Technical Clarification or Information" (RTCI) No. 043. The samples described in this Sampling Plan are to be collected by Fernald Atomic Trades & Labor Council (FAT&LC) personnel.

With regards to analytical methods and performance, a Contract Services Laboratory (CSL) will be subcontracted by Foster Wheeler to complete the laboratory analyses for air emissions and wastewater samples identified in this Sampling Plan in accordance with approved procedures. The CSL will be evaluated prior to subcontract award regarding its ability to meet the quality assurance/quality control (QA/QC) requirements of this Plan and to perform work in accordance with the analytical methods prescribed herein.

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2.0 DATA QUALITY OBJECTIVES AND QUALITY CONTROL

Decisions will be made as a result of the AWR Project sample collection and analysis efforts. Members of the decision process related to these efforts include appropriate AWR Project personnel from both Fluor Fernald and Foster Wheeler. These members include the Project Manager (PM), Operations/Maintenance/Systems Closure Manager, environmental safety and health (ES&H) professionals, and quality specialists. This section provides an overview of the DQOs and QC elements associated with the AWR Project sampling and analysis efforts that implement this decision process.

2.1 DQOs and Intended Use of Acquired Data

As defined by the U.S. Environmental Protection Agency (EPA), DQOs are qualitative and quantitative statements developed to specify the quality of data from field and laboratory data collection activities needed to support specific decisions. The DQOs describe the level of data needed, why the data is needed, and how the data will be used to support process operations. DQOs also ensure that the data collected is of sufficient quality and quantity for the data user's application. The DQOs for the AWR Project are outlined in Document No. 624-P621-12, *Data Quality Objectives.*

2.1.1 Wastewater

Analytical data will be utilized to determine if the wastewater meets the AWWT WAC prior to its transfer. If the AWWT WAC is met, then process wastewater from the AWR Project is transferred to the FEMP AWWT facility for final treatment and discharge in accordance with the FEMP National Pollutant Discharge Elimination System (NPDES) permit. Wastewater found to exceed the AWWT WAC limits will be returned to the waste retrieval system for use in the sluicing process or treated to meet the WAC, as appropriate, prior to its transfer to the FEMP AWWT facility.

The AWWT can accept a total of 7,200 gallons per day (gpd) at the rate of 5 gallons per minute (gpm) from the AWR Project. The WAC for the AWWT facility is provided in Appendix A of this Sampling Plan. In addition, several other water quality parameters (i.e., chloride, nitrate, carbonate, and sulfate) are to be monitored and reported to Fluor Fernald in accordance with the TRD for the AWR Project.

2.1.2 Air Emissions

Air emissions associated with the AWR Project must meet applicable DOE and EPA environmental regulations and AWR Contract requirements. In the initial phase of the AWR Project, the accumulated radon gas in the silo headspaces is purged through the RCS. In addition, the RCS continually operates throughout the waste transfer and storage process of the AWR Project. Air emissions from the RCS stack will be monitored to ensure the appropriate air emission standards are being met.

The continuous air monitoring systems, as later described in Sections 3 and 4 of this Sampling Plan, are used to assess RCS operations and process control, as well as to signal the need for corrective actions to prevent onsite or public exposures from air emissions exceeding established limits. These monitoring systems will have alarms that are preset to provide timely warnings to AWR Project operations staff. For example, if the radon concentrations do not exceed the preset alarm levels for the monitors located upstream of each carbon bed, then the

relevant AWR Contract and regulatory requirements are being met. In addition, the ratio between the concentrations measured by the upstream and downstream monitors is maintained at or above the design value. If the preset alarm levels are exceeded, then alarms will sound and indications will be shown on the control panel located in the AWR Project control trailer. Mitigation measures and corrective actions will be implemented accordingly. In the same sense, if the radon concentrations do not exceed the preset alarm level for the stack monitors, then the RCS is functioning within limits and no mitigative actions are required. If the preset stack alarm levels are exceeded, then alarms will sound and indications will be shown on the control panel located in the AWR Project control trailer, with corresponding mitigation measures and corrective actions implemented as described in the *Process Control Plan* for the AWR Project, Document No. 624-P622-36.

2.1.3 Silo Residues

Samples of the silo residues will be taken and stored onsite for future use as determined by Fluor Fernald. The specific means of obtaining the samples, sample storage requirements, and DQOs and related analytical requirements are not yet defined. Details related to silo residues sampling will be documented for review and approval upon finalization.

2.2 Elements of Quality Control (QC)

This section presents QC requirements relevant to the analysis of wastewater and air emissions samples that shall be followed by the CSL during analytical activities producing definitive data (i.e., data not measured using onsite instruments) for the AWR Project. The purpose of these requirements is to produce data of known quality that satisfies the AWR Project goals and that meets or exceeds the requirements of the standard methods of analysis. These requirements provide a mechanism for ongoing control and evaluation of data quality measurements.

CSL QC samples (i.e., blanks and laboratory control samples) will be included in the preparation batch with the field samples. The preparation batch is a number of samples (not to exceed 20) that are similar in composition and that are extracted or digested at the same time and with the same lot of reagents. The identity of each preparation batch will be unambiguously reported with the analyses so that a reviewer can identify the QC samples and the associated wastewater or air emission sample. The type of QC samples used for spiking will include the analytes of interest. Additional QC samples may be added to those required by the method to ensure accurate and precise data.

2.2.1 Laboratory Control Sample (LCS)

A LCS is an aliquot of a contaminant-free matrix fortified (spiked) with a known concentration of compound. Samples shall have a LCS spiked with appropriate analytes of interest. The CSL shall prepare and analyze a LCS with each batch of samples. The LCS is subjected to the entire analytical procedure in order to evaluate method performance. Present recovery determinations from these control samples shall be monitored to provide a continuous measure of each method's accuracy.

When an analyte in a LCS is outside the acceptable recovery limit, corrective action must be performed. After the system problems have been resolved and system control has been reestablished, samples in the analytical batch will be reanalyzed for the out-of-control method. When an analyte in a LCS exceeds the upper or lower control limits and no corrective action is performed, an appropriate validation flag shall be applied to affected results.

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2.2.2 Internal Standards (IS)

IS are measured amounts of certain compounds added prior to analysis of samples. These standards are used in an IS calibration method to correct sample results by columns injection losses or viscosity effects. When the IS results are outside the acceptance limits, corrective action must be performed. If corrective actions are not performed, then an appropriate validation flag shall be applied to the sample results.

2.2.3 Method Blank

A method blank is defined as a CSL-demonstrated analyte-free matrix that is carried through the entire analytical procedure. A method blank is prepared and analyzed for each batch of samples for applicable parameters. The method blank is used to determine the level of CSL background contamination. Unfavorable method blank performance renders associated data suspect and requires corrective action and/or data qualification.

The presence of analytes in a method blank at concentrations greater than the practical quantification limit indicates a need for corrective action. Corrective actions shall be performed to eliminate the source of contamination prior to proceeding with analyses. No analytical data will be corrected for the presence of analytes in blanks. When an analyte is detected in the blank and in the associated samples and corrective actions are not necessary, an appropriate validation flag shall be applied to the sample results.

2.2.4 Field Duplicate

A field duplicate sample is a second sample collected at the same location as the original sample. Duplicate sample results are used to assess precision, including variability associated with both the CSL analysis and the sample collection process. Duplicate samples are collected simultaneously or in immediate succession, using identical recovery techniques, and treated in an identical manner during storage, transportation, and analysis.

For water samples, field duplicates shall be collected and analyzed for 10 percent of the samples. The sample containers will be assigned a control number such that they cannot be identified (blind duplicate) as duplicate samples by CSL personnel performing the analysis. For air emission samples, the analyses discussed in this Sampling Plan involve analyses of filters taken from a continuous stack monitor. As the sampler contains a single filter, which is changed on a bi-weekly basis, collection of a field duplicate sample from the stack monitor is not proposed.

2.2.5 Matrix Spike/Matrix Spike Duplicate (MS/MSD)

An aliquot of a matrix (e.g., water) is fortified, or spiked, with a known concentration of target compounds. The spike solution will consist of the same compounds used for the LCS. The MS/MSD are subjected to the entire analytical procedure in order to indicate both accuracy and precision of the method for the matrix by measuring the percent recovery and the relative percent difference of the two spiked samples. These samples are also used to assess matrix interference effects on the method, as well as to evaluate instrument performance. MS/MSD shall be analyzed for each analytical batch in order to maintain continuous surveillance of acceptable method performance.

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2.2.6 Analytical Methods

Analysis of the wastewater and air emissions samples shall comply with methods approved or recognized by the EPA and/or other regulatory agencies. The analytical methods for wastewater and air emissions samples are identified in Appendices B and D, respectively, of this Sampling Plan. No specific analysis is identified for the archived K-65 silo residues at this time.

2.3 Supplies and Consumables

The CSL used for conducting wastewater and air emissions samples shall provide and inspect supplies and consumables prior to use in analyses. The materials description in the methods of analysis will be used as a guideline for establishing the acceptance criteria for these materials. Introduction of interfering compounds into the analytical process shall be monitored by analysis of methods blanks. In addition, a blank sample prepared using a new batch of reagent should be analyzed before that batch is accepted for use on actual samples. Each new lot of spiking solution for LCSs (see Section 2.2.1) and for MS/MSDs (see Section 2.2.5) should be analyzed before the lot is accepted.

The inventory and storage system for these materials will assure use before manufacturer's expiration dates and storage under safe and chemically compatible conditions. For the handling of consumables used in the actual collection of samples in the field, see Section 6 of this Sampling Plan.

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3.0 SAMPLING MEDIA AND SOURCES

Both wastewater and air emissions samples will be collected and analyzed as part of the AWR Project. In addition, process monitoring of radon concentrations will be performed and samples of silo residues will be collected for future use. This section describes these samples and their respective sources. Section 4 and related appendices of this Sampling Plan provide details regarding the respective guidelines used for sample collection and methods of analysis for only wastewater and air emissions for the AWR Project.

3.1 Wastewater

Water will be used to hydraulically transport silo residues from the existing silos into the TTA. During this transfer process, water may be added to the sluicing operations or periodically removed. Wastewater withdrawn from the sluicing process (via one 7,500-gallon filtrate storage tank) and the RCS (via two 3,000-gallon condensate tanks) will be eventually transferred to the FEMP AWWT facility.

Foster Wheeler has identified two wastewater streams requiring segregation and transfer to the FEMP AWWT facility, and therefore, requiring characterization. The first wastewater stream is the accumulation of condensate during the operation of the RCS. This condensate is collected in two 3,000-gallon tanks in the RCS Building. The second wastewater stream is a portion of the water used during the slurry transfer activities. Although the wastewater from the sluicing operation is recycled to reduce water usage, a portion of this wastewater (including water from the Decant Sump Tank) is processed through a filtration system located on the TTA deck. Wastewater may be removed as filtrate for transfer to the FEMP AWWT facility during the latter stages of the AWR Project when the overall TTA storage capacity is limited. This filtrate is collected in a 7,500-gallon tank located on the TTA deck.

3.1.1 RCS Condensate Tanks

As a function of the RCS operations, condensate will accumulate and be collected in two 3,000-gallon condensate tanks in the RCS Building prior to final transfer to the FEMP AWWT facility. The sampling guideline for wastewater (i.e., condensate) emanating from these tanks is summarized in Section 4 of this Sampling Plan and provided in Appendix C to this Plan.

3.1.2 Filtrate Storage Tank

Although the water used in the sluicing operations is enclosed in a closed loop network, periodically excess wastewater (in the latter stages of the AWR Project) will be processed through a filtration system and collected in a 7,500-gallon filtrate storage tank on the TTA deck prior to final transfer to the FEMP AWWT facility. The sampling guideline for wastewater (i.e., filtrate) emanating from this tank is summarized in Section 4 of this Sampling Plan and provided in Appendix C to this Plan.

3.2 Air Emissions

In the initial phase of the AWR Project, the accumulated radon gas in the silo headspaces is purged through the RCS. In addition, the RCS continually operates throughout the waste transfer process, and continues operation for the TTA throughout the waste storage phase of the AWR Project.

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3.2.1 RCS Stack

Monitoring the radon concentrations in the RCS stack is required to demonstrate compliance with the AWR Contract requirements for onsite and offsite concentrations. Monitoring the particulate emissions in the RCS stack using an isokinetic sampler (supplemented by CSL analyses of filter paper composites) is required to demonstrate compliance with the dose limit in Title 40 of the Code of Federal Regulations (CFR) Part 61, Subpart H. Emissions from the RCS stack will also monitored for compliance with other applicable emissions standards. The monitors used for this sampling (both radon and particulate emissions) are described in Section 4 of this Sampling Plan. Specifically, operation of the stack monitor is described in Section 4.2.1 of this Plan. The sampling guideline for airborne particulate emissions (i.e., RCS stack sampling) is provided in Appendix E to this Plan.

As stated, monitoring of particulate emissions will be conducted using an isokinetic sampler in the RCS stack. The filter element from the continuous monitor will be changed every two weeks. If there is evidence of no significant build up of particulates, then the sampling frequency may be lengthened with the approval of the EPA and the Ohio Environmental Protection Agency (OEPA). Also, the monitor will be inspected when the filter is changed. These filter papers will then be analyzed either onsite or by the CSL using the methods identified in Appendix D of this Plan to confirm data from the monitor, as well as to document compliance with 40 CFR 61. In addition, semi-annual composites of these filters will be analyzed by the CSL, with resulting data used in the calculation of the total effective dose equivalent (TEDE). This value is combined with the dose values from other Fluor Fernald activities at the FEMP site to demonstrate compliance with 40 CFR 61 and DOE Order 5400.5. The semi-annual composites will also be analyzed for lead to demonstrate compliance with Ohio Administrative Code (OAC) 3745-31-05(A)(3), *"Permit to Install New Sources of Pollution"*.

3.2.2 Process Monitoring of Radon Concentrations

Carbon bed performance is instrumental in reducing the concentrations of radon in the silo and TTA headspaces and in managing the emissions of radon to the environment. It is important to have a measurement that provides for an assessment of carbon bed performance so trends can be promptly identified, and steps taken to enhance performance if necessary. In addition, it is necessary to meet the AWR Project Contract requirement requiring that the dose rate from radon in the silo headspaces is reduced to below 10 mrem/hr during construction periods of Phase 1 and during Phase 2 of the AWR Project.

A representative air stream will be diverted through an in-line monitor at one of two locations to measure radon concentrations upstream of the four carbon bed systems. One measurement point is upstream of the junction where TTA, process, and RCS ducts join. This point is used to assess the performance of the RCS in the reduction of radon concentrations in the headspaces. The measurement at the second location (downstream of that junction) serves as a "before" measurement for comparing "before" and "after" concentrations to assess the performance of each carbon bed. A representative air stream must also be diverted through an in-line monitor to measure radon concentrations downstream of each carbon bed to assess bed performance for process control purposes. These four measurements serve as the "after" concentrations for comparing "before" and "after" concentrations to assess the performance of each carbon bed.

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4.0 SAMPLING AND ANALYTICAL METHODS

Representative samples must be collected to appropriately characterize process wastewater and air emissions from the AWR Project in accordance with this Sampling Plan. Collection, handling, and shipment of samples will be performed according to AWR Project procedures, as low as reasonably achievable (ALARA) practices, and applicable U.S. Department of Transportation (DOT) shipping guidelines.

4.1 Wastewater

CSL analytical methods will be used in determining whether or not the AWWT WAC is met, however, screening is first performed to determine the likelihood of wastewater samples in meeting the radionuclide WAC parameters, and if so determined, will be sent to the CSL for more definitive analysis. The CSL will then perform a two-step confirmation process. The CSL will first determine if the radionuclide WAC parameters are met, and if so met, then will determine whether the WAC metals and general chemistry parameters are met. A summary of analytical procedures, containers, preservatives, and holding time requirements for wastewater samples is provided in Appendix B of this Sampling Plan.

Representative samples are needed from each batch of RCS condensate wastewater and filtrate wastewater in sufficient time prior to planned discharge. This timeframe must allow for field screening, sample packaging and shipment to the CSL for analysis, data receipt and reporting, etc., as required, to determine that the AWWT WAC requirements are met. The transfer of wastewater to the FEMP AWWT cannot occur until the WAC is met and Fluor Fernald approval is obtained.

The design of the AWR Project, more specifically the RCS condensate tanks and the TTA filtrate storage tank, includes ports or outlets for the collection of wastewater samples. These ports will be the source of wastewater collected for sampling under this Sampling Plan. Each tank is considered a batch release and will be circulated, as required, to ensure a representative sample of tank contents. Circulation of the condensate tanks is not required since the condensate is free of solids and homogeneous in nature. Contents of the filtrate tank may not be homogeneous in nature, and therefore, will be circulated to achieve the mixing of one tank volume prior to sampling.

To ensure a representative wastewater sample is collected from the RCS condensate tanks, one sampling line volume will be purged prior to collection of the sample. This one line volume will include water held in the piping from the individual tank to the sampling port. To ensure a representative wastewater sample is collected from the filtrate tank, one tank volume (i.e., 7,500 gallons) will be recirculated prior to sampling and one sampling line volume will be purged prior to collection of the sample. Appendix C of this Sampling Plan provides a guideline for collecting these wastewater samples for the AWR Project.

4.1.1 Sample Collection and Screening

For screening of AWR Project wastewater samples, the samples need to be properly collected (as summarized above and described in the Appendix C guideline) and then analyzed to determine the overall concentrations of radionuclides. Samples of wastewater (approximately 1 liter or less) will be collected in plastic (or glass) bottles from sampling ports on the RCS condensate tanks and the TTA filtrate storage tank. The outside of the bottles will be cleaned

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and bagged to prevent cross-contamination and then sent to either the onsite FEMP laboratory or the CSL for gross alpha and beta analyses. Samples from the bottles will be dried and analyzed using a proportional counter. Procedures A-01-R and B-01-R of DOE's Environmental Measurements Laboratory (EML) Procedures Manual, HASL-300, will be used for this screening analysis. These analyses should provide an adequate screening evaluation to determine whether the water is likely to be less than or greater than the WAC discharge limits.

Table 4-1 lists the radiological limits from the WAC and the predominant radionuclides in the waste. This information was used to determine preliminary screening analysis limits. When both factors were considered, the most limiting alpha emitter was determined to be Ra-226 and the preliminary gross alpha screening limit was determined to be approximately 100 pCi/L. Water containing concentrations of gross alpha activity below this level can be assumed to meet the WAC without further analysis. Similarly, the most limiting beta emitter was found to be Pb-210 and the preliminary gross beta screening limit should be approximately 60 pCi/L. This limit accounts for the fact that Pb-210 and its daughter bismuth (Bi)-210 occur with approximately equal beta activities, but only Pb-210 is listed in the WAC.

Table 4-1. WAC Discharge Limits and Sample Screening Considerations

Radionuclide (and Emission Type)	Discharge Limit, pCi/L	Relative Activity (pCi/L)[1,2]	
		Silo 1	Silo 2
Ac-227 (β)	10	2	3
Pb-210 (β)	30	42	72
Po-210 (α)	80	59	88
Pa-231 (α)	10	---	2
Ra-226 (α)	100	100	100
Ra-228 (α)	100	---	---
Th-228 (α)	400	<1	3
Th-230 (α)	300	14	29
Th-232 (α)	50	<1	<1
U-234 (α)	500 (or 5 ppm)	<1	<1
U-235/236 (α)	600 (or 5 ppm)	<1	<1
U-238 (α)	600 (or 5 ppm)	<1	<1

Notes: [1] Source: Hazard Analysis Report for Operable Unit 4 (OU4) Silos, Appendix C, Table 4-4.
[2] Compared to 100 pCi of Ra-226.

By meeting these concentrations, samples have a high probability of meeting the WAC. For samples exceeding the screening limit, further analyses by the CSL (e.g., high-resolution spectroscopy, RCRA metals, and general chemistry analysis) are justified. If after analysis by the CSL the discharge limits are not met, then the water will not be transferred to the AWWT facility. Note that the screening limits may be raised or lowered to balance unnecessary analytical costs versus the costs of unnecessary treatment and resampling of the water.

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4.1.2 CSL Radiological Analytical Methods

Samples that pass the screening evaluations are sent to the CSL for a more definitive determination using high-resolution gamma spectra analysis with a large, sensitive germanium detector system. This system will utilize a multi-channel analyzer and sophisticated software to identify the energy of specific gamma peaks and quantify the concentrations of radionuclides (e.g., Pa-231, Ra-226, Th-228, Th-230, Th-232, U-234, and U-235). This system will be calibrated in accordance with applicable standards and will have sufficient sensitivity and accuracy to measure the concentration of the radionuclides in the wastewater samples to levels approximately one-half of the specified AWWT WAC discharge limits.

Both typical and alternative analytical methods, or approved equivalents, to be used by the CSL are presented in Tables 4-2 and 4-3. The monitoring and reporting of results obtained from the testing of these parameters will satisfy the AWR Contract requirements for radiological characterization data associated with AWR Project wastewater.

Table 4-2. Typical Analytical Methods for Wastewater Analyses

Parameter	Analytical Method[1]
Radionuclide	
Ac – 227	G-01 and A-01-R
Pb – 210	Pb-01-RC
Po – 210	Po-01-RC
Pa – 231	G-01 and A-01-R
Ra – 226	Ra-06-RC
Ra – 228	Th-01-RC
Th – 228	Th-01-RC
Th – 230	
Th – 232	
U – 234	U-02-RC
U – 235/236	
U – 238	

Notes: [1] EML procedure specifies test methods and detection limits, as provided in the HASL-300.

Table 4-3. Alternative Analytical Methods for Wastewater Analyses

Parameter	Analytical Method[1]
Radionuclide	
Gross alpha	A-01-R
Gross beta	B-01-R
Gamma isotopic	Ga-01-R

Notes: [1] EML procedure specifies test methods and detection limits, as provided in HASL-300.

4.1.3 Remaining CSL Analytical Methods

Upon confirmation that the CSL analytical data indicates the respective samples meet the AWWT WAC for radionuclides, the CSL will use the methods prescribed in Table 4-4, or approved equivalents, for the determination of metals and general chemistry parameters required by the AWWT WAC or related AWR Contract technical requirements. Results from the testing of parameters related to the AWWT WAC will be used in determining whether or not the wastewater can be discharged to the FEMP AWWT facility. Results of the remaining parameters are to be reported to Fluor Fernald in accordance with the TRD of the AWR Contract.

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Table 4-4. Analytical Methods for Metals and General Chemistry Parameters

Parameter	Analytical Method
Metal	
Arsenic	6010B[1]
Barium	6010B[1]
Cadmium	6010B[1]
Chromium	6010B[1]
Iron	6010B[1]
Lead	6010B[1]
Mercury	7470A[1]
Selenium	6010B[1]
Silver	6010B[1]
General Chemistry	
Total suspended solids	160.2[2]
Chloride[3]	325.1[2]
Nitrate[3]	352.1[2]
Carbonate (Hardness)[3]	130.1[2]
Sulfate[3]	375.1[2]

Notes: [1] *Test Methods for Evaluating Solid Waste Physical/Chemical Methods*, EPA Report Number SW-846 (EPA 1998), specifies test methods and detection limits.
[2] *Methods for Chemical Analysis of Water and Wastes*, EPA Report Number 600/4-79-020 (EPA 1979) specifies test methods and detection limits.
[3] Parameter is required to be monitored and reported in accordance with AWR Contract *Technical Requirements Document*, Document No. 40710-RP-0001, Feb. 3, 1999, Rev. 1.

4.2 Air Emissions

RCS stack air emissions will be sampled and continuously monitored using isokinetic sampling to ensure a representative composite particulate sample is obtained. The isokinetic sampler will be inspected and the filter changed as described below. The air emissions will also be monitored for radon. Refer to Appendices D and E of this Plan for proposed air emissions analyses and sampling guidelines, respectively.

4.2.1 Stack Monitoring

The RCS stack must be continuously monitored as required by the Clean Air Act (CAA) regulations (40 CFR 61) and DOE Order 5400.5. The continuous monitor serves two functions: (1) to collect a sample of the stack gas for measurement of the concentration of radon, and (2) to collect a representative sample of particulates to assess the concentrations of other radionuclides and toxic chemicals (e.g., lead) present. An isokinetic sampler meeting American National Standards Institute (ANSI) N13.1-1969 is required to get a representative sample of particulates. The same sampling system will be used to collect the air sample for radon, although the isokinetic feature is not necessary.

The isokinetic sample system consists of the following:

- Sampler head,
- Particulate sampler,
- Sample line,
- Particulate radiation detector,
- Radon detector,

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- Sample flow measurement device,
- Sample flow controller,
- Control system,
- Pump, and
- Return line.

Sampler Head. The sampler head is inserted into the stack approximately eight diameters after the RCS exhaust air (which enters at a higher elevation than the building ventilation air) enters the stack and approximately two stack diameters before the diameter is reduced.

Particulate Sampler. The sampler consists of tube with the appropriate number of nozzles arranged to collect air from different locations in the stack. Devices to measure stack flow and temperatures are also attached to the sampler.

Sample Line. The sample line is a two-inch line that exits the stack and runs down to near ground level where the remainder of the system is located. To minimize particulate line losses, the bends in the line are made with a radius of approximately 20 inches, the inside surface of the line is selected for smoothness, and the length of horizontal runs is minimized. The sample line runs from the sampler in the stack to sampler modules at ground level that house the rest of the sampler system.

Particulate Radiation Detector. The particulate radiation detector is discussed in the paragraph entitled "Particulate Monitoring" of this section.

Radon Detector. The radon detector is discussed in the paragraph entitled "Radon Monitoring" of this section.

Sample Flow Measurement Device. A sample flow measurement device is located in the equipment console and serves to measure the airflow rate in the sample line. The sample flow controller, also located in the console adjusts the flow in the sample line to maintain isokinetic-sampling conditions (i.e., the linear velocity in the stack air equals the linear velocity of air entering the sampler). This flow control is achieved through the control system.

Control System. The control system collects measurement signals for the stack flow, the sample loop flow, the particulate detector and the radon detector for processing and control. The control loop serves to automatically adjust the sample flow rate to maintain isokinetic-sampling conditions. The signals are transmitted to the AWR Project control trailer and recorded. An alarm point is provided to indicate when isokinetic-sampling conditions are not maintained. Detector alarms are discussed in the respective paragraphs for particulate and radon monitoring in this section.

Pump. The pump, located in one of the sampler modules, is the motive force for pulling air from the stack and through the sampling system. The pump is sized to so that the system can compensate for the possible buildup of material on the particulate filter.

Return Line. The exhaust from the pump is returned to the stack through the return line. This line requires no special features, but will be designed to minimize pressure losses in order to enhance pump life.

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In addition to the real time monitoring of particulate radioactivity and radon concentration, the filter paper sample is changed weekly, bi-weekly (or monthly, if justified by DQOs) and the monitor is inspected at that time. Approved DOE or EPA sampling and analytical methods must be followed in the field and by the CSL. Both typical and alternative analytical methods to be used by the CSL are presented in Appendix D of this Sampling Plan.

Further explanation relating to the use of field monitoring methods for radon and particulate emissions is provided below. The sampling guideline for RCS stack is provided in Appendix E of this Plan. Collection, handling, and shipment of samples will be performed according to approved AWR Project procedures, ALARA practices, and applicable DOT shipping guidelines.

Radon Monitoring –
Radon concentrations in the RCS air effluent will be measured in the RCS stack. The type of monitor to be used will be a continuous monitor such as a Pylon Radon Measurement System, or equivalent. The Pylon monitor will have the capability to draw in a sample of air from the stack and give a real-time measurement of the radon concentration present.

The "High" alarm will be set at 2,000 pCi/L, and the "High-High" alarm will be set at 6,000 pCi/L. A concentration of 6,000 pCi/L in the stack airflow of 10,300 cubic feet per minute (cfm) corresponds to an instantaneous onsite concentration of 0.15 working levels (WL), which is the "worst-case" concentration, and a maximum annual offsite concentration of 0.015 pCi/L (if maintained at 6,000 pCi/L for the entire year).

Particulate Monitoring –
For particulate monitoring of RCS air effluent, the type of isokinetic sampler will be used in the RCS stack with an Eberline Alpha Continuous Air Monitor (CAM), or equivalent. The sampler will have the capability to draw an isokinetic sample from the stack, pass the sample through a filter paper and then to analyze the alpha emissions from the particulate material collected. The monitor "High" alarm will be set at a particulate concentration of 1×10^{-12} µCi/mL. This concentration corresponds to an offsite dose rate of less than 0.1 mrem/year. The "High-High" alarm will be set at 5×10^{-12} µCi/mL.

In addition, the semi-annual analysis of the filter paper composite will include the analysis of lead to demonstrate compliance with the regulatory standard for lead in ambient air (0.1 $\mu g/m^3$) referenced in OAC 3745-31-05(A)(3). The maximum concentration of lead in air is calculated from the weight of lead collected by the continuous monitor, the ratio of stack flow-to-sample flow, and the atmospheric dispersion calculated by EPA CAP88 modeling.

4.2.2 Radon Process Monitoring

As previously described in Section 3.2.2, radon concentrations will be measured in six locations for process monitoring as part of the AWR Project. Four of these monitoring locations are immediately downstream of each of the four carbon bed filters for use in assessing RCS process operations. The other two monitoring locations will be in the ductwork upstream of the carbon beds, before and after the junction of the inlet ducts from the silos, TTA, and future process facilities. These measurements serve to assess the concentration of radon in the silo headspaces and before adsorption. Comparisons between the concentrations before and after adsorption give a measure of the effectiveness of the carbon beds.

The type of monitor to be used downstream of each carbon bed filter will be a continuous monitor such as a Pylon CRM-1, or equivalent. The monitor will have the capability to draw in a

sample of air from a duct to be assessed and give a real-time measurement of the radon concentration present. Since this radon process monitoring is real-time in nature and not part of the air emissions monitoring for the RCS stack, it is not specifically addressed by the sampling guideline provided in Appendix E of this Sampling Plan.

5.0 DOCUMENTATION AND RECORDKEEPING

Records management for the AWR Project will be conducted in accordance with the *Records Management Plan*, Document No. 624-P621-04, and related AWR Project procedures. Additional information is provided in this section related specifically to the documentation and recordkeeping associated with the sampling efforts for the AWR Project.

5.1 Field Logbook

A field logbook shall be maintained and shall document the sampling activities associated with collecting wastewater and air emissions samples for the AWR Project. This logbook will be a bound book with no loose pages. Entries shall be made in permanent waterproof black ink. No pages shall be removed from the logbook for any reasons. If corrections are necessary, then they shall be made by drawing a single line through the original entry (so that the original entry can still be read) and writing the corrected entry alongside.

The logbook shall include the date of the sampling activity, AWR Project personnel collecting the sample, source of the sample media, sample identification designation, time of collection, analysis to be performed, preservatives (as required), and any other information necessary to process the sample or to recreate the sampling event.

5.2 Sample Container Labeling

Each sample will be labeled, chemically preserved (if required), sealed immediately after collection, and placed on ice or refrigerated (if required). To minimize handling of sample labels, labels will be completed prior to sample collection. The sample container label will be filled in using waterproof ink and will be firmly affixed to the sample containers and protected by clear tape.

At a minimum, each sample will have a sample label or tag containing the information in the following list:

- Project name,
- Sample identification,
- Date of sample collection,
- Time of sample collection,
- Analyses to be performed,
- Preservatives, and
- Initials of individual collecting the sample.

5.3 Sample Packaging and Shipping

Samples will be packaged in leak-proof zip-lock bags and sealed to contain accidental spillage. Bags containing samples may be packaged in a second bag or cooler containing wet ice if required by the specific preservative requirements for analysis. The second bag or cooler will be sealed to prevent leakage.

Samples to be shipped to an offsite laboratory (i.e., CSL) will be packaged and shipped in a U.S. Department of Transportation (DOT)-approved container, which is provided by the CSL for that purpose. Prior to packaging, shipping containers will be scanned by radiological control personnel to ensure the external surface of the containers is within DOE Order 5400.5 free release criteria. Assurance must be made that the container is shipped in accordance with DOT requirements. Material is considered radioactive by the DOT at $\geq$ 2 nCi/g. Any container exceeding the free release criteria limit will be rejected for shipment and corrective measures will be taken before the samples are shipped. Samples will be shipped for overnight delivery.

5.4 Chain-of-Custody (COC)

For samples shipped for analysis, a COC form will be completed by a designated field team member responsible for sample custody and signed off by the receiving laboratory. As a matter of record, a COC will be prepared for samples collected and analyzed onsite and not processed for shipment offsite. Information specified on the COC record will contain the same level of detail as found in the field logbook. The custody record bill includes the following information:

- Site name;
- Names of the PM and the personnel responsible for collection of the listed sample;
- Sample identification;
- Date and time each sample was collected;
- Type of sampling conducted (composite/grab);
- Number of sample containers shipped;
- Analyses requested;
- Sample preservation information;
- Name of carrier used to ship the samples and a bill of lading or air bill number; and
- Signature of the person relinquishing samples to the transporter, with the date and time of transfer noted, and of the designated sample custodian at the receiving facility.

In addition, if samples are known to require rapid turnaround because of project time constraints or analytical concerns (e.g., extraction time or sample retention period limitations, etc.), then the person completing the COC record will note these constraints in the remarks section of the custody record. The relinquishing individual will record shipping data (e.g., air bill number, organization, time, and date) on the original COC record, which will be transported with the samples to the laboratory and retained in the laboratory's file. A COC guideline (including a typical sample tag, seal, and COC form) to be used for the AWR Project is provided in Appendix F of this Sampling Plan.

5.5 Records Storage

Sampling activities will be recorded in the field logbook, which will be maintained in the field office. Copies of COC forms, as well as analytical data from field screening and from the laboratory, will be retained by AWR Project document control. AWR Project records storage will be conducted in accordance with the *Records Management Plan* and related AWR Project procedures.

5.6 Analytical Data

This section provides information related to the required analytical laboratory documentation levels and analytical turn-around times for air and water samples collected as part of the AWR Project.

5.6.1 Wastewater Samples

For wastewater samples, the CSL is to provide a data package consistent with the QA/QC requirements of the CSL's approved Quality Assurance (QA) Program (ASTM 1992). It is anticipated that the CSL will meet the FEMP-defined analytical level of "Analytical Support Level (ASL) E" (non-standardized protocols) for the parameters listed in Appendix B of this Sampling Plan. Field screening will meet the FEMP-defined analytical level "ASL A", which provides qualitative field analyses.

Data validation will be conducted in accordance with Foster Wheeler Environmental Corporation (FWENC) Corporate Procedure SCG-201, *Organic and Inorganic Data Validation.* Analytical laboratory audits will be conducted to assess CSL performance in accordance with FWENC Corporate Procedure SCI-006, *Analytical Laboratory Audits.* Analytical turn-around times will vary upon request, depending on the specific time requirement for transferring wastewater from the AWR Project facilities to the AWWT. If needed, a 48-hour turn-around time will be requested for analytical results.

5.6.2 Air Emission Samples

For radon process monitoring (both upstream and downstream of the carbon beds), this monitoring will meet the FEMP-defined analytical level "ASL A", which provides qualitative field analyses. Foster Wheeler will ensure that the radon monitors are calibrated in accordance with manufacturer's requirements and at the established frequencies and that measurements of radon concentrations are recorded and reviewed at a frequency sufficient to detect performance trends and/or situations requiring mitigation. Radon monitoring for the stack will also meet the FEMP-defined analytical level of "ASL E".

For air emission monitoring, the isokinetic particulate filter sample is collected once per two weeks (or a month if justified) for the analysis of long-lived alpha and beta emitters (see Appendix D of this Sampling Plan). The initial/ending sampling dates and times, sample volume, and stack flow for that period of time are recorded. The CSL data package should be received within a 30-day turnaround time period.

The filter paper from the particulate stack monitor is essentially analyzed three times. The in-line monitor will meet the FEMP-defined analytical level of "ASL A", which provides qualitative field analyses (for radionuclides only). The bi-weekly onsite or CSL analysis will meet the FEMP-defined analytical level of "ASL E", and the semi-annual composites are also considered "ASL E" (non-standardized protocols), subject to concurrence by Fluor Fernald.

Data validation will be conducted in accordance with FWENC Corporate Procedure SCG-201, *Organic and Inorganic Data Validation.* Analytical laboratory audits will be conducted to assess CSL performance in accordance with FWENC Corporate Procedure SCI-006, *Analytical Laboratory Audits.*

6.0 WASTE MANAGEMENT

Minimal amounts of waste are anticipated from the sampling activities associated with the AWR Project. A time-phased estimate of secondary waste generation has been prepared for the entire AWR Project, including the waste from sampling activities as described in this section, and is contained in Document No. 624-P622-22, *Timed Estimate of Secondary Waste*, and Document No. 624-ACR007-01, *Waste Handling Work Plan*. In addition, Fluor Fernald has prepared a *Waste Management Plan* for the AWR Project.

6.1 Wastewater

Wastewater generated during the sampling activities (e.g., line purge water, rejected samples, etc.) will be returned to the waste transfer process. No segregated wastewater will be stored or discharged onsite.

6.2 Consumables

Consumables (e.g., gloves, PPE, etc.) will be disposed of in accordance with the *Waste Management Plan*, the *Waste Handling Work Plan*, and related FEMP site procedures. Attachments to the *Waste Management Plan* include the Project Waste Identification and Disposition (PWID) Report and Material Segregation and Container-ization Criteria (MSCC). These documents allow for the tracking and containerization of waste for the AWR Project.

7.0 REFERENCES

Table 7-1 provides a list of the FEMP plans and procedures consulted in the preparation of this Plan.

Table 7-1. List of Referenced FEMP Plans and Procedures

Number	Title
EP-0005	Controlling Wastewater Discharges into the FEMP Wastewater Treatment System
EP-0010	Responding to Stack Monitoring Alarms
EW-0002	Chain of Custody/Request of Analysis Record for Sample Control
EW-0012	Tank/Sump Contents Removal
EW-1021	Preparation of PWID Report
FD-1000	Sitewide CERCLA Quality Assurance Project Plan
PT-0005	Packaging Low Level Radioactive Waste (LLRW) in Drums
PT-0007	Packaging LLRW in Metal Boxes
PT-0009	Collection of Contaminated Trash for Disposal
PT-0014	FEMP Approved Packaging and Shipping Containers
PT-0018	Preparation of Document for Offsite Shipment of Hazardous Materials
RP-0009	Radiological Requirements for the Release of Materials at the Fernald Environmental Management Project
RP-0010	Identification and Movement of Radioactive Materials
RP-0017	Liquid Radioactive Standards Survey Requirements
PL-0002	AWR Project Waste Management Plan

Other references used in the development of this Plan include:

American Public Health Association, American Water Works Association, and Water Environment Federation, *Standard Methods for the Examination of Water and Wastewater*, 20th Edition, 1998.

American Society of Testing and Materials, *"Standard Practice for Generation of Environmental Data to Waste Management Activities: Quality Assurance and Quality Control Planning and Implementation"*, 1992, ASTM D 5283-92.

American Society of Testing and Materials, *"Standard Practice for Generation of Environmental Data to Waste Management Activities: Development of Data Quality Objectives"*, 1995, ASTM D 5792-95.

Code of Federal Regulations, Title 40, Part 61, Appendix B, *"Method 114 – Test Methods for Measuring Radionuclide Emissions from Stationary Sources"*.

U.S. Environmental Protection Agency, *"Methods for Chemical Analysis of Water and Wastes"*, EPA 600/4-79-020, 1979.

U.S. Environmental Protection Agency, *"Prescribed Methods for Measurement of Radioactivity in Drinking Water"*, EPA-600/4-80-032, August 1980.

U.S. Environmental Protection Agency, *"Determination of Lead-210 in Drinking Water, Method 909.0"* (May 1982) and *"Determination of Polonium-210 in Drinking Water by Alpha Particle Counting, Method 912.0"* (October 1983), EPA Region I Library Local Call Number 01A0004860.

U.S. Environmental Protection Agency, *"Test Methods for Evaluating Solid Waste Physical/Chemical Methods"*, 1998, EPA SW-846.

Foster Wheeler Environmental Corporation (FWENC) Corporate Procedure SCI-004, *Sample Preservation, Chain of Custody, Packaging and Shipping*, 1996.

FWENC Corporate Procedure SCG-201, *Organic and Inorganic Data Validation*, 1996.

FWENC Corporate Procedure SCI-006, *Analytical Laboratory Audits*, 1998.

APPENDICES

APPENDIX A

Advanced Wastewater Treatment Facility (AWWT) Waste Acceptance Criteria (WAC) for the Accelerated Waste Retrieval (AWR) Project

Parameter	Discharge Limit (pCi/L)[1]		
Radionuclide			
Actinium – 227 (Ac-227)	10		
Lead – 210 (Pb-210)	30		
Polonium – 210 (Po-210)	80		
Protactinium – 231 (Pa-231)	10		
Radium – 226 (Ra-226)	100		
Radium – 228 (Ra-228)	100		
Thorium – 228 (Th-228)	400		
Thorium – 230 (Th-230)	300		
Thorium – 232 (Th-232)	50		
Uranium – 234 (U-234)	5 ppm		
Uranium – 235/236 (U-235/U-236)			
Uranium – 238 (U-238)			
Metal	**kg/day[1]**	**lb/day[1]**	**ppm[1,2]**
Arsenic (As)	0.14	0.3	5
Barium (Ba)	2.7	6.0	100
Cadmium (Cd)	0.006	0.013	0.22
Chromium (Cr)	0.14	0.3	5
Iron (Fe)	0.03	0.06	1
Lead (Pb)	0.03	0.07	1.2
Mercury (Hg)	0	0	0
Selenium (Se)	0.03	0.06	1
Silver (Ag)	0.0014	0.003	0.05
General Chemistry			
Total suspended solids (TSS)	1,000 ppm		

Notes: [1] pCi/L = picocuries per liter; ppm = parts per million; kg/day = kilograms per day; lb/day = pounds per day.
[2] Concentration calculated assuming maximum allowable flow of 7,200 gpd in accordance with AWWT WAC.

000078

APPENDIX B

Summary of Analytical Procedures, Containers, Preservatives, and Holding Time Requirements for Wastewater Samples

Radionuclides				
Parameter	Analytical Procedure[1]	Holding Time	Preservative Requirements	Number/Type Containers Per Sample
Ac-227	Ga-01 and A-01-R	1-Year	HNO_3 to pH < 2	1-1Liter Plastic or Glass
Pb-210	Pb-01-RC	1-Year	HNO_3 to pH < 2	1-1Liter Plastic or Glass
Po-210	Po-01-RC	1-Year	HNO_3 to pH < 2	1-1Liter Plastic or Glass
Pa-231	Ga-01 and A-01-R	1-Year	HNO_3 to pH < 2	1-1Liter Plastic or Glass
Ra-226	Ra-06-RC	1-Year	HNO_3 to pH < 2	1-1Liter Plastic or Glass
Ra-228	Th-01-RC	1-Year	HNO_3 to pH < 2	1-1Liter Plastic or Glass
Th-228	Th-01-RC	1-Year	HNO_3 to pH < 2	1-1Liter Plastic or Glass
Th-230				
Th-232				
U-234	U-02-RC	1-Year	HNO_3 to pH < 2	1-1Liter Plastic or Glass
U-235/236				
U-238				
Gross alpha	A-01-R	1-Year	HNO_3 to pH < 2	1-1Liter Plastic or Glass
Gross beta	B-01-R	1-Year	HNO_3 to pH < 2	1-1Liter Plastic or Glass
Gamma isotopic	Ga-01-R	1-Year	HNO_3 to pH < 2	1-1Liter Plastic or Glass

Metals				
Parameter	Analytical Procedure[1]	Holding Time	Preservative Requirements	Number/Type Containers Per Sample
As	6010B	6-Months	HNO_3 to pH < 2	1-1Liter Plastic or Glass
Ba	6010B	6-Months	HNO_3 to pH < 2	1-1Liter Plastic or Glass[2]
Cd	6010B	6-Months	HNO_3 to pH < 2	1-1Liter Plastic or Glass[2]
Cr	6010B	6-Months	HNO_3 to pH < 2	1-1Liter Plastic or Glass[2]
Fe	6010B	6-Months	HNO_3 to pH < 2	1-1Liter Plastic or Glass[2]
Pb	6010B	6-Months	HNO_3 to pH < 2	1-1Liter Plastic or Glass[2]
Hg	7470A	28-Days	HNO_3 to pH < 2	1-1Liter Plastic or Glass[2]
Se	6010B	6-Months	HNO_3 to pH < 2	1-1Liter Plastic or Glass[2]
Ag	6010B	6-Months	HNO_3 to pH < 2	1-1Liter Plastic or Glass[2]

General Chemistry				
Parameter	Analytical Procedure[1]	Holding Time	Preservative Requirements	Number/Type Containers Per Sample
TSS	160.2	7-Days	Cool to 4 °C	1-100 ml Plastic or Glass
Chloride	325.1	7-Days	None Required.	1-50 ml Plastic or Glass
Nitrate	352.1	24-Hours	Cool to 4 °C	1-100 ml Plastic or Glass
Carbonate (Hardness)	130.1	6-Months	Cool to 4 °C, HNO_3 to pH < 2	1-100 ml Plastic or Glass
Sulfate	375.1	7-Days	Cool to 4 °C	1-50 ml Plastic or Glass

Notes:
[1] EPA procedures specify test methods and detection limits.
[2] Extracted into same sample container as Arsenic.

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APPENDIX C

Accelerated Waste Retrieval (AWR) Project Sampling and Analysis Guidelines

SUBJECT: WASTEWATER SAMPLE COLLECTION GUIDELINE

I. Scope and Application

This guideline applies to wastewater samples collected for the AWR Project at the U.S. Department of Energy (DOE) Fernald Environmental Management Project (FEMP) site. The goal of this guideline is to ensure that the wastewater samples collected from either of the two condensate tanks or the filtrate storage tank are representative of the wastewater scheduled for discharge into the Advanced Wastewater Treatment (AWWT) facility. Detailed procedures for collecting wastewater samples for the AWR Project are to be developed as part of *the Radon Control System (RCS) Phase 1 and 2 Standard Operating Procedures* (SOPs), AWR Project Submittals 624-P633-01 and 624-P636-01, respectively, and the *AWR SOPs* (Submittal No. 624-P6315-01).

II. Summary

This guideline outlines the requirements for the collection of wastewater from the two RCS condensate tanks and the Transfer Tank Area (TTA) filtrate storage and ensures that the samples collected are representative of wastewater to be released to the AWWT. Samples will be collected in a timely manner and with such care to avoid resampling, thus minimizing potential delays to the AWR Project.

III. Equipment

The following equipment shall be necessary for the collection of wastewater samples from the condensate tanks and TTA filtrate storage tank:

A. Container(s) to collect purge wastewater (pre-sampling);
B. Sample containers with labels;
C. Preservatives as applicable, and
D. Spill containment materials.

IV. Safety

Only AWR Project personnel trained in accordance with the *Project Specific Health and Safety Plan* (HASP) will be allowed to perform or participate in the collection of wastewater samples. Refer to SOPs and Radiation Work Permit for details regarding the appropriate training and level of personal protective equipment (PPE) required for sampling.

V. Procedure Guide

A. RCS Condensate Tanks – Perform the following:

1. Locate the tap or sampling port for the tank to be sampled.

2. Barricade or otherwise prevent access to the area by unauthorized personnel during sampling.

3. Place a polyethylene ground cover under the sampling port to contain spillage.

4. Place a dedicated and metered container beneath the sampling port to collect purge or pre-sampled wastewater.

5. Purge or evacuate wastewater from the line between the tank and the sampling port. This line volume shall consist of wastewater contained in the line between the tank and the sampling port and shall be determined based on post-construction measurements.

6. Collect a sufficient volume of wastewater, based on laboratory recommendations, in clean sample containers. As appropriate, the containers shall already contain the preservative.

7. Return the purged wastewater back into the waste transfer system.

8. Close valves to prevent accidental release of wastewater from the line.

9. Complete sample container labeling per Manual Chain-of-Custody (COC) Procedures.

10. Store dedicated purge wastewater container in predetermined location.

11. Dispose of polyethylene sheeting.

12. Remove area barricades.

13. Process samples per Manual COC Procedures.

B. TTA Filtrate Storage Tank – Perform the following:

1. Locate the tap or sampling port.

2. Barricade or otherwise prevent access to the area by unauthorized personnel during sampling.

3. Place a polyethylene ground cover under the sampling port to contain spillage.

4. Place a dedicated and metered container beneath the sampling port to collect purge or pre-sampled wastewater.

5. Recirculate tank contents equivalent to one tank volume (i.e., 7,500 gallons). Purge or evacuate the line between the filtration system and the sampling port. This line volume shall consist of wastewater contained in

the line between the filtration system and the sampling port and shall be determined based on post-construction measurements.

6. Collect a sufficient volume of wastewater, based on laboratory recommendations, in clean sample containers. As appropriate, the containers shall already contain the preservative.

7. Return the purged water back into the waste transfer system.

8. Close valves to prevent accidental release of wastewater from the line.

9. Complete sample container labeling per Manual COC Procedures.

10. Store dedicated purge wastewater container in predetermined location.

11. Dispose of polyethylene sheeting.

12. Remove area barricades.

13. Process samples per Manual COC Procedures.

VII. Quality Control/Quality Assurance

The bound field logbook will be maintained by the Project Manager or his designee when not in the possession of the field sampling team. The logbook shall detail each sampling event in reproducible detail. Entries shall be made in black, indelible ink, each page signed, and dated. Subsequent corrections shall be made by a single line drawn through the original entry, entry of the corrected information, and initialing and dating by the individual making the correction. Copies of field logbooks will be retained and become part of the completed project records in accordance with the AWR Project *Records Management Plan*.

APPENDIX D

Typical and Alternative Analytical Methods for Air Emissions Analyses

"Typical" Analytical Methods for Air Emissions Analyses

Parameter	Analytical Method[1]
Metals	
Pb	7000A[2]
Radionuclide	
Ac – 227	G-01[3]
Pb – 210	Pb-01-RC[3]
Po – 210	Po-02-RC[3]
Pa – 231	G-01[3]
Ra – 226	Ra-02-RC[3]
Th – 230	Th-01-RC[3]

Notes: [1] For radionuclides, method or approved equivalent must comply with Method 114 of 40 CFR 61, Appendix B, *Test Methods for Measuring Radionuclide Emissions from Stationary Sources.*
[2] *Test Methods for Evaluating Solid Waste Physical/Chemical Methods*, EPA Report Number SW-846 (EPA 1998), specifies test methods and detection limits.
[3] EML procedure specifies test methods and detection limits, as provided in the *Procedures Manual of the EML*, HASL-300.

"Alternative" Analytical Methods for Air Emissions Analyses

Parameter	Analytical Method[1]
Radionuclide	
Gross alpha	A-01-R[2]
Gross beta	Ba-01-R[2]
Gamma isotopic	Ga-01-R[2]

Notes: [1] For radionuclides, method or approved equivalent must comply with Method 114 of 40 CFR 61, Appendix B, *Test Methods for Measuring Radionuclide Emissions from Stationary Sources.*
[2] EML procedure specifies test methods and detection limits, as provided in the *Procedures Manual of the EML*, HASL-300.

The radiological analyses listed above are for measurements made on individual filter papers taken from the stack monitor or filter paper composites. The lower limits for detection are taken from the Procedures Manual of the EML, HASL-300. The corresponding concentrations will be determined by dividing the analytical sensitivity by the amount of stack air sampled, i.e., the integrated flow rate for a week, two weeks, or a month, depending on the frequency of filter replacement – to be determined later. For composites, the airflow will ordinarily be integrated over the six-month period of collection. Additional information related to the above analyses is provided in the table below.

Radionuclide	Test Number	Test Name	Detection Method	Detection Limit (Becquerel, Bq)
Gross alpha	A-01-R	Alpha Radioassay	Alpha Proportional	0.017[1]
Gross beta	B-01-R	Beta Radioassay	Beta Proportional	0.067[2]
Gamma isotopic	Ga-01-R	Gamma Radioassay	Gamma Spectrometry	See Note 3.
Ac-227	Ga-01-R	Gamma Radioassay	Gamma Spectrometry	25[4]
Pb-210	Pb-01-RC	Pb-210 in Bone, Food, Urine, Feces, Blood, Air, and Water	Beta Proportional	0.01
Po-210	Po-02-RC	Polonium in Water, Vegetation, Soil and Air Filters	Alpha Spectrometry	0.0015
Pa-231	Ga-01-R	Gamma Radioassay	Gamma Spectrometry	0.33[4]
Ra-226	Ra-02-RC	Radium-226 – Emanation Procedure	Ionization Chamber	0.0033
Th-230	Th-01-RC	Thorium in Urine	Alpha Spectrometry	0.00044

Notes: [1] Estimated based on 0.5 cpm and a 50% counting efficiency.
[2] Estimated based on 1 cpm and a 25% counting efficiency.
[3] "For typical counting systems and sample types, activity levels of about 40 Bq are easily measured and sensitivities as low as 0.002 Bq can be achieved for many nuclides." (Reference, HASL-300.)
[4] Estimated from 0.002 Bq by dividing by 0.1 and the gamma fractional abundance.
(Actual sensitivities may vary depending on procedures of the analytical laboratory to be selected.)

APPENDIX E

Accelerated Waste Retrieval (AWR) Project Sampling and Analysis Guidelines

SUBJECT: AIR EMISSIONS MONITORING – RADON CONTROL SYSTEM (RCS) STACK SAMPLING GUIDELINE

I. Scope and Application

This guideline applies to air emission samples collected for the AWR Project at the U.S. Department of Energy (DOE) Fernald Environmental Management Project (FEMP) site. Specifically, this guideline describes air emission monitoring for radioactive particulate matter using isokinetic sampling to ensure a representative composite particulate sample is obtained from the RCS. The isokinetic filter sample will be continuously monitored and collected bi-weekly (or monthly if justified) for analysis. Detailed procedures for conducting air emission monitoring for the AWR Project are to be developed as part of *the RCS Phase 1 and 2 Standard Operating Procedures* (SOPs), AWR Project Submittals 624-P633-01 and 624-P636-01, respectively,

II. Summary

Air is drawn into a covered housing and passed through a filter using a high-flow suction motor. Airborne particulate matter is collected on the filter. The flow rate of the air is measured along with a measurement of the sample airflow rate. An automatic controller ensures that the proper ratio is maintained to achieve isokinetic-sampling conditions. The sample is monitored continuously by an alpha-sensitive detector. The filter sample is removed every two weeks (or monthly if justified) and analyzed to quantify the amount and type of radioactivity released. Method or approved equivalent must comply with Method 114 of Title 40 of the Code of Federal Regulations (CFR) Part 61, Appendix B, *Test Methods for Measuring Radionuclide Emissions from Stationary Sources.*

III. Equipment

A. Isokinetic sampler;
B. Eberline Alpha CAM, or equivalent;
C. Filter (pre-weighed); and
D. Flow Rate Recorder.

IV. Safety

Only AWR Project personnel trained in accordance with the *Project Specific Health and Safety Plan* (HASP) will be allowed to perform or participate in the collection of air emission samples. Refer to SOPs and Radiation Work Permit for details regarding the appropriate training and level of personal protective equipment (PPE) required for sampling.

V. Procedure Guide

A. RCS Stack – Perform the following:

1. Calibrate the sampler per manufacturer's instructions and record the calibration in the logbook.
2. Use filters of predetermined weight.
3. Mount the filter in the filter holder and clamp onto the sampler.
4. Start the sampler pump and record the time.
5. Record the initial flow rate, temperature, and barometric pressure.
6. Run sample collection for the length of time specified, generally two weeks (or monthly if justified), but monitored continuously.
7. Take intermediate readings of flow rate, temperature, and barometric pressure and record in the logbook.
8. Take final readings of flow rate, temperature, and barometric pressure prior to filter retrieval.
9. Carefully remove the filter using gloves and forceps and fold it up to collect material on the filter. Place in an appropriate sample container.
10. Label and package sample in accordance with Manual Chain-of-Custody (COC) Procedures.
11. Install new filter (as in Step 3).
12. Complete field logbook entries.

VII. Quality Control/Quality Assurance

The bound field logbook will be maintained by the Project Manager or his designee when not in the possession of the field sampling team. The logbook shall detail each sampling event in reproducible detail. Entries shall be made in black, indelible ink, each page signed, and dated. Subsequent corrections shall be made by a single line drawn trough the original entry, entry of the corrected information, and initialing and dating by the individual making the correction. Copies of field logbooks will be retained and become part of the completed project records in accordance with the AWR Project *Records Management Plan*.

APPENDIX F

Accelerated Waste Retrieval (AWR) Project Sampling and Analysis Guidelines

SUBJECT: MANUAL CHAIN-OF-CUSTODY (COC) GUIDELINE

I. Scope and Application

This chain-of-custody (COC) guideline applies to wastewater and air emission samples collected for the AWR Project at the U.S Department of Energy (DOE) Fernald Environmental Management Project (FEMP) site. The goal is to ensure the integrity of the samples from collection to final disposition by documenting possession. COC documentation will trace possession of samples from their collection through transfers of custody until final disposition, including archiving where required. This guideline can be developed into a formal procedure for use during the AWR Project, or a FEMP COC procedure could be adopted. This guideline excludes the K-65 material collected and archived for future testing.

II. Summary

COC is a process for the tracking of samples. The components of this COC guideline include sample labels or tags, sample or custody seals, field logbooks, COC records, sample requests for analysis, and shipping/transport information. Each document is filled out to transmit appropriate data and to track the sample.

This guideline will be applied to samples collected during operation and maintenance (O&M) of the AWR Project, including air emissions and wastewater samples. This guideline does not apply to the transfer of samples between sampling team members. The project designation and sampling event may be eliminated from the label and documented in a logbook if necessary to transmit blind quality control samples.

III. Equipment

A. Sample labels or tags;
B. Sample or custody seals;
C. Field logbook;
D. COC form;
E. Sample request for analysis; and
F. Black indelible ink pen.

IV. Safety

Only AWR Project personnel trained in accordance with the *Project Specific Health and Safety Plan* (HASP) will be allowed to perform or participate in the collection of wastewater samples. Refer to applicable Standard Operating Procedure (SOP) and Radiation Work Permit for details regarding the appropriate training and level of personal protective equipment (PPE) required for sampling.

V. Procedure Guide

A. Samples under Custody – COC requirements are necessary whenever a sample leaves the sampling teams' custody. A sample is considered to be under a person's custody if any of the following conditions are met:

1. The sample is in the person's physical possession.
2. The sample is in the line-of-sight of the person after he/she as taken possession.
3. That person secures the sample so any tampering can be detected.
4. A sample is secured by the person in possession in an area that only authorized personnel can enter.

B. Sample Labels or Tags – Sample labels or tags will be affixed to sample containers prior to or at the time of sampling. To the extent practicable, sample bottles will be labeled prior to collection. Sample labels will be waterproof paper or plastic with adhesive backs or waterproof tags, as appropriate. *A typical sampling label is provided as an attachment to this guideline.* Labels will be completed with black indelible ink and will include the following information:

1. Sampling activity name and/or number;
2. Sample number to be assigned by the Project Manager or his designee;
3. Sample location, i.e., stack, sampling port, tank, etc.;
4. Sampling date and time;
5. Sample preservation used as applicable;
6. Media sample or sample type;
7. Analyses required; and
8. Special comments as needed.

C. Sample or Custody Seals – Sample or custody seals are used to detect tampering of samples, following sample collection prior to the time of analysis. The seal will be attached in such a way that it is necessary to beak the seal in order to open the sample container. Here, "sample containers" may refer to either individual sample containers or a shipping container. Seals will be affixed to the container before they leave the custody of the sampling personnel. *A typical custody seal is provided as an attachment to this guideline.*

Custody seals will be waterproof paper or plastic with adhesive backs. Samples designated for shipment that leave the sampler's custody will have a sample seal affixed, which includes the following information:

1. Name of collector(s); and

2. Date and time of sealing the container.

D. Field Logbook – A field logbook entry will be made at the time the sample is collected; the entry will be completed at the time the sample is taken. The field logbook entry will include, but not limited to, the following information:

1. Sampling activity name;

2. Sample number to be assigned by the Project Manager or his designee;

3. Name(s) of collector(s) and identification of others present including radiological control personnel;

4. Name and site address of Project Manager or his designee;

5. Date and time of sample collection;

6. Sample location, i.e., stack, sampling port, or tank;

7. Sample media (e.g., water, air particulate, etc.)

8. Analytical parameter(s) to be measured;

9. Preservatives as appropriate;

10. Location of sampling point;

11. Designation of QC samples (e.g., blank and duplicates);

12. Sampling methodology;

13. Observations during sampling;

14. COC control number and sample request documentation;

15. Sample distribution and method of shipping;

16. Initials of responsible observer; and

17. Field observations and measurements including radiological scans of containers.

E. COC Records – The sampling personnel will complete the COC record at the time of the sampling event. *A typical COC record form is attached to this guideline.* The records will be signed as relinquished or received each time the sample changes possession, from the collection to final disposition. The COC record will include the following information:

1. Sampling activity name;

2. Sample number to be assigned by the Project Manager or his designee;

3. Date and time of sample collection;

4. Name of sample collector(s);

5. Signature(s) of collector or sample custodian;

6. Container type;

7. Preservatives as applicable;

8. Analysis requested;

9. Chain-of-custody control number; and

10. Signature and date blocks for personnel relinquishing or receiving sample custody for the life of the sample (e.g., sample collector, shipper, and receiving laboratory).

F. Sample Request for Analysis Sheet – A request for analysis sheet will be submitted to the lab for the collected samples unless arrangements with the laboratory have been made in writing and acknowledged. The request for analysis sheet will outline the desired analysis for the samples.

VI. Quality Control/Quality Assurance

The bound field logbook will be maintained by the Project Manager or his designee when not in the possession of the field sampling team. The logbook shall detail each sampling event in reproducible detail. Entries shall be made in black, indelible ink, each page signed, and dated. Subsequent corrections shall be made by a single line drawn trough the original entry, entry of the corrected information, and initialing and dating by the individual making the correction. Copies of completed COC records, laboratory request for analysis sheets, completed analytical data, and field logbooks will be retained and become part of the completed project records in accordance with the AWR Project *Records Management Plan.*

Attachment to Manual COC Guideline

SAMPLE TAG OR LABEL (TYPICAL)

SAMPLE NO.: _____
PROJECT: _____
DATE: ___/___/___ TIME: _____ HRS: _____
MEDIUM: WATER _____ SOIL _____ SEDIMENT _____
OTHER _____ (Specify)
TYPE: GRAB _____ COMPOSITE _____ OTHER _____ (Specify)
PRESERVATION: _____ pH: _____
ANALYSIS: _____
SAMPLED BY: _____
LAB NO.: _____
REMARKS: _____

SAMPLE OR CUSTODY SEAL (TYPICAL)

CUSTODY SEAL

Person Collecting Sample: _____
(Print Name)

_____ Sample No.: _____
(Signature)

Date Collected: _____ Time: _____

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Attachment to Manual COC Guideline

CHAIN-OF-CUSTODY FORM (TYPICAL)

FOSTER WHEELER ENVIRONMENTAL CORPORATION
CHAIN OF CUSTODY RECORD

PROJECT

SAMPLERS: (Signature)

SAMPLE NUMBER	DATE	TIME	COMP.	GRAB	NO. CONTAINERS	REMARKS OR SAMPLE LOCATION	PRESERVATION: ICED	PRESERVATION: SPECIFY CHEMICALS ADDED AND FINAL pH IF KNOWN

Relinquished by: (Signature) ①	Date / Time	Received by: (Signature)	Relinquished by: (Signature) ④	Date / Time	Shipped via:
Relinquished by: (Signature) ②	Date / Time	Received by: (Signature)	Received for Laboratory by: (Signature)	Date / Time	Shipping Ticket No.
Relinquished by: (Signature) ③	Date / Time	Received by: (Signature)	Remarks		

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FOSTER WHEELER

FOSTER WHEELER ENVIRONMENTAL CORPORATION

BERM EXCAVATION PLAN

DOCUMENT 624-P621-11, Rev. 0

FOR THE

SILOS 1 AND 2
ACCELERATED WASTE RETRIEVAL PROJECT

SUBMITTED TO:

FLUOR FERNALD, Inc.

CONTRACT FSC 624

November 10, 2000

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FOSTER WHEELER ENVIRONMENTAL CORPORATION

BERM EXCAVATION PLAN
Revision 0

Recommended by:

Foster Wheeler Engineering Manager

11/10/00
Date

Approved by:

Foster Wheeler Project Manager

11-13-00
Date

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TABLE OF CONTENTS

1.0 INTRODUCTION 1
- 1.1 Purpose 1
- 1.2 Scope of Work 1
- 1.3 Background Brief 1
- 1.4 Radiological Surveys 2
- 1.5 General Description of Excavation Activities 3
- 1.6 Environmental Protection Measures 4
- 1.7 Safe Work Plan 4

2.0 EXCAVATION Plan 5
- 2.1 General Excavation Activities 5
- 2.2 Phase 1 – Foundation Excavations Adjacent to Silos 1 and 2 5
- 2.3 Phase 2A and Phase 2B – Operational Excavation 5

APPENDIX A. ATTACHED DRAWINGS

11FCD003, Silo Waste Retrieval System – Excavation Plan, Phase 1
11FCD004, Silo Waste Retrieval System – Excavation Plan, Phase 2A & 2B
11FCD005, Silo Waste Retrieval System – Cross Section, Sheet 1
11FCD006, Silo Waste Retrieval System – Cross Section, Sheet 2
11FCD007, Silo Waste Retrieval System – Cross Section, Sheet 3
11FCD008, Silo Waste Retrieval System – Cross Section, Sheet 4
11FCD009, Silo Waste Retrieval System – Erosion Control Plan, Phase 1
11FCD010, Silo Retrieval System – Erosion Control Plan, Phase 2A & 2B

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ACRONYMS AND ABBREVIATIONS

ALARA	as low as reasonably achievable
ARARs	applicable or relevant and appropriate requirements
AWR	Accelerated Waste Retrieval
BEP	Berm Excavation Plan
CFR	*Code of Federal Regulations*
DOE	U.S. Department of Energy
EPA	U.S. Environmental Protection Agency
FAT&LC	Fernald Atomic Trades and Labor Council
FEMP	Fernald Environmental Management Project
Fluor Fernald	Fluor Fernald, Inc.
Foster Wheeler	Foster Wheeler Environmental Corporation
FSM	Full-Scale Mock-Up
H:V	horizontal to vertical
FWENC	Foster Wheeler Environmental Corporation
OEPA	Ohio Environmental Protection Agency
OSDF	Onsite Disposal Facility
SP	Stockpile
SWRS	Silo Waste Retrieval System
WAC	waste acceptance criteria
WAO	Waste Acceptance Organization
WHWP	Waste Handling Work Plan

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1.0 INTRODUCTION

The Berm Excavation Plan (BEP) is one of the supporting project plans for the Accelerated Waste Retrieval (AWR) Project at the Fernald Environmental Management Project (FEMP) site. This project is located approximately 15 miles northwest of Cincinnati, Ohio, owned by the U.S. Department of Energy (DOE), and managed by Fluor Fernald, Inc. (Fluor Fernald). The AWR Project is being performed by Foster Wheeler Environmental Corporation (Foster Wheeler) under Fluor Fernald Contract FSC 624.

This section provides introductory information on the purpose, scope of work, background, general description of excavation activities, and environmental protection measures associated with the BEP. Section 2.0 summarizes execution, methods, and procedures for berm excavation, transportation, and disposal activities. Section 2.0 also describes the three excavation phases necessary to support the AWR Project, including any contingency planning when discrete objects are encountered. Berm excavation drawings are included in Appendix A.

1.1 Purpose

The purpose of the BEP is to introduce construction and operational procedures relative to the excavation and removal of containment berms associated with Silos 1 and 2 AWR Project. The BEP emphasizes the excavation methods employed to mitigate the impacts on the silo's structural integrity throughout the AWR Project construction and operational activities.

1.2 Scope of Work

The primary scope of work for the BEP addresses the excavation of the 3:1 horizontal to vertical (H:V) berm surrounding Silos 1 and 2 during the waste removal operations. Construction activities include the excavation of foundations for the support structure associated with the Silo Waste Retrieval System (SWRS). The BEP does not include excavation outside of the Silos 1 and 2 areas.

1.3 Background Brief

From 1951 to 1960, DOE produced approximately 6,800 cubic meters of K-65 material while processing high-grade uranium ores. Four concrete silos were built to support the uranium process. Silos 1 and 2 provide the storage of the K-65 material. Silo 3 contains a different type of material and is not in the scope of this project. Silo 4 was never used for material storage; it will serve as the primary operations center during the Full-Scale Mock-Up (FSM).

The K-65 material currently stored in Silos 1 and 2 contains radionuclides such as radium (the contaminant of concern) and thorium. Radium degrades into several elements, among which is radon. During the first 10 years of service, the silos developed fractures in the exterior concrete surface. Periodic inspections revealed radon gas leaks to atmosphere. Soil berms were placed around the silos to enhance their structural integrity and to reduce the hazards to human health and the environment. These berms were initially sloped at 1.5 to 1 (H:V).

Later, in 1983, the berm slopes were revised to incorporate a slope of 3 to 1 (H:V) in order to mitigate soil erosion. The silo domes were foamed to further reduce the release of radon gas to the atmosphere.

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1.4 Radiological Surveys

Based on U.S. Environmental Protection Agency (EPA) and Ohio EPA (OEPA) approval of existing berm soil sampling data and sampling requirements in Reference letter number DOE-0455-99, *Proposed Phase II Soil Sampling and Analyses within Soil Remediation Area 7*, no additional sampling and monitoring is required. However, to proactively address the potential berm soil contamination from silo leakage, the berm soil and silos will be visually monitored for silo leakage during berm excavation activities as part of the normal continuous Fluor Fernald Waste Acceptance Organization (WAO) oversight activities.

If berm soil impacted by leakage from the silos is to be encountered, the DOE believes that it will be at two primary locations. The first location would be in the vicinity of one of the silo decant piping penetrations within the silo tank wall or at the associated pipe blind flanges. These locations of the decant piping penetrations are known. The second location would be at a location of seepage through a crack in the silo tank wall itself. If any such locations do exist, the specific locations are presently unknown due to the past placement of silo berm soil.

The proposed physical sampling methodology has been developed to address both of the potential leak scenarios. In either leak scenario, it is believed that any potential leaked materials will be uncovered during excavation of the 2 feet of berm soil immediately adjacent to the silo wall. It is further assumed that leaked materials can be visually determined due to composition or visual color differences within the berm soil.

The silo waste retrieval design specifies a maximum differential of 10 feet will be maintained between the silo contents and berm soil. During waste retrieval and berm excavation operations, a procedural target of a 5-foot (±1 foot) differential will be employed. Three waste acceptance criteria (WAC) verification samples will be taken to correspond to each 5-foot lift of silo berm soil, beginning with the surface of the berm. One sample will be taken near the decant piping penetrations. Additionally, two other WAC samples will be taken at randomly selected locations in the lift surface. These samples will be analyzed for total uranium prior to initiating excavation of the 5-foot lift. Once analytical results are received, excavation can commence, and the soil from that 5-foot lift can be directly dispositioned to the Onsite Disposal Facility (OSDF) or Stockpile (SP)-7 based upon the analytical results.

If all three sample results are below the WAC, the soil from that lift will be directly dispositioned to the OSDF. If any of the three results exceed the WAC, then either the entire 5 feet lift can be excavated and dispositioned to SP-7 or further physical samples may be taken to further delineate the above WAC area horizontally prior to excavation. The above WAC portion of the 5 foot lift would then be dispositioned to SP-7, while the remaining portion of the 5-foot lift can be dispositioned to the OSDF.

In cases where visual evidence of leak material is encountered, excavation of the area will be suspended and a WAC sample will be taken and analyzed for total uranium and technecium-99 regardless of lift. Further physical samples will be taken to delineate the area horizontally and vertically to delineate above-WAC the volume to be dispositioned to SP-7. After EPA/OEPA approval of this plan is received, Fluor Fernald will further detail the procedure for WAC verification sampling of the berm soil in an *Excavation Monitoring Project-Specific Plan*, submitted for approval prior to initiating excavation.

The radiological surveys required for potentially contaminated berm soils will be performed by health physics technicians provided by Fluor Fernald under the direction of Foster Wheeler.

Noncontaminated soil will be loaded into dump trucks and transported to a location designated by Fluor Fernald.

The compliance requirements of the *Waste Handling Work Plan* (*WHWP*) (Document No. 624-ACR007-01) will be met during the excavation work performed under the BEP. The *WHWP* includes requirements for waste transfer protocols, waste storage containers, and secondary waste that is not contained within the silos. Discrete objects may be encountered during the berm excavation, such as abandoned utilities or tools left within the berm during construction. Each object will be surveyed and then packaged for disposal in accordance with the *WHWP*.

1.5 General Description of Excavation Activities

The berm excavation activities are divided into three phases:

- Phase 1 includes excavation to support construction activities before silo remediation begins.
- Phase 2A includes berm excavation around Silo 1 that occurs during the remediation of Silo 1.
- Phase 2B includes berm excavation around Silo 2 that occurs during the remediation of Silo 2.

During the three phases, Foster Wheeler will excavate approximately 17,400 cubic yards of berm soil around Silo 1 and Silo 2. Exhibit 2-1 shows the approximate volumes of berm excavation for each phase.

Exhibit 2-1. Estimated Volume of Berm Excavation

Phase	Estimated Volume (cubic yards)
1	11,000
2A	3,600
2B	2,800

The primary factors to be observed during excavation are the maintenance of (1) the structural integrity of the silo walls, and (2) as low as reasonably achievable (ALARA) radiation protection for workers.

***Note*: Foster Wheeler shall visually monitor the structural condition of Silo 1 and Silo 2 during excavation activities. If and when it is determined that the silo condition appears to be unsafe—or is substantially different than described in the contract documents—Foster Wheeler will stop the work and inform Fluor Fernald immediately. Fluor Fernald will evaluate the condition and then provide Foster Wheeler with directions for further action within 24 hours.**

Excavation equipment includes a Gradall excavator, a small dozer, a bucket loader, and a dump truck. The excavator will perform the bulk of the berm removal. Before Phase 1 excavation begins, an Equipment Exclusion Zone and a Hand Excavation Zone will be marked with wooden stakes and flags. Both zones are established to minimize any impacts of heavy equipment on the silo walls. The Equipment Exclusion Zone and the Hand Excavation Zone for each phase of excavation is shown on Drawings 11FCD003, 11FCD006, and 11FCD007.

The Equipment Exclusion Zone is an area that extends approximately 26 feet from the Silo 1 and 2 walls at the beginning of Phase 1. No heavy equipment is allowed inside this zone. As excavation work progresses, this Equipment Exclusion Zone is gradually reduced, with the approval of the Field Engineer.

1.6 Environmental Protection Measures

Foster Wheeler shall take all reasonable measures, as described in the AWR contract documents, to protect the environment and the safety of both on-site personnel and the general public in surrounding communities. The guiding principle for these measures is the application of ALARA goals and compliance with applicable or relevant and appropriate requirements (ARARs), as described in the *Environmental Control Plan*, Document No. 624-P621-10.

1.7 Safe Work Plan

To be submitted under separate cover.

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2.0 EXCAVATION PLAN

This section describes the procedures to be used for performing the berm excavation, transportation, and disposal in support of the AWR Project. Berm excavation drawings are provided in Appendix A.

2.1 General Excavation Activities

Foster Wheeler will maintain the berms until the project is completed. Any eroded areas will be repaired as soon as weather permits. Upon completion of the AWR Project, erosion controls (such as seed and mulch) will be placed on all disturbed areas.

A heavy geotextile (16 ounces per square yard) will be placed on slopes steeper than 2:1 (H:V) to stabilize the slope and to prevent the formation of rills. The geotextile will be peeled back in sections to allow for excavation. Hold-down staples will be used in accordance with the manufacturer's recommendations. Plastic sheeting with sandbags or other weights will be used, as required, in order to keep open excavation surfaces dry.

Excavation of berm material will be continuously monitored by Fluor Fernald WAO to ensure WAC compliance. Any OSDF-prohibited items will be segregated and managed in accordance with WAO direction. The excavated soils will be directly loaded into trailer dump trucks and manifested by Fluor Fernald WAO to the OSDF or SP-7. Two trailers will be used to contain and transport the soil to a location designated by Fluor Fernald. The trucks will be covered for dust control and rain protection.

2.2 Phase 1 – Foundation Excavations Adjacent to Silos 1 and 2

During Phase 1, Foster Wheeler shall excavate portions of the berm to construct the foundations required for erection of the SWRS Support Structure (see Drawing 11FCD003). Foster Wheeler construction personnel will perform Phase 1 excavation and construction activities.

The SWRS Support Structure has (1) a fixed, rotating structural support (the turntable), and (2) a movable structure (the bridge) that glides on a concrete runway using air bearings to support the structure's weight and to provide a smooth movement into new positions. Concrete foundations are required for both the fixed structural support (the turntable) and the concrete runway.

The work area shall be surveyed. Exclusion zones shall be laid out and flagged in accordance with the drawings. Silt fence will be installed as shown on Drawings 11FCD009 and 11FCD010. Soil around the turntable foundation and the concrete runway foundation is excavated to an elevation of 582.5 feet. The area east of Silo 1 is graded at an elevation of 578 feet to facilitate the initial assembly of the SWRS support structure. The area between the silos and the SWRS foundations is graded as shown on Drawing 11FCD003.

2.3 Phase 2A and Phase 2B – Operational Excavation

Phase 2A and 2B designates the excavation work on a periodic basis around Silo 1 and 2, respectively, concurrent with waste removal operations from each particular silo. Phase 2A and 2B excavation activities will be performed by personnel from the Fernald Atomic Trades & Labor Council (FAT&LC). A FAT&LC crew of five members generally will be required. This crew

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consists of an excavator operator, front-end loader operator, health physics technician, and two laborers. This crew is needed for a minimum duration of 140 working days to perform both Phase 2A and 2B. This time does not include the setup time between the phases to move the superstructure and equipment.

Before starting excavation, a field survey crew will perform an elevation survey and layout in accordance with the drawings. This activity is similar to Phase 1 during which a series of flags and wooden stakes were used to establish a Hand Excavation Zone and an Equipment Exclusion Zone.

To avoid any additional loads on the silo walls, excavating equipment must remain outside of the Equipment Exclusion Zone shown in Drawings 11FCD003 and 11FCD004. In addition, operators are required to demonstrate good control of equipment before excavating near the silos. The Hand Excavation Zone (an area extending 2 feet around Silos 1 and 2) is designated to further protect the silo walls from damage by excavation equipment.

Phase 2A starts with excavation of the berm soil around Silo 1 to an elevation of 586 feet as shown on Drawing 11FCD004. The cross section of Silo 1 is shown on Drawing 11FCD006. Excavation of the berm soil around Silo 1 is started only after the waste removal operation at Silo 1 begins. The expected duration for Phase 2A excavation is a nominal 70 working days per silo.

Phase 2B starts with excavation of berm soil around Silo 2 to an elevation of 586 feet as shown on Drawing 11FCD004. The cross section of Silo 2 is shown on Drawing 11FCD007. Excavation of the berm soil around Silo 2 will be started only after: (1) Silo 1 remediation is completed, (2) the bridge structure is moved on top of Silo 2, (3) all support facilities are readied for Silo 2 remediation operations, and (4) the waste removal operation at Silo 2 begins. The expected duration for Phase 2B excavation is a nominal 70 working days per silo.

Fluor Fernald allows a maximum height differential of 10 feet between the top of the berm elevation and the waste level in the silos. This maximum allowable height differential was established because of the deteriorating structural condition of the silos; the differential is intended to limit external and internal stresses on the silo walls.

At times during excavation, the equipment cab is located below the top of the waste elevation in the silo. During these times, the soil remaining in place will provide shielding to the equipment operator. It is estimated that a berm height of 4 feet higher than the top of the silo waste level will provide adequate protection from radiation. Therefore, the berm excavation and silo waste removal activities will be coordinated to maintain a target differential of 5 feet ($\pm$1 foot) higher than the waste level in the silos. As previously stated, the maximum allowable differential is 10 feet. ALARA protection of workers is verified continuously by monitoring equipment.

To maintain the berm soil at a level of between 4 and 10 feet higher than the waste levels in the silos, the excavated soil level and the silo waste level is recorded daily in a log. The daily log is reviewed by the Site Superintendent and Field Engineer to determine approximate height of berm to be removed (if any) the next morning. Berm excavation activity may not be started each day without prior approval from the Field Engineer. On the basis of the projected production rate of the waste removal process, an average volume of 50 cubic yards of berm soil will be removed each day during silo remediation. Once a portion of berm is removed using equipment, the remaining material within the Hand Excavation Zone will be assisted to cave in/fall away from the silo walls using a hand held tool attached to a long pole to meet ALARA requirements.

3387

In all areas except between the two silos, the edge of the Gradall, loader, and dump truck is kept outside the Equipment Exclusion Zone. Directly between the two silos, it is not possible to maintain the Equipment Exclusion Zone. Therefore, a Gradall is used to excavate the berm soil. Use of small equipment generates additional load on the wall. However, this equipment is selected such that combined load from (1) 6 feet of soil (maximum differential that Foster Wheeler maintains), and (2) the small equipment does not exceed the load from 10 feet of soil (maximum differential allowed by Fluor Fernald). The Equipment Exclusion Zone is based on the load line (a line drawn at 45° upward from the base of a silo that intersects Phase I berm elevations). As the excavation progresses, the Equipment Exclusion Zone can be reduced after approval from the Field Engineer.

During excavation activities, the area is graded to avoid accumulation of surface water in low areas. Surface runoff is diverted to the existing surface water collection system. A small ditch is graded between the two silos to divert the runoff east and west.

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APPENDIX A

BERM EXCAVATION DRAWINGS

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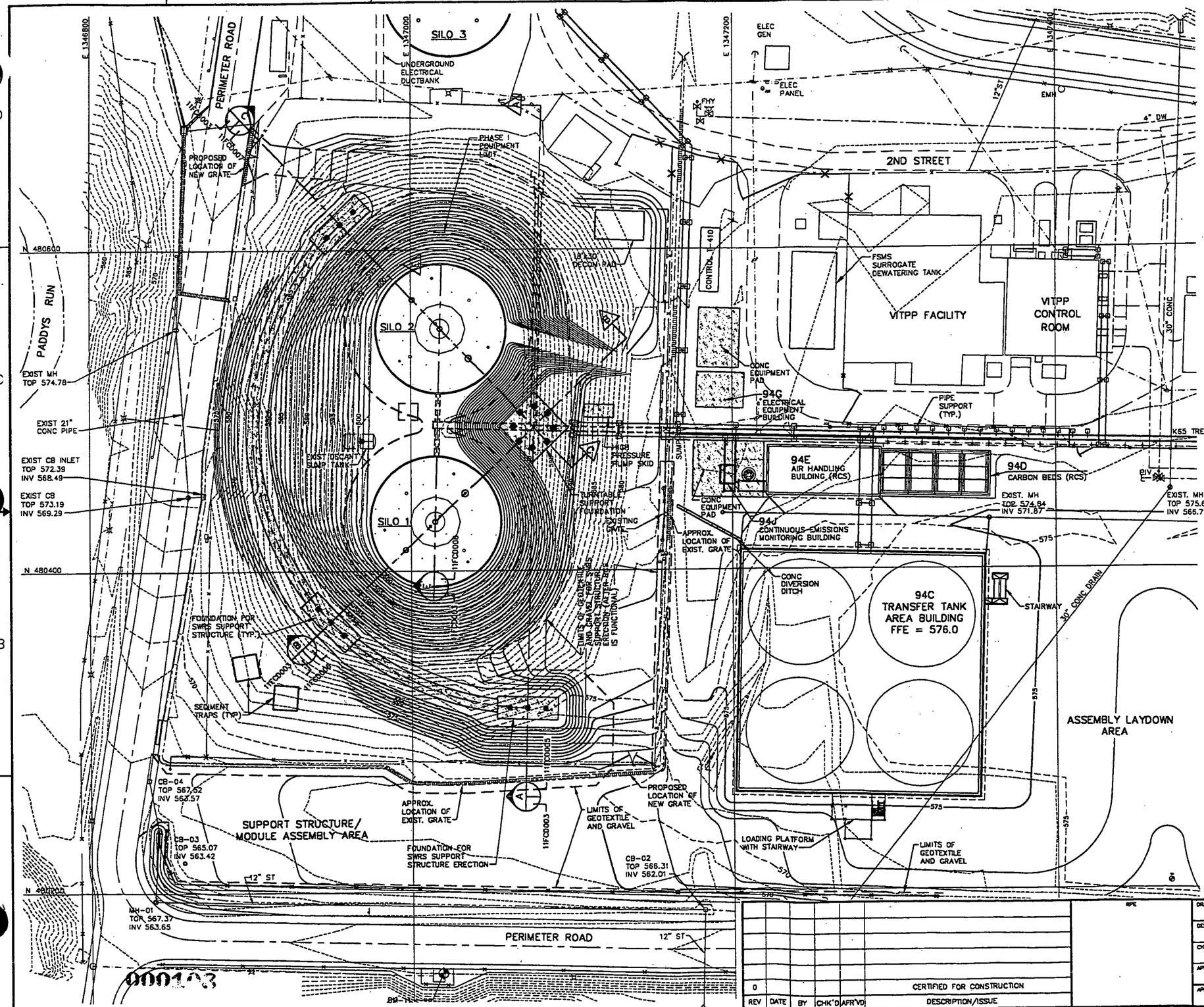

NOTES:

1. SEE DRAWING 05FCD011 FOR GENERAL NOTES AND LEGEND.
2. SEE DRAWING 66FCD002 FOR STORM WATER SYSTEM DRAINAGE PLAN.
3. SEE DRAWING 66FCD007 FOR STORM WATER SYSTEM PROFILES.
4. SEE DRAWING NUMBERS 11FCD009 AND 11FCD010 FOR EROSION CONTROL PLANS.
5. CONTRACTOR WILL BE RESPONSIBLE FOR LOCATING EXISTING UTILITIES BEFORE BEGINNING EXCAVATION.
6. ALL EROSION CONTROL MEASURES WILL BE INSTALLED AT THE BEGINNING OF EXCAVATION AND MAINTAINED FOR THE DURATION OF THE PROJECT.
7. AREAS DISTURBED BY EXCAVATION ACTIVITIES ARE TO BE SEEDED AND MULCHED AS SOON AS PRACTICAL. REFER TO SPECIFICATION SECTION 02924.
8. REFER TO SPECIFICATION SECTION 02300 FOR EARTHWORK.
9. BM-11 LOCATION: N 480,149.10, E 1,347,018.61, ELEV. 569.14
10. SEPARATION FABRIC SHALL BE MIRAFI 180 N OR EQUIVALENT.
11. REFER TO SPECIFICATION SECTION 02722 FOR AGGREGATE AND/OR GRADED, CRUSHED AGGREGATE BASE COURSE.
12. REFER TO SPECIFICATION SECTION 02630 FOR STORM DRAINAGE.
13. CONTRACTOR RESPONSIBLE FOR LOCATING EXISTING FEATURES WITH SURVEY TIE-INS.
14. EXISTING STANDPIPE AT DECANT SUMP TANK TO BE PROTECTED DURING ALL PHASES OF EXCAVATION WITH A 2' HAND EXCAVATION AREA AROUND PIPE.

STATE OF OHIO NORTH (NAD 83)

LETTER OR NUMBER OF SECTION OR DETAIL
DRAWING ON WHICH SECTION OR DETAIL IS TAKEN
DRAWING ON WHICH SECTION OR DETAIL IS SHOWN

SECTION & DETAIL KEY

000108

30 0 30 60

SCALE IN FEET

THE ORIGINAL DRAWING AND SUBSEQUENT REVISIONS THEREOF, WITH APPROVAL NAMES, INITIALS, AND THE PE SEAL, IF APPLICABLE, ARE MAINTAINED IN THE FILES OF FWENC.

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APPROVED BY DATE

DEPARTMENT OF ENERGY
FERNALD ENVIRONMENTAL MANAGEMENT PROJECT
SILOS 1 AND 2 ACCELERATED WASTE RETRIEVAL PROJECT
FERNALD, OHIO
FDF CONTRACT NO. FSC 624

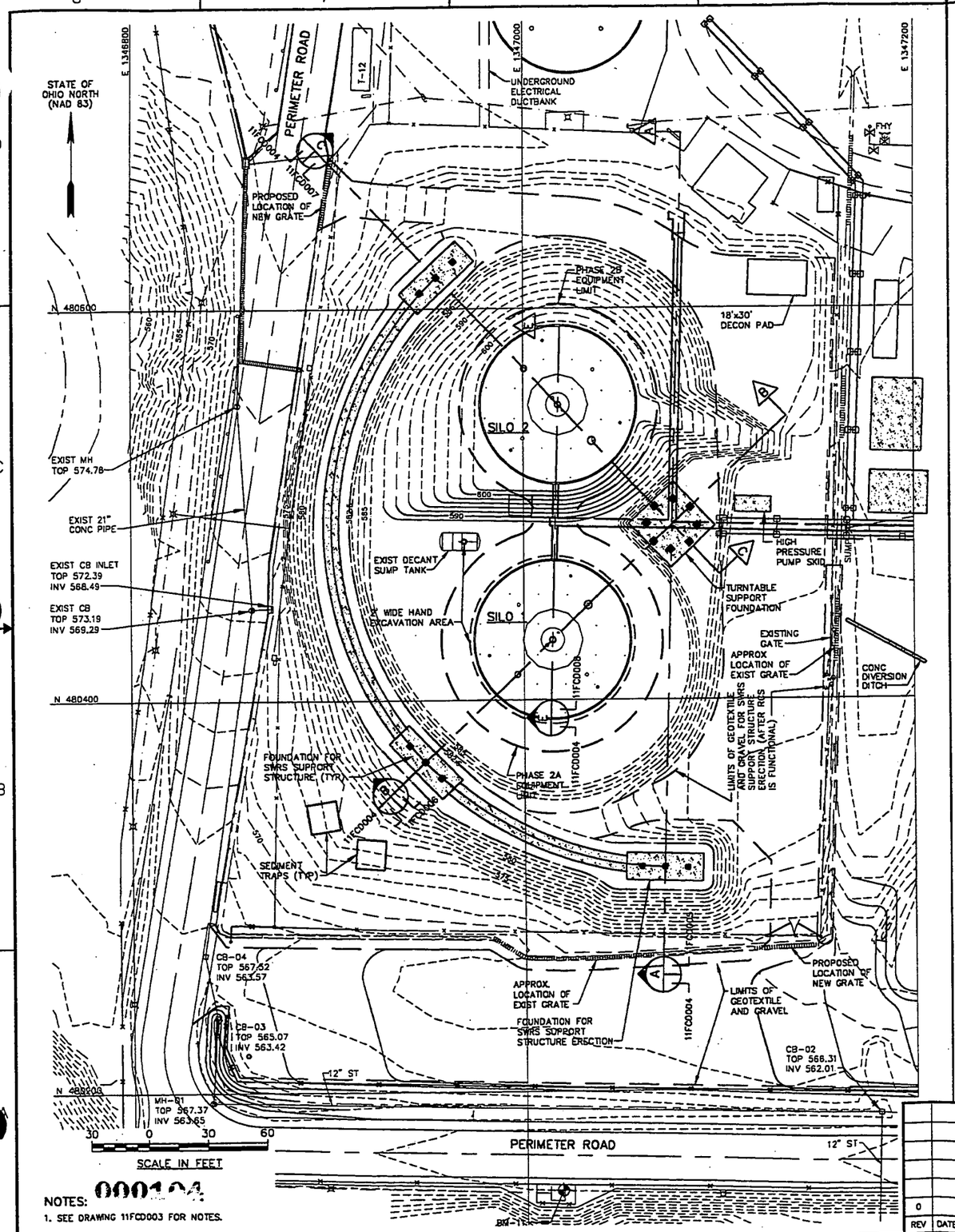
FOSTER WHEELER
FOSTER WHEELER ENVIRONMENTAL CORPORATION

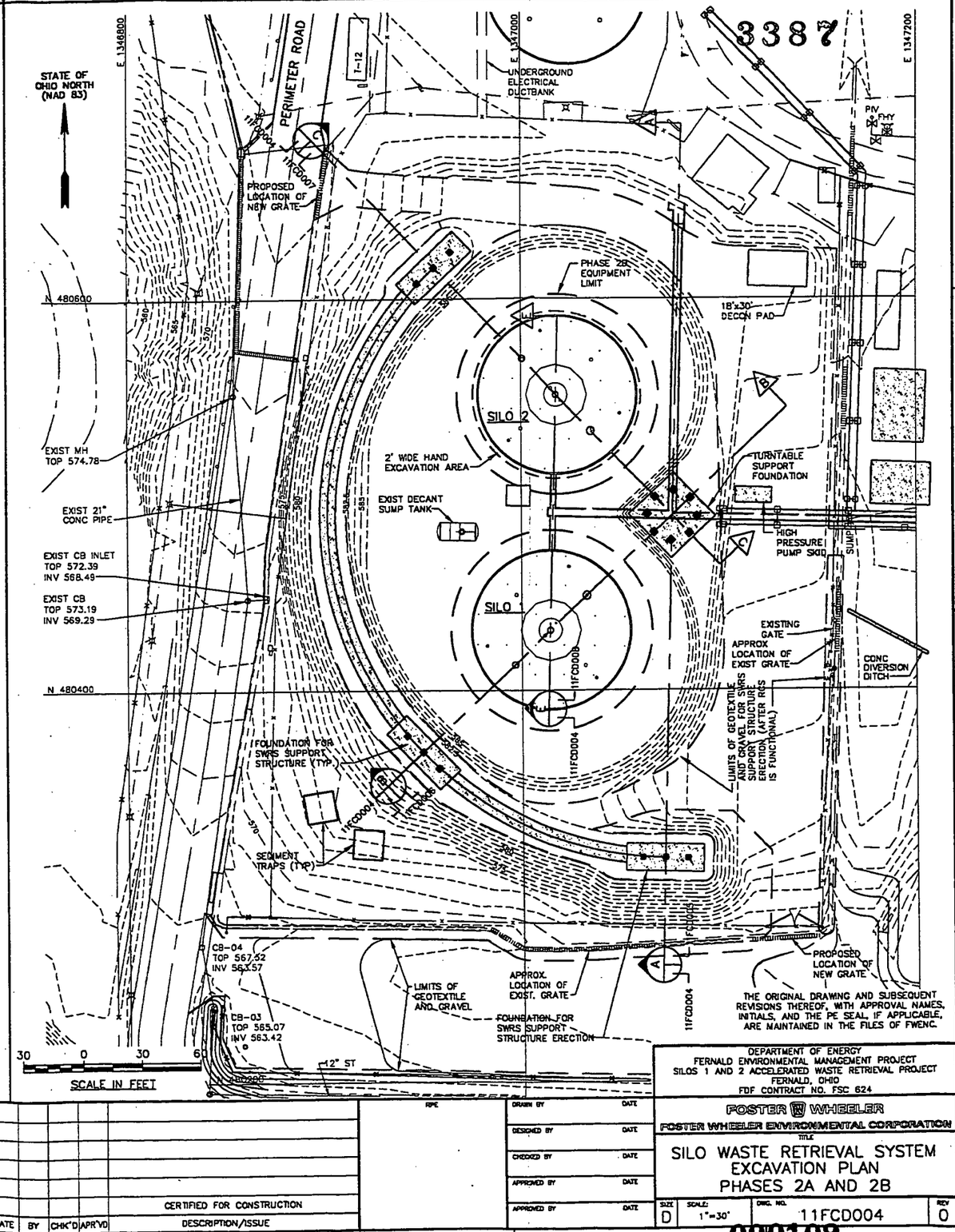
TITLE
SILO WASTE RETRIEVAL SYSTEM
EXCAVATION PLAN
PHASE 1

SIZE	SCALE:	DWG. NO.	REV
D	1"=30'	11FCD003	0

FILENAME: 11FCD003.DWG

XREF DRAWINGS: 30-EXB3 30-PRO





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NOTES:
1. SEE DRAWING 11FCD003 FOR NOTES.

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FERNALD ENVIRONMENTAL MANAGEMENT PROJECT
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FERNALD, OHIO
FDF CONTRACT NO. FSC 624

FOSTER WHEELER
FOSTER WHEELER ENVIRONMENTAL CORPORATION

DRAWN BY / DATE
DESIGNED BY / DATE
CHECKED BY / DATE
APPROVED BY / DATE
APPROVED BY / DATE

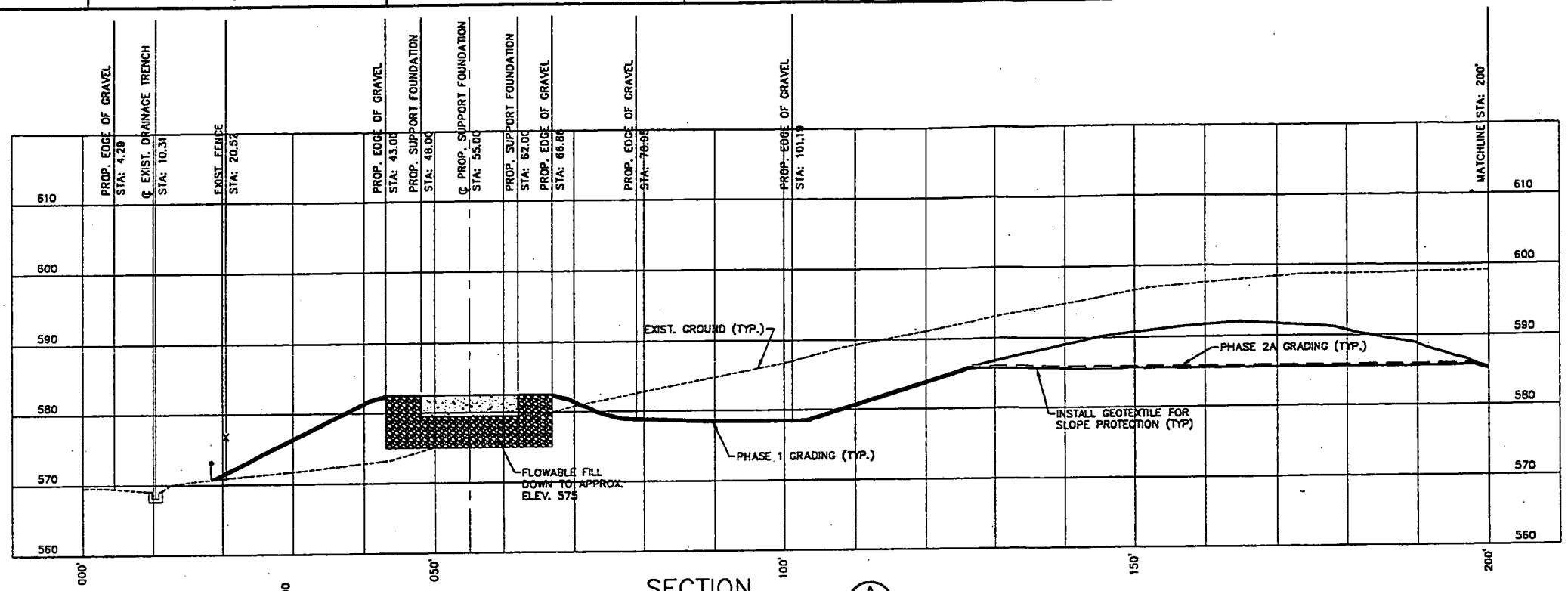
TITLE
SILO WASTE RETRIEVAL SYSTEM
EXCAVATION PLAN
PHASES 2A AND 2B

SIZE	SCALE:	DWG. NO.	REV
D	1"=30'	11FCD004	0

000109

FILENAME: 11FCD004.DWG

3387



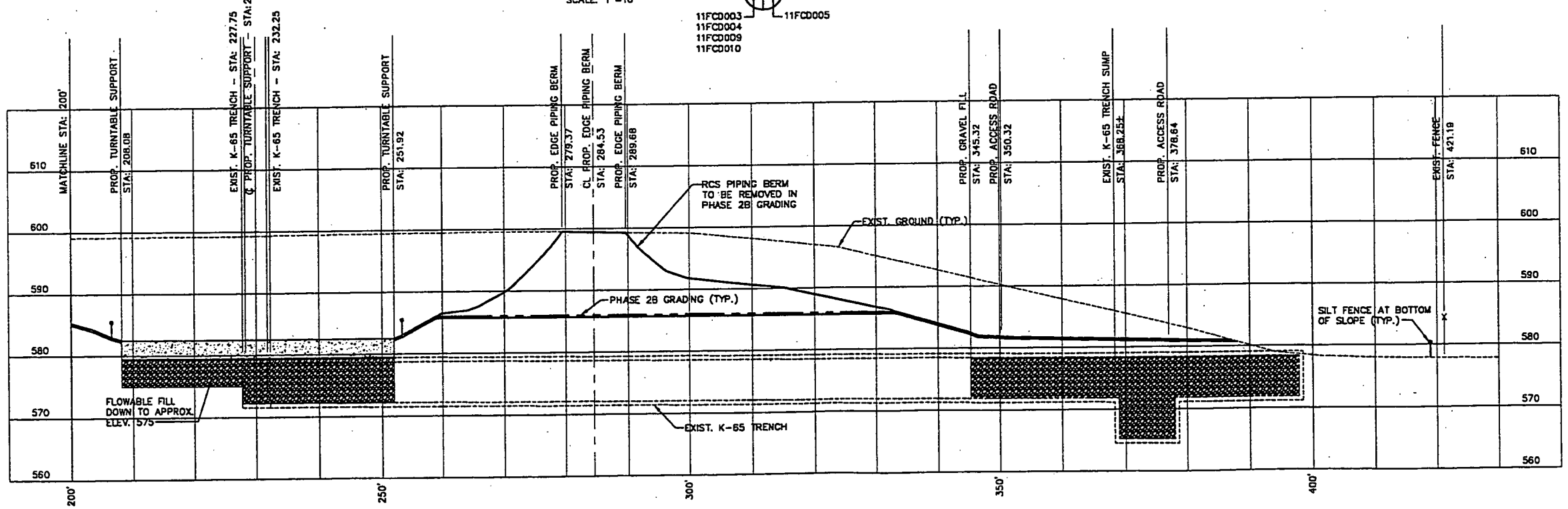
SECTION

SCALE: 1"=10'

A

11FCD003
11FCD004
11FCD009
11FCD010

11FCD005



SECTION (CONT.)

SCALE: 1"=10'

A

11FCD003
11FCD004
11FCD009
11FCD010

11FCD005

000110

LETTER OR NUMBER OF SECTION OR DETAIL

DRAWING ON WHICH SECTION OR DETAIL IS TAKEN

DRAWING ON WHICH SECTION OR DETAIL IS SHOWN

SECTION AND DETAIL KEY:

NOTES:

1. SEE DRAWING NO. 11FCD003 – SILO WASTE RETRIEVAL SYSTEM, EXCAVATION PLAN, PHASE 1 AND 11FCD004 – SILO WASTE RETRIEVAL SYSTEM, EXCAVATION PLAN, PHASES 2A AND 2B, FOR PLAN GRADING AND NOTES.

000105

THE ORIGINAL DRAWING AND SUBSEQUENT REVISIONS THEREOF, WITH APPROVAL NAMES, INITIALS, AND THE PE SEAL, IF APPLICABLE, ARE MAINTAINED IN THE FILES OF FWENC.

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FERNALD ENVIRONMENTAL MANAGEMENT PROJECT
SILOS 1 AND 2 ACCELERATED WASTE RETRIEVAL PROJECT
FERNALD, OHIO
FDF CONTRACT NO. FSC 624

FOSTER WHEELER

FOSTER WHEELER ENVIRONMENTAL CORPORATION

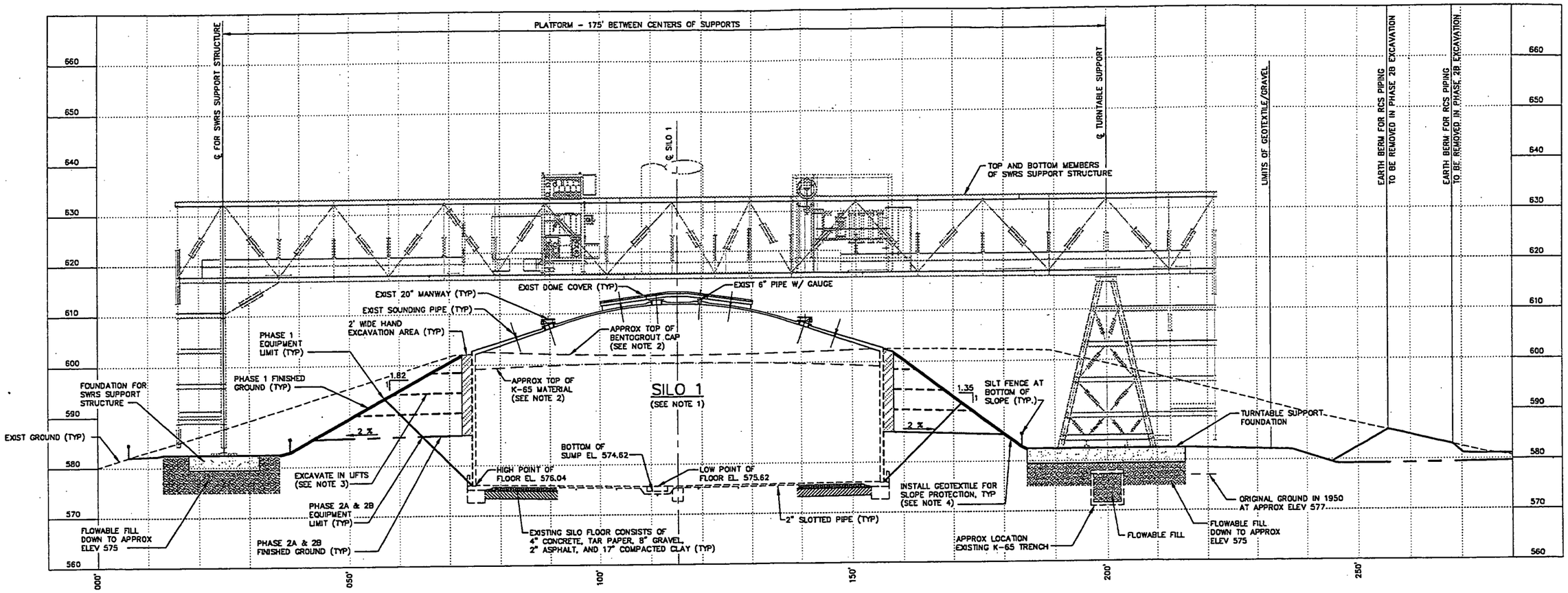
TITLE

SILO WASTE RETRIEVAL SYSTEM
CROSS SECTIONS
SHEET 1

SIZE	SCALE:	DWG. NO.	REV
D	1"=10'	11FCD005	0

FILENAME: 11FCD005.DWG

3387



SECTION

SCALE: 1"=10'

B

11FCD003
11FCD004
11FCD009
11FCD010

11FCD006

NOTES:

1. SILO 1 CONTAINS APPROXIMATELY 115,900 CUBIC FEET OF MATERIAL (INCLUDING RESIDUE AND DISCRETE OBJECTS) AND APPROXIMATELY 12,600 CUBIC FEET OF BENTOGROUT.
2. APPROXIMATE LOCATION OF BENTOGROUT CAP AND K-65 MATERIAL COMES FROM SECTION 2.5.1 OF THE TECHNICAL REQUIREMENTS DOCUMENT.
3. EXCAVATION AROUND SILOS DURING PHASE 2A AND PHASE 2B WILL BE COORDINATED WITH THE HEIGHT OF K-65 MATERIAL WITHIN EACH SILO, AN INITIAL TARGET DIFFERENTIAL OF 5±1 FEET WILL BE EMPLOYED; AT NO TIME WILL THE HEIGHT DIFFERENTIAL ON BOTH SIDES OF SILO WALL EXCEED 10 FEET UNTIL FINISHED GROUND ELEV OF 586 IS REACHED.
4. SEE SPECIFICATION SECTION 02375 FOR GEOTEXTILE. REMOVE PORTIONS OF GEOTEXTILE TO EXCAVATE EACH LIFT AND REATTACH AFTER EXCAVATION WORK IS FINISHED.

LETTER OR NUMBER OF SECTION OR DETAIL
DRAWING ON WHICH SECTION OR DETAIL IS TAKEN
DRAWING ON WHICH SECTION OR DETAIL IS SHOWN

SECTION & DETAIL KEY

000126

000111

THE ORIGINAL DRAWING AND SUBSEQUENT REVISIONS THEREOF, WITH APPROVAL NAMES, INITIALS, AND THE PE SEAL, IF APPLICABLE, ARE MAINTAINED IN THE FILES OF FWENC.

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DEPARTMENT OF ENERGY
FERNALD ENVIRONMENTAL MANAGEMENT PROJECT
SILOS 1 AND 2 ACCELERATED WASTE RETRIEVAL PROJECT
FERNALD, OHIO
FDF CONTRACT NO. FSC 624

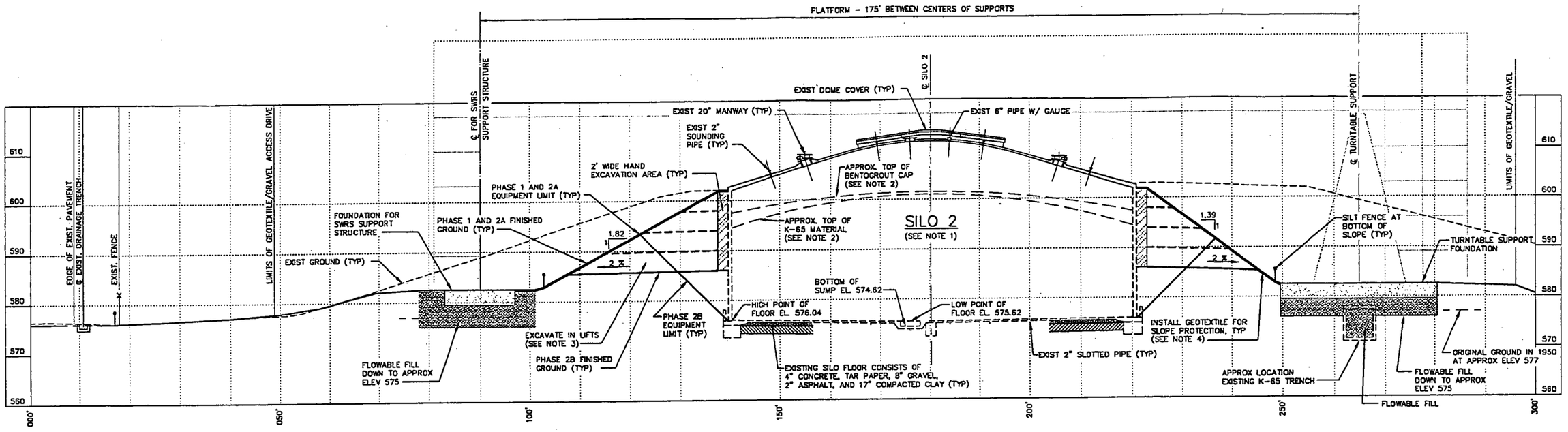
FOSTER WHEELER
FOSTER WHEELER ENVIRONMENTAL CORPORATION

TITLE
SILO WASTE RETRIEVAL SYSTEM
CROSS SECTIONS
SHEET 2

SIZE	SCALE:	DWG. NO.	REV
D	1"=10'	11FCD006	0

FILENAME: 11FCD006.DWG

3387



SECTION

SCALE: 1"=10'

C

11FCD003
11FCD004
11FCD009
11FCD010

11FCD007

000112

LETTER OR NUMBER OF SECTION OR DETAIL

DRAWING ON WHICH SECTION OR DETAIL IS TAKEN

DRAWING ON WHICH SECTION OR DETAIL IS SHOWN

SECTION & DETAIL KEY

NOTES:

1. SILO 2 CONTAINS APPROXIMATELY 100,400 CUBIC FEET OF MATERIAL (INCLUDING RESIDUE AND DISCRETE OBJECTS) AND APPROXIMATELY 11,100 CUBIC FEET OF BENTOGROUT.
2. APPROXIMATE LOCATION OF BENTOGROUT CAP AND K-65 MATERIAL COMES FROM SECTION 2.5.1 OF THE TECHNICAL REQUIREMENTS DOCUMENT.
3. EXCAVATION AROUND SILOS DURING PHASE 2A AND PHASE 2B WILL BE COORDINATED WITH THE HEIGHT OF K-65 MATERIAL WITHIN EACH SILO, AN INITIAL TARGET DIFFERENTIAL OF 5±1 FEET WILL BE EMPLOYED; AT NO TIME WILL THE HEIGHT DIFFERENTIAL ON BOTH SIDES OF SILO WALL EXCEED 10 FEET UNTIL FINISHED GROUND ELEV OF 586 IS REACHED.
4. SEE SPECIFICATION SECTION 02375 FOR GEOTEXTILE. REMOVE PORTIONS OF GEOTEXTILE TO EXCAVATE EACH LIFT AND REATTACH AFTER EXCAVATION WORK IS FINISHED.

000102

THE ORIGINAL DRAWING AND SUBSEQUENT REVISIONS THEREOF, WITH APPROVAL NAMES, INITIALS, AND THE PE SEAL, IF APPLICABLE, ARE MAINTAINED IN THE FILES OF FWENC.

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DEPARTMENT OF ENERGY
FERNALD ENVIRONMENTAL MANAGEMENT PROJECT
SILOS 1 AND 2 ACCELERATED WASTE RETRIEVAL PROJECT
FERNALD, OHIO
FDF CONTRACT NO. FSC 624

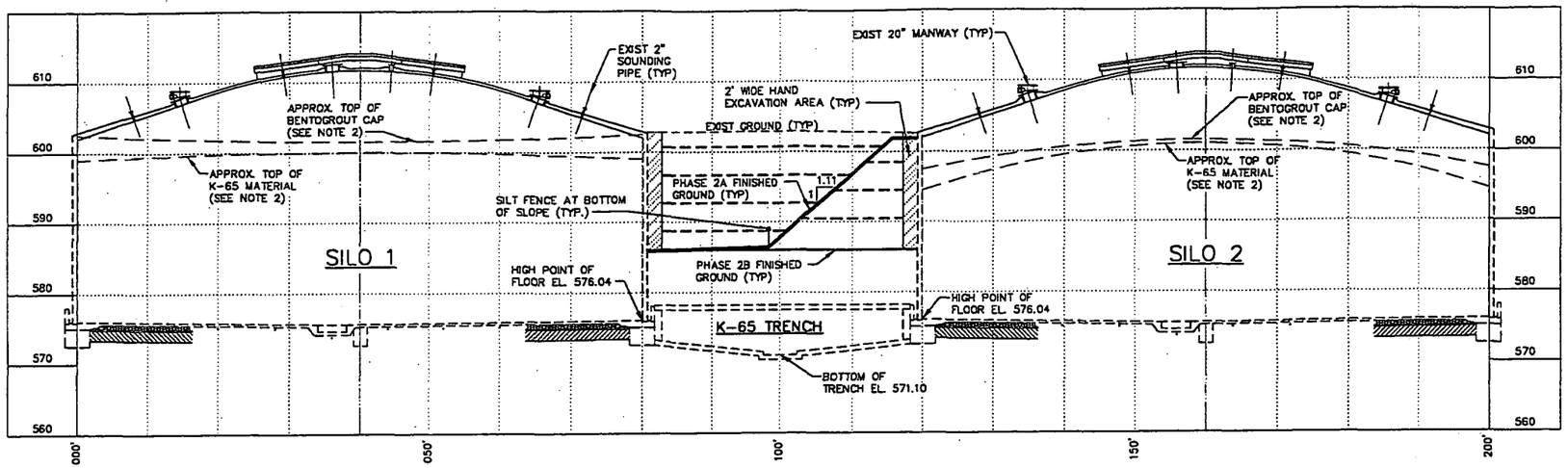
FOSTER WHEELER
FOSTER WHEELER ENVIRONMENTAL CORPORATION

TITLE
SILO WASTE RETRIEVAL SYSTEM
CROSS SECTIONS
SHEET 3

SIZE	SCALE:	DWG. NO.	REV
D	1"=10'	11FCD007	0

FILENAME: 11FCD007.DWG

3387



SECTION E

SCALE: 1"=10'

11FCD003
11FCD004
11FCD009
11FCD010

11FCD008

000113

LETTER OR NUMBER OF SECTION OR DETAIL

DRAWING ON WHICH SECTION OR DETAIL IS TAKEN

DRAWING ON WHICH SECTION OR DETAIL IS SHOWN

SECTION & DETAIL KEY

NOTES:

1. SILO 1 CONTAINS APPROXIMATELY 115,900 CUBIC FEET OF MATERIAL (INCLUDING RESIDUE AND DISCRETE OBJECTS) AND APPROXIMATELY 12,600 CUBIC FEET OF BENTOGROUT.
2. SILO 2 CONTAINS APPROXIMATELY 100,400 CUBIC FEET OF MATERIAL (INCLUDING RESIDUE AND DISCRETE OBJECTS) AND APPROXIMATELY 11,100 CUBIC FEET OF BENTOGROUT.
3. APPROXIMATE LOCATION OF BENTOGROUT CAP AND K-65 MATERIAL COMES FROM SECTION 2.5.1 OF THE TECHNICAL REQUIREMENTS DOCUMENT.
4. EXCAVATION AROUND SILOS DURING PHASE 2A AND PHASE 2B WILL BE COORDINATED WITH THE HEIGHT OF K-65 MATERIAL WITHIN EACH SILO. AN INITIAL TARGET DIFFERENTIAL OF 5±1 FEET WILL BE EMPLOYED; AT NO TIME WILL THE HEIGHT DIFFERENTIAL ON BOTH SIDES OF SILO WALL EXCEED 10 FEET UNTIL FINISHED GROUND ELEV OF 586 IS REACHED.
5. SEE SPECIFICATION SECTION 02375 FOR GEOTEXTILE. REMOVE PORTIONS OF GEOTEXTILE TO EXCAVATE EACH LIFT AND REATTACH AFTER EXCAVATION WORK IS FINISHED.

000108

THE ORIGINAL DRAWING AND SUBSEQUENT REVISIONS THEREOF, WITH APPROVAL NAMES, INITIALS, AND THE PE SEAL, IF APPLICABLE, ARE MAINTAINED IN THE FILES OF FWENC.

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APPROVED BY — DATE

DEPARTMENT OF ENERGY
FERNALD ENVIRONMENTAL MANAGEMENT PROJECT
SILOS 1 AND 2 ACCELERATED WASTE RETRIEVAL PROJECT
FERNALD, OHIO
FDF CONTRACT NO. FSC 624

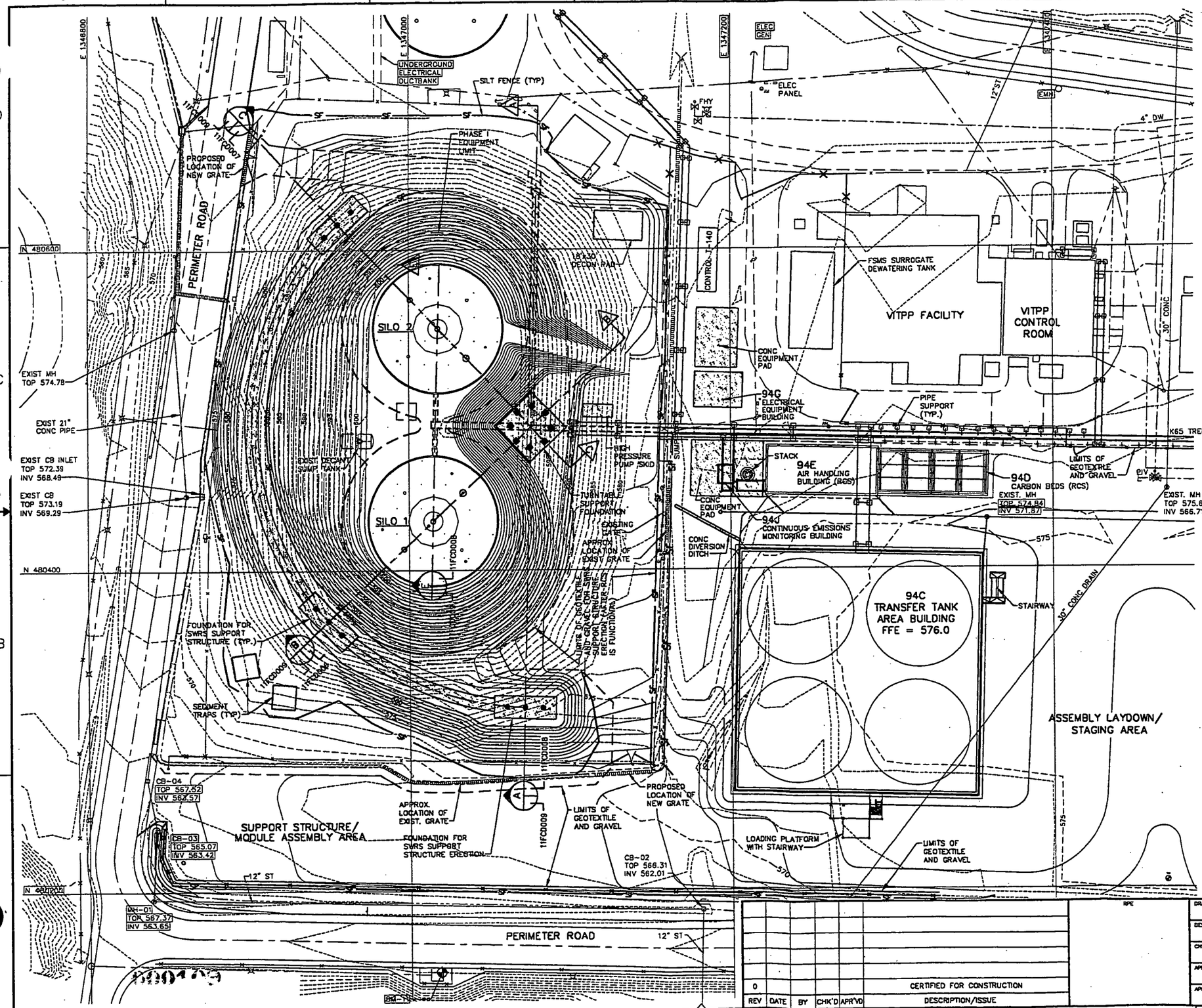
POSTON WHEELER
FOSTER WHEELER ENVIRONMENTAL CORPORATION

TITLE
SILO WASTE RETRIEVAL SYSTEM
CROSS SECTIONS
SHEET 4

SIZE	SCALE:	DWG. NO.	REV
D	1"=10'	11FCD008	0

FILENAME: 11FCD008.DWG

3387



NOTES:

1. SEE DRAWING 05FCD011 FOR GENERAL NOTES AND LEGEND.
2. SEE DRAWING 66FCD002 FOR STORM WATER SYSTEM DRAINAGE PLAN.
3. SEE DRAWING 66FCD007 FOR STORM WATER SYSTEM PROFILES.
4. CONTRACTOR WILL BE RESPONSIBLE FOR LOCATING EXISTING UTILITIES BEFORE BEGINNING EXCAVATION.
5. ALL EROSION CONTROL MEASURES WILL BE INSTALLED AT THE BEGINNING OF EXCAVATION AND MAINTAINED FOR THE DURATION OF THE PROJECT.
6. AREAS DISTURBED BY EXCAVATION ACTIVITIES ARE TO BE SEEDED AND MULCHED AS SOON AS PRACTICAL. REFER TO SPECIFICATION SECTION 02924.
7. REFER TO SPECIFICATION SECTION 02300 FOR EARTHWORK.
8. BM-11 LOCATION: N 480,149.10 E 1,347,018.61 ELEV. 569.14
9. SEPARATION FABRIC SHALL BE MIRAFI 180 N OR EQUIVALENT.
10. REFER TO SPECIFICATION SECTION 02722 FOR AGGREGATE AND/OR GRADED, CRUSHED AGGREGATE BASE COURSE.
11. REFER TO SPECIFICATION SECTION 02630 FOR STORM DRAINAGE.
12. CONTRACTOR RESPONSIBLE FOR LOCATING EXISTING FEATURES WITH SURVEY TIE-INS.
13. EXISTING STANDPIPE AT DECANT SUMP TANK TO BE PROTECTED DURING ALL PHASES OF EXCAVATION WITH A 2' HAND EXCAVATION AREA AROUND PIPE.
14. SEDIMENT TRAPS ARE DESIGNED TO GATHER SILT FROM RUNOFF AREA AT THE STORAGE RATE OF 67 cy. PER ACRE.

STATE OF OHIO NORTH (NAD 83)

000114

30 0 30 60

SCALE IN FEET

LETTER OR NUMBER OF SECTION OR DETAIL

DRAWING ON WHICH SECTION OR DETAIL IS TAKEN

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SECTION & DETAIL KEY

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DEPARTMENT OF ENERGY
FERNALD ENVIRONMENTAL MANAGEMENT PROJECT
SILOS 1 AND 2 ACCELERATED WASTE RETRIEVAL PROJECT
FERNALD, OHIO
FDF CONTRACT NO. FSC 624

FOSTER WHEELER
FOSTER WHEELER ENVIRONMENTAL CORPORATION

TITLE
SILO WASTE RETRIEVAL SYSTEM
EROSION CONTROL PLAN
PHASE 1

SIZE	SCALE:	DWG. NO.	REV
D	1"=30'	11FCD009	0

FILENAME: 11FCD009.DWG

3387

STATE OF OHIO NORTH (NAD 83)

PERIMETER ROAD

UNDERGROUND ELECTRICAL DUCTBANK

PROPOSED LOCATION OF NEW GRATE

PHASE 2B EQUIPMENT LIMIT

18'x30' DECON PAD

SILO 2

SILO 1

EXIST MH TOP 574.78

EXIST 21" CONC PIPE

EXIST CB INLET TOP 572.39 INV 568.49

EXIST CB TOP 573.19 INV 569.29

EXIST DECANT SUMP TANK

2' WIDE HAND EXCAVATION AREA

HIGH PRESSURE PUMP SKID

TURNTABLE SUPPORT FOUNDATION

EXISTING GATE

APPROX LOCATION OF EXIST GRATE

CONC DIVERSION DITCH

LIMITS OF GEOTEXTILE AND GRAVEL FOR SWRS SUPPORT STRUCTURE ERECTION (AFTER RCS IS FUNCTIONAL)

FOUNDATION FOR SWRS SUPPORT STRUCTURE (TYP.)

PHASE 2A EQUIPMENT LIMIT

SEDIMENT TRAPS (TYP)

CB-04 TOP 567.52 INV 563.57

CB-03 TOP 565.07 INV 563.42

CB-02 TOP 566.31 INV 562.01

MH-01 TOP 567.37 INV 563.65

APPROX. LOCATION OF EXIST. GRATE

FOUNDATION FOR SWRS SUPPORT STRUCTURE ERECTION

LIMITS OF GEOTEXTILE AND GRAVEL

PROPOSED LOCATION OF NEW GRATE

12" ST

PERIMETER ROAD

N 480600

N 480400

N 480200

E 1346800

E 1347000

E 1347200

30 0 30 60

SCALE IN FEET

THE ORIGINAL DRAWING AND SUBSEQUENT REVISIONS THEREOF, WITH APPROVAL NAMES, INITIALS, AND THE PE SEAL, IF APPLICABLE, ARE MAINTAINED IN THE FILES OF FWENC.

NOTES:

1. SEE DRAWING 11FCD009 FOR NOTES.

REV	DATE	BY	CHK'D	APR'VD	DESCRIPTION/ISSUE
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DEPARTMENT OF ENERGY
FERNALD ENVIRONMENTAL MANAGEMENT PROJECT
SILOS 1 AND 2 ACCELERATED WASTE RETRIEVAL PROJECT
FERNALD, OHIO
FDF CONTRACT NO. FSC 624

FOSTER WHEELER
FOSTER WHEELER ENVIRONMENTAL CORPORATION

TITLE
SILO WASTE RETRIEVAL SYSTEM
EROSION CONTROL PLAN
PHASES 2A AND 2B

SIZE	SCALE:	DWG. NO.	REV
D	1"=30'	11FCD010	0

000115

FILENAME: 11FCD010.DWG

3387

OPERATIONAL ENVIRONMENTAL CONTROL PLAN

FOR THE

SILOS 1 AND 2 ACCELERATED WASTE RETRIEVAL (AWR) PROJECT

REVISION 2

NOVEMBER 2000

000116

3387

TABLE OF CONTENTS

1.0 INTRODUCTION 1

2.0 METHODS AND CONTROLS 2

2.1 Air Emissions Control 2
2.2 Dust Control 5
2.3 Wastewater Control 6
2.4 Stormwater Control 7
2.4.1 Employee Training 8
2.4.2 Spill Prevention Control and Countermeasures 9
2.4.3 Inspections and Recordkeeping 10

2.5 Erosion Control 11
2.6 Decant Sump Tank Waste Water Management 12
2.7 Secondary Waste Management 12

Appendix 5.1 – ARAR Compliance Matrix
Appendix 5.2 – Radon Control System Performance Calculations
Appendix 5.3 - Storm Water Drainage Plan
Appendix 5.4 – Waste Handling Work Plan
Appendix 5.5 - Silos Projects Environmental Monitoring Plan

000115

3387

ACRONYM LIST

ALARA	as low as reasonably achievable
ARARs	Applicable or Relevant and Appropriate Requirements
AWR	Accelerated Waste Retrieval
AWWT	Advanced Wastewater Treatment
BAT	best available technology
BMPs	best management practices
CCA	Clean Air Act
CCB	Change Control Board
CCWW	City of Cincinnati Water Works
CERCLA	Comprehensive Environmental Response, Compensation and Liability Act as amended
CFC	certified for construction
CFR	Code of Federal Regulations
DCGs	Derived Concentration Guides
DOE	U.S. Department of Energy
ECP	Environmental Control Plan
ED	Engineering Design
EDE	effective dose equivalent
EP	Environmental Protection
EPA	Environmental Protection Agency
EW	Environmental Restoration/Waste Management
FDF	Fluor Daniel Fernald
FEMP	Fernald Environmental Management Project
FRD	Functional Required Documents
HEPA	high efficiency particulate air
HVAC	Heating, Ventilating, and Air Conditioning
NEPA	National Environmental Policy Act
NFPA	National Fire Protection Association
NPDES	National Pollutant Discharge Elimination System
NWP	Nationwide Permit
OAC	Ohio Administrative Code
ODNR	Ohio Department of Natural Resources
OEPA	Ohio Environmental Protection Agency
ORC	Ohio Revised Code
OSHA	Occupational Safety and Health Administration
PTI	Permit to Install
RCRA	Resource Conservation and Recovery Act as amended
RCS	Radon Control System
SDWA	Safe Drinking Water Act
SOPs	Standard Operating Procedures
SWMUs	Solid Waste Management Units
SWPPP	Stormwater Pollution Prevention Plan
TBC	to be considered
TCLP	Toxicity Characteristic Leaching Procedure
TRD	Technical Requirements Document
TSD	treatment, storage or disposal
TSS	Total Suspended Solids
TTA	Transfer Tank Area
USACE	U.S. Army Corps of Engineers
WAC	waste acceptance criteria

3387

1.0 INTRODUCTION

This Environmental Control Plan (ECP) describes the methods and controls that are to be incorporated into the design and operation of the Accelerated Waste Retrieval (AWR) Project to minimize the impacts of operation activities on the environment. These methods and controls, as described in Section 2.0, are intended to minimize the environmental impacts of air emissions, dust, wastewater, stormwater, erosion, and secondary waste generation resulting from AWR Project activities at the U.S. Department of Energy (DOE) Fernald Environmental Management Project (FEMP) site. Controls implemented to minimize the environmental impact of construction activities were documented in the Pre-operational Environmental Control Plan, submitted and approved as part of the AWR Project Site Preparation Package in May 2000.

AWR Project activities are to be performed in compliance with applicable environmental laws and regulations. These laws and regulations, at both the federal and state level, have been incorporated into Applicable or Relative and Appropriate Requirements (ARARs) for Operable Unit 4 at the FEMP. This ECP describes the design and operational control strategies used for the AWR Project to ensure compliance with these ARARs. The specific strategy for compliance with each ARAR is documented in the **ARAR Compliance Summary** (Appendix 5.1).

Control of air emissions during AWR Project operations is discussed in Section 2.1 of this plan. Detail on the performance of the Radon Control System, including estimates of the offsite impact of radon emissions during each phase of the project, is provided in the **Radon Control System Performance Calculations** (Appendix 5.2)

Wastewater resulting from AWR Project operations will be recycled to the extent practical to minimize wastewater discharges. When discharge of wastewater is necessary, the wastewater will be sampled, pretreated as necessary, and discharged to the FEMP Advanced wastewater Treatment (AWWT) facility. Acceptance criteria for the AWWT, and plans for management of wastewater, are described in Section 2.3

The design of site grading and storm water drainage for the AWR Project site was detailed, and approved by U.S. EPA and OEPA in the AWR Project Site Preparation Package (May 2000). Storm water and erosion controls for the facility construction and operation (FSMS, berm excavation, and waste retrieval) phases of the AWR project are described in sections 2.4 and 2.5 of this plan. The Storm water Drainage Plan included as part of the Site Preparation Package has been updated as required to detail the basis for, and function of, the storm water and erosion controls during the facility construction, and operation phases of the project. This updated plan is included in the **Storm Water Drainage Plan** (Appendix 5.3)

Management of secondary waste from AWR operations is discussed in Section 2.6 of this plan. Generation estimates and disposal plans for each secondary waste stream are detailed in the **Waste Handling Work Plan** (Appendix 5.4)

Overall FEMP site environmental monitoring is performed by Fluor Fernald Inc. Project-specific enhancements to the site-wide monitoring programs to address air, direct radiation, and wastewater impacts during the AWR and Silo 3 Projects are documented in the **Silos Projects Environmental Monitoring Plan, Document 400000-PL-0010** (Appendix 5.5)

3387

2.0 METHODS AND CONTROLS

This section describes the various methods and controls to be incorporated into the design, construction, and operation of the AWR Project to minimize the impacts of operation activities on the environment. These impacts are mitigated through the use of controls associated with air emissions, dust, wastewater, stormwater, erosion, and secondary waste generation.

2.1 Air Emissions Control

Air emissions are controlled for the AWR Project by the Radon Control System Radon Control System (RCS). Emissions from the Silos 1 and 2 headspace, the Silos Waste Retrieval System, and the Transfer Tank Area (TTA) are collected and ducted to the RCS. The RCS system is designed to maintain negative pressure in the Silo headspaces, waste retrieval system, and TTA Tanks. Air emissions from AWR Project activities are evaluated for four distinct phases:

Phase 1: Silos 1 and 2 Headspace Reduction
Phase 2: Silo 1 Waste Retrieval
Phase 2B: Silo 2 Waste Retrieval
Phase 2C: TTA Ventilation

Phase 1 operation of the RCS will be established prior to accomplishing initial penetration of the Silo domes. During penetration and modification of the manways, the RCS will be operated to maintain negative pressure in the headspace and assure airflow into the silo through the manways. In this manner, potential emissions to the environment will be directed through the RCS for treatment. The methods to be employed for initial access through the domes of Silos 1 and 2 to complete connections to the RCS and Waste Retrieval Systems, will be detailed in the **Silo Penetration Plan** which will be submitted for review and approval as part of the Remedial Action Work Plan for RCS Phase 1 Operation.

During all four of these phases, airflow in the air emission control system will be closely controlled to minimize the release of air emissions to the environment. To the extent practical, the system will be operated in a 'recycle' mode where all or most of the air is withdrawn from the Silo or TTA headspace, circulated through the RCS, and discharged back into the Silo or TTA. The airflow discharged to the environment through the exhaust stack will be minimized to the amount necessary to maintain negative pressure and to provide effective operation and control of the system.

The RCS is also designed to provide control and monitoring of emissions from the future Silos 1 and 2 Full-scale Stabilization Facility. The impact of emissions from operation of the Silos 1 and 2 Full-scale Stabilization Facility will be addressed in detail in the Remedial Design documentation prepared based upon the specific design for that facility.

To meet the requirements of air emission ARARs, the RCS is designed to provide Best Available Technology (BAT) control, as defined by Ohio Revised Code (ORC) Section 3704.01(F), for radionuclide particulate and radon emissions. The BAT air emission control system for the AWR Project is depicted on Exhibit 2-1. Flow rates and mass balance data for each of the phases of RCS operation are provided on Drawings 20FMD001 and 20FMD002 (RD Package Appendix C).

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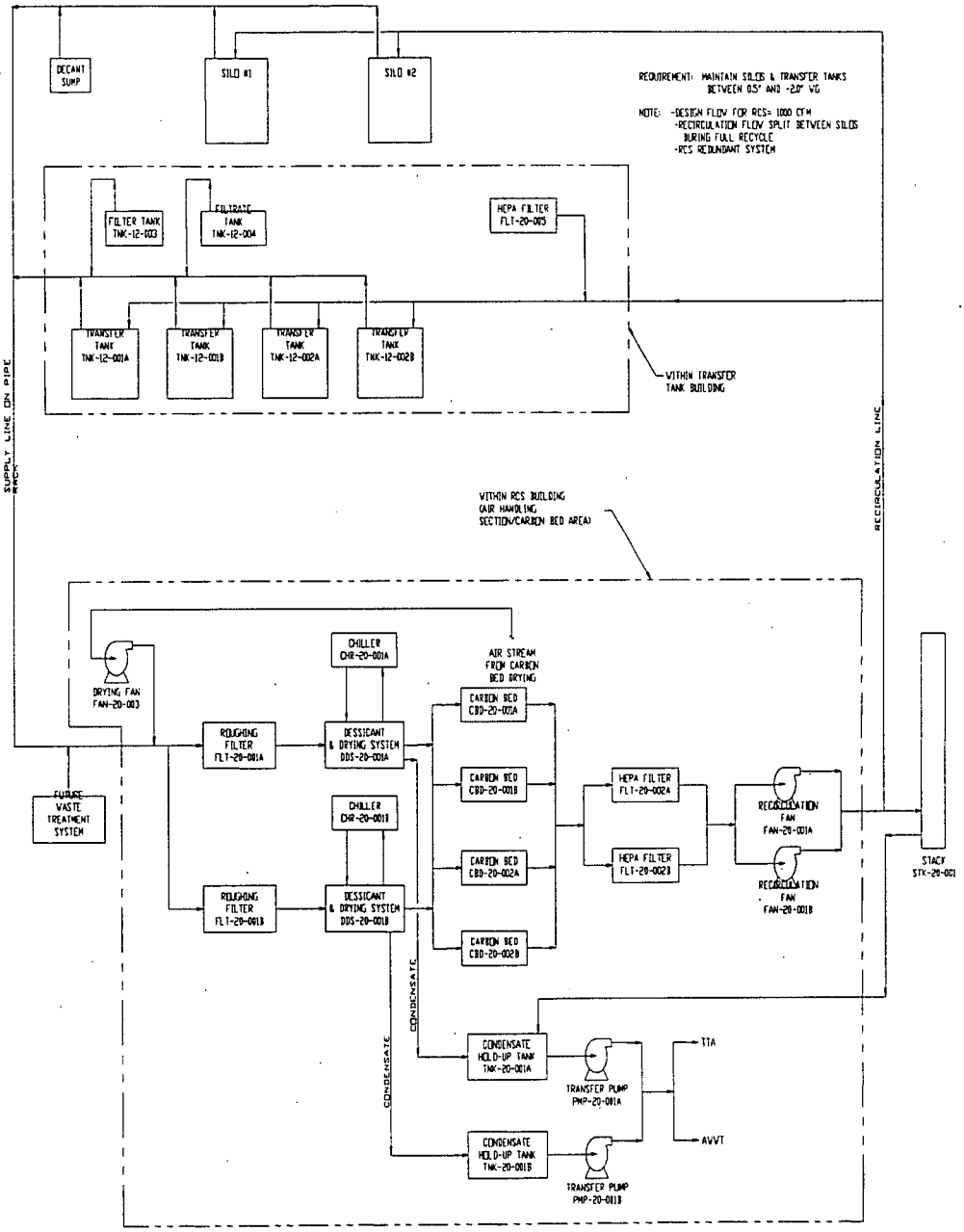
Exhibit 2-1 – RCS schematic

Radon Control System (RCS)



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The waste retrieval systems, and associated air emission controls for the AWR are designed to minimize emissions of particulate radionuclides. Recirculated supply air to the silos is returned at a rate and pressure that will prevent ducting or particulate agitation during Phase 1 RCS operation. The retention time for the supply air into the silo headspace is approximately 90 minutes at the beginning of Phase 1 and becomes longer during subsequent phases as waste retrieval progresses. During Phase 2 operations, air is pulled into the silos through filters on the three enclosures on the bridge. This design will ensure that particulate infiltration into the system is minimized. In addition, the moisture level if the silo material during sluicing operations will minimize particulate generation.

The control of particulates that become entrained in the silo air stream that is exhausted to the RCS is accomplished by using 95% ASHRAE roughing filters (FLT-20-001A and FLT-20-001B) upstream of the desiccant dryer skids (DDS-20-001A and DDS-20-001B). These filters will remove most of the particulates from the silos or from the radon decay to its daughters during the transit of ventilation air from the silos. These filters also protect the desiccant skids by preventing obstruction of the cooling coil and desiccant wheel of the operating skid. Ultimately, the roughing filters and desiccant dryers prevent passage of particulates into the carbon adsorption beds. While the carbon adsorption beds are used to hold up the radon and allow it to decay, they also acts as media filters by trapping the particulate daughters associated with radon decay. Directly downstream of the carbon adsorption beds, a set of HEPA filters (FLT-20-002A and FLT-20-002B) are used to remove particulate that pass through or are released from the adsorption beds prior to stack discharge. The HEPA filters are certified to remove at least 99.97% of the particulates at the most penetrating particle size (0.3 microns).

The stack receives the treated RCS ventilation stream from sources associated with the AWR Project and from the building exhaust for the RCS Building. The exhaust air from the RCS Building is also filtered through a set of HEPA filters (FLT-77-002A and FLT-77-002B) prior to discharge. Also, the supply air to the RCS Building is filtered to remove particulates. The air stream exiting the stack is continuously monitored and alarmed for radiological particulate discharges. Upon an out-of-parameter reading for radiological particulates, an alarm will be initiated and the RCS will be placed in a recirculation mode or will be shutdown.

Detailed analysis of radon emissions, including modeling of offsite impact, from material handling and process equipment is descried in the **Radon Control System Performance Calculations** (Appendix 5.1). These data are summarized below.

Exhibit 2-2: Radon Emissions from the RCS Exhaust Stack

AWR Project Phase	Stack Exhaust Radon (pCi/l)	On-site Weekly Average Radon (pCi/l)	Fence-line Annual Average Radon (pCi/l)
1. Headspace Reduction	0.85	6.32E-06	1.89E-06
2A. Silo 1 Retrieval	297	2.32E-03	6.93E-04
2B. Silo 2 Retrieval	253	2.02E-03	6.02E-04
2C. TTA Ventilation	7	5.31E-05	1.59E-05

Continuous Isokinetic sampling of the stack exhaust for particulate radionuclides shall be performed in compliance with Title 40 of the Code of Federal Regulations (CFR), Part 61, Subpart H, and DOE Order 5400.5, Section IV.6.B. A stack monitor is located between the high efficiency particulate air (HEPA) filters and the stack. In addition, the stack exhaust is

continuously monitored for radon. The monitor will be located after a sufficient length of straight duct downstream of the HEPA filters to ensure that the distribution of any remaining particulates in the stack is uniform. The monitor consists of a probe assembly and a sampling and monitoring rack. The probe assembly fits into the stack and has the capability for measuring stack flow and for withdrawal of an isokinetic sample. The sample rack includes a flow controller that matches the flow rate in the sample nozzle with that in the duct, and a coincidence counter for analyzing the radiation from the sample collected on a filter paper. The air stream flows through the filter paper is directed through a continuous radon monitor that measures the concentration of radon in the stack effluent. Analytical instruments will be provided for separately distinguishing radon daughters from other alpha and beta emitting radionuclides.

Monitoring data is continuously collected and analyzed by a local computer, then transferred to the AWR Project Control Trailer for display and recordkeeping. Alarm circuits are available to alert the AWR Control Room operator if an out-of-specification condition exists in the stack. Alarm setpoint are established to alert operations personnel and initiate appropriate corrective actions in order to maintain emissions within specified levels. Operating controls for the entire system are included in the AWR Control Room. These controls allow for the shutdown or start-up of any piece of equipment in the RCS. These controls are presented in greater detail in the **Process Control Summary**, Section 2.2 of this RD Package.

Data from the continuous stack monitors, as well as data from ambient air monitors, will be used to demonstrate that emissions from the AWR operations are within specified criteria. For example, the radon emissions measured by the continuous radon monitor in the RCS stack will be used to calculate the resulting radon concentration at offsite receptors to demonstrate that the 0.5pCi/l annual average above background criterion has been met. These modeled values will be compared to ambient concentrations measured at fence-line air monitors to provide validation of the modeling results.

2.2 Dust Control

The spread of fugitive dust is controlled during the construction and operation of the AWR Project facilities in compliance with applicable regulations and Best Available Technology (BAT) requirements for control of fugitive dust emissions. Site-specific BAT control measures for fugitive dust control at the FEMP have been developed by DOE and approved by OEPA. These control measures are documented in RM-0047, "FEMP Fugitive Dust Requirements."

Implementation of fugitive dust control measures for the AWR Project, consistent with RM-0047, is described in detail in the "Fugitive Dust Control Plan for the AWR Project" (Document No. 40710624-P6455-01) and in the Pre-operational Environmental Control Plan, both of which were submitted and approved as part of the Site Preparation Package in May 2000. Fugitive Dust will be controlled during berm excavation, facility construction, and operation activities through implementation of these same measures.

As specified by the Fugitive Dust Control Plan, AWR Project field activities will be observed by project personnel for visible emissions. The number of pieces or type of dust suppression equipment in operation controlling visible dust emission in a designated area will not preclude stopping project field activities in that area. Personnel should be on-call during non-work periods seven days per week, including holidays, to respond to the generation of visible dust during off-hours.

Mechanical dust generating field activities in an observed area shall cease immediately if a fugitive dust standard or site-specific limit is exceeded for that observed area. An increase in BAT dust controls and/or work practices needs to be implemented to bring the fugitive dust emissions to, at a minimum, below the standard or limit during dust generating activities (including wind erosion).

2.3 Wastewater Control

Water shall be added to the silo waste in order to transfer the waste to the Transfer Tank Area (TTA). A settle decant process allows for the reuse of water used to transfer the waste to the TTA storage tanks and minimizes any wastewater discharge to the FEMP Advanced Wastewater Treatment (AWWT). Water used in decontaminating the waste retrieval equipment drains to the waste retrieval system and is sent to the TTA storage tanks and processed containment/control features to preclude environmental releases.

In addition, liquids condensed from the gas steam generated at the RCS will be transferred to shielded hold-up tanks, held up for up to 40 days for radon decay, and returned to the waste retrieval/transfer system for reuse or pumped into the AWWT. Water required to be pumped to the AWWT is first sampled, analyzed, and radiologically surveyed to meet the waste acceptance criteria (WAC) of the AWWT (see Exhibit 2-3) prior to pumping. This characterization ensures that the wastewater does not exceed the parameters specified in Exhibit 2-3.

As a contingency, if the wastewater characterization indicates that the wastewater stream does not meet the AWWT WAC, then pretreatment of the stream using ultra-filtration is performed. Water is then resampled to confirm that it meets the WAC. If the wastewater still exceeds the WAC, then additional treatment using ultra-filtration and/or ion exchange processing is performed. The wastewater may also be recirculated through the TTA system. The water is then resampled to confirm that it meets the WAC.

Exhibit 2-3: Wastewater Acceptance Criteria for AWR Liquid Discharge to AWWT

METALS PARAMETER	DISCHARGE LIMIT • (kg/day)	DISCHARGE LIMIT • (lb/day)	RADIONUCLIDE PARAMETER	DISCHARGE LIMIT (pCi/L)
Arsenic (As)	0.14	0.3	Actinium-227 (^{227}Ac)	10
Barium (Ba)	2.7	6.0	Lead-210 (^{210}Pb)	30
Cadmium (Cd)	0.006	0.013	Polonium-210 (^{210}Po)	80
Chromium (Cr)	0.14	0.3	Protactinium-231 (^{231}Pa)	10
Lead (Pb)	0.03	0.07	Radium-226 (^{226}Ra)	100
Mercury (Hg)	0	0	Radium-228 (^{228}Ra)	100
Selenium (Se)	0.03	0.06	Thorium-228 (^{228}Th)	400
Silver (Ag)	0.0014	0.003	Thorium-230 (^{230}Th)	300
Iron (Fe)	0.3	0.06	Thorium 232 (^{232}Th)	5 ppm
			Uranium-234 (^{234}U)	
			Uranium-234/236 ($^{235/236}$U)	5 ppm
			Uranium-238 (^{238}U)	
MAXIMUM FLOW				5 gpm (7,200 gpd)
TOTAL SUSPENDED SOLIDS (TSS)				1,000 ppm

In addition to the above criteria, no listed or characteristic hazardous waste, nor wastewater containing concentrations of RCRA metals (e.g., lead) above the RCRA toxicity characteristic (TC) limits, may be discharged to the AWWT without appropriate pretreatment.

Based upon the Final Design for the AWR Project, data on projected generation and character of the wastewater to be generated, as well as the proposed means of managing the wastewater, will be compiled into a request for modification of the FEMP NPDES Permit (permit No. 1IO0004*FD). This request will be submitted to OEPA for review at least 180 days prior to initiating wastewater discharge.

2.4 Stormwater Control

The existing FEMP Stormwater Pollution Prevention Plan (PL-3083, Rev. 0) defines current requirements for management of stormwater, consistent with the FEMP NPDES Permit (permit No. 1IO0004*FD) within the project site. The AWR Project area is contained within two drainage watersheds. The following paragraphs describe the existing and proposed stormwater control measures at the AWR Project site to ensure the segregation and proper management of uncontaminated and contaminated stormwater. These control measures are outlined in greater detail in the **Stormwater Drainage Plan** (Appendix 5.3).

Existing—An existing perimeter channel collects runoff from the Silo domes and the surrounding berms. The perimeter channel consists of a combination of small rectangular concrete channels, concrete curb, grates, and pipes. The perimeter channel drains to the Waste Pit Area Runoff Control Sump which was installed as part of CERCLA Removal Action 2 and is located 1,000 feet west-northwest of the silos. The sump has a capacity of 350,000 gallons. This sump also receives drainage from the waste pits to the north. A 12-in. main leads from the sump into the Bio-Surge Lagoon, which discharges to the Advanced Wastewater Treatment (AWWT) facility.

Areas not surrounded by the perimeter channel ultimately drain to the Pilot Plant Drainage Ditch (PPDD), which runs south of the project area and enters Paddy's Run at NPDES outfall STRM 4005, and drains a total of approximately 78 acres. As illustrated on Drawing No. 66FCD001, the majority of this area reaches the PPDD via an existing storm water basin at the southeast quadrant of the project area. Two culverts cross the southern perimeter road and discharge stormwater to the PPDD; one culvert crosses the west perimeter road, draining to the Waste Pit Area Runoff Control Sump.

Proposed—Control measures were employed during implementation of AWR Project site preparation activities to assure that impacts to natural resources in the Paddy's Run corridor were minimized. As described in the AWR Project Site Preparation Package, excavation activities were planned and implemented to minimize the area disturbed. Disturbance (excavation, removal of trees, etc.) was avoided in areas immediately adjacent to Paddy's Run. Erosion and sediment control measures were employed during excavation to prevent impacts from stormwater runoff. Finally, final grading left in place by the completed site preparation work maintained drainage patterns, and incorporated measures to prevent impacts to Paddy's Run due to spills or releases during the operational phase of the AWR Project.

AWR Project facility construction and operations activities implemented under this RD package will not change or move existing drainage divides. Erosion and siltation in the concrete channels surrounding Silos 1 and 2 will be prevented through erosion and sediment control measures identified in Section 2.5. The perimeter road functions as the outer limit of

3387

operations. Rainfall will not directly contract the TTA process area since it is equipped with a roof and gutter system. Therefore, contaminated stormwater from this area is not anticipated.

Stormwater drainage during facility construction and operation (FSMS, berm excavation, and waste retrieval) activities is illustrated on Drawing 66FCD001. Drainage from the Silo 1 and 2 domes and berms, and from the Silo 4 area, will continue to be collected by the existing trench system and discharged to the Waste Pit Area Runoff Control Sump (WPSRC). As detailed on drawing 66FCD002, silt fence and sediment traps will be utilized to prevent silt buildup in the trench system. The trench will be included in the erosion and sediment control inspections to provide additional assurance that it has not become obstructed. For the purpose of designing the drainage and stormwater controls for the AWR Project, the project area has been divided into eight drainage areas. These drainage areas are summarized below.

Drainage Area	Description	Outlet
1	Construction Trailer Area	Existing SE stormwater basin at 18" outlet
2	Laydown Area	Existing SE stormwater basin at CB-01
3	Assembly Area	Exiting SE stormwater basin at CB-01
4	TTA and RCS roof drains	Existing SE basin via 18" outlet
5	Area South of Silos 1 and 2	PPDD via CB-02
6	TTA control area	Basin at NE quadrant of project area
7	Silo 1 and 2 area	WPSRC sum via perimeter trench
8	Silo 4 area	WPSRC sump via existing drainage

These drainage areas, as well as the runoff coefficients and flows used to assure adequate capacity of the drainage system, are detailed in the **Storm Water Drainage Plan** (Appendix 5.3).

2.4.1 Employee Training

Construction personnel receive appropriate environmental and safety training on their job requirements. Environmental awareness is raised by issuing periodic bulletins concerning such topics as spill control. Supervisors are responsible for providing on-the-job training with respect to hazardous materials handling and company environmental policy. This training is documented and records are kept onsite.

Work being performed on the AWR Project is required to comply with the environmental policies of the FEMP site. In addition, site personnel are to perform the work as specified in the applicable certified for construction (CFC) drawings and construction specifications.

Earthwork operations and general construction personnel are subject to normal industrial hazards, and therefore, appropriate precautions are to be taken. Employees are to be trained to follow appropriate Occupational Safety and Health Administration (OSHA) standards with regard to fall protection and trench safety. In addition, hazards involved in working around heavy equipment will be addressed during the daily safety briefings, safe workplans, and in the Project-Specific Health and Safety Plan. Specific safety measures to be employed include high visibility PPE, lights, and back-up alarms.

3387

2.4.2 Spill Prevention Control and Countermeasures

The potential impact of a release resulting from failure of various AWR systems was considered during development of the stormwater drainage plan. The following three potential sources of release were evaluated.

1) Silo failure during retrieval
2) Failure of one of the TTA tanks
3) Failure of the Slurry Transfer Line during retrieval

The potential impact of a failure at Silo 1 and 2 during retrieval is minimized by the design of the retrieval operation and by maintenance of the existing drainage system. First, the water flows to and from the silos during retrieval will be closely controlled to minimize the inventory of water in the silo and to assure that the addition of water is stopped immediately upon a silo failure. Second, as will be outlined in the **Berm Excavation Plan** (RD Package Section 4.0), excavation of the berms will be coordinated with the retrieval. An initial target differential of 5±1 feet between the level of material inside the silo and the berm outside the silo will be employed. At no time will the differential exceed 10 feet. In addition to providing containment of any material potentially released due to failure of the Silo wall, maintaining the berm higher than the level of Silo material will assure containment of any water that would penetrate the Silo wall during waste retrieval. As described in the Berm Excavation Plan, the berm material will be visually monitored for moisture and potential silo leaks during excavation to assess if the berm soil has been potentially contaminated by K-65 slurry/supernate. This potentially contaminated material will be sampled and appropriately dispositioned. Finally, as described in Section 2.3, drainage patterns and runoff controls will be maintained such that any release that was to escape the silo would be contained and directed to the WPSRC sump.

The release resulting from failure of one of the TTA tanks would be contained by the sealed concrete walls and floor of the TTA building. The floor drains to a sump, which would be used to pump the contained material to an appropriate location, such as one of the other TTA tanks.

The transfer pipe used to transfer the silo material from the Silo Waste Retrieval System to the TTA utilizes double-walled pipe to minimize the risk of pipe failure, the amount of material potentially released in the event of a pipe failure, the amount of material potentially released in the event of a pipe failure would be limited to the inventory contained in the line—approximately 250 gallons, thus minimizing the likelihood that the release would drain beyond the project area. As illustrated on Drawing 66FCD001, the area underneath the transfer line drains to the southeast stormwater basin. A concrete diversion berm will be installed to prevent drainage to the south directly into the Pilot Plant Drainage Ditch. A valve will be installed at the outlet of the basin to allow any material that was to reach the basin to be contained before reaching the Pilot Plant Drainage Ditch.

The design and construction of hazardous material storage tanks (e.g., fuel tanks and chemical tanks) and secondary containment will conform to the CFC drawings and specifications. Tanks are to be located away from heavy traffic and protected with bollards as necessary. Containers five gallons in size (minimum) are required to be labeled with the appropriate Hazardous Identification Label (diamond) as identified in the National Fire Protection Association (NFPA) Code NFPA-704.

Heavy equipment and mechanical equipment are to be maintained in good repair so as to minimized the release of engine, transmission, or other oils; engine coolants; or hydraulic fluids.

Idle equipment is to be parked as far away from drainage channels as practical. A drip pan can be used under equipment that is leaking, with immediate action taken to repair the equipment or remove it from the FEMP site.

Fueling operations are to be performed with care, with allowances made for fuel expansion to prevent inadvertent small releases. Fuel tanks are to be contained within temporary dikes and inspected regularly. Spilled material is to be cleaned up as son as practical, placed in appropriate containers, and managed accordingly.

If a spill occurs at the AWR Project site, safe and practical methods available are to be used to prevent material from entering stormwater drainage channels. Spills are to be reported immediately to Fluor Fernald. Spill response kits containing absorbent material are to be available during construction, operations, and systems closure for the AWR Project and are to be located for easy access. Absorbent pillows, temporary earth dikes, or other means are to be located for easy access. Absorbent pillows, temporary earth dikes, or other means are to be readily available on-site for use, as appropriate, without risking personnel safety.

2.4.3 Inspections and Recordkeeping

The Construction Manager, or designee, is to conduct site inspections of the site during construction activities to confirm compliance with BMPs on a weekly basis, or within 24 hours of a rainfall event exceeding 0.5 inches within a 24-hour period. Items to be inspected include, but are not limited to, the following:

- Conditions of erosion controls, such as:
  - Silt fences,
  - Drainage ways,
  - Gully formation,
  - Areas needing seeding or reseeding, and
  - Access roads.
- General housekeeping on-site;
- Evidence of silt build-up or obstruction of the Silos 1 and 2 perimeter trench;
- Evidence of poor fueling practices or leaking fuel tanks;
- Evidence of leaks from other tanks or equipment; and
- Stormwater channels inspected for oil sheen, debris, siltation, or other disturbance.
- Evidence of silt build-up or obstruction of the Silos 1 and 2 perimeter trench

A written record of the inspection, including all notifications and deficiencies, is to be kept in the field office trailer and made available to the FEMP personnel for review. Conditions noted during the inspections that require corrective action are to be repaired as soon as practical.

3387

2.5 Erosion Control

Erosion Controls are placed during the construction phase to minimize soil movement from excavated or disturbed areas. These controls are to be installed prior to the initiation of excavation in the affected areas. These controls are based on standards specified in the FEMP Stormwater Pollution Prevention Plan and the Ohio Department of Natural Resources (ODNR) Rainwater and Land Development Manual, and were detailed in the AWR Project Site Preparation Package approved in May 2000. The measures outlined in the AWR Site Preparation Package to lessen the environmental impact due to erosion are to be taken during AWR Project Construction include:

- Every effort is to be made to keep disturbed areas to a minimum;
- Existing natural drainage is to be maintained, where possible, to avoid disturbing areas within vegetation;
- Silt fences are to be placed at the bottom of slopes that are planned to be disturbed;
- Culvert entrances and exits are to be protected with erosion control matting and seed;
- Seeding and mulching will follow construction as soon as practical;
- Overseeding or reseeding (including fertilizing when necessary) are to be performed as necessary until vegetation is established;
- Management and control of temporary stockpiles to prevent runoff
- Silt is to be removed from diversion ditches and silt fences, as required by the applicable construction specifications and at the end of construction. The silt will be disposed at an approved disposal site;
- Erosion control measures are to be inspected at least weekly or within 24 hours of a 0.5-in. rainfall; and
- Remediation of problems identified in a weekly site inspection are to be completed in a timely manner.

In addition to the erosion control measures specified in the Site Preparation Package, additional measures will be installed prior to excavation of berm material to preclude spread of contamination due to runoff during berm excavation. These erosion control include:

- Silt fence surrounding the excavation area to prevent sediment runoff into the perimeter trench
- Sediment traps at the southwest corner of Silo 1
- Maintenance of the inlet protection installed around catch basins south of Silo 1 during site preparation construction

000123

3387

- Maintenance of the Silos perimeter trench to assure it remains free of obstruction

The location, function, and basis of these erosion control features is detailed in the **Storm Water Drainage Plan** (Appendix 5.3). Control of berm excavation is detailed in the **Berm Excavation Plan** (RD Package Section 4.0).

2.6 Decant Sump Tank Waste Water Management

The K-65 decant sump tank located to the west of the K-65 Silos is part of the K-65 Silo drainage and stormwater management system. In 1994, a Maintenance Action Work Plan for the K-65 Decant Sump Tank was implemented to manage the liquid accumulating in the Decant Sump Tank. The Work Plan specified monitoring of the liquid level in the tank and removal of the accumulated liquid at a decant sump tank level of 75 percent of available capacity, or more frequently if deemed necessary by the facility owner. This maintenance action was designed to mitigate the threat of overfilling the decant sump tank and minimize the potential for release of liquid to the surrounding environment.

During the AWR Project, retrieval of the material from Silos 1 and 2, and excavation of berm material, have the potential to impact the rate liquid accumulation in the Decant Sump Tank. In order to provide enhanced protection from release of liquid from the Decant Sump Tank, the procedures and process controls for the waste retrieval operation incorporate additional steps to provide protection from releases from the decant sump tank. These steps include continuous monitoring of the liquid level and rate of infiltration into the sump tank, and alarm setpoints to initiate appropriate corrective action (removal of liquid from the tank, adjustment, or shutdown of waste retrieval, etc.). These measures are discussed in greater detail in the **Process Description** (RD Package Section 2.1)

2.7 Secondary Waste Management

The primary waste stream for the AWR Project is identified as being the materials contained within the existing concrete silos. Secondary waste is generated during the process of construction and/or remediation of the primary waste stream.

The management of secondary waste, is described in detail in the **Waste Handling Work Plan** for the AWR Project (Appendix 5.1 of this Environmental Control Plan). All secondary waste will be segregated, characterized, packaged, and dispositioned in accordance with site procedures. Based upon the Final Design, a Project Waste Identification and Disposition (PWID) Report will be prepared in accordance with procedure EW-1021, *Preparation of the Project Waste Identification and Disposition (PWID) Report.* The PWID will document the anticipated waste streams, generation rates, and Fluor Fernald-approved disposition for secondary waste resulting from AWR operations. FWENC will provide data on tracking of secondary waste generated to Fluor Fernald for updating of the appropriate inventory database. As waste is generated, the volumes of each waste stream will be tracked against the PWID, and the PWID will be updated as necessary due to any changes from the initial estimates. For the AWR Project, waste containers are to be placed in areas designated for such storage. Waste containers are to be clearly marked and arranged in a logical sequence for further waste management by FDF.

In addition, the soil removal associated with excavations around the silos is addressed in the **Berm Excavation Plan** (RD Package Section 4.0).

Section 5.1
ARAR Comp. Matrix

APPENDIX 5.1

ARAR COMPLIANCE MATRIX

Exhibit 3-1. Chemical-Specific ARARs and TBC Requirements

Category	ARAR/TBC Requirement	Requirement Assessment	Compliance Strategy	Cross Reference Index
Radionuclide Emissions (Except Airborne Radon-222)	Title 40 of the Code of Federal Regulations (CFR) Part 61, Subpart H. Emissions of radionuclides to ambient air from a US Department of Energy (DOE) facility shall not exceed an amount that might cause a member of the public to receive an effective dose equivalent (EDE) of 10 mrem/yr. Monitoring is required at release points having potential to discharge radionuclides that could cause an EDE in excess of 1% of standard (0.1 mrem/ year) to any member of the public.	Radioactive air emissions from AWR Project activities might contribute to the dose to members of the public from the air pathway during implementation of remedial actions.	Emissions of all materials in the silos will be minimized by using sealed hatches and piping. The RCS is designed to operate at a negative pressure. The RCS stack will have an isokinetic sampling system and all discharges will be continuously monitored for radioactivity. Stack alarms and backup power are also provided.	See sections on the RCS and the HVAC Systems of the *Functional Requirements Document* (FRD), Document No. 624-P622-02. Also, see the AWR Project *Environmental ALARA Report*, Document No. 624-P622-10B, and Section 2.1, Air Emissions Control, of this ECP for additional information.
Radon-222 Emissions (Interim Storage)	40 CFR 61, Subpart Q. No source at a DOE facility shall emit more than 20 pCi/m^2 -s of radon-222 as an average for the entire source during periods of storage and disposal.	This requirement is applicable only to storage and disposal of radium-bearing byproduct material, such as the silo residues. Interim storage of silo residues, including the TTA, qualify as sources.	Source storage units (i.e., TTA tanks) are sealed and headspace radon gas is treated by the RCS. Monitoring of the treatment discharge will demonstrate compliance with 40 CFR 61, Subpart Q, and DOE Order 5400.5.	See section on the RCS of the *System Design Descriptions* (SDD), Document No. 624-P622-30. Also, see the AWR Project *Environmental ALARA Report* and Section 2.1, Air Emissions Control, of this ECP for additional information.
Radon-222 Emissions (Fence Line Impact)	10 CFR 834 (Proposed)	Maximum annual average fence line radon concentration not to exceed 0.5 pCi/L above background.	A radon monitor is installed downstream of the particulate sampler, which will draw air samples from the stack, with results fed back to the AWR Project control trailer for readout and recording. Continuous radon monitoring is provided. Emissions are to be controlled by the RCS to result in a maximum annual average fence line impact of 0.5 pCi/L.	See section on the RCS of the *SDD*. Also, see the AWR Project *Environmental ALARA Report* and Section 2.1, Air Emissions Control, of this ECP for additional information.

000132

Exhibit 3-1. Chemical-Specific ARARs and TBC Requirements

Category	ARAR/TBC Requirement	Requirement Assessment	Compliance Strategy	Cross Reference Index
Protection of Air from Residual Radioactive Material	DOE Order 5400.5, Chapter IV, 6.b (Proposed 10 CFR 834). ***Interim Storage:*** The above-background concentration of radon-222 in air above an interim storage facility must not exceed 100 pCi/L at any point, an annual average of 30 pCi/L over the facility, or an annual average of 3 pCi/L at or above any location outside the site.	DOE Orders are identified as TBCs only when no promulgated ARARs exist, to ensure the adequate protection of human health and the environment. Portions of DOE Order 5400.5 were selected as TBCs to ensure adequate protection of the public during and following remediation. Management of radium and thorium bearing wastes might result in the release of radon gas to the environment.	Emissions of all materials in the silos will be minimized by using sealed hatches and piping. The RCS is designed to operate at a negative pressure except for a portion of the recycle line between the carbon beds and the return damper. Continuous radon monitoring is to be conducted on the RCS stack discharge to determine compliance with DOE Order 5400.5. The RCS stack has an isokinetic sampling system and all discharges are to be continuously monitored for radon and particulate radionuclides. Stack alarms and backup power are also provided.	See sections on the RCS and the HVAC Systems of the *FRD*. Also, see the AWR Project *Environmental ALARA Report* and Section 2.1, Air Emissions Control, of this ECP for additional information.
Ohio Water Quality Standards Use Designation and Criteria	OAC 3745-1-07. All pollutants or combinations of pollutants shall not exceed, outside the mixing zone, the Numerical and Narrative Criteria for Aquatic Life Habitat and Water Supply Use Designation listed in Tables 7-1 through 7-15 of this rule.	This requirement is met by compliance with the FEMP National Pollutant Discharge Elimination System (NPDES) permit.	The process minimizes the water used to transfer the silo waste material, thereby minimizing the wastewater discharge to the AWWT facility. Water sent to the AWWT facility is first sampled, analyzed, and radiologically surveyed to meet the AWWT facility WAC, and therefore, meets the requirements of the site NPDES permit limits. The existing concrete storm water trench drain around the perimeter of the silos will be maintained. The trench drain leads to a rectangular concrete sump located to the northwest of the silos. No other contaminated storm water is expected to be discharged during any phase of the AWR Project.	See sections on the Storm Water System and the Wastewater System of the *FRD*, as well as Sections 2.3 and 2.4 of this ECP for additional information.

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Exhibit 3-1. Chemical-Specific ARARs and TBC Requirements

Category	ARAR/TBC Requirement	Requirement Assessment	Compliance Strategy	Cross Reference Index
Ohio Water Quality Standards "Five Freedoms" for Surface Water	OAC 3745-1-04. All surface waters of the state shall be free from: • Objectionable suspended solids; • Floating debris, oil and scum; • Materials that create a nuisance; • Toxic, harmful or lethal substances; and • Nutrients that create nuisance growth.	Requires compliance with the FEMP NPDES permit.	See above discussion relating to control of wastewater and storm water discharges associated with the AWR Project.	See sections on the Storm Water System and the Wastewater System of the *FRD*, as well as Sections 2.3 and 2.4 of this ECP for additional information.
OEPA NPDES Permit No. 1I000004*ED	Wastewater associated with the AWR project wastes must be treated if necessary to ensure compliance with the terms and conditions of the FEMP NPDES permit. DOE is required to notify the Ohio Environmental Protection Agency (OEPA) of any activities or changes at the site which have the potential to significantly alter the character of the wastewater streams being discharged under its existing NPDES permit. A NPDES permit modification is required if the discharge is deemed significant enough to cause a change in the character of the wastewater stream. The existing NPDES permit must also be modified to reflect the addition of any new point source discharges of process wastewaters and storm waters.	Wastewater must be eliminated, recycled, or minimized during the AWR Project to the extent practicable. Wastewater discharges associated with the AWR Project wastes must be pretreated, if required, to ensure compliance with NPDES permit requirements.	Fluor Fernald, in consultation with Foster Wheeler, determines the necessity for modifying the FEMP NPDES, and if required, submits a modification request to OEPA a minimum of 180 days prior to initiation of operation.	See sections on the Storm Water System and the Wastewater System of the *FRD*, as well as Sections 2.3 and 2.4 of this ECP for additional information.

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Exhibit 3-2. Location-Specific ARARs and TBC Requirements

Category	ARAR/TBC Requirement	Requirement Assessment	Compliance Strategy	Cross Reference Index
Endangered Species Protection	50 CFR Part 402; Ohio Revised Code (ORC) 1518, 1513.25; and OAC 1501-18-1-01. Federal agencies must not jeopardize the continued existence of any endangered or threatened species, or destroy and adversely modify critical habitat of such species.	Although the FEMP is located within the range of the Indiana bat, a federally listed endangered species, no sighting has occurred on the FEMP. Therefore, this requirement is relevant and appropriate. Any potential impacts of the remedial actions on this species must be evaluated and appropriate actions taken.	Pictures and descriptions of endangered species are to be posted in the change trailer and in the break room trailer. All construction and operating personnel are to be instructed to notify managers whenever animals are encountered on the AWR Project site.	Methods of accomplishment to satisfy this ARAR is to be documented in the *Project Specific Health and Safety Plan*, Document No. 624-P8B21-01, which is to be submitted to Fluor Fernald 30 days prior to construction.
Compliance with Floodplains/ Wetlands Environmental Review Requirements	10 CFR Part 1022; and Executive Order 11990. DOE actions in a wetland must first evaluate the potential adverse effects those actions might have on the wetland and consider the natural and beneficial values served by the wetlands.	This requirement is applicable because the FEMP is a DOE facility. Several alternatives might result in destruction or modification of wetland areas.	Wetlands are not being impacted by the project. All work occurs in areas that have been historically used for OU 4 construction and operations.	The CFC drawings and construction specifications address requirements of wetland mitigation in the unlikely event that they are encountered.

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Exhibit 3-3. Action-Specific ARARs and TBC Requirements

Category	ARAR/TBC Requirement	Requirement Assessment	Compliance Strategy	Cross Reference Index
National Environmental Policy Act (NEPA) Evaluations	10 CFR 1021.2. DOE actions must be subjected to NEPA evaluation as outlined by Council on Environmental Quality regulations in 40 CFR 1500-1508.	A *NEPA Supplemental Analysis* has been prepared and approved addressing NEPA requirements for the AWR Project.	A NEPA analysis has been completed. This analysis is reviewed to ensure that AWR Project activities are being performed within its framework.	The CFC drawings and specifications reflect mitigation of NEPA concerns if identified.
Nationwide Permit Program	33 CFR 330. The US Army Corps of Engineers (USACE) can issue a Nationwide Permit (NWP) as a general permit for certain classes of actions that involve dredge or fill activities in wetlands or navigable waters. Discharges of dredged or fill material into wetlands may require wetland delineation.	This requirement is applicable to remediation activities that may require construction of access roads and utility lines resulting in minor wetland disturbances. All dredge and fill activities related to construction of these access roads and utility lines will be conducted in accordance with the substantive terms and conditions of NWP 14 (Road Crossing) and NWP 12 (Utility Line Backfill and Bedding). OEPA has been granted Section 401 State Water Quality Certification for NWP 12 and NWP14.	Roads and utilities to support this project are currently being constructed (by others). The plans were prepared by Fluor Daniel Northwest, Project 40315, June 1998. All of the intrusive work for the AWR Project takes place within the perimeter road currently being constructed. No wetlands are to be disturbed. No trees are to be removed. All work occurs in areas that have historically been used for OU 4 construction and operations, and therefore, permitting is not anticipated to be required.	See the CFC drawings and construction specifications regarding delineation of work areas and related mitigation measures to implement during construction.
Discharge of Storm Water Runoff	40 CFR 122.26; and OAC 3745-38. 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.	This requirement is applicable to industrial sites and construction site of greater than 5 acres that discharge storm water runoff to the waters of the US. This requirement is applied through the FEMP NPDES Permit.	The existing concrete storm water trench drain around the perimeter of the silos will be maintained. The trench drain leads to a rectangular concrete sump located to the northwest of the silos.	See section on the Storm Water System of the *FRD*, as well as Section 2.4 of this ECP for additional information.

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Exhibit 3-3. Action-Specific ARARs and TBC Requirements

Category	ARAR/TBC Requirement	Requirement Assessment	Compliance Strategy	Cross Reference Index
Discharge of Treatment System Effluent	40 CFR 125.100; and 40 CFR 125.104. Best Management Practices: Develop and implement a BMP program to prevent the releases of toxic or hazardous pollutants to waters of the US. Development and implementation of a site-wide BMP Program is also required as a condition of the FEMP NPDES Permit. The BMP program must: • Establish specific objectives for the control of toxic and hazardous pollutants; and • Include a prediction of direction, rate of flow, and total quantity of toxic and hazardous pollutants where experience indicates a reasonable potential for equipment failure.	The requirement is ***not applicable*** because BMP under the NPDES permit program applies only to ancillary facilities of manufacturing units that might have releases of toxic or hazardous pollutants. The purpose of the BMP program is relevant and appropriate to prevent release from spills or runoff during implementation of remedial actions. The current FEMP NPDES permit does not contain a BMP Plan requirement. BMP requirements have been superseded by the *SWPPP*.	BMP requirements for management of hazardous materials stored or used in the AWR Project (e.g., storage of fuel for an emergency generator) are implemented through the FEMP site *SWPPP*.	Not applicable.
Ohio Water Well Standards	OAC 3745-9-10. Abandonment of Test Holes and Wells Upon completion of testing, a test hole or well shall be either completely filled with grout or such materials as will prevent contaminants from entering groundwater.	This requirement is applicable to any test borings and wells that might be installed and/or closed as part of these remedial alternatives.	Test holes and monitoring wells are to be filled with grout and also contain a layer of bentonite. Requirements are shown by means of a CFC drawing detail and construction specification.	See the CFC drawings and construction specifications for methods of abandonment.

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Exhibit 3-3. Action-Specific ARARs and TBC Requirements

Category	ARAR/TBC Requirement	Requirement Assessment	Compliance Strategy	Cross Reference Index
Implementation of Health and Environmental Protection Standards for Uranium Mill Tailings	40 CFR 192, Subpart C. This subpart contains guidance, criteria, and supplemental standards for compliance with Subparts A and B of 40 CFR 192.	This requirement is relevant and appropriate to remediation activities involving Silos 1 and 2 material. Radioactive materials in this operable unit are primarily byproduct residues from uranium processing. Requirements for design of controls should be consistent with design of controls for other residual radioactive materials such as mill tailings.	Appropriate design controls, as discussed in Exhibit 3-1 for compliance with other ARARs related to controlling and monitoring radon air emissions, are being provided for the RCS. These controls also meet the requirements of this ARAR. Groundwater monitoring is not within the scope of the AWR Project.	See sections on the RCS and the HVAC Systems of the FRD. Also, see the AWR Project *Environmental ALARA Report* and Section 2.1, Air Emissions Control, of this ECP for additional information.
Hazardous Waste Determinations	40 CFR 262.11; and OAC 3745-52-11. Any generator of waste must determine whether or not the waste is hazardous. The procedures to be followed include: • To identify whether a particular material of concern is a "solid waste"; • To identify whether a particular exclusion applies to the material eliminating if from definition as a "solid waste"; • To identify whether a particular solid waste might be classified as a hazardous waste; and • To determine if a material otherwise classified as a "hazardous waste" might be excluded from Resource and Conservation Recovery Act (RCRA) regulation.	Procedures are established to determine whether wastes are subject to the requirements of RCRA. The materials in Silos 1 and 2 are specifically exempt from the applicability of RCRA requirements. However, these procedures are relevant and appropriate to determine whether OU 4 wastes, whether excluded or not, exhibit the characteristics of hazardous waste. The wastes stored in the silos are sufficiently similar to hazardous wastes based on the Toxicity Characteristic Leaching Procedure (TCLP) results. Silos 1 and 2 contain material that must be treated, stored, and disposed in accordance with RCRA.	The generation of secondary waste for the AWR Project is to be minimized as much as possible. Wastes are characterized and identified, as necessary, according to the requirements of 40 CFR 261. A satellite accumulation area is to be provided for these wastes at the AWR Project site, as appropriate. Newly generated hazardous waste is not expected from the AWR Project.	See the *Waste Handling Work Plan* for the AWR Project, Document No. 624-ACR007-01, for additional information.

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Exhibit 3-3. Action-Specific ARARs and TBC Requirements

Category	ARAR/TBC Requirement	Requirement Assessment	Compliance Strategy	Cross Reference Index
Empty Containers	40 CFR 261.7; and OAC 3745-51-7. Containers that have held hazardous wastes are "empty" and exempt from further RCRA regulations if one or more of the following are met: • No more than 2.5 cm (1 in) of residue remains on bottom of inner liner; • Less than 3% by weight of total capacity remains (≤ 110-gal container); and • Less than 0.3% by weight of total capacity remains (> 110-gal container). Exemption requirements for containers that have held acutely hazardous ("P" listed) wastes are somewhat more restrictive.	The materials in Silos 1 and 2 are specifically exempt from the applicability of RCRA requirements. However, these procedures are relevant and appropriate since the materials stored in Silos 1 and 2 are sufficiently similar to hazardous wastes based on TCLP results. (This requirement will be applicable to non-excluded solid waste that exhibits a hazardous characteristic.) Containers used to treat or store the contents of Silos 1 and 2 might contain residues that exhibit hazardous waste characteristics that may be removed before the containers might be reused or disposed.	Hazardous waste containers are not emptied and reused as part of the work scope under the AWR Project.	See the *Waste Handling Work Plan* for the AWR Project for additional information.

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Exhibit 3-3. Action-Specific ARARs and TBC Requirements

Category	ARAR/TBC Requirement	Requirement Assessment	Compliance Strategy	Cross Reference Index
Generators Who Transport Hazardous Waste for Off-site Treatment, Storage, or Disposal	40 CFR 262.20 – 262.33; 40 CFR 263.20 – 263.31; OAC 3745-52-20 through 33; and OAC 3745-53-20 through 31. Any generator who transports hazardous waste for off-site treatment, storage or disposal must originate and follow-up the manifest for off-site shipments.	The materials in Silos 1 and 2 are specifically exempt from the applicability of RCRA requirements. However, these procedures are relevant and appropriate since the material stored in Silos 1 and 2 are sufficiently similar to hazardous wastes based on TCLP results. (This requirement will be applicable to non-excluded solid waste that exhibits a hazardous characteristic.) Any wastes determined to be RCRA hazardous waste removed from this operable unit for off-site treatment, storage, or disposal are subject to the manifest requirement.	The generation of secondary waste for the AWR Project is to be minimized as much as possible. Newly generated hazardous or mixed waste is not expected from the AWR Project that would require off-site treatment, storage or disposal.	See the *Waste Handling Work Plan* for the AWR Project for additional information.

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Exhibit 3-3. Action-Specific ARARs and TBC Requirements

Category	ARAR/TBC Requirement	Requirement Assessment	Compliance Strategy	Cross Reference Index
Treatment, Storage, or Disposal Facility Standards	40 CFR 264, Subpart B; and OAC 3745-54-13 through 16. ***General Standards:*** These include: • ***Waste Analysis (OAC 3745-54-13)*** Operators of a facility must obtain a detailed chemical and physical analysis of a representative sample of each hazardous waste to be treated, stored, or disposed of at the facility prior to treatment, storage, or disposal. • ***Security (OAC 3745-54-14)*** Operators of a facility must prevent the unknowing or unauthorized entry of persons or livestock into the active portions of the facility, maintain a 24-hr surveillance system, or surround the facility with a controlled access barrier and maintain appropriate warning signs at facility approaches. • ***Inspections (OAC 3745-54-15)*** Operators of a facility must develop a schedule for regular inspections.	The material in Silos 1 and 2 are specifically exempt from the applicability of RCRA requirements. However, these procedures are relevant and appropriate since the material stored in Silos 1 and 2 are sufficiently similar to hazardous wastes based on TCLP results. (This requirement will be applicable to non-excluded solid waste that exhibits a hazardous characteristic.) Waste removed from this operable unit which exhibits a hazardous characteristic, similar to RCRA hazardous waste, must be treated, stored, and disposed in accordance with treatment, storage, or disposal (TSD) facility standards.	RCRA TSD facility standards apply to the design and operation of the AWR Project, and as such, has been reflected in appropriate design drawings and specifications, as well as operating and maintenance procedures. Representative samples of waste are to be collected, security provided through 24-hr surveillance system, and inspections performed, as appropriate, of processing systems while attention to ALARA principles is applied to all appropriate AWR Project activities.	See the CFC drawings, and specifications, as well as the *Contingency Plan and Emergency Response*, (Document No. 624-P621-09), which has been prepared for the AWR Project. In addition, various AWR Project operating and maintenance procedures will be prepared prior to operations.

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Exhibit 3-3. Action-Specific ARARs and TBC Requirements

Category	ARAR/TBC Requirement	Requirement Assessment	Compliance Strategy	Cross Reference Index
Treatment, Storage or Disposal (TSD) Facility Preparedness and Prevention	40 CFR 264, Subpart C; OAC 3745-54-31 through 35; and OAC 3745-54-17. ***OAC 3745-54-31*** – TSD operators must design, construct, maintain, and operate facilities to minimize the possibility of a fire, explosion, or any unplanned sudden or non-sudden release of hazardous waste to air, soil, or surface water which might threaten human health or the environment. ***OAC 3745-54-32*** – All facilities must be equipped with an internal communication or alarm system, a telephone, or a 2-way radio for calling outside emergency assistance, fire control, spill control, and decontamination equipment and water at an adequate volume and pressure to supply water hose streams, foam producing equipment, automatic sprinklers, or water spray systems. ***OAC 3745-54-33*** – All fire protection and spill control and decontamination equipment and communication and alarm systems must be tested and maintained as necessary to assure proper emergency operation.	The material in Silos 1 and 2 are specifically exempt from the applicability of RCRA requirements. However, these procedures are relevant and appropriate since the material stored in Silos 1 and 2 are sufficiently similar to hazardous wastes based on TCLP results. (This requirement will be applicable to non-excluded solid waste that exhibits a hazardous characteristic.) Waste removed from this operable unit which exhibits a hazardous characteristic must be treated, stored, or disposed in accordance with TSD facility standards.	RCRA TSD facility standards apply to the design and operation of the AWR Project, and as such, has been reflected in appropriate design drawings and specifications, as well as operating and maintenance procedures. Representative samples of waste are to be collected, security provided through 24-hr surveillance system, and inspections performed, as appropriate, of processing systems while attention to ALARA principles are applied to all appropriate AWR Project activities. Applicable OAC requirements for emergency preparedness and prevention have also been incorporated into the design of the AWR Project facilities, as well as the operating and maintenance procedures for the AWR Project. These procedures included the testing and maintenance of emergency systems.	See the CFC drawings, and specifications, as well as the *Contingency Plan and Emergency Response*, which has been prepared for the AWR Project. In addition, various AWR Project operating and maintenance procedures will be prepared prior to operations.

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Exhibit 3-3. Action-Specific ARARs and TBC Requirements

Category	ARAR/TBC Requirement	Requirement Assessment	Compliance Strategy	Cross Reference Index
Treatment, Storage, or Disposal Facility Contingency Plan and Emergency Procedures	40 CFR 264, Subpart D; OAC 3745-54-51 through 52; and OAC 3745-54-55 though 56. ***OAC 3745-54-51.*** Each facility operator must have a contingency plan designed to minimize hazards to human health or the environment due to fire, explosions, or any unplanned releases of hazardous waste constituents to the air, soil, or surface/groundwater. ***OAC 3745-54-52.*** Contingency plans should address procedures to implement a response to incidents involving hazardous waste, and provide for internal and external communications, arrangements with local emergency authorities, and emergency coordinator list, a facility emergency equipment list indicating equipment descriptions and locations, and a facility personnel evacuation plan. ***OAC 3745-54-55 through 56.*** Each facility must have an emergency coordinator who has responsibility for coordinating all emergency response measures.	The material in Silos 1 and 2 are specifically exempt from the applicability of RCRA requirements. However, these procedures are relevant and appropriate since the wastes stored in Silos 1 and 2 are sufficiently similar to hazardous wastes based on TCLP results. (This requirement will be applicable to non-excluded solid waste that exhibits a hazardous characteristic.) Wastes removed from this operable unit which exhibits a hazardous characteristic must be treated, stored, or disposed in accordance with TSD facility standards.	RCRA TSD facility standards apply to the design and operation of the AWR Project, and as such, has been reflected in appropriate design drawings and specifications, as well as operating and maintenance procedures. Representative samples of waste are to be collected, security provided through 24-hr surveillance system, and inspections performed, as appropriate, of processing systems while attention to ALARA principles are applied to all appropriate AWR Project activities. Applicable OAC requirements for emergency preparedness and prevention have also been incorporated into the design of the AWR Project facilities, as well as the operating and maintenance procedures for the AWR Project. These procedures included the testing and maintenance of emergency systems.	See the CFC drawings, and specifications, as well as the *Contingency Plan and Emergency Response*, which has been prepared for the AWR Project. In addition, various AWR Project operating and maintenance procedures will be prepared prior to operations.

21

Document No. 624-P62210, Rev. 1

Contract No. FSC 624
October 23, 2000

000143

3387

Exhibit 3-3. Action-Specific ARARs and TBC Requirements

Category	ARAR/TBC Requirement	Requirement Assessment	Compliance Strategy	Cross Reference Index
Closure	40 CFR 264, Subpart G; OAC 3745-55-11; OAC 3745-55-14; and OAC 3745-55-16. Operators must close the facility in a manner that: • Minimizes the need for further maintenance; • Minimizes post-closure escape of hazardous constituents; and • Complies with specific unit type closure requirements. All contaminated equipment, structures and soils must be properly disposed or decontaminated. Following closure, a survey plot showing the location of hazardous waste disposal units with respect to surveyed benchmarks must be filed with the legal total zoning authority.	The material in Silos 1 and 2 are specifically exempt from the applicability of RCRA requirements. However, these procedures are relevant and appropriate since the wastes stored in Silos 1 and 2 are sufficiently similar to hazardous wastes based on TCLP results. Contractor's facility must be clean closed, or else media remediation to meet closure performance standard. (This requirement will be applicable to non-excluded solid waste that exhibits a hazardous characteristic.)	Equipment or items used in performance of work that require decontamination are cleaned per approved plans. TTA is not closed as part of this scope of work.	Decontamination wastes are described in the AWR Project *Waste Handling Work Plan.*

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Exhibit 3-3. Action-Specific ARARs and TBC Requirements

Category	ARAR/TBC Requirement	Requirement Assessment	Compliance Strategy	Cross Reference Index
Container Storage	40 CFR 264, Subpart I; and OAC 3745-55-71 through 78. Containers of RCRA hazardous waste must be: • Maintained in good condition; • Compatible with hazardous waste to be stored; • Closed during storage (except to add or remove waste); and • Managed in a manner that will not cause the container to rupture or leak. Storage areas must be inspected weekly for leaking and deteriorated containers and containment systems. Place containers on a sloped, crack-free base, and protect from contact with accumulated liquid. Provide a containment system with a capacity of 10% of the volume of the largest container of free liquids. Remove spilled or leaked waste in a timely manner.	The materials in Silos 1 and 2 are specifically exempt from the applicability of RCRA requirements. However, these procedures are relevant and appropriate since the material stored in Silos 1 and 2 are sufficiently similar to hazardous wastes based on TCLP results. (This requirement will be applicable to non-excluded solid waste that exhibits a hazardous characteristic.) These requirements are relevant and appropriate for alternatives utilizing containers for temporary storage or storage before disposal.	No hazardous material is expected to be newly generated from the AWR Project. All secondary waste is handled per the approved *Waste Handling Work Plan*.	See the AWR Project *Waste Handling Work Plan* for additional information.

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Exhibit 3-3. Action-Specific ARARs and TBC Requirements

Category	ARAR/TBC Requirement	Requirement Assessment	Compliance Strategy	Cross Reference Index
Tank Systems	40 CFR Part 264, Subpart J; and OAC 3745-55-91 through 96. Design, operating standards, and inspection requirement for tank units within which hazardous waste is stored or treated. • Tank design must be compatible with the material being stored; • Tank must be designed and have sufficient strength to store or treat waste to ensure it will not rupture or collapse; and • Tank must have secondary containment that is capable of detecting and collecting releases to prevent migration of wastes or accumulated liquids to the environment.	The material in Silos 1 and 2 are specifically exempt from the applicability of RCRA requirements. However, these procedures are relevant and appropriate since the material stored in Silos 1 and 2 are sufficiently similar to hazardous wastes based on TCLP results. (This requirement will be applicable to non-excluded solid waste that exhibits a hazardous characteristic.) Design criteria, operating standards, and inspections for tank treatment units will be relevant and appropriate for alternatives utilizing treatment or storage in a tank prior to disposal.	The tanks and equipment used to store silos material in the TTA are designed for material compatibility and strength, and also provide secondary containment capable of detecting and collecting releases. Operating standards are to meet FEMP requirements; including the inspection of tank integrity and leak detection systems that are performed by remote closed circuit television (CCTV) technology.	Design criteria for the TTA system is provided in the *Design Criteria Package* for the AWR Project, Document No. 40710-624-P622-03. Additional information is also provided in the *FRD* and the *Process Descriptions* (Document No. 624-P622-20) for the AWR Project.

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Exhibit 3-3. Action-Specific ARARs and TBC Requirements

Category	ARAR/TBC Requirement	Requirement Assessment	Compliance Strategy	Cross Reference Index
Closure Requirements for Tanks	40 CFR 264.197; and OAC 3745-55-97. At closure, the facility owner must do the following: • Remove all waste residues; • Remove or decontaminate all tank system components; • Remove or decontaminate all contaminated soils and structures; and • Manage all of the above as hazardous wastes. If all contaminated soils cannot be removed, the landfill requirements of 40 CFR 264.310 apply.	These standards pertain to closure of any tanks and appurtenances used to store or treat Silos 1 and 2 material during remediation. These requirements are relevant and appropriate because circumstances and wastes subject to potential release are similar to those RCRA is designed to address.	Tanks that are used to store or treat silo material are not to be closed under the AWR Project scope of work. Equipment or items used in performance of work that require decontamination are to be cleaned per approved plans.	Decontamination wastes are described in the AWR Project *Waste Handling Work Plan.*
Miscellaneous Units	40 CFR 264, Subpart X; and OAC 3745-57-91 through 92. Environmental performance standard, monitoring, inspection, and post-closure care for treatment in miscellaneous units as defined in 40 CFR 260.10.	The material in Silos 1 and 2 are specifically exempt from the applicability of RCRA requirements. However, these procedures are relevant and appropriate since the material stored in Silos 1 and 2 are sufficiently similar to hazardous waste based on TCLP results. (This requirement will be applicable to non-excluded solid waste that exhibits a hazardous characteristic.) Miscellaneous units might be utilized under various alternatives to stabilize waste that is sufficiently similar to hazardous waste.	The use of RCRA miscellaneous units is not proposed for the AWR Project, and therefore, this requirement does not apply.	Not applicable.

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Exhibit 3-3. Action-Specific ARARs and TBC Requirements

Category	ARAR/TBC Requirement	Requirement Assessment	Compliance Strategy	Cross Reference Index
Corrective Action for Solid Waste Management Units (SWMUs)	40 CFR 264, Subpart S; and 40 CFR 264.552 and 264.553. Corrective Action Management Units might be designated at the site as areas where remediation wastes (solid, hazardous, or contaminated media and debris) might be placed during the process of remediation. Temporary units consisting of tanks and container storage units might be used to store and treat hazardous waste during the process of corrective action.	The material in Silos 1 and 2 are specifically exempt from the applicability of RCRA requirements. However, these procedures are relevant and appropriate since the material stored in Silos 1 and 2 are sufficiently similar to hazardous waste based on TCLP results. (This requirement will be applicable to non-excluded solid waste that exhibits a hazardous characteristic.) During the process of remediation, waste materials might require temporary management for the purpose of staging or treating material.	Material is staged and stored in accordance with approved AWR Project *Standard Operating Procedures* (SOPs). Waste materials are not being treated under the scope of work for the AWR Project. Temporary management of waste materials is performed per approved *Waste Handling Work Plan.*	See the AWR Project *Waste Handling Work Plan* for additional information.

000148

Exhibit 3-3. Action-Specific ARARs and TBC Requirements

Category	ARAR/TBC Requirement	Requirement Assessment	Compliance Strategy	Cross Reference Index
Containment Building	40 CFR 264, Subpart DD. Hazardous waste and debris might be placed in units known as containment buildings for the purpose of interim storage or treatment. Containment buildings must be fully enclosed to prevent exposure to the elements and ensure containment of managed wastes. Floor and containment walls must be designed and constructed of material of sufficient strength and thickness to support themselves, the waste contents, and any personnel and heavy equipment that operate within the operable unit. All surfaces coming in contact with hazardous waste must be chemically compatible with the waste. Primary barriers must be constructed to prevent migration of hazardous constituents into the barrier. Secondary containment systems including secondary barrier and leak detection systems must also be constructed for containment buildings used to manage wastes containing free liquids.	The material in the silos is specifically exempt from the applicability of RCRA requirements. However, these procedures are relevant and appropriate since the material stored in Silos 1 and 2 are sufficiently similar to hazardous wastes based on TCLP results. (This requirement will be applicable to non-excluded solid waste that exhibits a hazardous characteristic.) During the process of remediation, waste materials might require temporary management for the purpose of staging or treating the material.	The TTA enclosure meets the requirements for containment buildings by providing a fully enclosed facility that prevents exposure to the elements while ensuring containment of the waste materials. Compatible materials of sufficient strength and secondary containment and leak detection are provided.	See sections on TTA in the *Design Criteria Package* and the FRD for the AWR Project. Additional information is also provided in the *Process Descriptions* for the AWR Project.

000149

Exhibit 3-3. Action-Specific ARARs and TBC Requirements

Category	ARAR/TBC Requirement	Requirement Assessment	Compliance Strategy	Cross Reference Index
Radiation Dose Limit (All Pathways)	DOE Order 5400.5, Chap. II, Sec. 1.a (Proposed 10 CFR 834). The exposure of members of the public to radiation sources as a consequence of all routine DOE activities shall not cause, in a year, an effective dose equivalent greater than 100 mrem from all exposure pathways.	DOE Orders are identified as TBCs only when no promulgated ARARs exist, to ensure adequate protection of human health and the environment. Portions of DOE Order 5400.5 were selected as TBCs to ensure adequate protection of public during and following remediation. Radiation sources within this operable unit might contribute to the total dose to members of the public from this DOE facility.	The wastes to be handled as part of the AWR Project exhibit characteristics that may be radiological in nature; however, appropriate design controls, including shielding and layers of containment of the waste features that isolate workers and the public from these wastes, have been applied to the design of the appropriate systems. The law (10 CFR 835) also requires administrative controls to further reduce radiation exposure levels to as low as reasonably achievable (ALARA). ALARA principles are accomplished by radiological protection practices such as maximizing distance between the workers and the radiation source, shielding the workers from the radiation source, or minimizing the time or duration of the workers' exposure to the radiation source.	See the *ALARA Analysis* for the AWR Project.

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Exhibit 3-3. Action-Specific ARARs and TBC Requirements

Category	ARAR/TBC Requirement	Requirement Assessment	Compliance Strategy	Cross Reference Index
Control of Fugitive Dust	OAC 3745-17-08. Requires the minimization or elimination of visible emissions of fugitive dust generated during grading, loading, or construction operations and other practices, which emit fugitive dust.	The implementation of remedial action alternatives may require the movement of dirt and other material likely to result in fugitive dust emissions. This requirement is relevant and appropriate because the FEMP site is not located in an area subject to this regulation.	Potential dust-generating activities that are conducted as part of the AWR Project are to be closely monitored for visible emissions, while being controlled using best management practices (BMPs) as necessary. For example, the use of water or other suitable dust suppression chemicals are to be used for controlling dust from activities associated with demolition, construction operations, grading roads, or clearing land. Open trucks are covered when transporting materials likely to become airborne. Also, soil stockpile areas are covered with canvas, plastic, or other suitable material during stockpiling and staging operations. RM-0047 contains the BAT determination for the FEMP site, including the applicable emission standards.	See Section 2.2, Dust Control, of this ECP and the *Fugitive Dust Control Plan* for the AWR Project, Document No. 624-P6455-01, for additional information.

000151

Exhibit 3-3. Action-Specific ARARs and TBC Requirements

Category	ARAR/TBC Requirement	Requirement Assessment	Compliance Strategy	Cross Reference Index
Prevention of Air Pollution Nuisance	ORC 3704.01-.05; and OAC 3745-15-07. Measures shall be taken to adopt and maintain a program for the prevention, control, and abatement of air pollution in order to protect and enhance the quality of the state's air resource so as to promote the public health, welfare, and economic vitality of the people of the state. The emission or escape into open air from any source whatsoever of smoke, ashes, dust, dirt, grime, acids, fumes, gases, vapors, odors, and combinations of the above in such a manner or in such amounts as to endanger the health, safety, or welfare of the public or to cause unreasonable injury or damage to property shall be declared a public nuisance and is prohibited.	This requirement is applicable to AWR Project activities. Some potential exists for emissions of radionuclides and toxic chemicals to the air, which might endanger individuals or damage property.	Emissions of all materials in the silos are minimized by using sealed hatches and piping. The RCS is designed to operate at a negative pressure. The RCS stack has an isokinetic sampling system and all discharges are continuously monitored for radioactivity. Stack alarms and backup power are also provided.	See sections on the RCS and the HVAC Systems of the *FRD*. Also, see the AWR Project *Environmental ALARA Report* and Section 2.1, Air Emissions Control, of this ECP for additional information.

000152

3382

Exhibit 3-3. Action-Specific ARARs and TBC Requirements

Category	ARAR/TBC Requirement	Requirement Assessment	Compliance Strategy	Cross Reference Index
Control of Visible Particulate Emissions from Stationary Sources	OAC 3745-17-07. Discharge of particulate emissions into ambient air from any stack of a shade or density greater than 20% opacity is prohibited. Transient exceedence limits are included in this regulation.	This requirement is applicable to AWR Project activities.	Particulate emissions greater than 20% opacity are not anticipated for the AWR Project.	Information related to opacity requirements are discussed in the *Fugitive Dust Control Plan* and the AWR Operations *Training Plan* (Document No. 624-P6315-02.
Permit to Install (PTI)	OAC 3745-31-05 (A)(3). The Director of Ohio Environmental Protection Agency (OEPA) 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, not prevent or interfere with the attainment or maintenance of ambient air quality standards, and not result in a violation of any applicable air pollution control laws.	An administrative PTI is not required for the AWR Project. However, the substantive requirements of this section must be met by employing Best Available Technology for treating particulate and off-gas emissions during treatment operations. OEPA may also require stack performance testing to evaluate controls.	Air emissions are controlled via the RCS, which is designed to operate at a negative pressure and includes BAT such as carbon beds and HEPA filtration. Emission monitoring equipment is provided per 40 CFR 61 requirements (see Exhibit 3-1 for ARARs relating to radionuclide emissions). Foster Wheeler is to conduct performance tests of air pollution control systems to demonstrate compliance for OEPA as necessary.	See sections on the RCS and the HVAC Systems of the *FRD*. Also, see the AWR Project *Environmental ALARA Report* and Section 2.1, Air Emissions Control, of this ECP for additional information.
Ohio EPA Air Toxics Policy [used in conjunction with OAC 3745-31-05 (A)(3)]	The current PTI regulations provide the Director of OEPA with a mechanism to require the evaluation of toxic air contaminants from new sources. The OEPA Air Toxics Policy provides a mechanism for calculating the Maximum Acceptable Ground-Level Concentration for a toxic substance. This value at the site boundary will be modeled to the stack to determine a stack limit. All toxic compounds that will exceed the stack limit shall be controlled administratively or by BAT to lower emissions to below the calculated stack limit.	For toxic compound emissions that are calculated to exceed the established stack limit, administrative controls shall be implemented or emissions shall be controlled by implementing BAT for toxic emissions. Performance of these control measures may be verified through performance testing during operation.	The AWR air pollution control systems are designed and installed per applicable codes, standards, and regulations. Emission monitoring equipment is provided per 40 CFR 61 requirements (see Exhibit 3-1 for ARARs relating to radionuclide emissions). Foster Wheeler is to conduct performance tests of air pollution control systems to demonstrate compliance for OEPA as necessary.	See sections on the RCS and the HVAC Systems of the *FRD*. Also, see the AWR Project *Environmental ALARA Report* and Section 2.1, Air Emissions Control, of this ECP for additional information.

0001153

Section 5.2
RCS Perf. Calc.

3387

APPENDIX 5.2

RADON CONTROL SYSTEM PERFORMANCE CALCULATION

CALCULATION COVER SHEET

PROJECT Fernald Silos 1 & 2 AWR SUBJECT RCS Performance

CLIENT Fluor Daniel Fernald

CALCULATION NO. CA-FSC624-FM-001 PROJECT NO. FSC-624

NO OF SHEETS 43 DESIGN LEVEL 3

CALCULATION OTHERS __YES_x_NO PREPARER D. W. Hendrickson, P.E. / K.D. Rickett

REVIEWED BY Kyle Kleinhans DATE 11/28/00

ASSUMPTIONS THAT REQUIRE CONFIRMATION X YES NO

ASSUMPTIONS CONFIRMED BY _____ DATE _____

PRINT NAME, DATE AND INITIAL

Rev No	Affected Sheets	Prepared by Date	Checked by Date	Verified by Date
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CONTENTS

I. CRITERIA 3
A. Purpose of Calculation 3
B. Functional Requirements 3
II. APPLICABLE CODES AND STANDARDS 3
III. METHODOLOGY 3
IV. ASSUMPTIONS 4
V. CALCULATIONS 5
A. Carbon Bed ^{222}Rn Adsorption 5
1. Dynamic Adsorption Coefficient, K_a 5
2. Gas Rate Adjustment for Chiller Operation 7
3. Condensate Removal of ^{222}Rn 8
4. Carbon Bed Efficiency 10
5. Application of Chiller and Carbon Bed Analysis 11
B. Evaluation of ^{222}Rn Sources and Gas Concentrations 12
1. Phase 1, Silo Headspace Concentration Reduction 12
2. Phase 2A, Silo 1 Mining 13
3. Phase 2B, Silo 2 Mining 19
4. Phase 2C, TTA Ventilation 21
5. Phase 3, Future Waste Treatment Facility (FWTF) Operations and TTA Ventilation 22
6. Summary of ^{222}Rn Source and Concentration Calculations 24
C. Condensate ^{222}Rn Concentrations 24
D. Consequences of ^{222}Rn Stack Emissions 26
1. General Exposure Evaluation 27
2. Definition of Limits 27
3. On-Site Dispersion Coefficients 29
4. Off-Site Dispersion Coefficients 32
5. Design Basis Emission Consequences 33
E. Design Selections and Calculation Implementation 34
VI. REFERENCES 42

RCS PERFORMANCE CALCULATION

I. CRITERIA

A. Purpose of Calculation

The purpose of this calculation is to develop material balance estimates across the radon control system (RCS) of the Silos 1 & 2 Accelerated Waste Retrieval (AWR) at Fernald (Ohio).

B. Functional Requirements

The RCS must provide ventilation of silo and Transfer Tank Area (TTA) vessels. The RCS must chill the ventilation stream to improve radon adsorption and must adsorb radon from the gas stream. During some phases of operation, treated gas will be recycled to the vessels.

II. APPLICABLE CODES AND STANDARDS

Radon-222 (^{222}Rn) and its daughter emissions must result in exposure of less than:

Table 1: Ambient Air Limitations (Reference 1a)

Location	Distance (m)	Limit
Off-Site	350	0.5 pCi/L ^{222}Rn/L
On-Site	100	0.2 WL, instantaneous [1]
On-Site	100	0.02 WL, weekly average

Note: 1 "WL" limits are described in §V.D.2.

III. METHODOLOGY

The overall AWR and RCS operations are complex. To address this complexity, the full life of RCS operational conditions is developed and evaluated.

The methodology employed in this calculation is to:

- Evaluate performance of ^{222}Rn adsorption by carbon bed
- Evaluate ^{222}Rn sources and gas concentration during:
  - Phase 1, Silo headspace concentration reduction
  - Phase 2A, Silo 1 mining
  - Phase 2B, Silo 2 mining
  - Phase 2C, TTA ventilation
  - Phase 3, Future Waste Treatment Facility (FWTF) Operation and TTA Ventilation
- Evaluate ^{222}Rn in condensates
- Evaluate ^{222}Rn stack emissions and their consequences

- Application of the calculation to design choices and develop the mass balance of the RCS.

IV. ASSUMPTIONS

The following system assumptions are to be applied. Other specific instance assumptions are stated with individual calculations as necessary.

1. Gas streams entering the chiller are at 75°F and 100% RH.
2. Gas streams exiting the chiller and dryer are at 36°F and 15% RH this will allow for a 4°F rise in temperature via conduction through the bed (i.e. air exits bed @ 40°F). All calculations are performed @ 40°F to obtain a conservative estimate of bed performance.
3. Four carbon beds (40,000 lb each) are operated in parallel.
4. Gas rates from vessels to the RCS are:

Table 2: Vessel Gas Rates (acfm) to RCS

Phase	Silo 1	Silo 2	TTA 1A	TTA 1B	TTA 2A	TTA2B	FWTF
1	250	250	0	0	0	0	0
2A	250	250	125	125	0	0	0
2B	0	250	125	125	125	125	0
2C	0	0	125	125	125	125	0
3	0	0	125	125	125	125	500

5. Building ventilation to the stack is 9310 acfm at 75°F and 100%RH
6. Condensate will collect for 20 days, decay for 15 days, and be discharged or reused in the process.
7. Filled and filling TTA tanks will have 2 ft of water on top of settled solids for shielding and ^{222}Rn reduction.
8. Internal diameters of silos and TTA tanks are 80 ft and 66 ft, respectively.
9. Normally, treated gas will not be recirculated to TTA tanks.
10. TTA tanks will have cone bottoms, 6 in drop over 33 ft radius, and domed tops with a height of 3 ft 6 in, sidewall height = 30 ft; tanks will be filled to a maximum of 27 ft sidewall.
11. Exposed surface areas of Silo waste material being mined will be 1.5 times the cross-section of the Silo.
12. Normally, treated gas will not be recycled to a Silo undergoing mining.
13. No water cover will be maintained on residues of a silo undergoing mining.
14. Gas streams from the FWTF will be 420,000 pCi ^{222}Rn/L at 75°F and 100% RH.
15. TTA mining will require water cover removal.
16. Assumption 11 will apply for TTA mining as 1.5 times TTA tank cross-section.
17. On-site worker exposure limit is at a distance of 100 m from the stack, center of plume, under winds of 0.5 m/s, and fumigation conditions with an inversion lid of 200 ft.
18. Stack height is 150 ft; stack discharge diameter is 3 ft.

19. Radon daughter concentration leaving the carbon bed is negligible.
20. Negligible heat transfer from heats of adsorption will occur across the carbon bed.

V. CALCULATIONS

A. Carbon Bed ^{222}Rn Adsorption

The performance of carbon bed adsorption (See Ref. 2) is expressed as:

$$C_o = C_i \cdot e^{-\left(\frac{\lambda \cdot K_a \cdot M}{F}\right)} \qquad \textbf{(EQN 1)}$$

where:

C_o	=	Outlet concentration, pCi ^{222}Rn/L air
C_i	=	Inlet concentration, pCi ^{222}Rn/L air
$t_{1/2}$	=	^{222}Rn half-life, 3.8235 days (Reference 3)
λ	=	$\ln(2)/t_{1/2}$, 1.2589E-04/min for ^{222}Rn
M	=	Mass of carbon, g
F	=	Gas flow rate, L/min
K_a	=	^{222}Rn dynamic adsorption coefficient, L/g (pCi ^{222}Rn adsorbed/g carbon / pCi ^{222}Rn/L air)

1. Dynamic Adsorption Coefficient, K_a

a) K_a as a Function of Temperature

Reference 4 provides the following data of $K_a(T)$:

Table 3: Temperature Dependence of K_a

T (°C)	K_a (L/g)	T (°C)	K_a (L/g)
0	16.5	15	9.0
5	13.6	20	6.8
10	11.7	24	6.1
Reference State: 15% RH, atm. pressure			

Data reduction of Table 3 K_a data indicates that the best fit of data is found with a fourth-order expression of the form:

$$K_a(T) = EXP\left[b_1 + b_2 \cdot T^{-1} + b_3 \cdot T^{-2} + b_4 \cdot T^{-3}\right] \left(L/g\right) \qquad \textbf{(EQN 2)}$$

Where:

T = Temperature, Kelvin

b_i = Regression coefficients

$b_1 = 1{,}030.4$; $b_2 = -895{,}870$; $b_3 = 2.9501E8$; $b_4 = -2.485E10$

Assumption 2 requires chiller gas product at 40°F

T = (40°F - 32°F)(5K/9°F) + 273.15K = 277.59 K

Applying EQN 2:

$$K_a(40°F) = EXP\left[1030.4 + \frac{-895{,}870}{277.59} + \frac{2.5901E8}{(277.59)^2} + \frac{-2.485E10}{(277.59)^3}\right] = 14.051\left(L/g\right)$$

b) K_a as a Function of Gas Stream Humidity

Reference 5 provides that K_a is a function of humidity with a decrease of 30% over increasing humidity from 0% relative humidity (RH) to 100% RH.

This function is expressed as:

$$K_a'(T,RH) = K_a(T,15\%)\cdot\left(1 - 0.3\left(\frac{RH - RH_0}{100}\right)\right)\left(L/g\right) \qquad \text{(EQN 3)}$$

where:

$K_a'(T,RH)$ = Adsorption coefficient at T and RH

$K_a(T,15)$ = Adsorption coefficient at T and RH = 15%

RH = Relative humidity, operational

RH_0 = Relative humidity, standard state selection

Assumption 2 requires gas product at 40°F and 15% RH.

$$K_a'(40°F,15\%) = K_a(40°F,15\%)\cdot\left(1 - 0.3\left(\frac{15-15}{100}\right)\right) = 14.051\cdot(1 - 0.3(0))$$

$$K_a' = 14.051 \ L/g$$

<u>K_a will be limited to a value of 10.5 in this calculation</u>. This value was determined based upon using 80,000 pounds of new carbon (<u>$K_a = 13.1$</u>) and 80,000 pounds of the Fernald GFE carbon (<u>$K_a = 9.6$</u>). These values of <u>K_a</u> were determined based upon testing performed by Barnebey-Sutcliffe and are found in Reference 20. **The above analysis was included in the calculation for information purposes.**

2. Gas Rate Adjustment for Chiller Operation

From §V.A.1 above, ^{222}Rn adsorption is improved by chilling the gas stream. When chilled, water is condensed and removed resulting in lower gas rates to the carbon beds with lower moisture. Assumptions 2 and 3, and Reference 6 provide:

Table 4: Operating Stream Conditions

Location	T (°F)	RH (%)	Specific Volume (ft^3/lb dry air)	*H* (lb water/lb dry air)
Chiller Inlet	75	100%	13.884	0.01883
Chiller Outlet	40	15%	12.61	0.000768

The air (dry) mass entering and leaving the chiller and dryer is evaluated as (where Q [=] volume/time and in = out):

$$\dot{m}_{air} = \frac{Q_{in}}{\hat{V}_{inlet}} \frac{\frac{ft^3}{min}}{\frac{ft^3}{lb\,dry\,air}} [=] \frac{lb\,dry\,air}{min} \qquad \text{(EQN 4)}$$

and volume on exit is:

$$Q_{out} = \dot{m}_{air} \cdot \hat{V}_{outlet} = Q_{in} \cdot \frac{\hat{V}_{outlet}}{\hat{V}_{inlet}} [=] \frac{ft^3}{min} \qquad \text{(EQN 5)}$$

For conditions of Table 4:

$$\dot{m}_{air} = \frac{Q_{in}}{13.884} \frac{lb\,dry\,air}{min} \quad and \quad Q_{out} = \frac{12.61}{13.884} \cdot Q_{in} = 0.90825 \cdot Q_{in} \frac{ft^3}{min}$$

The amount of condensate generated is calculated by difference across the chiller and dryer as:

$$\dot{m}_{H_2O,in} = \dot{m}_{air} \left(\frac{lb\,dry\,air}{min} \right) \cdot H_{in} \left(\frac{lb\,H_2O}{lb\,dry\,air} \right) [=] \frac{lb\,H_2O}{min} \qquad \text{(EQN 6)}$$

$$\dot{m}_{H2O,out} = \dot{m}_{air}\left(\frac{\text{lb dry air}}{\text{min}}\right)\cdot H_{out}\left(\frac{\text{lb } H_2O}{\text{lb dry air}}\right)[=]\frac{\text{lb } H_2O}{\text{min}} \qquad \text{(EQN 7)}$$

Combining Equations 4, 6, and 7 across the chiller and dryer,

$$\dot{m}_{Cond} = \dot{m}_{H2O,in} - \dot{m}_{H2O,out} = \frac{Q_{in}}{\hat{V}_{inlet}}\cdot(H_{in} - H_{out})\frac{\text{lb } H_2O}{\text{min}} \qquad \text{(EQN 8)}$$

$$Q_{Cond} = \frac{\dot{m}_{Cond}}{\rho_{H2O}}\frac{\frac{\text{lb } H_2O}{\text{min}}}{\frac{\text{lb } H_2O}{\text{L}}}[=]\frac{\text{L}}{\text{min}} \qquad \text{(EQN 9)}$$

where: ρ_{H2O} = density of water, 2.20462 lb/L.

3. Condensate Removal of ^{222}Rn

The liquid condensate will absorb radon from the gas stream. Reference 7 provides radon equilibrium solubility (calculation provided in §V.C.) as:

$$S_{222Rn,aq.} = \frac{\frac{0.55017 \text{ pCi } ^{222}Rn}{\text{L water}}}{\frac{\text{pCi } ^{222}Rn}{\text{L air}}}$$

The concentration of ^{222}Rn in the liquid is collected is:

$$C_{222Rn,Cond} = S_{222Rn,aq.}\left(\frac{\text{pCi/L water}}{\text{pCi/L air}}\right)\cdot C_{222Rn,air\,in}\left(\frac{\text{pCi}}{\text{L air}}\right)[=]\frac{\text{pCi}}{\text{L water}} \qquad \text{(EQN 10)}$$

where:

$C_{222Rn,air\,in}$ = concentration of ^{222}Rn in gas entering chiller/dryer, pCi/L

The activity of ^{222}Rn in the condensate is calculated as:

$$A_{222Rn,Cond} = Q_{Cond}\left(\frac{\text{L}}{\text{min}}\right)\cdot C_{222Rn,Cond}\left(\frac{\text{pCi}}{\text{L}}\right)[=]\frac{\text{pCi}}{\text{min}} \qquad \text{(EQN 11)}$$

And the activity of the inlet gas is:

$$A_{222Rn,In} = Q_{In}\left(\frac{\mathrm{L}}{\mathrm{min}}\right)\cdot C_{222Rn,In}\left(\frac{\mathrm{pCi}}{\mathrm{L}}\right)[=]\frac{\mathrm{pCi}}{\mathrm{min}} \qquad \text{(EQN 12)}$$

Thus, the activity of the gas exiting the chiller/dryer is:

$$A_{222Rn,Out} = A_{222Rn,In} - A_{222Rn,Cond} \qquad \text{(EQN 13)}$$

The gas stream ^{222}Rn concentration is found by EQN 13 and EQN 5 with substitution by EQNs 12, 11, 8, 9, and 10:

$$C_{222Rn,Out} = \frac{A_{222Rn,In} - A_{222Rn,Cond}}{Q_{Air\,Out}}\frac{pCi/\mathrm{min}}{L/\mathrm{min}}[=]\frac{pCi}{L}$$

$$= \frac{A_{222Rn,In} - A_{222Rn,Cond}}{Q_{In}}\cdot\frac{\hat{V}_{In}}{\hat{V}_{Out}}$$

$$= \frac{Q_{In}\cdot C_{222Rn,In} - Q_{Cond}\cdot C_{222Rn,Cond}}{Q_{In}}\cdot\frac{\hat{V}_{In}}{\hat{V}_{Out}}$$

$$= \left(\frac{Q_{In}\cdot C_{222Rn,In}}{Q_{In}} - \frac{Q_{In}}{\hat{V}_{In}}\cdot\frac{(H_{In}-H_{Out})}{\rho_{H2O}}\cdot\frac{S_{222Rn,aq.}\cdot C_{222Rn,In}}{Q_{In}}\right)\cdot\frac{\hat{V}_{In}}{\hat{V}_{Out}}$$

$$C_{222Rn,Out} = C_{222Rn,In}\cdot\left(1 - S_{222Rn,aq.}\cdot\frac{(H_{In}-H_{Out})}{\hat{V}_{In}\cdot\rho_{H2O}}\cdot\right)\cdot\frac{\hat{V}_{In}}{\hat{V}_{Out}} \qquad \text{(EQN 14)}$$

where: $\hat{V}\left(\mathrm{L}/\mathrm{lb\,dry\,air}\right) = \hat{V}\left(\mathrm{ft}^3/\mathrm{lb\,dry\,air}\right)\cdot 28.317\,\mathrm{L}/\mathrm{ft}^3$

Evaluating EQN 14 relative to $C_{222Rn,In}$:

$$C_{222Rn,Out} = C_{222R,In} \cdot \left(1 - \left(\frac{\frac{0.55017\ \text{pCi}\ ^{222}\text{Rn}}{\text{L water}}}{\frac{\text{pCi}\ ^{222}\text{Rn}}{\text{L air}}}\right) \cdot \frac{(0.01883 - 0.000768)}{\frac{13.884\,\text{ft}^3}{\text{lb dry air}} \cdot \frac{28.317\text{L}}{\text{ft}^3} \cdot \frac{2.20462\ \text{lb}}{L}}\right) \cdot \frac{\frac{13.884\,\text{ft}^3}{\text{lb dry air}}}{\frac{12.61\,\text{ft}^3}{\text{lb dry air}}}$$

$$C_{222Rn,Out} = 1.1010 \cdot C_{222Rn,In}\ \text{pCi}/\text{L} \qquad \textbf{(EQN 15)}$$

4. Carbon Bed Efficiency

Reforming EQN 1 and defining the carbon bed efficiency (η):

$$\frac{C_o}{C_i} = 1 - \eta = e^{-\left(\frac{\lambda \cdot K_a \cdot M}{F}\right)} \qquad \textbf{(EQN 16)}$$

$$\eta = 1 - e^{-\left(\frac{\lambda \cdot K_a \cdot M}{F}\right)}$$

where:

F = Chilled air rate to carbon beds = $Q_{Out|Chiller}$

For varying system flow rates over four carbon beds (Assumption 3, M = 4*40,000 lb = 72,574,784 g), the efficiencies of the beds are tabulated in Table 5.

Table 5: Carbon Bed Efficiency with Chilled Gas Rate

Q_{in} (ft^3/min)	Q_{out} (ft^3/min) EQN5	F (L/min)	η EQN 16
125	113.53	3,214.9	1
250	227.06	6,429.7	1
375	340.59	9,644.6	0.999952
500	454.13	12,859	0.999425
625	567.66	16,074	0.997441
750	681.19	19,289	0.993081
875	794.72	22,504	0.98592
1000	908.25	25,719	0.976011

5. Application of Chiller and Carbon Bed Analysis

Example Calculation:

- Assume Phase 1 operations
- Assume Silo headspace ^{222}Rn concentrations of:
  - Silo 1: 252,292 pCi/L
  - Silo 2: 249,715 pCi/L

Table 6: Source Terms and Ventilation		
Vessel	Q (ft^3/min) [Table 2]	$C_{222Rn,air}$ (pCi/L)
Silo 1	250	252,292
Silo 2	250	249,715
Sum	500	251,003.3

From Table 5: $Q_{Out|Chiller} = 454.13\ ft^3/min$

$$EQN\ 8 \Rightarrow \dot{m}_{Cond} = \frac{\frac{500\,ft^3}{min}}{\frac{13.884\,ft^3}{lb\,dry\,air}} \cdot (0.01883 - 0.000768)\frac{lbH_2O}{lb\,dry\,air} = 0.65041\frac{lb\,H_2O}{min}$$

$$EQN\ 9 \Rightarrow Q_{Cond} = \frac{0.65041}{2.20462}\frac{\frac{lb\,H_2O}{min}}{\frac{lb\,H_2O}{L}} = 0.29502\frac{L\,water}{min}$$

$$EQN\ 10\&11 \Rightarrow A_{222Rn,Cond} = \frac{0.29502\,L\,water}{min} \cdot \frac{0.5501744\,pCi/L\,water}{pCi/L\,air} \cdot \frac{251{,}003.3\,pCi}{L\,air} = 40{,}740.9\frac{pCi}{min}$$

$$EQN\ 15 \Rightarrow C_{222Rn,Out} = 1.1010 \cdot 251{,}003.\frac{pCi}{L} = 276{,}354.3\frac{pCi}{L}$$

Across the carbon beds, using EQN 16 and Table 5:

$$C_o = C_i \cdot (1 - \eta) \qquad \textbf{(EQN 17)}$$

$$C_o = 276{,}354.3\frac{pCi}{L} \cdot (1 - 0.999425) = 158.9\frac{pCi}{L}$$

∴For purposes of hand calculation, recirculation of the treated gas may be neglected. This recycle will be included in spreadsheet forms of this equation set.

B. Evaluation of ^{222}Rn Sources and Gas Concentrations

1. Phase 1, Silo Headspace Concentration Reduction

The time-dependent headspace concentration of a vessel under recirculatory ventilation may be expressed as:

$$C_t = \frac{E/V}{\left(\lambda + \frac{\eta Q}{V}\right)} \cdot \left(1 - e^{-\left(\lambda + \frac{\eta Q}{V}\right)t}\right) + C_0 \cdot e^{-\left(\lambda + \frac{\eta Q}{V}\right)t} \; [=] \frac{\text{pCi}}{\text{L}} \qquad \textbf{(EQN 18)}$$

where:

C_t	=	Concentration at time t, pCi/L
C_0	=	Initial concentration, pCi/L
E	=	Emission rate from materials to the headspace, pCi/min
V	=	Headspace volume, L
η	=	Reduction in radon across treatment beds
Q	=	Ventilation flowrate through headspace, L/min
λ	=	Decay constant, 1.2589E-04/min for ^{222}Rn
t	=	Duration of ventilation, min

The term $\left(\lambda + \frac{\eta Q}{V}\right)$ in EQN 18 reflects decay of ^{222}Rn and displacement frequency with treated gas return.

To apply EQN 18, the emission rate (E) must be evaluated. The silos are currently unventilated. Evaluating EQN 18 as $t \rightarrow 4$ and $Q = 0$, and rearranging:

$$E = C_\infty \cdot V \cdot \lambda \qquad (t \rightarrow \infty, Q = 0) \qquad \textbf{(EQN 19)}$$

References 8 and 9 provide:

Table 7: Silo Headspace Concentrations and Volumes

Silo	C (pCi/L)	V (L)
1	1.82E+07	7.90E+05
2	1.13E+07	1.27E+06

Substituting Table 7 values into EQN 19:

$$E_{Silo\,1} = \frac{18.2\text{E}6\,\text{pCi}}{\text{L}} \cdot 0.76\text{E}6\text{L} \cdot \frac{1.26\text{E}-4}{\text{min}} = 1.8101\text{E}9\,\frac{\text{pCi}}{\text{min}}$$

$$E_{Silo2} = \frac{11.3E6\ pCi}{L} \cdot 1.27E6L \cdot \frac{1.26E-4}{min} = 1.8067\ E9 \frac{pCi}{min}$$

Evaluating EQN 18 using ventilation rates from Table 2, and C_0 and V from Table 7, over varying time of ventilation, the headspace concentrations are calculated and provided in Table 8.

Table 8: Time Dependent Phase 1 Silo Headspace ^{222}Rn

t (min)	Silo 1 C_t (pCi/L)	Silo 2 C_t (pCi/L)
10	1.66E+07	1.07E+07
100	7.49E+06	6.50E+06
500	443,686	889,913
1,000	254,333	286,805
1,440	252,329	252,739
7,200	252,292	249,715
14,400	252,292	249,715

Table 8 values demonstrate steady-state concentrations are achieved in one to two days. The five-day values will be used in this analysis for silo ventilation.

As seen in the example calculation of §V.A.5, above, the Phase 1, steady-state, carbon bed ^{222}Rn exhaust concentration will be: $C_o = 158.9\ {}^{pCi}/_{L}$.

2. Phase 2A, Silo 1 Mining

   a) Silo 2 Headspace

During this Phase Silo 2 will continue under ventilation, Silo 1 will be mined, and TTA tanks 1A and 1B will be filled.

From Table 2: 750 cfm will be treated; 250 cfm from Silo 2
From Table 5: $\eta = 0.993081$
From Table 7: $V_{Silo2} = 1.27E+06$ L
Evaluating EQN 18 for this efficiency, noting that:

$$\left(\lambda + \frac{\eta \cdot Q}{V}\right)_{Silo2} = \left(\frac{1.26E-04}{min} + \frac{0.993081 \cdot \frac{250\ ft^3}{min} \cdot \frac{28.317\ L}{ft^3}}{1.27E+6\ L}\right) = \frac{5.66E-3}{min}$$

A five-day, steady-state, concentration from Silo 2 will be:

$$EQN\,18 \Rightarrow C_{Silo2,2A} = \frac{1.8067E9\text{pCi/min}/1.27E6\text{L}}{5.66E-3/\text{min}} \cdot \left(1 - e^{-\left(\frac{5.66E-3}{\text{min}}\right)\cdot 7200\,\text{min}}\right) + \frac{249{,}715\text{pCi}}{\text{L}} \cdot e^{-\left(\frac{5.66E-3}{\text{min}}\right)\cdot 7200\,\text{min}}$$

$$C_{Silo2,2A} = 251{,}342.4\,\frac{\text{pCi}}{\text{L}}$$

b) Tank TTA 1A and TTA 1B Emissions

The TTA tanks, unlike the initial Silo condition, will not have a clay barrier. Their radon emissions must be evaluated other than by EQNs 18 and 19 directly.

In §V.B.1 emissions of radon were evaluated from known present concentrations. At outset, these vessels will have no material to generate radon. Reference 10 provides emanation of radon from uranium mill tailings as a function of radium content as:

$$\dot{E} = \frac{0.6\text{pCi}\ ^{222}\text{Rn/m}^2\text{s}}{\text{pCi}\ ^{226}\text{Ra/g}}$$

Radon, with a high solubility in water, may be reduced in emission to the headspace by placement of water above the tailings. Reference 1d provides this functionality as an efficiency in reduction:

$$\eta_{Rn,H2O} = 1 - e^{-0.0717\cdot depth(in)} \qquad \textbf{(EQN 20)}$$

The surface emanation rate and EQN 20 reduction may be applied to evaluate emission of radon to the headspace as:

$$E = C_{226Ra} \cdot \dot{E} \cdot A \cdot e^{-0.0717\cdot depth(in)}\ [=]\ \frac{\text{pCi}}{\text{min}} \qquad \textbf{(EQN 21)}$$

where:

C_{226Ra}	=	Concentration of ^{226}Ra in the solids, pCi/g
A	=	Area of solid surface, vessel cross-section, m^2
depth	=	height of water on top of tailings, inches and a conversion of seconds/minute is required.

Reference 1b provides 95% confidence interval radium content of silo wastes as:

Table 9: Silo Waste ^{226}Ra Content (95% CI)	
Silo	^{226}Ra (pCi/g)
1	477,000
2	263,000

Assumptions 7 and 8 provide 2 ft of water cover in 66-ft-diameter tanks. Application of these inputs for Silo 1 wastes entering TTA tanks 1A and 1B to EQN 21 yields:

$$E_{TTA1A/B} = \frac{477{,}000\,\text{pCi}\,^{226}\text{Ra}}{\text{g}} \cdot \frac{0.6\,\text{pCi}\,^{222}\text{Rn/m}^2\text{s}}{\text{pCi}\,^{226}\text{Ra/g}} \cdot \left(\frac{66\text{ft}}{2} \cdot \frac{0.3048\,\text{m}}{\text{ft}}\right)^2 \cdot \pi \cdot e^{-0.0717\left(2\text{ft}\cdot\frac{12\text{in}}{\text{ft}}\right)} \cdot \frac{60\,\text{s}}{\text{min}}$$

$$E_{TTA1A/B} = 9.7655E+8\,\frac{\text{pCi}}{\text{min}}$$

Looking ahead to Silo 2 waste materials:

$$E_{TTA2A/B} = \frac{263{,}000\,\text{pCi}\,^{226}\text{Ra}}{\text{g}} \cdot \frac{0.6\,\text{pCi}\,^{222}\text{Rn/m}^2\text{s}}{\text{pCi}\,^{226}\text{Ra/g}} \cdot \left(\frac{66\text{ft}}{2} \cdot \frac{0.3048\,\text{m}}{\text{ft}}\right)^2 \cdot \pi \cdot e^{-0.0717\left(2\text{ft}\cdot\frac{12\text{in}}{\text{ft}}\right)} \cdot \frac{60\,\text{s}}{\text{min}}$$

$$E_{TTA2A/B} = 5.3843E+8\,\frac{\text{pCi}}{\text{min}}$$

Within the TTA tanks, with no recirculation (See Assumption 9), the steady-state concentration may be determined as a reduction of EQN 18 as:

$$C_t = \frac{E/V}{\left(\lambda + \frac{Q}{V}\right)} \quad [=] \quad \frac{\text{pCi}}{\text{L}} \qquad \textbf{(EQN 22)}$$

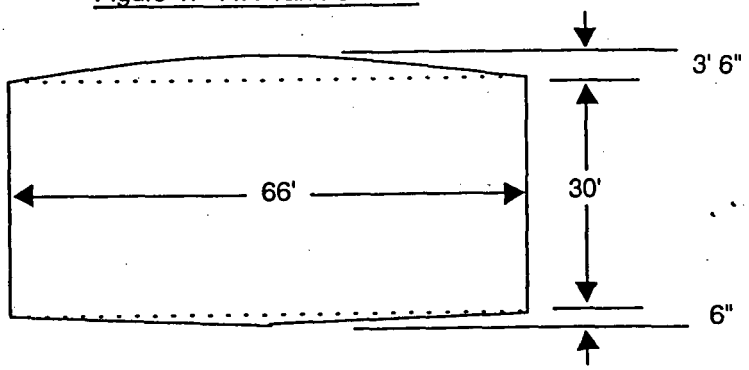
where variables are defined as above, but V varies with the extent of fill of the tank.

As V varies in EQN 22, the time to turn over the headspace changes allowing the concentration to change (increase). The range of V may be established by the design of the tanks (See Assumption 10) as depicted in Figure 1.

The volume of the dome is:

$$V_{Dome} = \frac{\pi \cdot h \cdot r^2}{4} = \frac{\pi \cdot (3.5\,\text{ft}) \cdot (33\,\text{ft})^2}{4} \cdot \frac{28.317\,\text{L}}{\text{ft}^3} = 84{,}768\,\text{L} \qquad \text{(EQN 23)}$$

Figure 1: TTA Tank Sketch



The volume of the cone bottom is:

$$V_{Cone} = \frac{\pi \cdot r^2 \cdot h}{3} = \frac{\pi \cdot (33\,\text{ft})^2 \cdot (0.5\,\text{ft})}{3} \cdot \frac{28.317\,\text{L}}{\text{ft}^3} = 16{,}146\,\text{L} \qquad \text{(EQN 24)}$$

The volume of the sidewall area is:

$$V_{Upright} = \pi \cdot r^2 \cdot h = \pi \cdot (33\,\text{ft})^2 \cdot (30\,\text{ft}) \cdot \frac{28.317\,\text{L}}{\text{ft}^3} = 2.9063\,E\,6\,\text{L} \qquad \text{(EQN 25)}$$

The initial volume of each TTA tank is:

$$V_{Init} = V_{Dome} + V_{Cone} + V_{Upright} = 3.007\,E6\,\text{L} \qquad \text{(EQN 26)}$$

At maximum fill the gas space, V_{min}, is (Assumption 10):

$$V_{min} = V_{Init} - V_{Cone} - \frac{27}{30} \cdot V_{Upright} = 375{,}400\,\text{L} \qquad \text{(EQN 27)}$$

Applying EQN 22 over the filling of the tank from V_{Init} to V_{min} for Silo 1 wastes, and again anticipating the calculation for Silo 2 wastes, the gas phase ^{222}Rn in the TTA tanks (Q from Assumption 4) are provided in Table 10.

Table 10: TTA Tank ^{222}Rn Concentrations

V (L)	C (pCi ^{222}Rn/L)	
	Silo 1 Waste	Silo 2 Waste
3.00E+06	249,293	137,451
2.50E+06	253,364	139,695
2.00E+06	257,570	142,015
1.50E+06	261,919	144,412
1.00E+06	266,417	146,892
500,000	271,072	149,459
375,400	272,257	150,112
350,000	**272,500**	**150,246**

For conservative purposes (and long term storage) a maximum (V=350,000 L) gas concentration will be used.

c) Silo 1 Emissions During Mining

During Phase 1 operations, this vessel is operated with a clay cap for reducing radon emissions. During mining, the clay must be removed to excavate the tailings. The tailings will be disturbed. To account for these conditions, Assumption 11 provides an effective surface area of 1.5 times the silo cross-section. With no water cover on the Silo 1 waste and no gas recirculation to this silo (See Assumptions 12 & 13), EQN 21 reduces to:

$$E_{Silo\,1,2A} = C_{222Ra} \cdot E' \cdot A' \,[=]\, \frac{\text{pCi}}{\text{min}} \qquad \textbf{(EQN 28)}$$

where:

A' = Effective area of silo waste surface, 1.5*A, m^2

Applying Silo dimensions of Assumption 8 and waste composition of Table 9,

$$EQN\ 28 \Rightarrow E_{Silo1,2A} = \frac{477{,}000\,\text{pCi}\,^{226}\text{Ra}}{\text{g}} \cdot \frac{0.6\,\text{pCi}\,^{222}\text{Rn/m}^2\text{s}}{\text{pCi}\,^{226}\text{Ra/g}} \cdot 1.5 \cdot \left(\frac{80\text{ft}}{2} \cdot \frac{0.3048\,\text{m}}{\text{ft}}\right)^2 \cdot \pi \cdot \frac{60\text{s}}{\text{min}}$$

$$E_{Silo1,2A} = 1.2028sE+10\ \frac{\text{pCi}}{\text{min}}$$

Reference 1c provides current waste and clay volumes in the silos as:

Table 11: Silo Material Inventories

Material	Silo 1		Silo 2	
	yd^3	m^3	yd^3	m^3
K-65	4,293	3,282	3,719	2,843
Clay	471	360	411	314
Total	4,764	3,642	4,130	3,158

Tables 7 and 11 values define the range of Silo 1 headspace volumes from:

V_{Init} = 0.79 E6 L

V_{Final} = $V_{Init} + V_{waste}$ = 0.79 E6 + 3.642 E6 = 4.432 E6 L.

Applying EQN 22 from V_{Init} to V_{Final}, the Silo 1 ^{222}Rn headspace concentration varies as tabulated in Table 12. Q is provided in Table 2.

Table 12: Silo 1, Phase 2A ^{222}Rn Headspace Concentration

V(L)	C (pCi ^{222}Rn/L)
7.90E+05	1,675,591
1.00E+06	1,669,443
1.147E+06	**1,665,166**
1.50E+06	1,654,985
2.00E+06	1,640,774
2.50E+06	1,626,806
3.00E+06	1,613,073
3.50E+06	1,599,571
4.00E+06	1,586,292
4.40E+06	1,575,827

For conservative purposes, the radon concentration corresponding to V = 1.147 E6 L is chosen. This volume represents the headspace volume when the clay cap is removed.

d) Phase 2A Gas Treatment

The composite gas stream in Phase 2A, from §§V.B.2.a, V.B.2.b, V.B.2.c, and Table 2 are summarized in Table 13. The combined Table 13 treatment stream to the chiller is found to be 729,253 pCi/L as:

$$C_{222Rn,In,2A} = \frac{\sum C \cdot Q}{\sum Q} \qquad \textbf{(EQN 29)}$$

Table 13: Phase 2A Gas Streams		
Vessel	Q (ft^3/min)	C (pCi ^{222}Rn/L)
Silo 1	250	1,665,166
Silo 2	250	256,288
TTA 1A	125	272,500
TTA 1B	125	272,500
Total	750	731,318

The chiller outlet and carbon bed inlet concentration is:

$$EQN15 \Rightarrow C_{222Rn,Out,2A} = 1.1010 \cdot 731{,}318 \frac{\text{pCi}}{\text{L}} = 805{,}184 \frac{\text{pCi}}{\text{L}}$$

Applying treatment efficiency from Table 5 and EQN 17:

$$C_{o,2A} = 805{,}184 \frac{\text{pCi}}{\text{L}} \cdot (1 - 0.993081) = 5{,}571 \frac{\text{pCi}}{\text{L}}$$

3. Phase 2B, Silo 2 Mining

a) Silo 1 Headspace

Following Silo 1 mining in Phase 2A, no ventilation of Silo 1 will be conducted. No ^{222}Rn contribution will be derived from this vessel.

b) Tank TTA 1A and 1B Emissions

During Phase 2B, these vessels will be filled and will exhibit headspace concentrations of ^{222}Rn of 272,500 pCi/L (see §V.B.2.b, Table 10).

c) Tank TTA 2A and 2B Emissions

During Phase 2B, these vessels will be filled and will exhibit headspace concentrations of ^{222}Rn of 150,246 pCi/L (see §V.B.2.b, Table 10).

d) Silo 2 Headspace

In the manner of §V.B.2.c, the initial and final Silo 2 gas space volumes from Tables 7 and 11 are:

V_{Init} = 1.27E+06 L

V_{Final} = 4.428E+06 L.

Applying EQN 28 with Table 9 concentrations and Assumption 8 dimensions:

$$EQN\,28 \Rightarrow E_{Silo2,2B} = \frac{263{,}000\,\text{pCi}}{\text{g}} \cdot \frac{0.6\text{pCi}^{222}\text{Rn/m}^2\text{s}}{\text{pCi/g}} \cdot 1.5 \cdot \left(\frac{80\text{ft}}{2} \cdot \frac{0.3048\text{m}}{\text{ft}}\right)^2 \cdot \pi \cdot \frac{60s}{\text{min}}$$

$$E_{Silo2,2B} = 6.63207E+09\,\frac{\text{pCi}}{\text{min}}$$

Applying EQN 22 from V_{init} to V_{final}, the ^{222}Rn headspace concentration varies as tabulated in Table 14. Q is provided in Table 2.

For conservative purposes, the radon concentration of Table 14 corresponding to V = 1.5E6 L is chosen. This volume corresponds to the volume when the clay cap is removed.

Table 14: Silo 2, Phase 2B ^{222}Rn Headspace Concentration

V(L)	C (pCi ^{222}Rn/L)
1.27E+06	916,147
1.50E+06	912,497
2.00E+06	904,662
2.50E+06	896,960
3.00E+06	889,388
4.00E+06	874,622
4.40E+06	868,852

e) Phase 2B Gas Treatment

The composite gas stream in Phase 2B, from §§V.B.3.b, V.B.3.c, V.B.3.d, and Table 2 are summarized in Table 15. The combined Table 15 treatment stream to the chiller is found through EQN 29 to be 445,081 pCi/L.

The chiller outlet and carbon bed inlet concentration is:

$$EQN15 \Rightarrow C_{222Rn,Out,2B} = 1.1010 \cdot 445{,}081.1 \frac{\text{pCi}}{\text{L}} = 490{,}036.2 \frac{\text{pCi}}{\text{L}}$$

Table 15: Phase 2B Gas Streams		
Vessel	Q (ft^3/min)	C (pCi ^{222}Rn/L)
Silo 2	250	912,497
TTA 1A	125	272,500
TTA 1B	125	272,500
TTA 2A	125	150,246
TTA 2B	125	150,246
Total	750	445,081.1

Applying treatment efficiency from Table 5 and EQN 17:

$$C_{o,2A} = 490{,}036.2 \frac{\text{pCi}}{\text{L}} \cdot (1 - 0.993081) = 3{,}390.56 \frac{\text{pCi}}{\text{L}}$$

4. Phase 2C, TTA Ventilation

During Phase 2C, neither silo will contribute to the ventilation stream. The TTA components will contribute as described in §§V.B.3.b and V.B.3.c and Table 2. These conditions are summarized in Table 16, with a composite gas stream concentration through EQN 28 of 211,373 pCi/L.

Table 16: Phase 2C Gas Streams		
Vessel	Q (ft^3/min)	C (pCi ^{222}Rn/L)
TTA 1A	125	272,500
TTA 1B	125	272,500
TTA 2A	125	150,246
TTA 2B	125	150,246
Total	500	211,373.3

The chiller outlet and carbon bed inlet concentration is:

$$EQN\,15 \Rightarrow C_{222Rn,Out,2C} = 1.1010 \cdot 211{,}373.3\frac{\text{pCi}}{\text{L}} = 232{,}722.9\frac{\text{pCi}}{\text{L}}$$

Applying treatment efficiency from Table 5 and EQN 17:

$$EQN\,17 \Rightarrow C_{o,2C} = 232{,}722.9\frac{\text{pCi}}{\text{L}} \cdot (1 - 0.999425) = 133.81\frac{\text{pCi}}{\text{L}}$$

5. Phase 3, Future Waste Treatment Facility (FWTF) Operations and TTA Ventilation

During Phase 3, a treatment plant for the silos wastes returns a gas stream (Assumption 14) at 500 cfm with 420,000 pCi ^{222}Rn/L. As the radon must be sourced, one may infer that at least one of the TTA vessels have been, or are undergoing, mining.

The concentration of gases during TTA mining may be evaluated on the basis of the headspace volume and EQNs 22 and 28.

Assumptions 7, 10, 15, and V_{min} of §V.B.2.b yield a gas space volume minimum of a TTA tank under mining as **V = 568,755 L**.

For mining of Silo 1 wastes (TTA 1A or 1B), EQN 27 may be applied as in §V.B.2.c based upon Table 9 and Assumption 16:

$$EQN\,28 \Rightarrow E_{TTA1A/B,3} = \frac{477{,}000\,\text{pCi}\,^{226}\text{Ra}}{\text{g}} \cdot \frac{0.6\,\text{pCi}\,^{222}\text{Rn/m}^2\text{s}}{\text{pCi}\,^{226}\text{Ra/g}} \cdot 1.5 \cdot \left(\frac{66\text{ft}}{2} \cdot \frac{0.3048\,\text{m}}{\text{ft}}\right)^2 \cdot \pi \cdot \frac{60\text{s}}{\text{min}}$$

$$E_{TTA1A/B,3} = 8.18691E+9\frac{\text{pCi}}{\text{min}}$$

And

$$EQN\,22 \Rightarrow C_{TTA1A/B,3} = \frac{E/V}{\left(\lambda + \frac{Q}{V}\right)} = \frac{8.18691\text{E9}\,\text{pCi/min/568,755L}}{\left(\frac{1.2589\text{E}-4}{\text{min}} + \frac{(125\text{ft}^3/\text{min})\cdot(28.317\text{L/ft}^3)}{568{,}755\text{L}}\right)} = 2{,}267{,}082\frac{\text{pCi}}{\text{L}}$$

Comparably, for Silo 2 waste (TTA 2A or 2B):

$$EQN\,28 \Rightarrow E_{TTA2A/B,3} = \frac{263{,}000\,\text{pCi}^{226}\text{Ra}}{\text{g}} \cdot \frac{0.6\,\text{pCi}^{222}\text{Rn/m}^2\text{s}}{\text{pCi}^{226}\text{Ra/g}} \cdot 1.5 \cdot \left(\frac{66\text{ft}}{2} \cdot \frac{0.3048\,\text{m}}{\text{ft}}\right)^2 \cdot \pi \cdot \frac{60\,\text{s}}{\text{min}}$$

$$E_{TTA2A/B,3} = 4.5139\text{E}+9\,\frac{\text{pCi}}{\text{min}}$$

And

$$EQN\,22 \Rightarrow C_{TTA2A/B,3} = \frac{E/V}{\left(\lambda + \frac{Q}{V}\right)} = \frac{4.51395\text{E}9\,\text{pCi/min/568{,}755L}}{\left(\frac{1.2589\text{E}-4}{\text{min}} + \frac{(125\,\text{ft}^3/\text{min})\cdot(28.317\,\text{L/ft}^3)}{568{,}755\,\text{L}}\right)} = 1{,}249{,}985\,\frac{\text{pCi}}{\text{L}}$$

As it is uncertain which vessel will be mined first, parametric analysis using EQNs 29 and 28 result in the generation of Table 17. Supporting data is extracted from Table 16 and Assumption 14.

Table 17: Phase 3 Parametric Analysis

Q, Gas Flows (ft^3/min)							Gas Conc. (pCi ^{222}Rn/L)	
FWTF	TTA 1A	TTA 1B	TTA 2A	TTA 2B	Sum	Mining	Chiller $C_{t,in}$	Carbon Beds C_{out}
500	125	125	125	125	1,000	None	315,687	8,338.0
500	**125**	**125**	**125**	**125**	**1,000**	**TTA 1A**	**565,009**	**14,923.2**
500	**125**	**125**	**125**	**125**	**1,000**	**TTA 1B**	**565,009**	**14,923.2**
500	125	125	125	125	1,000	TTA 2A	453,154	11,968.8
500	125	125	125	125	1,000	TTA 2B	453,154	11,968.8
500	125	125	125	0	875	TTA 2A	496,426	7,695.5
500	125	0	125	125	875	TTA 1A	606,796	9,406.4
500	125	0	0	125	750	TTA 1A	682,888	5,201.9
500	125	0	0	0	625	TTA 1A	789,416	2,223.9
500	0	125	125	125	875	TTA 2A	478,962	7,424.7
500	0	0	125	0	625	TTA 2A	585,997	1,650.9
500	0	0	0	0	500	None	420,000	266.1

The variance of flow rates and mining activities indicate that the peak concentrations of Table 17 are when only TTA 1A or 1B remains and is being mined. However, in terms of consequence down stream, the highest consequence is seen if all TTA tanks remain and either TTA 1A or 1B is being mined. This is due to treatment efficiency degradation at higher flow rates. Therefore, this highest consequence case is chosen as most conservative (C_{out} = 14,923 pCi/L).

6. Summary of ^{222}Rn Source and Concentration Calculations

Gas stream rates and concentrations are collected in Table 18. Carbon Bed effluents are collected in Table 19.

Table 18: Gas Stream Rates and Concentrations

Vessel	Silo 1	Silo 2	TTA 1A	TTA 1B	TTA 2A	TTA 2B	FWTF	Sum
Phase	Gas Stream Rates (ft^3/min)							
1	250	250	0	0	0	0	0	500
2A	250	250	125	125	0	0	0	750
2B	0	250	125	125	125	125	0	750
2C	0	0	125	125	125	125	0	500
3	0	0	125	125	125	125	500	1,000
Phase	Gas Stream ^{222}Rn (pCi/L)							
1	252,292	249,715	0	0	0	0	0	251,146
2A	1,665,166	256,288	272,500	272,500	0	0	0	731,318
2B	0	912,497	272,500	272,500	150,246	150,246	0	445,081
2C	0	0	272,500	272,500	150,246	150,246	0	211,373
3	0	0	2,267,082	272,500	150,246	150,246	420,000	565,009

Table 19: Carbon Bed Effluents

Phase	Q_{out} (ft^3/min)	C_{out} (pCi ^{222}Rn/L)
1	454.13	159.04
2A	681.19	5,571
2B	681.19	3,390.40
2C	454.13	133.93
3	908.25	14,923.21

Table 18 and 19 values may increase slightly as a function of recycle in spreadsheet application. Table 18 values provide kernels for the recycle. However, as the effluents from the carbon beds do not exceed approximately 1% of the inlet, even complete recycle will result in less than 1% growth.

C. Condensate ^{222}Rn Concentrations

Sections V.A.2 and V.A.3 provide for calculation of the quantity and activity of condensates from the chiller. Given the continuous nature of collection, short half-life of ^{222}Rn, and the (See Assumption 6) time of aggregation and decay, the majority of the radon will have decayed at the time of discharge.

During the time of collection, the rate of change of ^{222}Rn in the condensate is:

000170

$$dA = (Q_{COND} \cdot C_{COND})dt - \lambda A dt \qquad \text{(EQN 30)}$$

Integrating this equation over t = 0 to t_1 with the boundary condition that A = 0 at t = 0,

$$A_{t_1} = \frac{Q_{COND} \cdot C_{COND}}{\lambda} - e^{\left(\lambda \cdot t_1 - \ln\left(\frac{Q_{COND} \cdot C_{COND}}{\lambda}\right)\right)} \qquad \textbf{(EQN 31)}$$

where:

t_1	=	End of condensate collection interval, hr
A_{t1}	=	Activity in condensate collected by time t_1, pCi
Q_{COND}	=	Condensate collection rate, L/hr
C_{COND}	=	Condensate activity at collection, pCi/L
λ	=	^{222}Rn decay constant, 7.5536E-3/hr

Following the period of condensate collection, the collected activity will simply decay until the condensate is discharged such that

$$A_{t_2} = A_{t_1} \cdot e^{-\lambda(t_2 - t_1)} = \left(\frac{Q_{COND} \cdot C_{COND}}{\lambda} - e^{\left(\lambda \cdot t_1 - \ln\left(\frac{Q_{COND} \cdot C_{COND}}{\lambda}\right)\right)}\right) \cdot e^{-\lambda(t_2 - t_1)}$$

(EQN 32)

As EQN 32 is linear with respect to the product ($Q_{COND} \cong C_{COND}$) one may assume a unit value for this product (1 pCi/hr) whereupon the activity is a simple product. For Assumption 6 durations of t_1 = 20 days (480 hours) and t_2 = 35 days (840 hours), the activity in the collected condensate at the time of discharge is:

$$A_d = 8.4948\,\text{hr} \cdot \left(Q_{COND} \cdot C_{COND} \frac{\text{pCi}}{\text{hr}}\right) [=]\ \text{pCi} \qquad \textbf{(EQN 33)}$$

where:

A_d	=	^{222}Rn activity in discharged condensate, pCi

The meaning of EQN 33 is that over the 20 days of collection of unit ^{222}Rn activities and 15 days of decay, 8.4948 units of ^{222}Rn activity remain to be discharged with the collected condensate.

The decayed activity of the condensate is evaluated using EQNs 8 and 9 => QCOND; EQN 10 => C_{COND} (as collected); Q is total Q_{COND} over 20 days (See Assumption 6); EQN 33 => A_d. The concentration $C_{Discharge} = A_d/Q$. The results of these calculations, using Table 4 and Table 18 input are provided in Table 20.

Table 20: Discharge Condensate ^{222}Rn Concentration

Phase	Q_{in} (ft^3/min)	C_{in} (pCi/L)	Q_{Cond} (L/min)	C_{Cond} (pCi/L)	A_d (pCi)	Q (L)	$C_{Discharge}$ (pCi/L)
1	500	251,146	0.2950	138,124	2.077E+07	8,497	2,443.9
2A	750	731,318	0.4425	401,353	9.054E+07	12,745	7,121.2
2B	750	445,081	0.4425	244,872	5.523E+07	12,745	4,333.6
2C	500	211,373	0.2950	116,292	1.749E+07	8,497	2,058.1
3	1000	565,009	0.5900	310,854	9.348E+07	16,993	5,501.3

Check Calculation of ^{222}Rn Equilibrium Coefficient

Reference 7 provides the Henry's Law coefficient (K) of ^{222}Rn as 2,260 atm.

Basis: 1 Ci ^{222}Rn/L in the gas

$$SpA = \frac{\ln(2)}{t_{1/2}} \cdot \frac{N_{Avg}}{MW} \cdot \frac{Ci \cdot s}{3.7E10 dis} = 153{,}841.7 \frac{Ci}{g}$$

Gas Phase Pressure:

$$P = \frac{1Ci}{L} \cdot \frac{g}{153{,}841.7Ci} \cdot \frac{mol}{222g} \cdot \frac{22.4L \cdot atm}{mol} = 6.558747E-7\,atm$$

Henry's Law: P = K X (X = liquid phase concentration)

$$\therefore X = \frac{6.558747E-7\,atm}{2260\,atm} = 2.9021E-10 = \frac{n\,(atoms)\,solute}{n\,(molecule)\,solvent}$$

For 1 liter of water:

$$n\,(molecule)\,solvent = 1L \cdot \frac{1000g}{L} \cdot \frac{mol}{18.0152g} \cdot \frac{6.02252E23\ molecule}{mol} = 3.343021E25\,molecules$$

$$n^{222Rn} = X \cdot n\,(molecule)\,solvent = (2.9021E-10) \cdot (3.343021E25) = 9.7101784E15\,atoms$$

$$\therefore \frac{Ci\,^{222}Rn/L\,water}{Ci\,^{222}Rn/L\,air} = \frac{9.7101784E15\,atoms}{L} \cdot \frac{mol}{6.02252E23\,atoms} \cdot \frac{222g}{mol} \cdot \frac{153{,}841.7\,Ci}{g} = 0.5501744$$

D. Consequences of ^{222}Rn Stack Emissions

Evaluations of this section are intended to provide the transforms necessary to evaluate process releases of ^{222}Rn in relation to stated limits described in Table 1.

1. General Exposure Evaluation

The consequences of ^{222}Rn stack release from the RCS is a function of the:

- Activity and flow rate from the RCS to the stack,
- Building ventilation entering the stack,
- Height and exit diameter of the stack, and
- Gaseous dispersion.

The total stack flow rate is:

$$Q_{stack} = Q_{bld} + Q_{RCS} \; [=] \; \frac{m^3}{s} \qquad \text{(EQN 34)}$$

Where:

Q_{stack} = Stack effluent rate, m^3/s
Q_{bld} = Building ventilation rate, m^3/s
Q_{RCS} = RCS discharge to the stack, m^3/s

Under most conditions of operation, Q_{RCS} is a fraction of the gas leaving the carbon beds as that flow, and its ^{222}Rn concentration, will be modified by makeup air and return of air to the silos or TTA vessels.

As the active vessels and equipment are operated under partial vacuum, the building gas radon concentration may be neglected and the stack ^{222}Rn concentration expressed as:

$$C_{stack} = \frac{C_{RCS} \cdot Q_{RCS}}{Q_{stack}} \; [=] \; \frac{pCi}{m^3} \qquad \text{(EQN 35)}$$

The ^{222}Rn atmospheric concentration at a point of exposure is:

$$C_{atm} = C_{stack} \cdot Q_{stack} \cdot \chi/Q \; [=] \; \frac{pCi}{m^3} \qquad \text{(EQN 36)}$$

Where:

C_{atm} = Atmospheric concentration at a given point, pCi/m^3
χ/Q = Atmospheric dispersion coefficient for a specified weather condition, distance, and direction, s/m^3

With the determination of appropriate χ/Q values, atmospheric concentrations at points of exposure may be evaluated and compared to limits of Table 1.

2. Definition of Limits

As defined in Table 1, the off-site exposure limit is 0.5 pCi ^{222}Rn/L at a range of 350 m. On-site exposure limits are in terms of "Working Levels" (WL). Reference 11 provides that:

> *Working Level (WL) is any combination of short-lived radon daughters (for radon-222: polonium-218, lead-214, bismuth-214, and polonium-214...) in 1 liter of air that will result in the ultimate emission of 1.3x10^5 MeV of potential alpha particle energy.*

To appropriately describe WL units to a comparison of EQN 36 results, WL must be converted to an equivalent expression of ^{222}Rn concentration.

Application of the WL definition was presaged within Reference 12 to describe that the worker exposure hazard primarily lies in the concentration of the radon daughters in the air, rather than simply of the radon, because of inhalation and body uptake of the solid daughters. As described in Reference 12, and because of gaseous filtration in the RCS, a filtered gas stream is no longer in equilibrium between ^{222}Rn and its daughters. By Assumption 19, the daughters can be considered negligible following treatment and one must determine the activity of the daughters at the time of exposure due to their ingrowth.

Applying the commercial program RADDECAY (Grove Engineering, Reference 13) to a chosen unit release of 1 Ci of ^{222}Rn with a decay time of 200 seconds (Assumption 17, distance/velocity), the daughter alpha energy attributed by such a release may be determined as in Table 21.

Table 21: Daughter Alpha Energy Per Initial Ci ^{222}Rn (200s decay)

Unit	Isotope						Ref.
	^{222}Rn	^{218}Po	^{214}Pb	^{214}Bi	^{214}Po	Total	
Ci at t=200s	0.99958	0.53106	0.024985	0.0010026	0.0010024		13
SpA (Ci/g)	1.54E+05	2.83E+08	3.28E+07	4.46E+07	3.21E+14		3
MW	222	218	214	214	214		3
g	6.50E-06	1.88E-09	7.62E-10	2.25E-11	3.12E-18		
atoms	1.76E+16	5.19E+12	2.14E+12	6.33E+10	8.78E+03		
Daughter Alpha (MeV/atom)		13.6898014	7.689801	7.688462	7.688462		14
Daughter Alpha (MeV/Ci ^{222}Rn Initial)		7.10E+13	1.65E+13	4.86E+11	6.75E+04	8.80E+13	

As developed in Table 21, with regard to Reference 11, a gas stream with a concentration of 1 Ci ^{222}Rn/L at release (and at the release point) will result in a 200 s alpha potential of:

$$WL = \frac{\alpha(\text{MeV/Ci/L Initial})}{1.3\text{E5 MeV/WL}} = \frac{8.8\text{E13}}{1.3\text{E5}} = \frac{6.769\text{E8 WL}}{\text{Ci } ^{222}\text{Rn Initial/L}} \qquad \text{(EQN 37)}$$

The atmospheric concentrations corresponding to the WL limits of Table 1 may be derived as:

$$C_{atm,0.2WL} = \frac{0.2\,WL}{\left(\dfrac{6.769\text{E8 WL}}{\text{Ci } ^{222}\text{Rn Initial/L}}\right)} \cdot \frac{10^{12}\,\text{pCi}}{\text{Ci}} = 295.5\,\frac{\text{pCi}}{\text{L}} \qquad \text{(EQN 38)}$$

and

$$C_{atm,0.02WL} = \frac{0.02\,WL}{\left(\dfrac{6.769\text{E8 WL}}{\text{Ci } ^{222}\text{Rn Initial/L}}\right)} \cdot \frac{10^{12}\,\text{pCi}}{\text{Ci}} = 29.55\,\frac{\text{pCi}}{\text{L}} \qquad \text{(EQN 39)}$$

With these transformations, Table 1 values may be expressed as represented in Table 22.

Table 22: Ambient Air Limitations

Location	Distance (m)	Limit
Off-Site	350	0.5 pCi ^{222}Rn/L
On-Site	100	295.5 pCi ^{222}Rn/L, instantaneous
On-Site	100	29.55 pCi ^{222}Rn/L, weekly average

3. On-Site Dispersion Coefficients

On-site consequences and compliance with the limits of Table 22 require that χ/Q values be developed for application in EQN 34. The atmospheric conditions for instantaneous exposure limits (See Assumption 17) for this analysis are those of an inversion engendered fumigation (Pasquille Class G – very stable).

Reference 15 provides χ/Q for fumigation as:

$$\chi/Q = \frac{EXP\left[\dfrac{-y^2}{2\sigma_{y,G}^2}\right]}{(2\pi)^{1/2} \cdot H\,\sigma_{y,G} \cdot \bar{u}} \quad [=] \quad \frac{s}{m^3} \qquad \text{(EQN 40)}$$

Where:

y = crosswind distance, y = 0 at center of plume, m

$\sigma_{y,G}$ = Horizontal dispersion parameter, Class G, m

H = Height of inversion lid, m
u = mean inverse wind speed, m/s

Table 11.3.3 of Reference 15 provides that $\sigma_{y,G}$. 2/3 $\sigma_{y,F}$. Figure 11.3-3 (See Ref. 15) provides $\sigma_{y,F}$ versus distance, wherein $\sigma_{y,F}$ (100m) = 4m. Thus,

$$\sigma_{y,G} = \frac{2}{3}\sigma_{y,F} = \frac{2}{3}(4m) = \frac{8}{3}m \qquad \text{(EQN 41)}$$

Substituting y = 0, u = 0.5 m/s, and H = 200 ft (See Assumption 17) and $\sigma_{y,G}$ into EQN 40:

$$\chi/Q_{Onsite.inst.} = \frac{\mathrm{EXP}\left[\frac{-(0)^2}{2\left(8/3\right)^2}\right]}{(2\pi)^{1/2}\cdot\left(200\mathrm{ft}\cdot\frac{0.3048\mathrm{m}}{\mathrm{ft}}\right)\left(8/3\,\mathrm{m}\right)\left(\frac{0.5\mathrm{m}}{\mathrm{s}}\right)} = 4.9082sE-03\frac{s}{\mathrm{m}^3}$$

This result may be applied before establishment of actual gas rates and concentrations to determine allowed release rates by reforming EQN 36 as:

$$C_{stack}\cdot Q_{stack} = \frac{C_{atm}\left(\frac{\mathrm{pCi}}{\mathrm{L}}\right)}{\chi/Q\left(\frac{\mathrm{s}}{\mathrm{m}^3}\right)\cdot\left(\frac{\mathrm{m}^3}{1000\mathrm{L}}\right)}\ [=]\ \frac{\mathrm{pCi}}{\mathrm{s}} \qquad \text{(EQN 42)}$$

Application of EQN 42 for instantaneous release and on-site exposure limits yields:

$$\left(C_{stack}\cdot Q_{stack}\right)_{0.2WL} = 6.020\,E7\,\mathrm{pCi/s}$$

Weekly average limits for on-site workers may be established based upon a χ/Q applicable to such exposure. For the purposes of weekly average exposures, the atmospheric conditions for this analysis are those of a Table meteorology (Pasquille Class F).

Reference 16 (Screen3 model) provides the capability to evaluate low-level hourly exposure to contaminants released to the atmosphere. Application of the Screen3 model (see Ref. 16) with the input parameters of Table 23 results in a hourly χ/Q of :

$$\chi/Q_{On-site,hourly} = \frac{54.89\frac{\mu g}{m^3}}{1\frac{g}{s}\cdot 10^6\frac{\mu g}{g}} = 5.489E-05\frac{s}{m^3} \qquad \textbf{(EQN 43)}$$

Table 23: Silos 1 & 2 AWR Screen3 Model Inputs	
Simple Terrain Inputs	Input Value
Source Type	Point
Emission Rate (g/s)	1.000
Stack Height (m)	45.72
Stack Inside Diameter (m)	0.6096
Stack Exit Velocity (m/s)	1.6170
Stack Gas Exit Temperature (K)	293.0
Ambient Air Temperature (K)	293.0
Receptor Height (m)	0.0000
Urbal/Rural Option	Rural
Building Height (m)	18.29
Minimum Horizontal Building Dimension (m)	48.77
Maximum Horizontal Building Dimension (m)	48.77

To consider weekly averaged exposures, one must adjust the hourly dispersion factor to address the site meteorological joint frequency distribution. Equations D and H of Table 11.3.1.1 (see Ref. 15) provide instantaneous and long-term sector-averaged expressions of χ/Q from elevated sources. The ratio of these equations provides a factor to account for the varying wind conditions as:

$$\frac{\chi/Q_{Long-term,sector-avg}}{\chi/Q_{Instantaneous}} = \sqrt{\frac{2}{\pi}}\cdot\sigma_{y,F}\cdot\frac{0.01f}{2\left(x/n\right)} = 0.0306_4 \qquad \textbf{(EQN 44)}$$

Where:

f	=	sector frequency, maximum = 12% (see Ref. 1e)
x	=	distance, 100 m
n	=	wind sectors (16)

The appropriate weekly χ/Q for weekly average exposures may be evaluated from EQNs 43 and 44 as:

$$\chi/Q_{Onsite,weekly} = \chi/Q_{hourly} \cdot 0.03064 = 1.682E-06 \frac{s}{m^3} \qquad \text{(EQN 45)}$$

Application of EQN 42 for weekly average release and on-site exposure limits yields:

$$\left(C_{stack} \cdot Q_{stack}\right)_{0.02WL} = 1.757E+09 \text{ pCi/s}$$

This section's results are applied to design basis gas streams in §V.D.5, below.

4. Off-Site Dispersion Coefficients

Reference 17 (CAP88-PC model) provides the capability to evaluate low-level chronic exposure to radionuclides released to the atmosphere.

Application of CAP88-PC for the Fernald Silos AWR Project with the Table 24 inputs results in a matrix of χ/Q values for varied directions and distances provided in Table 25.

4From Table 25, the greatest χ/Q is chosen to represent the direction and distance of the greatest off-site dose consequence. Thus, χ/Q for off-site application in EQN 36 is $\chi/Q_{off\text{-}site}$ = 5.020 E-07 s/m^3.

Table 24: CAP88-PC Inputs	
Run Options	Individual type; create χ/Q table
Met. Data	Wind File 93814 (Covington, Greater Cincinnati)
Source Data	Stack, 45.72 m (150 ft); 0.93 m (3 ft) diameter; momentum plume rise at 6.18 m/s (~8,600 ft^3/min)
Agri. Data	Rural, default
Nuclide Data	Rn-222, 1 Ci/yr

Table 25: Off-Site CAP88-PC χ/Q Results (s/m^3)

Dir	Distance (meters)					
	250	350	500	700	750	1500
N	2.253E-07	3.019E-07	3.831E-07	4.453E-07	4.507E-07	3.352E-07
NNW	1.430E-07	1.768E-07	1.961E-07	2.054E-07	2.047E-07	1.412E-07
NW	1.108E-07	1.394E-07	1.575E-07	1.663E-07	1.660E-07	1.147E-07
WNW	1.379E-07	1.740E-07	1.913E-07	1.963E-07	1.947E-07	1.303E-07
W	2.512E-07	3.092E-07	3.312E-07	3.325E-07	3.289E-07	2.162E-07
WSW	1.641E-07	2.066E-07	2.221E-07	2.203E-07	2.172E-07	1.393E-07
SW	1.665E-07	1.989E-07	2.134E-07	2.182E-07	2.165E-07	1.434E-07
SSW	1.363E-07	1.701E-07	1.907E-07	2.009E-07	2.001E-07	1.351E-07
S	2.156E-07	2.832E-07	3.433E-07	3.830E-07	3.847E-07	2.708E-07
SSE	1.348E-07	1.650E-07	1.866E-07	1.976E-07	1.968E-07	1.313E-07
SE	1.282E-07	1.660E-07	2.072E-07	2.364E-07	2.377E-07	1.647E-07
ESE	1.737E-07	2.248E-07	2.808E-07	3.180E-07	3.191E-07	2.151E-07
E	2.577E-07	3.414E-07	4.224E-07	4.724E-07	4.734E-07	3.208E-07
ENE	2.009E-07	2.666E-07	3.149E-07	3.375E-07	3.363E-07	2.255E-07
NE	2.391E-07	3.541E-07	4.508E-07	5.010E-07	**5.020E-07**	3.503E-07
NNE	2.088E-07	2.961E-07	3.913E-07	4.619E-07	4.681E-07	3.530E-07
Max	2.577E-07	3.541E-07	4.508E-07	5.010E-07	**5.020E-07**	3.530E-07
Max. Dir.	NNE	NE	NE	NE	NE	NNE

5. Design Basis Emission Consequences

Assumption 5 provides that building ventilation will be 9310 ft^3/min. Design choice of makeup air supply places the makeup air entry into the treated gas stream before diversion to the TTA/silos or stack. This configuration is in contradiction to Assumption 9. However, calculations of §V.A.5 demonstrate that recirculation of treated gas may be neglected in hand calculation of TTA discharge gas. In spreadsheet-based calculations, the recycle may be easily implemented with the results for all phases of operation provided in §V.E., below. Using this recycle, the developments of §§V.A–V.C, above, and selection of RCS bleeds to the stack provide input to Table 26 (C_{RCS}, Q_{RCS}, Q_{stack}, C_{stack}). Application of EQNs 34, 35, and 36 yield the results of Table 26.

Table 26 C_{RCS} values are seen to be lower than those of Table 19. These reductions are because of the placement and selection of makeup air rates.

Table 26: Silos 1 & 2 AWR Design Basis Exposure, ^{222}Rn

Exposure Basis					On-Site (instant.)	On-Site (weekly avg.)	Off-Site
Limit (pCi ^{222}Rn/L)					295.5	29.55	0.5
χ/Q (s/m^3)					4.91E-03	1.68E-06	5.020E-07
RCS Phase	C_{RCS} (pCi/L)	Q_{RCS} (ft^3/min)	Q_{stack} (ft^3/min)	C_{stack} (pCi/L)	C_{atm} (pCi/L)		
1	159.13	50	9,360	0.85	0.018	6.32E-06	1.89E-06
2A	5,570.81	525	9,835	297.38	6.775	2.32E-03	6.93E-04
2B	3,390.40	750	10,060	252.77	5.890	2.02E-03	6.02E-04
2C	133.93	500	9,810	6.83	0.155	5.31E-05	1.59E-05
3	14,923.21	979	10,289	1419.98	33.843	1.16E-02	3.46E-03

Table 26 results and limits demonstrate compliance with allowable emissions of ^{222}Rn regarding worker and public exposure.

E. Design Selections and Calculation Implementation

Tables 27a-31c (a, b, and c for each phase), below provide the material balances for the RCS operations across all phases of normal operation. Calculations are conducted in accordance with the development provided in this analysis. Where gas streams are being recycled, some values of concentrations will be notable to the reviewer as differing from specific values calculated above; such deviation is because of the recycling component accounted within the interative recycle calculations and heat supplied to the air by the fan at 10 hp (Break Horse Power basis) per 1000 ft^3/min. Stream numbers on Tables 27a-31c are those of process flow diagrams associated with the RCS and associated HVAC contributions (see Ref.s 18 and 19).

PHASE 1

Table 27a: Phase 1 RCS Material Balance

STREAM NUMBER	1	2	3	4	5	6	6a
COMPONENT	AIR FLOW FROM SILO 1	AIR FLOW FROM SILO 2	AIR FLOW FROM TTA	AIR TO CHILLER	AIR TO CARBON BED	AIR FROM CARBON BED	FAN INLET (TREATED GAS + FAN RECYCLE + MAKEUP)
AIR (LBS/HR)	1,081	1,081	--	2,161	2,161	2,161	2,919
WATER (LBS/HR)	20	20	--	41	2	2	2
TOTAL, (LBS/HR)	1,101	1,101	--	2,202	2,163	2,163	2,921
FLOW (CFM)	250	250	--	500	454	454	649
FLOW (GPM)	--	--	--				
RADON (PICOCURIES/L)	252,435	249,858	--	251,146	276,513	159	159
RADON (CURIES/HR)	0.107	0.106	--	0.213	0.213	0.0001228	0.0001754
TEMPERATURE (DEG F)	75	75	--	75	36	40	51
PRESSURE (INCHES WC)	--	--	--	--	--	--	--
NOTES	RELATIVE HUMIDITY=100%. RADON CONCENTRATION STEADY STATE	RELATIVE HUMIDITY =100%. RADON CONCENTRATION STEADY STATE	TTA NOT FUNCTIONAL IN PHASE 1	FLOW REPRESENTS SILOS 1 AND 2	CHILLER CONDITIONS AIR TO 36F AND 15% RELATIVE HUMIDITY	RADON REMOVAL BASED ON K=10.5 AND 4 CARBON BEDS	FLOW IS CARBON BED EXHAUST PLUS FAN RECYCLE FLOW + MAKEUP AIR. INCL. FAN HEAT

PHASE 1

Table 27b: Phase 1 RCS Material Balance

STREAM NUMBER	7	8	9	9A	10	11	12
COMPONENT	AIR TO SILO 1	AIR TO SILO 2	MAKEUP AIR TO TTA	RECYCLE AIR TO TTA	CONDENSATE TO HOLD-UP TANKS	AIR FROM FUTURE WASTE TREATMENT AREA	RCS TO STACK
AIR (LBS/HR)	976	976	--	--	--	--	210
WATER (LBS/HR)	1	1	--	--	39.0	--	0
TOTAL, (LBS/HR)	977	977	--	--	39.0	--	210
FLOW (CFM)	225	225	--	--	--	--	50.0
FLOW (GPM)	--	--	--	--	0.08	--	
RADON (PICOCURIES/L)	159	159	--	--	138,174	--	159
RADON (CURIES/HR)	0.0000608	0.0000608	--	--	0.00000245	--	0.00001352
TEMPERATURE (DEG F)	73.1	73.1	--	--	40	--	73.1
PRESSURE (INCHES WC)	--	--	--	--	--	--	--
NOTES			TTA NOT FUNCTIONAL IN PHASE 1	TTA NOT FUNCTIONAL IN PHASE 1		FUTURE WASTE TREATMENT AREA NOT FUNCTIONAL IN PHASE 1	RELATIVE HUMIDITY=4.4 %

PHASE 1

Table 27c: Phase 1 RCS Material Balance

STREAM NUMBER	13	14	15	16	17	18	19	20
COMPONENT	BUILDING VENT TO STACK	AIR TO STACK	FAN RECYCLE FLOW	MAKE-UP AIR	CONDENSATE TO FILTRATE TANKS	EQUIPMENT ENCLOSURE AIR INFLOW	EQUIPMENT ENCLOSURE AIR INFLOW	EQUIPMENT ENCLOSURE AIR INFLOW
AIR (LBS/HR)	40,219	40,436	758	--		--	--	--
WATER (LBS/HR)	757	757	0.0	--	12,519	--	--	--
TOTAL, (LBS/HR)	40,976	41,193	758	--	12,519	--	--	--
FLOW (CFM)	9,310	9,360	175	--		--	--	--
FLOW (GPM)	--	--	--	--	25	--	--	--
RADON (PICOCURIES/L)	--	0.850	159	--	2,445	--	--	--
RADON (CURIES/HR)	--	0.00001352	0.0000473	--	0.0000139	--	--	--
TEMPERATURE (DEG F)	75	75.0	73.1	--	--	--	--	--
PRESSURE (INCHES WC)								
NOTES	NOTE 2	RELATIVE HUMIDITY=99.5%	FLOW ENTERS FAN SUCTION AFTER CARBON BEDS	VARIABLE FLOW AS REQUIRED FOR MAKE-UP AND PRESSURE CONTROL	INTERMITTENT FLOW; DECAYED BY STORAGE	EQUIPMENT ENCLOSURES NOT INSTALLED IN PHASE 1	EQUIPMENT ENCLOSURES NOT INSTALLED IN PHASE 1	EQUIPMENT ENCLOSURES NOT INSTALLED IN PHASE 1

PHASE 2A

Table 28a: Phase 2A RCS Material Balance

STREAM NUMBER	1	2	3	4	5	6	6a
COMPONENT	AIR FLOW FROM SILO 1	AIR FLOW FROM SILO 2	AIR FLOW FROM TTA	AIR TO CHILLER	AIR TO CARBON BED	AIR FROM CARBON BED	FAN INLET (TREATED GAS + FAN RECYCLE + MAKEUP)
AIR (LBS/HR)	1,081	1,081	1,081	3,243	3,243	3,243	4,326
WATER (LBS/HR)	20	20	20	61	3	3	3
TOTAL, (LBS/HR)	1,101	1,101	1,101	3,304	3246	3,244	4,329
FLOW (CFM)	250	250	250	750	681	681	960
FLOW (GPM)	--	--	--	--	--	--	--
RADON (PICOCURIES/L)	1,665,166	256,288	272,500	731,318	805,184	5,571	5,571
RADON (CURIES/HR)	0.707	0.109	0.116	0.932	0.932	0.00645	0.00909
TEMPERATURE (DEG F)	75	75	75	75	36	40	51
PRESSURE (INCHES WC)	--	--	--	--	--	--	--
NOTES	RELATIVE HUMIDITY=100%. RADON CONCENTRATION STEADY STATE	RELATIVE HUMIDITY=100%. RADON CONCENTRATION STEADY STATE	RELATIVE HUMIDITY=100%. RADON CONCENTRATION STEADY STATE	FLOW REPRESENTS SILOS 1 AND 2 PLUS TTA	CHILLER CONDITIONS AIR TO 36F AND 15% RELATIVE HUMIDITY	RADON REMOVAL BASED ON K=10.5 AND 4 CARBON BEDS	FLOW IS CARBON BED EXHAUST PLUS FAN RECYCLE FLOW + MAKEUP AIR. INCL. FAN HEAT

PHASE 2A

Table 28b: Phase 2A RCS Material Balance

STREAM NUMBER	7	8	9	9A	10	11	12
COMPONENT	AIR TO SILO 1	AIR TO SILO 2	MAKEUP AIR TO TTA	RECYCLE AIR TO TTA	CONDENSATE TO HOLD-UP TANKS	AIR FROM FUTURE WASTE TREATMENT AREA	RCS TO STACK
AIR (LBS/HR)	--	976	1,081	--		--	2,267
WATER (LBS/HR)	--	1	20	--	58.5	--	2
TOTAL, (LBS/HR)	--	977	1,101	--	58.5	--	2,269
FLOW (CFM)	--	225	250	--		--	525
FLOW (GPM)	--	--	--	--	0.12	--	--
RADON (PICOCURIES/L)	--	5,571	--	--	402,353	--	5,571
RADON (CURIES/HR)	--	0.002130	--	--	0.0000107	--	0.00497
TEMPERATURE (DEG F)	--	72.7	75	--	40	--	72.7
PRESSURE (INCHES WC)	--	--	--	--		--	--
NOTES	NO RECYCLE FLOW TO SILO1 IN PHASE 2A		NO FLOW IN STREAM 9 DURING RECIRC OF TTA	9A FLOW EQUAL TO STREAM 8 DURING RECIRC OF TTA		FUTURE WASTE TREATMENT AREA NOT FUNCTIONAL IN PHASE 2	RELATIVE HUMIDITY=4.4 %

PHASE 2A

Table 28c: Phase 2A RCS Material Balance

STREAM NUMBER	13	14	15	16	17	18	19	20
COMPONENT	BUILDING VENT TO STACK	AIR TO STACK	FAN RECYCLE FLOW	MAKE-UP AIR	CONDENSATE TO FILTRATE TANKS	EQUIPMENT ENCLOSURE AIR INFLOW	EQUIPMENT ENCLOSURE AIR INFLOW	EQUIPMENT ENCLOSURE AIR INFLOW
AIR (LBS/HR)	40,233	42,511	1,084	--		324	324	324
WATER (LBS/HR)	758	760	0	--	12,519	6	6	6
TOTAL, (LBS/HR)	40,991	43,271	1,084	--	12,519	330	330	330
FLOW (CFM)	9,310	9,835	250	--		75	75	75
FLOW (GPM)	--	--	--	--	25	--	--	--
RADON (PICOCURIES/L)	--	297.4	5,571	--	7,121	--	--	--
RADON (CURIES/HR)	--	0.00497	0.00237	--	0.0000404	--	--	--
TEMPERATURE (DEG F)	75	74.9	72.7	--	--	75	75	75
PRESSURE (INCHES WC)	--	--	--	--	--	--	--	--
NOTES		RELATIVE HUMIDITY=95 .2%		VARIABLE FLOW AS REQUIRED FOR MAKE-UP AND PRESSURE CONTROL	INTERMITTENT FLOW; DECAYED BY STORAGE	SILO 1	SILO 1	SILO 1

PHASE 2B

Table 29a: Phase 2B RCS Material Balance

STREAM NUMBER	1	2	3	4	5	6	6a
COMPONENT	AIR FLOW FROM SILO 1	AIR FLOW FROM SILO 2	AIR FLOW FROM TTA	AIR TO CHILLER	AIR TO CARBON BED	AIR FROM CARBON BED	FAN INLET (TREATED GAS + FAN RECYCLE + MAKEUP)
AIR (LBS/HR)	--	1,081	2,161	3,242	3,242	3,242	4,326
WATER (LBS/HR)	--	20	41	61	3	3	3
TOTAL, (LBS/HR)	--	1,101	2,202	3,303	3,244	3,244	4,329
FLOW (CFM)	--	250	500	750	681	681	960
FLOW (GPM)	--						
RADON (PICOCURIES/L)	--	912,497	211,373	445,081	490,036	3,390	3,390
RADON (CURIES/HR)	--	0.388	0.180	0.567	0.567	0.00392	0.00553
TEMPERATURE (DEG F)	--	75	75	75	36	40	51
PRESSURE (INCHES WC)	--	--	--	--	--	--	--
NOTES	NO FLOW FROM SILO 1 IN PHASE 2B	RELATIVE HUMIDITY =100%. RADON CONCENT RATION STEADY STATE	RELATIVE HUMIDITY= 100%. RADON CONCENTR ATION: STEADY STATE	FLOW REPRESENTS SILOS 1 AND 2 PLUS TTA	CHILLER CONDITIONS AIR TO 36F AND 15% RELATIVE HUMIDITY	RADON REMOVAL BASED ON K=10.5 AND 4 CARBON BEDS	FLOW IS CARBON BED EXHAUST PLUS FAN RECYCLE FLOW + MAKEUP AIR. INCL. FAN HEAT

PHASE 2B

Table 29b: Phase 2B RCS Material Balance

STREAM NUMBER	7	8	9	9A	10	11	12
COMPONENT	AIR TO SILO 1	AIR TO SILO 2	MAKEUP AIR TO TTA	RECYCLE AIR TO TTA	CONDENSATE TO HOLD-UP TANKS	AIR FROM FUTURE WASTE TREATMENT AREA	RCS TO STACK
AIR (LBS/HR)	--	--	2,161	--		--	3,242
WATER (LBS/HR)	--	--	41	--	58.5	--	2
TOTAL, (LBS/HR)	--	--	2202	--	58.5	--	3,244
FLOW (CFM)	--	--	500	--		--	750
FLOW (GPM)	--	--	--	--	0.12	--	
RADON (PICOCURIES/L)	--	--	--	--	244,872	--	3,390
RADON (CURIES/HR)	--	--	--	--	0.0000065	--	0.00432
TEMPERATURE (DEG F)	--	--	75	--	40	--	72.7
PRESSURE (INCHES WC)	--	--	--	--	--	--	--
NOTES	NO RECYCLE FLOW TO SILOS IN PHASE 2B	NO RECYCLE FLOW TO SILOS IN PHASE 2B	NO FLOW IN STREAM 9 DURING RECIRC OF TTA	9A FLOW EQUALS 2X STREAM 8 IN PHASE 2A DURING RECIRC OF TTA		FUTURE WASTE TREATMENT AREA NOT FUNCTIONAL IN PHASE 2B	RELATIVE HUMIDITY=4.4 %

PHASE 2B

Table 29c: Phase 2B RCS Material Balance

STREAM NUMBER	13	14	15	16	17	18	19	20
COMPONENT	BUILDING VENT TO STACK	AIR TO STACK	FAN RECYCLE FLOW	MAKE-UP AIR	CONDENSATE TO FILTRATE TANKS	EQUIPMENT ENCLOSURE AIR INFLOW	EQUIPMENT ENCLOSURE AIR INFLOW	EQUIPMENT ENCLOSURE AIR INFLOW
AIR (LBS/HR)	40,233	43,487	1,084	--	--	324	324	324
WATER (LBS/HR)	758	760	1	--	12,519	6	6	6
TOTAL, (LBS/HR)	40,991	44,247	1,085	--	12,519	330	330	330
FLOW (CFM)	9,310	10,060	250	--	--	75	75	75
FLOW (GPM)				--	25	--	--	--
RADON (PICOCURIES/L)	--	252.8	3,390	--	4,334	--	--	--
RADON (CURIES/HR)	--	0.00432	0.001440	--	0.0000246	--	--	--
TEMPERATURE (DEG F)	75	74.8	72.7	--	--	75	75	75
PRESSURE (INCHES WC)	--	--	--	--	--	--	--	--
NOTES		RELATIVE HUMIDITY=93 .3%		VARIABLE FLOW AS REQUIRED FOR MAKE-UP AND PRESSURE CONTROL	INTERMITTENT FLOW; DECAYED BY STORAGE	SILO 2	SILO 2	SILO 2

PHASE 2C

Table 30a: Phase 2C RCS Material Balance

STREAM NUMBER	1	2	3	4	5	6	6a
COMPONENT	AIR FLOW FROM SILO 1	AIR FLOW FROM SILO 2	AIR FLOW FROM TTA	AIR TO CHILLER	AIR TO CARBON BED	AIR FROM CARBON BED	FAN INLET (TREATED GAS + FAN RECYCLE + MAKEUP)
AIR (LBS/HR)	--	--	2,161	2,161	2,161	2,161	2,919
WATER (LBS/HR)	--	--	41	41	2	2	2
TOTAL, (LBS/HR)	--	--	2,202	2202	2163	2163	2921
FLOW (CFM)	--	--	500	500	454	454	649
FLOW (GPM)	--	--	--	--	--	--	--
RADON (PICOCURIES/L)	--	--	211,373	211,373	232,723	134	134
RADON (CURIES/HR)	--	--	0.180	0.180	0.180	0.0001033	0.0001476
TEMPERATURE (DEG F)	--	--	75	75	36	40	51
PRESSURE (INCHES WC)	--	--	--	--	--	--	--
NOTES	NO FLOW FROM SILO IN PHASE 2C	NO FLOW FROM SILO IN PHASE 2C		FLOW REPRESENTS WTA PLUS TTA	CHILLER CONDITIONS AIR TO 36F AND 15% RELATIVE HUMIDITY	RADON REMOVAL BASED ON K=10.5 AND 4 CARBON BEDS	FLOW IS CARBON BED EXHAUST PLUS FAN RECYCLE FLOW + MAKEUP AIR. INCL. FAN HEAT

PHASE 2C

Table 30b: Phase 2C RCS Material Balance

STREAM NUMBER	7	8	9	9A	10	11	12
COMPONENT	AIR TO SILO 1	AIR TO SILO 2	MAKEUP AIR TO TTA	RECYCLE AIR TO TTA	CONDENSATE TO HOLD-UP TANKS	AIR FROM FUTURE WASTE TREATMENT AREA	RCS TO STACK
AIR (LBS/HR)	--	--	2,161	--	--	--	2,161
WATER (LBS/HR)	--	--	41	--	39.0	--	2
TOTAL, (LBS/HR)	--	--	2,202	--	39.0	--	2,163
FLOW (CFM)	--	--	500	--	--	--	500
FLOW (GPM)	--	--	--	--	0.08	--	--
RADON (PICOCURIES/L)	--	--	--	--	116,292	0	134
RADON (CURIES/HR)	--	--	--	--	0.00000206	0	0.0001138
TEMPERATURE (DEG F)	--	--	75	--	40	--	73.1
PRESSURE (INCHES WC)	--	--	--	--	--	--	--
NOTES	NO FLOW TO SILOS IN PHASE 2C	NO FLOW TO SILOS IN PHASE 2C	NO FLOW IN STREAM 9 DURING RECIRC OF TTA	9A FLOW EQUALS 2X STREAM 8 IN PHASE 2A DURING RECIRC OF TTA		FUTURE WASTE TREATMENT NOT FUNCTIONAL IN PHASE 2C	RELATIVE HUMIDITY=4.4 %

PHASE 2C

Table 30c: Phase 2C RCS Material Balance

STREAM NUMBER	13	14	15	16	17	18	19	20
COMPONENT	BUILDING VENT TO STACK	AIR TO STACK	FAN RECYCLE FLOW	MAKE-UP AIR	CONDENSATE TO FILTRATE TANKS	EQUIPMENT ENCLOSURE AIR INFLOW	EQUIPMENT ENCLOSURE AIR INFLOW	EQUIPMENT ENCLOSURE AIR INFLOW
AIR (LBS/HR)	40,233	42,401	758	--		--	--	--
WATER (LBS/HR)	758	759	0	--	12,519	--	--	--
TOTAL, (LBS/HR)	40,991	43,160	758	--	12,519	--	--	--
FLOW (CFM)	9,310	9,810	175	--		--	--	--
FLOW (GPM)	--	--		--	25	--	--	--
RADON (PICOCURIES/L)	--	6.83	134	--	2,058	--	--	--
RADON (CURIES/HR)	--	0.0001138	0.0000398	--	0.0000117	--	--	--
TEMPERATURE (DEG F)	75	74.9	73.1	--		--	--	--
PRESSURE (INCHES WC)	--	--		--		--	--	--
NOTES		RELATIVE HUMIDITY=95 .4%		VARIABLE FLOW AS REQUIRED FOR MAKE-UP AND PRESSURE CONTROL	INTERMITTENT FLOW; DECAYED BY STORAGE	EQUIPMENT ENCLOSURES NOT INSTALLED IN PHASE 2C	EQUIPMENT ENCLOSURES NOT INSTALLED IN PHASE 2C	EQUIPMENT ENCLOSURES NOT INSTALLED IN PHASE 2C

PHASE 3

Table 31a: Phase 3 RCS Material Balance

STREAM NUMBER	1	2	3	4	5	6	6a
COMPONENT	AIR FLOW FROM SILO 1	AIR FLOW FROM SILO 2	AIR FLOW FROM TTA	AIR TO CHILLER	AIR TO CARBON BED	AIR FROM CARBON BED	FAN INLET (TREATED GAS + FAN RECYCLE + MAKEUP)
AIR (LBS/HR)	--	--	2,161	4,321	4,321	4,321	4,321
WATER (LBS/HR)	--	--	41	82	3	3	3
TOTAL, (LBS/HR)	--	--	2,202	4,403	4,324	4,324	4,324
FLOW (CFM)	--	--	500	1,000	908	908	908
FLOW (GPM)	--	--	--	--	--	--	--
RADON (PICOCURIES/L)	--	--	710,019	565,009	622,078	14,923	14,923
RADON (CURIES/HR)	--	--	0.603	0.960	0.960	0.02303	0.02303
TEMPERATURE (DEG F)	--	--	75	75	36	40	40.0
PRESSURE (INCHES WC)	--	--	--	--	--	--	--
NOTES	NO FLOW FROM SILO IN PHASE 3	NO FLOW FROM SILO IN PHASE 3		FLOW REPRESENTS WTA PLUS TTA	CHILLER CONDITIONS AIR TO 36F AND 15% RELATIVE HUMIDITY	RADON REMOVAL BASED ON K=10.5 AND 4 CARBON BEDS	FLOW IS CARBON BED EXHAUST PLUS FAN RECYCLE FLOW + MAKEUP AIR. INCL. FAN HEAT

PHASE 3

Table 31b: Phase 3 RCS Material Balance

STREAM NUMBER	7	8	9	9A	10	11	12
COMPONENT	AIR TO SILO 1	AIR TO SILO 2	MAKEUP AIR TO TTA	RECYCLE AIR TO TTA	CONDENSATE TO HOLD-UP TANKS	AIR FROM FUTURE WASTE TREATMENT AREA	RCS TO STACK
AIR (LBS/HR)	--	--	2,161	--	--	2,161	4321
WATER (LBS/HR)	--	--	41	--	78.0	41	3
TOTAL, (LBS/HR)	--	--	2,202	--	78.0	2,202	4324
FLOW (CFM)	--	--	500	--	--	500	979
FLOW (GPM)	--	--	--	--	0.16	--	
RADON (PICOCURIES/L)	--	--	--	--	310,854	420,000	14,923
RADON (CURIES/HR)	--	--	--	--	0.000011	0.357	0.02482
TEMPERATURE (DEG F)	--	--	75	--	40	75	62.0
PRESSURE (INCHES WC)	--	--	--	--	--		
NOTES	NO FLOW TO OR FROM SILOS IN PHASE 3	NO FLOW TO OR FROM SILOS IN PHASE 3	NO FLOW IN STREAM 9 DURING RECIRUCLATION OF TTA	9A FLOW EQUALS 2X STREAM 8 IN PHASE 2A DURING RECIRC OF TTA			RELATIVE HUMIDITY=6%

PHASE 3

Table 32c: Phase 3 RCS Material Balance

STREAM NUMBER	13	14	15	16	17	18	19	20
COMPONENT	BUILDING VENT TO STACK	AIR TO STACK	FAN RECYCLE FLOW	MAKE-UP AIR	CONDENSATE TO FILTRATE TANKS	EQUIPMENT ENCLOSURE AIR INFLOW	EQUIPMENT ENCLOSURE AIR INFLOW	EQUIPMENT ENCLOSURE AIR INFLOW
AIR (LBS/HR)	40,233	44,551	--	--	--	--	--	--
WATER (LBS/HR)	758	761	--	--	12,519	--	--	--
TOTAL, (LBS/HR)	40,991	45,312	--	--	12,519	--	--	--
FLOW (CFM)	9,310	10,289	--	--	--	--	--	--
FLOW (GPM)	--	--	--	--	25	--	--	--
RADON (PICOCURIES/L)	--	1420.0	--	--	5,501	--	--	--
RADON (CURIES/HR)	--	0.02482	--	--	0.0000312	--	--	--
TEMPERATURE (DEG F)	75	74.0	--	--	--	--	--	--
PRESSURE (INCHES WC)	--	--	--	--	--	--	--	--
NOTES		RELATIVE HUMIDITY=93 .9%	NO FAN RECYCLE IN PHASE 3	VARIABLE FLOW AS REQUIRED FOR MAKE-UP AND PRESSURE CONTROL		EQUIPMENT ENCLOSURES NOT INSTALLED IN PHASE 3	EQUIPMENT ENCLOSURE S NOT INSTALLED IN PHASE 3	EQUIPMENT ENCLOSURES NOT INSTALLED IN PHASE 3

VI. REFERENCES

1. FDF, Silos 1 & 2 Accelerated Waste Retrieval (AWR) Project, RFP No. F98P168407, Fluor Daniel Fernald, Fernald (Hamilton County), Ohio, Feb. 3, 1999.
   a) Technical Requirement Document 40710-RP-0001, Section 2.4.1.1.2, "Radon Control System Design Requirements," Pp 50-51.
   b) Technical Requirement Document 40710-RP-0001, Appendix A, "Silos Residue Characterization," pg A-21.
   c) Part 7, Section 2.5.1, "K-65 Characterization Data."
   d) Technical Requirement Document 40710-RP-0001, Appendix D, "Evaluation of Water as a Fluid Diffusion Barrier to Reduce Radon Emanation from Radium Bearing Materials," July 1998.
   e) Technical Requirement Document 40710-RP-0001, Appendix C, "Physical Characterization of FEMP Site," Figure C-1, Wind Rose Data, 1994.
2. Langner, G. H., and D. T. Kendrick, "Controlling Radon Emissions with Activated Carbon Columns: Preliminary Investigations," RUST Geotech/DOE Grand Junction Projects Office, Grand Junction, Colorado, December 1, 1994. [Attachment D-1 to Reference 1]
3. Walker, F. W., J. F. Parrington, and F. Feiner, *Nuclides and Isotopes, 14th Ed.*, General Electric Company, San Jose, California, 1989.

4. Langner, G. H., Jr., "Controlling Radon Emissions with Activated Carbon Columns: Phase II Results," RUST Geotech/Doe Grand Junction Projects Office, Grand Junction, Colorado, Aug. 8, 1996. [Attachment D-2 to to Reference 1]
5. Strong, K. P., and D. M. Levins, "Dynamic Adsorption of Radon on Activated Carbon," *Proceedings of the 15th DOE Nuclear Air Cleaning Conference*, 1978. Pp 627–639.
6. Perry, Robert H., and Cecil H. Chilton, *Chemical Engineers' Handbook, Fifth Edition*, McGraw-Hill Book Company, New York, 1973.
7. Lowry, Jerry D., Willem F. Brutsaert, Thomas McEnerney, and Cindy Molk, "Point-of-Entry Removal of Radon for Drinking Water," *Journal of the American Water Works Association*, 79:162, 1987.
8. Byrne, John, "Environmental Radon Emissions for August 1999," Fluor Daniel Fernald, Internal Memorandum M:SWP(EM):99-0036, Fernald, Ohio, Sept. 9, 1999.
9. DOE, *Remedial Investigation Report for Operable Unit 4*, Volume 1 of 3, U. S. Department of Energy, Fernald Field Office, November 1993. Pp 3–7.
10. Keller, E. L, Letter to Wm. L. Boeck, Niagara University, "Regarding Predictions and Measured Radiological Values for the K-65 Residue Transfer," U. S. Department of Energy, Oak Ridge, Tenn., April 23, 1986.
11. NRC, 20 *Code of Federal Regulations* Subpart A – General Provisions, 20 CFR § 1003, "Definitions," Nuclear Regulatory Commission, Washington, D. C., July 1998.
12. Evans, Robley D., "Engineering Guide to the Elementary Behavior of Radon Daughters," *Health Physics*, Volume 38 (June), Pp 1173–1197, 1968.
13. Negin, C. A., RADDECAY, Grove Engineering, Rockville, Md., September 1987.
14. HEW, *Radiological Health Handbook*, U. S. Department of Health, Education, and Welfare, Rockville, Md., July 1970.
15. Schlein, Bernard, Lester A. Slaback, Jr., and Brian Kent Birky, *Handbook of Health Physics and Radiological Health, Third Edition*, Williams & Williams, Baltimore, Md., 1998.
16. EPA, *Screen3 Model Users Guide*, EPA-454/B-95-004 U. S Environmental Protection Agency, Office of Air Quality, Planning and Standards, Emissions, Monitoring and Anaysis Division, Research Triangle Park, North Carolina, September 1995.
17. CAP88-PC, Version 2.0, U. S. Department of Energy, Germantown, Md., June 1997.
18. FWENC, Silos 1 & 2 AWR Process Flow Diagrams, Radon Control System Drawings 20FMD013 through 20FMD020, Revision 0, Foster Wheeler Environmental Corporation, Nov. 1, 1999.
19. FWENC, Silos 1 & 2 AWR Process Flow Diagrams, HVAC Control System Drawings 77FMD006 through 77FMD008, Revision 0, Foster Wheeler Environmental Corporation, Nov. 1, 1999.
20. FWENC, "Evaluation of Activated Carbons and Adsorber Design for the Fernald Radon Control System", Technical Report - Waterlink Barnebey Sutcliffe Technical Department, Columbus, Ohio, May 25, 2000.

3387

3387

APPENDIX 5.3

STORMWATER DRAINAGE PLAN

ORIGINAL 3387

ATTACHMENT 1

FOSTER WHEELER ENVIRONMENTAL CORPORATION
CALCULATION COVER SHEET

Sheet 1 of ~~6~~ 7

PROJECT FDF Silos 1&2 AWR SUBJECT Stormwater Drainage

CLIENT Fluor Daniel Fernald

CALCULATION NO. CA-FSC624-FC-001 PROJECT NO. FSC 624

NO OF SHEETS 6 + 19 (ATTACH. A) DESIGN LEVEL _____

CALCULATION BY OTHERS ____ YES X NO PREPARER M. Hughes

REVIEWED BY _____ DATE _____

ASSUMPTIONS THAT REQUIRE CONFIRMATION ___ YES X NO

ASSUMPTIONS CONFIRMED BY _____ DATE _____

PRINT NAME, DATE AND INITIAL

Rev No	Affected Sheets	Prepared by Date	Checked by Date	Verified by Date
0	All	M. Hughes MSH 1/13/00	V. Bhatt [illegible] 1/13/00	NA [illegible]
0	ATTACH. A	M. Hughes MSH 1/13/00	V. Bhatt [illegible] 1/13/00	NA [illegible]
1	[illegible]	[illegible] 3/23/00	V. Bhatt 3/23/00	NA [illegible]
1	A6, A7, A8, A9, A10, A13	M. Hughes 3/23/00	V. Bhatt 3/23/00	NA [illegible]
2	P 7 of 7	M. Hughes 11/10/00	V. Bhatt 11/10/00	NA [illegible]

000199

Table of Contents:

Item	Sheet No.
CALCULATION COVER SHEET	1
TABLE OF CONTENTS	2
CRITERIA	2
APPLICABLE CODES, STANDARDS AND REGULATIONS	3
METHODOLOGY	3
ASSUMPTIONS	3
APPLICABLE BACKGROUND DATA	4
REFERENCES	5
CALCULATIONS	5
CONCLUSIONS	6, 7
ATTACHMENT A	A1 to A21

Criteria:

The purpose of this calculation is to analyze existing and proposed stormwater drainage for the Silos 1 & 2 project area at the U.S. Department of Energy facility in Fernald, Ohio. The calculations are developed to ensure the existing FEMP Stormwater System (SWS) together with any improvements and modifications required to support the AWR project meets the specific requirements of the Technical Requirements Document (TRD). Design and analysis includes calculations of pre- and post-development storm flows to determine the change in flow and loading to the existing AWR project area storm drainage system and to determine the need for modifications, if necessary, to the existing SWS..

Specific requirements for the Storm Water System (SWS) are listed in Section 2.3.2.1 of the Technical Requirements Document (Reference 7) and are attached as part of this report. This calculation supports the Storm Water System Drainage Plan submitted for EPA Approval Drawings 66FCD001 through 66FCD006 . Drawing 66FCD005 has been deleted and is not part of this Package.

3387

Applicable Codes, Standards and Regulations:

1. Location and Design Manual Volume 2 – Drainage Design, April 1992. Ohio Department of Transportation (ODOT).
2. Standard Specifications for Transportation Materials and Methods of Sampling and Testing, Seventeenth Edition, 1995. American Association of State Highway and Transportation Officials (AASHTO).
3. Construction and Material Specifications, January 1997. Ohio Department of Transportation (ODOT).
4. Rainwater and Land Development (Standards for Stormwater Management, Land Development and Urban Protection), Second Edition, January 1996. Dan Mecklenburg, Ohio Department of Natural Resources (ODNR).

Methodology:

The rational method, Q = CIA, will be used to determine storm water runoff for each drainage area. Then Manning's equation ($V = 1.49 \times R^{0.67} \times S^{0.5} / n$) will be used to determine the capacities for concrete drainage channel segment around Silos 1 and 2.. Manning's equation can be applied to ditches and culverts equally to determine velocity. The distance from the K-65 trench to the drainage culvert south of the drainage areas is approximately 280 feet. Time of travel is approximately 4 minutes for each drainage area at a general slope of .01 ft/ft, so a duration time of ten minutes is used to obtain rainfall intensities. Rainfall intensity for 10 minutes of a 10-year storm is approximately 5.4 inches per hour 6.6 inches per hour for the 25-year storm (Reference 4).

Assumptions:

1. The existing FEMP SWS in the AWR Project Area currently meets the technical requirements for the SWS as specified in the Technical Requirements Document (TRD) Reference 7.
2. Site Layout and Grading will be revised as necessary to facilitate existing Project Area drainage per Final Construction Drawings.
3. Activities related to the AWR Project are not anticipated to generate contaminated storm water. However, Areas 7 & 8 are located within "potentially contaminated" areas as designated by FEMP and therefore stormwater from these areas will continue to be collected by the existing concrete perimeter ditch system and conveyed to the Bio-Surge

lagoon for handling by the existing site SWS as "potentially contaminated" stormwater. This is consistent with the currently acceptable approach.

3387

4. Capacity calculations for Areas 1, 2, 3, 4, & 5 are based on 2 headwaters (i.e., 24 inches of stormwater above the invert of a 12 dia. pipe), at discharge culverts CB-01, CB-02 and the 18" dia. storm pipe located in the southeast portion of the east perimeter trench.

Applicable Background Data:

1. Waste Pit Area Stormwater Control, EH&S Improvements project, A.M. Kinney Inc, (Revision 0, CFC, December 1990), Revision 1, As-built, August 1993:
   - Drawing 40A-4445-G-00055, Location Plan, 1"=100'
   - Drawing 40A-4445-G-00056, Site Plan, 1"=100'
   - Drawing 40A-4445-G-00057, Grading Plan #1, 1"=100'
   - Drawing 40A-4445-G-00058, Grading Plan #2, 1"=100'
   - Drawing 40A-4445-G-00063, Trench Drain Profiles, 1"=33' H and 1"=10' V
   - Drawing 40A-4445-G-00065, Site Details, scale as shown
2. Drawing 94X-5900-G-00898, Civil Utility Plan, Layout of Utilities and Tie-ins, Parsons, Revision 5, As-built, September 1997.
3. Underground Utilities, Fernald Environmental Restoration Management Corporation, April 1998:
   - Grid 31A, Drawing 22A-5500-P-00804, Revision 6, 1"=60'
   - Grid 31B, Drawing 22A-5500-P-00805, Revision 7, 1"=40'
4. Silos Infrastructure Project, Fluor Daniel Northwest, Project 40315, <as-built eventually>, <later 1999>:
   - Drawing 94X-6100-G-02210, Plan & Profile #1, 1"=50' H and 1"=5' V
   - Drawing 94X-6100-G-02211, Plan & Profile #2, 1"=50' H and 1"=5' V
   - Drawing 94X-6100-G-02212, Plan & Profile #3, 1"=50' H and 1"=5' V
   - Drawing 94X-6100-G-02213, Cross sections #1, 1"=10'
   - Drawing 94X-6100-G-02214, Cross sections #2, 1"=10'
   - Drawing 94X-6100-G-02215, Cross sections #3, 1"=10'
   - Drawing 94X-6100-G-02216, Cross sections #4, 1"=10'
   - Drawing 94X-6100-G-02217, Cross sections #5, 1"=10'
   - Drawing 94X-6100-G-02214, Trench Drain Profiles, 1"=33' H and 1"=10' V

References:

3387

1. Hydraulic Design of Highway Culverts, FHWA Hydraulic Design Series No. 5, Federal Highway Administration, September 1985.
2. Soil Conservation Service Technical Release No. 55, Urban Hydrology for Small Watersheds, 1986.
3. Technical Paper No. 40, Rainfall Frequency Atlas of the US for Durations From 30 Minutes to 24 Hours & Return Periods From 1 to 100 Years, Weather Bureau, May 1961.
4. NOAA Technical Memorandum NWS Hydro-35, Five- to 60-Minute Precipitation Frequency for the Eastern and Central United States, National Oceanic and Atmospheric Administration, June 1977.
5. Construction Castings, Neenah Foundry Company, Catalog "R", 11th Edition, Neenah Wisconsin.
6. RFP No. F98P168407, Part 7, Technical Requirements Document (TRD), Revision 1, February 1999. Contract FSC 624, Silos 1 and 2 Accelerated Waste Retrieval Project, Fluor Daniel Fernald (FDF).
7. RFP No. F98P168407, Part 6, Statement of Work (SOW), Revision 1, February 1999. Contract FSC 624, Silos 1 and 2 Accelerated Waste Retrieval Project, Fluor Daniel Fernald (FDF).

Calculations: (see attached calculations sheets in Attachment A)

The AWR project is divided into 8 sub-areas consistent with the overall drainage plan and topography of the site (see Drawings 66FCD001 through 66FCD006).

Area #	Pre-development runoff	Post-development runoff	Outlet capacity
1	2.81 cfs (to the east)	4.09 cfs + 3.16 cfs = 7.25cfs	14.0 cfs
2	1.88 cfs	2.35 cfs	11.0 cfs
3	1.56 cfs	1.94 cfs	11.0 cfs
4	2.35 cfs	4.58cfs (3.16 to the east)	11.0 cfs
5	2.40 cfs	3.00 cfs	11.0 cfs
6	0.86 cfs	N/A	N/A
7	13.39 cfs (silo area)	13.05 cfs (silo area)	53.2 cfs
8	1.12 cfs	1.12 cfs	53.2 cfs

Stormwater from Area 7 is ultimately conveyed to the Bio-surge lagoon by an existing concrete perimeter ditch and a 21" dia. Culvert. The northeast quadrant of Area 7 drains to the concrete perimeter ditch and north to the lagoon. The southeast and southwest quadrants drain to the 21" dia. RCP via the concrete perimeter ditch and catch basin outlet at the road. The northwest quadrant drains to the 21" RCP via a trench drain crossing the perimeter road. The limiting flow of the concrete perimeter ditch surrounding the Silos occurs from the K-65 ditch north to the lagoon due to a 0.5% slope through this area. Increased slope translates to greater capacities. The capacity of this section of perimeter ditch is 41.7 cfs. The capacity of the 21" dia. culvert pipe, at 0.5% slope, draining the rest of the concrete perimeter ditch is 11.5 cfs (see attached nomograph, sheet A13 of A19). The total stormwater outlet capacity for Area 7 is 53.2 cfs and no other sub areas drain to Area 7. Area 8 is subject to minimal grading and construction activities which will not alter the existing SWS drainage for this area. Area 6 will be subjected to minimal grading and construction activities and the storm water drainage from this area flows along and away from the K-65 trench to the north and does not contribute runoff to either CB-01 or CB-02. Areas 1 through 5 are calculated using the Rational Method. From the K-65 trench to the south perimeter ditch is approximately 280', therefore overland sheet flow has not transformed into shallow trench flow. Time of travel (Tt) was calculated at 0.06 hours using the TR 55 Method which uses a 2 year, 24-hr. rainfall.

Conclusions:

The construction of the Silos 1 and 2 AWR Project will proceed in phases within 8 specific project drainage areas. The Stormwater Drainage Plan presented on Drawings 66FCD001 through 66FCD004 and Drawing 66FCD006 represents an overall plan to convey stormwater consistent with the TRD requirements and to prevent siltation and erosion for the entire project duration as well as the permanent stormwater drainage configuration. The calculations show the capacity of the existing SWS is adequate to handle the Post-development flows resulting from the Project activities for each of the 8 project areas. A total of nearly 8.0 acres will be disturbed during the construction of the project. Over half of this area will be minor grading with less than 1 foot of cut/fill in designated clean areas. Major earthwork will be required to construct foundations for the buildings, superstructure, and silo excavation. However, proper soil and erosion control, and other protective measures consistent with the specific requirements of the TRD will be employed. This should prevent contaminated stormwater from leaving the site. In addition, stormwater generated during each phase of excavation will be handled by the existing perimeter ditches. The two existing storm drainage culverts at the southern perimeter road provide sufficient capacity to handle the runoff from Areas 2 & 3, surface runoff from Area 4, and Area 5. The roof drainage from the TTA Building will be directed to the Eastern Perimeter drainage ditch by way of the existing, unused 12" storm pipe and then through the proposed 18" pipe into the detention

basin at the southeast portion of the Site. During construction of the TTA and RCS buildings, storm water will be removed from the excavation from a sump and pumped to the existing manhole in Area 4 and then to the east perimeter ditch. This will also be the method for removing stormwater when the slabs are being placed. The inlet and outlet protection at the ends of the pipes will remove the little amount of sediment involved in this procedure. The inlet and outlet protection will be maintenanced as noted on the drawings and in the Specifications. The post-development runoff is greater in each of the five areas, with diversion of the roof drainage through the existing storm drain to the perimeter ditch to the east the stormwater runoff into the perimeter ditch to the south increases only slightly from 8.19 cfs to 8.71 cfs. A 12" culvert pipe at two headwaters is capable of 5.5 cfs of flow, therefore the 2 12" dia. pipes in the south perimeter ditch have a combined capacity of 11.0 cfs. The 18" culvert pipe at the east perimeter at 2 headwaters is capable of 14.0 cfs of flow. The assumption is that this drainage system was originally designed to handle the flow from the area of the new TTA building. Since all the developed areas are to be treated with a gravel surface over a geotextile fabric, the chance of siltation and erosion in these areas is not considered to be significant. In the Silos 1 and 2 area, the configuration shown on the grading plan is the worst case scenario of Phase I grading. As excavation progresses to the Phase IIA and IIB grading, the erosion control measures will remain in the same configurations as shown for the Phase I excavation. The silt fence directs any narrow channel flow generated during a design storm from the southeast and southwest quadrants to the sedimentation basins at the southwest corner. These quadrants represent an area of 0.66 acres. In order to hold the equivalent sediment amount of 0.67 cy per acre, these sediment basins have been designed to hold a storage capacity of approximately 50.0. Other areas around the silos are bounded by gravelled areas with silt fence protecting the concrete perimeter ditch from siltation. Further soil and erosion control measures will be deployed as noted on the Stormwater Drainage Plan Drawings and in the Construction Specifications. Proposed modifications to the existing SWS are also shown on the Drawings and are made to facilitate existing drainage paths on the site. R2

ATTACHMENT A

Written description (SWS) Section 2.3.2.1	Sheet A2
SWS Requirements 001 through 010	Sheet A3
SWS Requirements 011 through 020	Sheet A4
Calculations	Sheet A5 to A12
Figure 11.6 Flow in Pipes	Sheet A13
Chart 7 Pipe Culvert Chart	Sheet 14
Rainfall Intensity Zone Map	Sheet A15
Rainfall Intensity Duration Curves	Sheet A16
Drawing 66FCD001, Rev 2	Sheet A17 **
Drawing 66FCD002, Rev 3	Sheet A18 **
Drawing 66FCD003, Rev 3	Sheet A19 **
Drawing 66FCD004, Rev 2	Sheet A20 **
Drawing 66FCD006, Rev 2	Sheet A21 **

** - 11" x 17" sheets

2.3.2.1 Stormwater System

The Contractor shall provide facilities to prevent the introduction into any stream, lake, aquifer, or other body of water, of any substances or materials which may pollute or degrade the water or be deleterious to fish and wildlife.

The potential for generation of contaminated stormwater, including any run-on and run-off, shall be minimized by process design and operation. Contaminated run-off could come from areas that are in direct contact with residue or have a high potential of coming in contact with residue, such as storage pads and stockpile areas. The quantity of contaminated stormwater from the AWR Project area shall be minimized by segregating clean area run-off from potentially contaminated run-off. Clean run-off could include building roof drainage and run-off from areas of fixed contamination. "Clean" stormwater shall be routed to the stormwater collection basin south of the project area. Clean stormwater shall not be discharged to the AWWT Facility.

Areas used for management of materials that could contribute to contaminated stormwater shall be protected from precipitation and stormwater run-on and run-off, to the extent practicable, in the design. Contaminated stormwater shall not be discharged with "clean" stormwater. Contaminated stormwater shall be contained and sampled prior to discharge into the existing WWS. Contaminated stormwater shall meet the wastewater acceptance criteria and other requirements identified in Section 2.3.2.2 for wastewater, including the limit on flow, prior to discharge to the AWWT facility.

New SWS shall be designed in accordance with FEMP site policy and Ohio stormwater requirements. The site Stormwater Pollution Prevention Plan, RM-0039 (Part 7 - Section 3.0) is used to satisfy the requirements of the FEMP National Pollutant Discharge Elimination System (NPDES) Permit. Stormwater control design details, construction methods, and materials shall be in accordance with Ohio approved stormwater standards. As referenced in the SPPP, stormwater management, as well as erosion and sediment control during construction, shall comply with the latest version of ODNR Rainwater and Land Development Manual (Part 7 - Section 5.0); the U.S. Technical Paper 40 (Part 7 - Section 5.0) may be used for levels for storm events at the FEMP.

Storm drain systems not directly connected to the SWS (if any), with catchments less than 160 acres, may be designed by the Rational Method. Stormwater control systems designed by the Rational Method shall use rainfall frequencies found in Technical Paper No. 40 (Part 7 - Section 5.0) and NWS Hydro-35 (Part 7 - Section 5.0). Those storm drain systems directly connected to an existing SWS shall be designed by Soil Conservation Service methods (e.g., TR-55, TR-20).

Environmental releases shall be avoided to the extent possible. Any spills or other unplanned releases to the environment shall be immediately reported to FDF and cleaned up to minimize the release of contaminants to the environment.

Limited stormwater control facilities shall be provided to the Contractor for the collection of stormwater from the Contractor's process facility location . Existing stormwater control features and facilities are shown on the following: the topographic map illustrated in Figure C-4 (Appendix C - Section C.2), drawing 40A-4455-G-00056 (Part 7 - Section 1.4), and drawing 94X-5900-G-00898 (Part 7 - Section 1.4). The Contractor, using assigned FDF personnel, shall maintain this system until project completion. In particular, the Contractor shall maintain the drainage ditches and other stormwater appurtenances in the project area in a manner that ensures continued operation of the SWS pursuant to its design standards. For example, any sediment build-up that affects run-off flow below design capacities shall be removed and managed by the Contractor.

Table 2-9 provides system requirements for the SWS. Regulatory requirements for the control of stormwater are listed in the ARARs in Appendix B.

Table 2-9 Stormwater System Requirements

Requirement Number	Requirement
SWS-001	Provide controlled stormwater drainage, collection, and segregation of contaminated stormwater from uncontaminated liquids.
SWS-002	Ensure that drainage basins, curbs, and catch or retention basins have efficient and adequate drainage.
SWS-003	Ensure that the existing drainage pattern is maintained by providing culverts (or other controls) as needed for the SWRS, RCS, and the TTA, which are located in potentially contaminated area.
SWS-004	Ensure that AASHTO and ODOT standards for paving, surfacing methods, materials, and design are observed. Where conflict exists between the AASHTO or ODOT standards and the ODNR Rainwater and Land Development manual, the ODNR manual shall take precedence.
SWS-005	Ensure that appropriate design storm events for Hamilton County are used in designing new culverts, analyzing existing culverts and identifying drainage differences, maintenance problems, and other impacts caused by changes in the current system.
SWS-006	Stormwater management systems for secondary containment areas for K-65 material, wastewater, hazardous substance or hazardous material tanks, and contaminated stormwater shall be designed for the 25-year, 24-hour storm. Stormwater controls for all other uncontaminated stormwater shall be designed for the 10-year, 24-hour storm.
SWS-007	Install erosion matting, check dams, riprap lining, or other methods specified in the ODNR Rainwater and Land Development manual (Part 7 - Section 5.0) to limit erosion, as appropriate to control excessive stormwater velocities.
SWS-008	Through design, minimize the use of stone or other materials needed to control erosion in the ditches.
SWS-009	Ensure that the road side ditches do not overtop the roads for the design storm.
SWS-010	Include measures to minimize and mitigate erosion and sediment transport in the runoff controls from the distributed areas.

Table 2-9 Stormwater System Requirements

Requirement Number	Requirement
SWS-011	Design storm drainage in accordance with the ODNR Rainwater and Land Development manual.
SWS-012	Ensure that drainage is by open ditch systems, and make use of existing drainage structures such as culverts and catch basins when possible.
SWS-013	Minimize ditch size by flooding the road shoulder if necessary.
SWS-014	Perform side slope and ditch design in accordance with the ODNR Rainwater and Land Development manual. Ditch checks may be placed where required. Ditch design shall not impact nearby underground utilities.
SWS-015	Ensure that earthwork conforms to ODNR Rainwater and Land Development manual standards and complies with the FDF waste management standards, discussed in Section 5.0.
SWS-016	Ensure that design changes and temporary modifications prevent erosion and control sediment during and subsequent to construction.
SWS-017	Using seed or mulch, stabilize areas disturbed during construction that are not surfaced or covered with riprap. Ensure that revegetation, seeding, and soil supplements conform to ODNR Rainwater and Land Development manual standards.
SWS-018	Ensure that open course stormwater drainage channels have low velocities that are non-erosive and limit sediment accumulation.
SWS-019	Ensure that construction areas and exposed soil, unworked and left exposed for thirty days or more are seeded per ODNR Rainwater and Land Development manual standards and FDF waste management requirements.
SWS-020	Contaminated stormwater shall be contained and characterized prior to discharge tothe AWWT facility. Contaminated stormwater shall meet the wastewater acceptance criteria in Table 2-10a and other requirements identified in Section 2.3.2.2 for wastewater including the limit on flow prior to discharge to the AWWT facility.

FOSTER WHEELER ENVIRONMENTAL CORPORATION

BY MSH DATE 3/21/00 SHEET A5 OF A21

CHKD. BY _____ DATE _____ OFS NO. 3387 DEPT. NO. _____

CLIENT _____

PROJECT AUDR CALC# CA-FSC624-FC-001

SUBJECT STORM WATER DIVERSION PRE-EXISTING CONDITIONS

$Q = CiA$ (RATIONAL METHOD)

ASSUME t_c = 10 MIN

10 YR, 24-HR STORM: i = 5.4 IN./HR
25 YR, 24-HR STORM: i = 6.6 IN./HR

AREA 1
A = 1.30 AC
C = 0.40 (TURF)
i = 5.4 (10 YR, 24 HR)
$Q = 0.40(5.4)(1.30) = 2.81$ CFS

AREA 2
A = 0.87 AC
C = 0.40
i = 5.4
$Q = 0.40(5.4)(0.87) = 1.88$ CFS

AREA 3
A = 0.72 AC
C = 0.40
i = 5.4
$Q = 0.40(5.4)0.72 = 1.56$ CFS

AREA 4
A = 1.09 AC
C = 0.40
i = 5.40
$Q = 0.40(5.4)(1.09) = 2.35$ CFS

AREA 5
A = 1.11 AC
C = 0.40
i = 5.4
$Q = 0.40(5.4)(1.11) = 2.40$ CFS

AREA 6
A = 0.40 AC
C = 0.40
i = 5.4
$Q = 0.40(5.4)(0.4) = 0.86$ CFS

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FOSTER WHEELER ENVIRONMENTAL CORPORATION

BY MSH DATE 3/21/00 | 3387 SHEET A6 OF A21

CHKD. BY _____ DATE _____ | DFS NO. _____ DEPT. NO. _____

CLIENT _____

PROJECT AWSC | CALC. #CA-FSC624-FC-001

SUBJECT STORM WATER RUNOFF, PRE-EXISTING CONDITIONS

AREA 7 $A = 2.83$ AC

COMPOSITE C: 2.59 (0.70) (STEEP, GRASSED)
0.12 (0.90)(2) (SILO ROOFS)

$\Rightarrow \frac{2.59(0.70) + 0.12(0.90)(2)}{2.83} = 0.72$

$i = 6.6$ (POTENTIALLY CONTAMINATED)

$Q = 0.72(6.6)(2.83) = 13.39$ CFS

AREA 8 $A = 0.37$ AC

COMPOSITE C: $\pi(41)^2 = 0.12$ (0.90) (SILO)
0.25 (0.40) (GRASS)

$C = \frac{0.12(0.90) + 0.25(0.40)}{0.37} = 0.56$

$Q = 0.56(6.6)(0.37) = 1.37$ CFS

SOUTH PERIMETER RD

$12' \times 355' = 0.10$ AC, $C = 0.90$

$Q = 0.90(5.4)0.10 = 0.48$ CFS

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FOSTER WHEELER ENVIRONMENTAL CORPORATION

BY MSH DATE 3/21/00 3387 SHEET A7 OF A21

CHKD. BY _____ DATE _____ OFS NO. _____ DEPT. NO. _____

CLIENT _____

PROJECT AWC [illegible] CA-FSC 634-FC-001

SUBJECT STORM WATER RUNOFF, POST-DEVELOPMENT CONDITIONS

$Q = CiA$
(RATIONAL METHOD)

ASSUME t_c = 10 MIN

10 YR, 24-HR STORM: i = 5.4 IN/HR
25 YR, 24-HR STORM: i = 6.6 IN/HR

AREA 1 A = 1.30 AC (W/ROADWAY)

COMPOSITE C: $\frac{(60 \times 12)(7) + (60 \times 25)2}{43{,}560} + 12(290) = 0.26$ (ROAD)

C = 0.90 (TRAILERS)

1.12 AC (GRAVEL) C = 0.50

$C = \frac{0.26(0.90) + 1.04(0.50)}{1.30} = 0.58$

$Q = 0.58(5.4)(1.30) = 4.09$ CFS

AREA 2 A = 0.87 AC
C = 0.50 (GRAVEL)
i = 5.4

$Q = 0.50(5.4)(0.87) = 2.35$ CFS

AREA 3

A = 0.72 AC
C = 0.50 (GRAVEL)
i = 5.4

$Q = 0.50(5.4)(0.72) = 1.94$ CFS

AREA 4 A = 1.09 AC

COMPOSITE C: $\frac{185 \times 180}{43{,}560} = 0.76$ AC (ROOFS) C = 0.90 (0.69% OF AREA)

0.33 AC (GRAVEL) C = 0.50

$C = \frac{0.76(0.90) + 0.33(0.50)}{1.09} = 0.78$

$Q = 0.78(5.4)(1.09) = 4.58$ CFS

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(3.16 CFS, ROOF DRAIN, TO AREA 1)

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AREA 5

A = 1.11 AC
C = 0.50 (GRAVEL)
i = 5.40
Q = 0.50(5.4)(1.11) = 3.00 CFS

AREA 6

THIS AREA DOES NOT CONTRIBUTE RUNOFF TO THE STORM WATER SYSTEM (SWS) SOUTH OF THE K-65 TRENCH. DEVELOPMENT IN THIS AREA IS MINIMAL AND STORM WATER RUNOFF INCREASE WILL BE INSIGNIFICANT.

AREA 7

A = 2.83 AC
70'X 220' = 0.35 AC, C = 0.50 (GRAVEL)
20'X 200' = 0.09 AC, C = 0.90 (CONC., RAIL)
$\pi(40)^2$ = 0.12 AC, C = 0.90 (SILOS)
2.83 - 0.35 - 0.09 - 0.12 - 0.12 = 2.15 AC, C = 0.70 (STEEP GRASSED)

$$C = \frac{0.35(0.50) + 0.09(0.9) + (0.24)(0.9) + 2.15(0.70)}{2.83}$$

C = 0.70
Q = 0.70(6.6)(2.83) = 13.05 CFS

AREA 8

DEVELOPMENT IN THIS AREA CONSISTS OF THE ADDITION OF A JOB TRAILER.
A = 60X12 = 0.02 AC, C = 0.90
Q = 0.90(6.6)0.02 = 0.10 CFS
THE ADDITION OF 0.10 CFS TO THE SWS DOES NOT REPRESENT A SIGNIFICANT IMPACT.

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BY MSH DATE 3/21/00 3387 SHEET 19 OF A21

CHKD. BY _____ DATE _____ OFS NO. _____ DEPT. NO. _____

CLIENT _____

PROJECT AWR CALC # CA-FSC624-FC-001

SUBJECT STORM WATER RUNOFF, POST DEVELOPMENT

SOUTH PERIMETER RD

Q = 0.48 CFS

9.19 CFS TOTAL TO SOUTH PERIMETER DITCH

(2.35 + 1.94 + 1.42 + 3.00 + 0.48)

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FOSTER WHEELER ENVIRONMENTAL CORPORATION

BY MSH DATE 3/22/00 3387 SHEET A10 OF A21

CHKD. BY _____ DATE _____ OFS NO. _____ DEPT. NO. _____

CLIENT _____

PROJECT AWR CALC# CA-FSC624-FC-001

SUBJECT STORM WATER RUNOFF

TIME OF TRAVEL (FOR SHEET FLOW < 300')

FROM TR-55 $T_t = \dfrac{0.007(nL)^{0.8}}{(P_2)^{0.5}(S)^{0.4}}$

WHERE

T_t = TRAVEL TIME (HRS).
n = MANNING'S ROUGHNESS COEFFICIENT
L = FLOW LENGTH (FT)
P_2 = 2YR., 24-HR RAINFALL (IN)
S = SLOPE OF HYDRAULIC GRADE LINE (FT/FT)

$n = 0.011$
$L = 280'$
$P_2 = 3.8$ IN
$S = 577 - 575 = 2'$ FALL IN $280' = 0.0071$ FT/FT

$\therefore T_t = \dfrac{0.007[0.011(280)]^{0.8}}{(3.8)^{0.5}(0.0071)^{0.4}} = 0.064$ HR (3.8 MIN)

000203

000215

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BY MSH DATE 3/22/00 — 3387 SHEET A11 OF A21

CHKD. BY _____ DATE _____ — OFS NO. _____ DEPT. NO. _____

CLIENT _____

PROJECT AWR — CALC # CA-FSC624-FC-001

SUBJECT PERIMETER TRENCH CAPACITIES

K-65 TRENCH → NORTH ("A")

1' BOT, DEPTH VARIES (1' MIN SIDES)	9+97.30 INV = 576.30	7+68.60 INV = 575.16	228.50' 1.14' FALL S = 0.50%

K-65 TRENCH → SOUTH ("B")

	10+02.70 576.40	11+58 574.50	155.30 1.9' S = 1.22%
1' BOTTOM 1.5' SIDES			
	11+58 574.50	12+15.27 569.40	57.27' 5.1 S = 8.91%
1' BOT 1.5' SIDES			
	12+15.27 569.40	14+41.50 567.50	226.23' 1.9' S = 0.84%
	14+41.50 567.50	15+30.10 565.50	88.60' 2.0' S = 2.26'
	15+30.10 565.50	15+47.40 569.41	17.3' 0.09' S = 0.52%

BEGIN 21" ϕ RCP : 146.0' @ 0.5%

000216

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FOSTER WHEELER ENVIRONMENTAL CORPORATION

BY MSH DATE 3/22/00 SHEET A12 OF

CHKD. BY _____ DATE _____ OFS NO. 3387 DEPT. NO. ___

CLIENT _____

PROJECT AWR CALC # CA-FSC624-FC-00

SUBJECT PERIMETER TRENCH CAPACITIES

$$Q_{(CFS)} = \frac{1.486}{n} R_H^{2/3} \sqrt{S_o}\ A$$

$n = 0.012$ (UNFINISHED CONC. CHANNEL)

R_H (FLOWING FULL) $= A/P$ $A = 1\ FT^2$ $R_H = 0.3$

$P = 3\ FT$

$S_o = 0.50\%$ $A = 1$

∴ LIMITING FLOW, TRENCH "A"

$$Q = \frac{1.486}{0.012}(0.33)^{0.67}\sqrt{0.50}(1)$$

$Q = 41.67$ CFS

∴ LIMITING FLOW TRENCH "B" $S = 0.52\%$

$$Q = \frac{1.486}{0.012}(0.375)^{0.67}\sqrt{0.52}\ (1.5)$$

$Q = 69.43$ CFS

CAPACITY OF 21" ϕ RCP @ $S = 0.50\%$
(SEE ATTACHED CHART)

$Q = 11.5$ CFS

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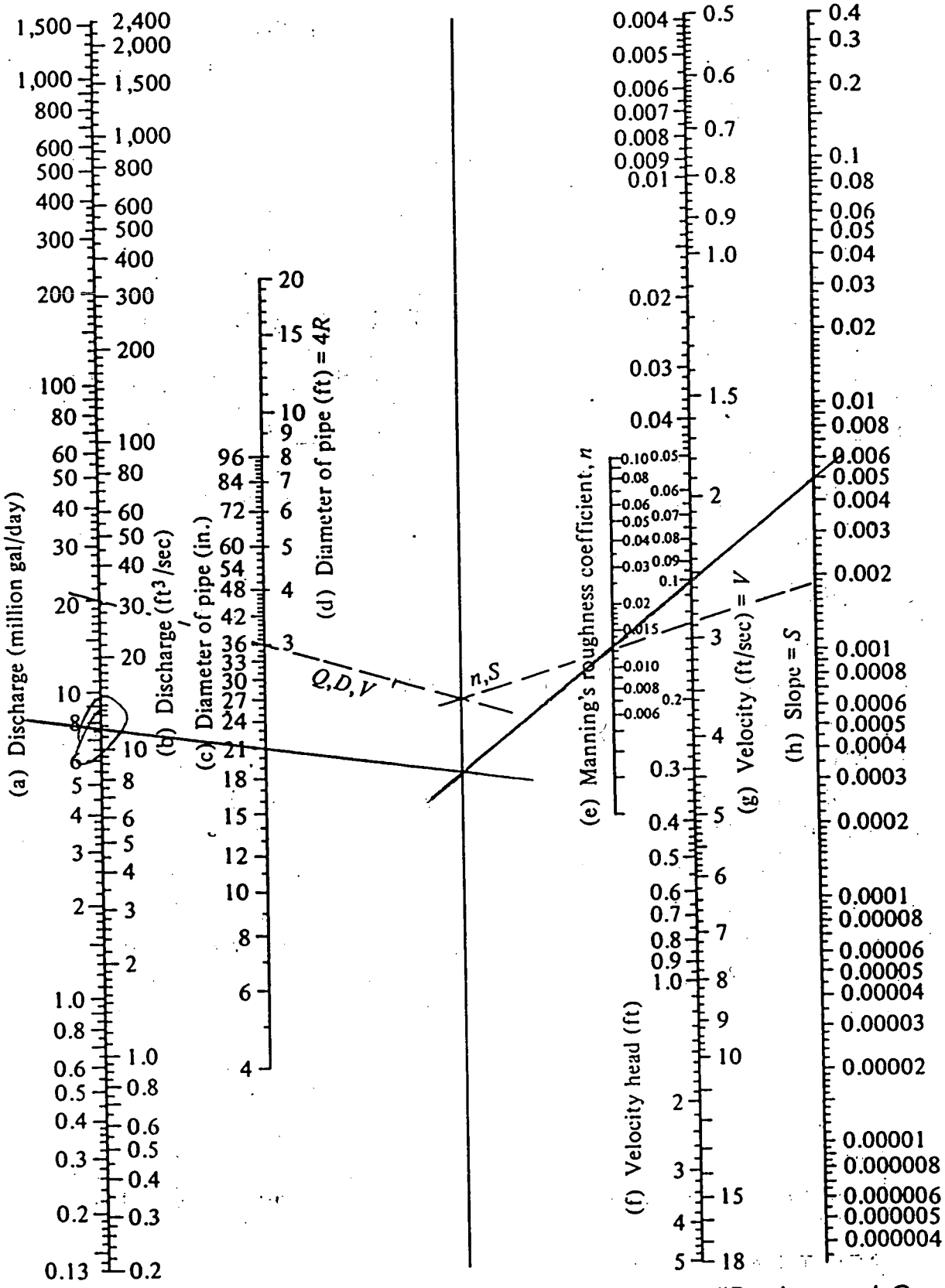
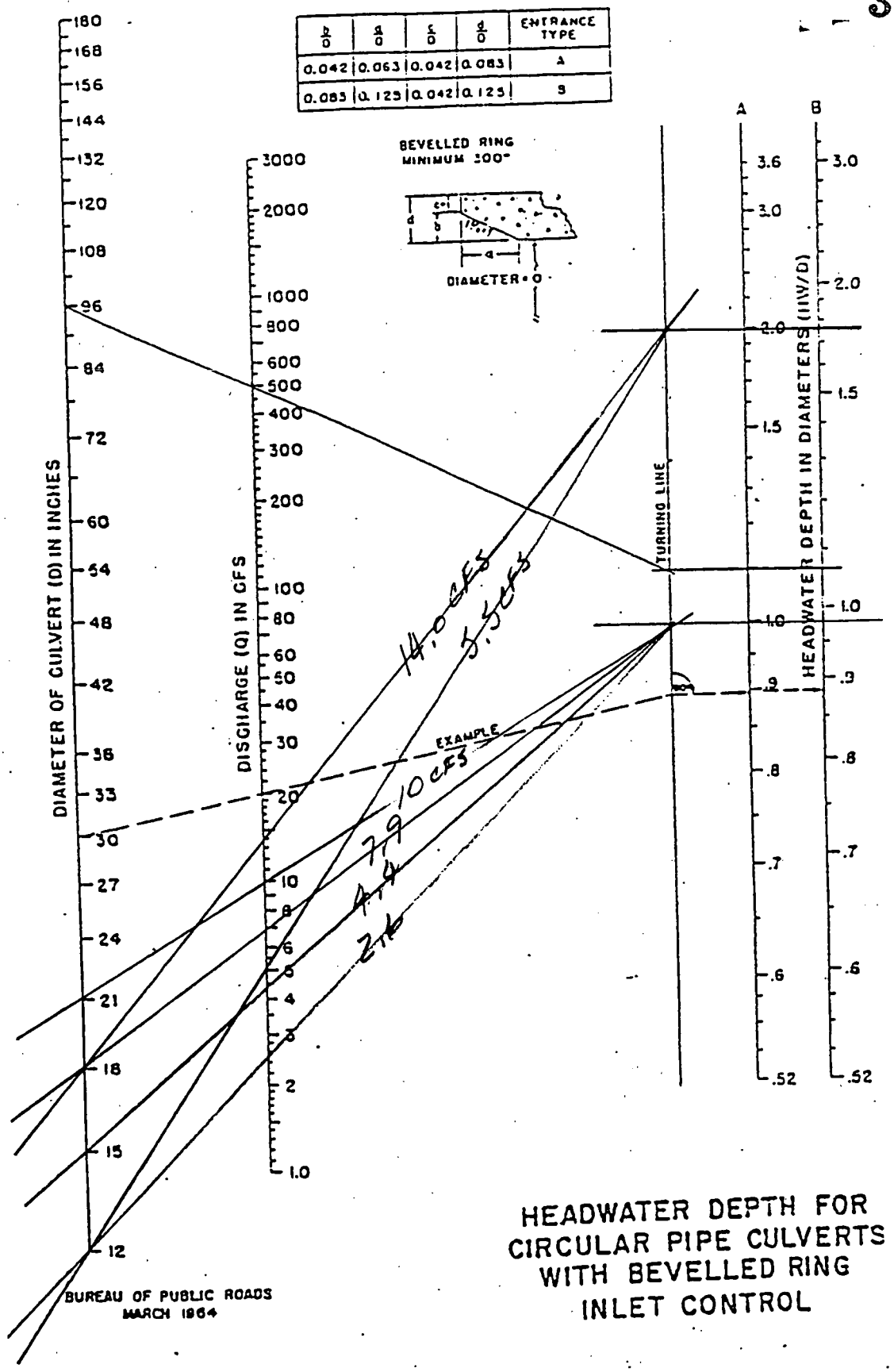


Fig. 11-6. *Flow in pipes (Manning's formula). (After "Design and Construction of Sanitary Storm Sewers," ASCE Manuals and Reports on Engineering Practice, No. 37, 1970.)*

CHART 7 H14 of H21

3387



b/D	a/D	c/D	d/D	ENTRANCE TYPE
0.042	0.063	0.042	0.083	A
0.083	0.125	0.042	0.125	B

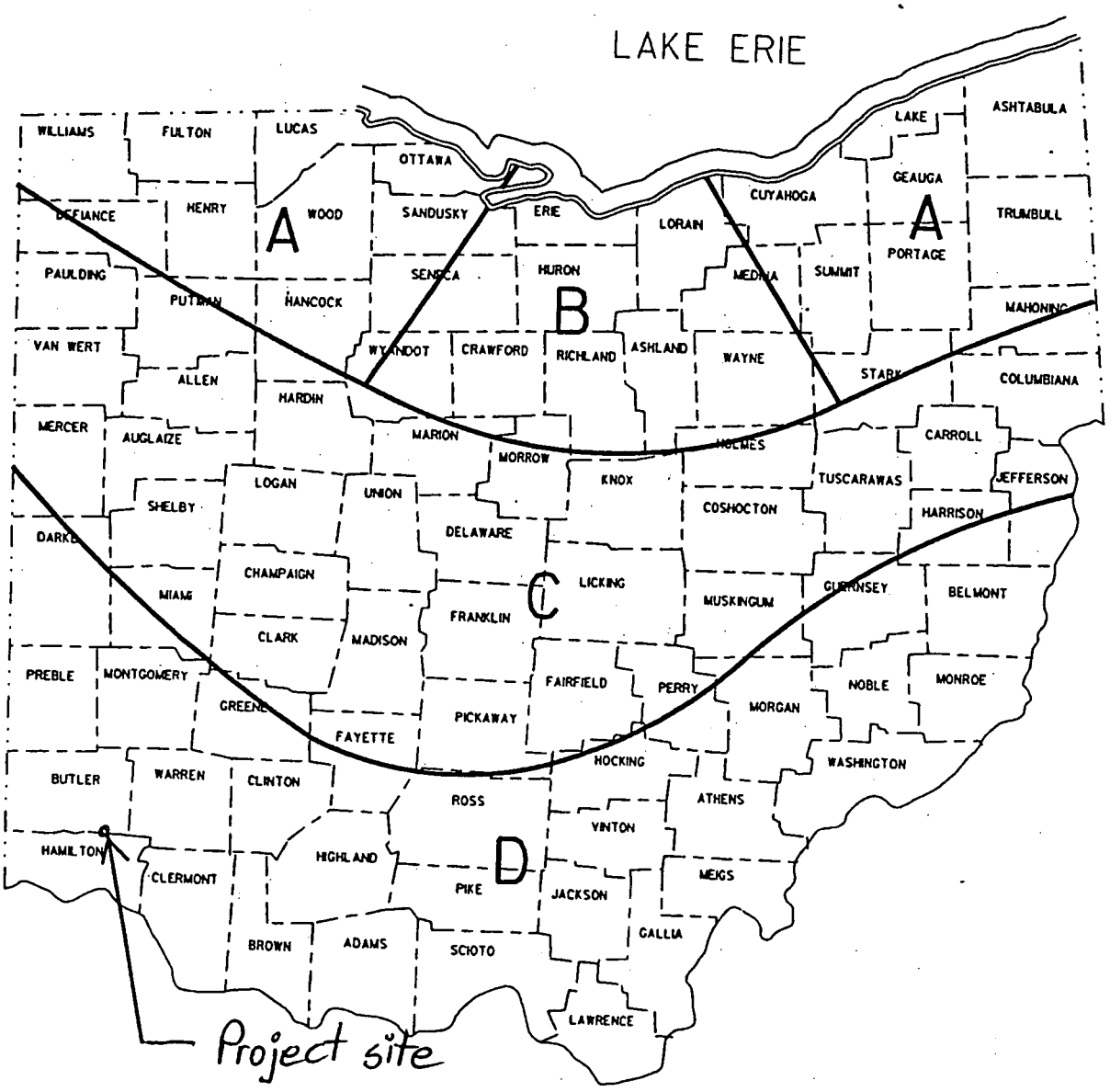
BUREAU OF PUBLIC ROADS
MARCH 1964

HEADWATER DEPTH FOR CIRCULAR PIPE CULVERTS WITH BEVELLED RING INLET CONTROL

FOSTER WHEELER ENVIRONMENTAL CORPORATION								
PROJECT: Fernald Silos 1 and 2 AWR					SUBJECT: Stormwater Drainage			
Revision								Sheet
By / Date								Project No: 2122.0308
Ch / Date								Calc: CA-FSC624-FC-001

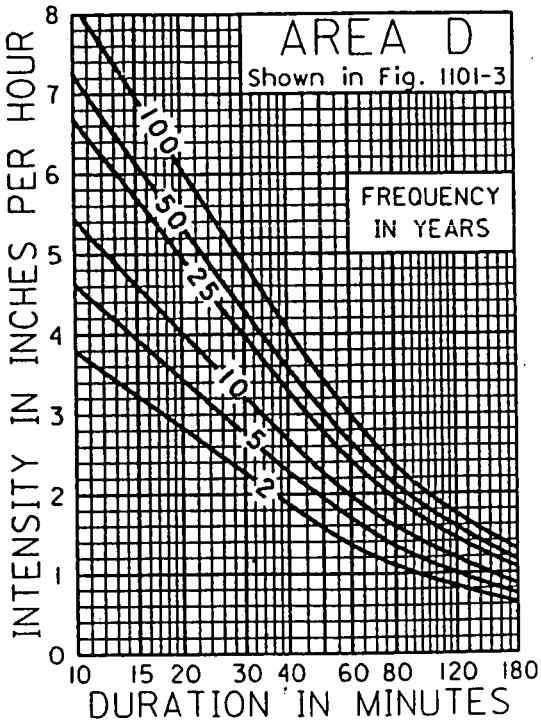
3387

RAINFALL INTENSITY ZONE MAP	1101-3
	REFERENCE SECTION 1101.24



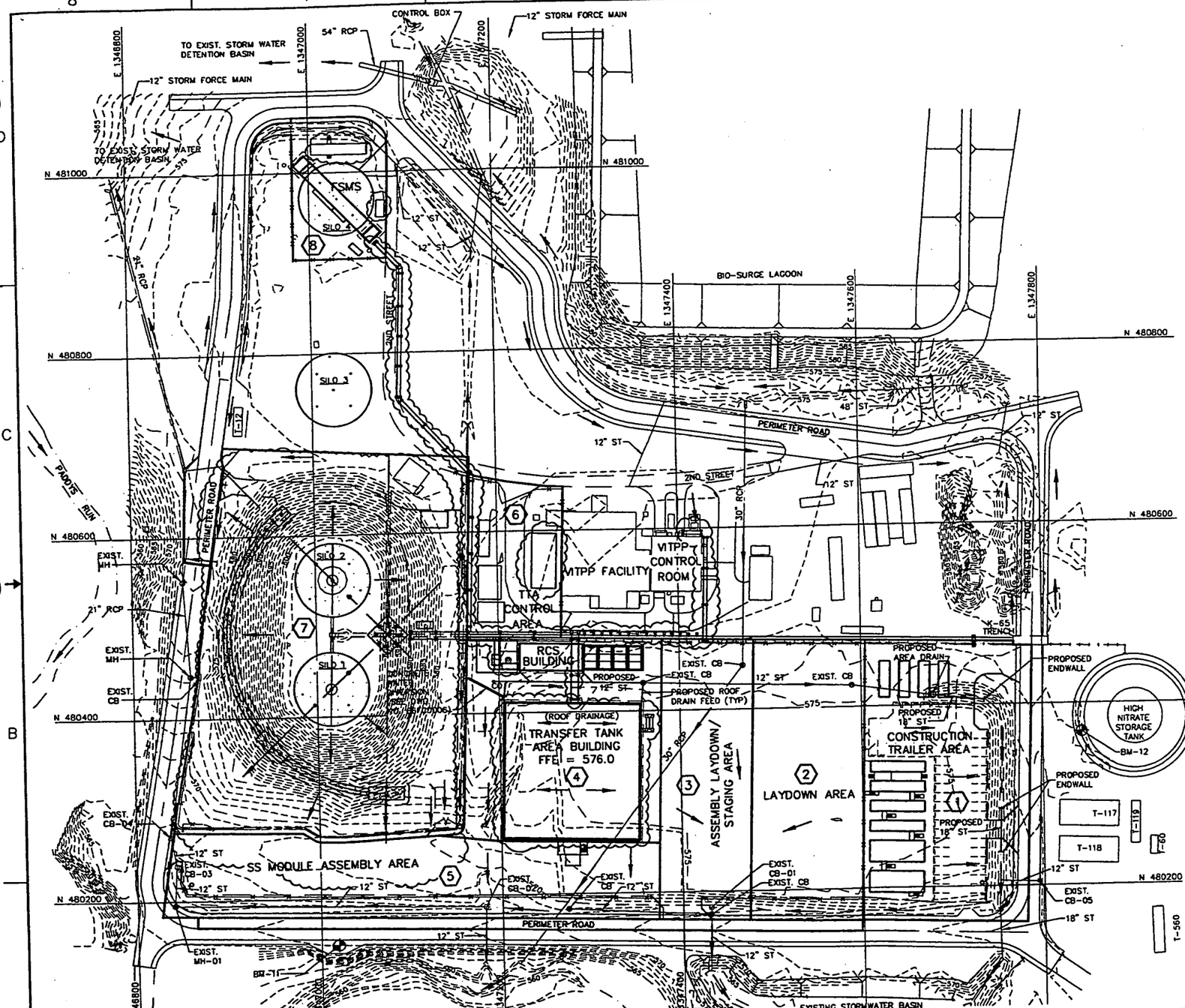
FOSTER WHEELER ENVIRONMENTAL CORPORATION								
PROJECT: Fernald Silos 1 and 2 AWR					SUBJECT: Stormwater Drainage			
Revision	Z							Sheet A16 of A21
By / Date	MSH	11/10/00						Project No: 2122.0308
Ch / Date								Calc: CA-FSC624-FC-001

3387



A17 of A21

3387



NOTES:

1. SEE DRAWING 05FCD011 FOR GENERAL NOTES AND LEGEND.
2. DRAINAGE AREAS AT THE SILO'S AND NORTH AND WEST OF THE PERIMETER ROAD DRAIN TO THE WEST TO AN EXISTING CONCRETE SUMP. THE CONCRETE SUMP CONTAINS A 12" DIA FORCE MAIN TO THE BIO-SURGE LAGOON.
3.

DRAINAGE AREA	DESCRIPTION OF DRAINAGE AREA	OUTLET
1	GRAVEL LOT	EXISTING STORMWATER BASIN AT 18"ø OUTLET
2	GRAVEL LOT	EXISTING STORMWATER BASIN AT CB-01
3	LAYDOWN AREA	EXISTING STORMWATER BASIN AT CB-01
4	TTA AND RCS BUILDINGS - GUTTERS	PROPOSED ROOF DRAINAGE TO 18"ø OUTLET EAST OF AREA 1
5	SOUTH OF SILO 1	12 IN. OUTLET FROM CB-02
6	TTA CONTROL AREA	EXISTING STORMWATER BASIN NORTH OF K-65 TRENCH
7	SILOS 1 AND 2 - PERIMETER TRENCH	CONCRETE SUMP TO BIO-SURGE LAGOON
8	SILO 4 - PERIMETER TRENCH	CONCRETE SUMP TO BIO-SURGE LAGOON
9	ALL OTHER AREAS OUTSIDE PROJECT	EXISTING STORMWATER BASINS

4. DRAINAGE AREAS 7 & 8 RUNOFFS HAVE BEEN CALCULATED USING A 25 YEAR, 24 HOUR STORM.
5. ALL OTHER DRAINAGE AREA RUNOFFS HAVE BEEN CALCULATED USING A 10 YEAR, 24 HOUR STORM.
6. STORM WATER CONTROLS FOR ALL AREAS WILL BE BASED ON OHIO DEPT. OF NATURAL RESOURCES (ODNR) RAINWATER AND LAND DEV. PLAN.
7. THE AWR STORMWATER DRAINAGE PLAN ACCOUNTS FOR ANY CHANGES FROM PHASED CONSTRUCTION WITHIN THE INDIVIDUAL DRAINAGE AREAS AS FOLLOWS:

ZONE	ZONE AREA (SF)	RUNOFF COEFFICIENT OF DRAINAGE	ZONE MAXIMUM FLOW OF STORMWATER IN CFS	STORMWATER CONVEYANCE SYSTEM CAPACITY
1	56,535	0.58	7.25	14.0 CFS
2	37,978	0.40	2.35	11.0 CFS
3	31,405	0.50	1.94	11.0 CFS
4	47,539	0.78	1.42	11.0 CFS
5	48,287	0.50	3.00	11.0 CFS
6	17,616	0.57	N/A	N/A
7	123,437	0.69	13.05	53.2
8	16,287	0.56	N/A	53.2
ROAD	4,260	0.90	0.48	11.0

8. REFERENCE CALCULATION NO. CA-FSC624-FC-001.

STORMWATER LEGEND:

- DRAINAGE AREA
- DRAINAGE AREA BOUNDARY
- FLOW DIRECTION
- PROPOSED CLEANOUT
- PROPOSED AREA DRAIN
- PROPOSED ENDWALL

STATE OF OHIO NORTH (NAD 83)

SCALE IN FEET: 60 0 60 120

000222

THE ORIGINAL DRAWING AND SUBSEQUENT REVISIONS THEREOF, WITH APPROVAL NAMES, INITIALS, AND THE PE SEAL, IF APPLICABLE, ARE MAINTAINED IN THE FILES OF FWENC.

REV	DATE	BY	CHK'D	APR'VD	DESCRIPTION/ISSUE
2					REVISED PER AWR-DCN-C-0008
1	6/1/00	WVD	VB	MSH	OHIO EPA COMMENTS
0	4/20/00	WVD	VB	MSH	CERTIFIED FOR CONSTRUCTION

PE

DRAWN BY W. MARVIN	DATE 4/20/00	
DESIGNED BY M. HUGHES	DATE 4/20/00	
CHECKED BY V. BHATT	DATE 4/20/00	
APPROVED BY M. HUGHES	DATE 4/20/00	
APPROVED BY JOHN LAWSON	DATE 4/20/00	

DEPARTMENT OF ENERGY
FERNALD ENVIRONMENTAL MANAGEMENT PROJECT
SILOS 1 AND 2 ACCELERATED WASTE RETRIEVAL PROJECT
FERNALD, OHIO
FDF CONTRACT NO. FSC 624

FOSTER WHEELER
FOSTER WHEELER ENVIRONMENTAL CORPORATION

TITLE
STORM WATER SYSTEM OVERALL DRAINAGE PLAN

SIZE D | SCALE: 1"=60' | DWG. NO. 66FCD001 | REV 2

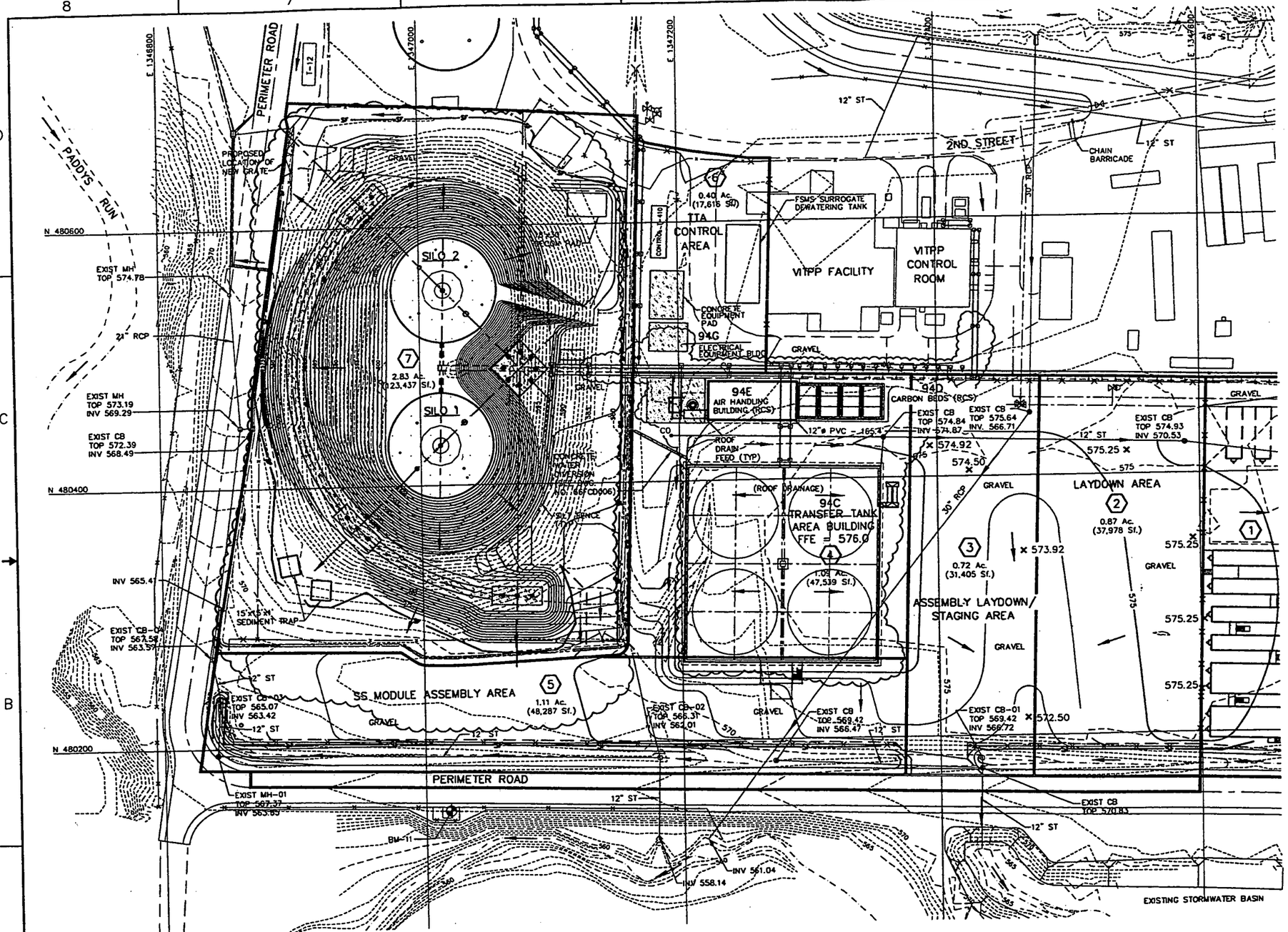
FILENAME: 66FCD001.DWG

XREF DRAWINGS:

000210

A1B of A21

3387



NOTES:

1. SEE DRAWING 05FCD011 FOR GENERAL NOTES AND LEGEND.
2. SILT FENCE TO BE INSTALLED AT THE BOTTOM OF ALL DISTURBED SLOPES, AND FOLLOW CONTOUR.
3. CULVERT ENTRANCES AND EXITS TO BE PROTECTED BY COIR MATTING AND NATURAL VEGETATION.
4. AREAS DISTURBED BY EXCAVATION ACTIVITIES ARE TO BE SEEDED AND MULCHED WITHIN 7 DAYS.
5. OVERSEEDING AND RESEEDING ARE TO BE PERFORMED AS NECESSARY UNTIL VEGETATION IS ESTABLISHED.
6. SILT IS TO BE REMOVED FROM DIVERSION DITCHES AND SILT FENCE INSTALLED AS REQUIRED BY THE SPECIFICATIONS AND AT THE END OF CONSTRUCTION.
7. REINFORCED SILT FENCING IS TO INSTALLED AROUND CATCH BASINS AS SPECIFIED ON PAGE 125 OF THE OONR RAINWATER AND LAND DEVELOPMENT MANUAL.
8. EROSION CONTROL MEASURES ARE TO BE INSPECTED WEEKLY AND WITHIN 24 HOURS OF A 0.5 INCH RAINFALL.
9. REMEDIATION OF PROBLEMS IDENTIFIED IN THE INSPECTION ARE TO BE COMPLETED IWITHIN 24 HOURS.
10. AWR PROJECT ACTIVITIES DO NOT SIGNIFICANTLY ALTER EXISTING DRAINAGE PATTERNS.
11. THE TTA BUILDING AREA ROOF DRAINAGE WILL BE DIRECTED TO THE EXISTING 12" STORM DRAIN SYSTEM AT THE NORTHEAST SECTION OF THE BUILDING.
12. EROSION AND SILTATION INTO THE CONCRETE CHANNEL IS TO BE PREVENTED.
13. ALL EROSION CONTROL MEASURES WILL BE BE INSTALLED AT THE BEGINNING OF EXCAVATION AND MAINTAINED FOR THE DURATION OF THE PROJECT.

STORMWATER LEGEND:

- (1) DRAINAGE AREA
- DRAINAGE AREA BOUNDARY
- FLOW DIRECTION
- CO PROPOSED CLEANOUT
- SF PROPOSED SILT FENCE

STATE OF OHIO NORTH (NAD 83)

LETTER OR NUMBER OF SECTION OR DETAIL
DRAWING ON WHICH SECTION OR DETAIL IS TAKEN
DRAWING ON WHICH SECTION OR DETAIL IS SHOWN

SECTION & DETAIL KEY

000223

40 0 40 80

SCALE IN FEET

000241

THE ORIGINAL DRAWING AND SUBSEQUENT REVISIONS THEREOF, WITH APPROVAL NAMES, INITIALS, AND THE PE SEAL, IF APPLICABLE, ARE MAINTAINED IN THE FILES OF FWENC.

REV	DATE	BY	CHK'D	APR'VD	DESCRIPTION/ISSUE
3					REVISED PER AWR-DCN-C-0008
2	6/1/00	WVM	VB	MSH	OHIO EPA COMMENTS
1	4/20/00	WVM	VB	MSH	AREA 2 GRAVELED, AREA 7 EXC & FNDN REMOVED
0	3/6/00	WVM	VB		CERTIFIED FOR CONSTRUCTION

RPE

		DATE
DRAWN BY	W. MARVIN	3/6/00
DESIGNED BY	M. HUGHES	3/6/00
CHECKED BY	V. BHATT	3/6/00
APPROVED BY	M. HUGHES	3/6/00
APPROVED BY	JOHN LAWSON	3/6/00

DEPARTMENT OF ENERGY
FERNALD ENVIRONMENTAL MANAGEMENT PROJECT
SILOS 1 AND 2 ACCELERATED WASTE RETRIEVAL PROJECT
FERNALD, OHIO
FDF CONTRACT NO. FSC 624

FOSTER WHEELER
FOSTER WHEELER ENVIRONMENTAL CORPORATION

TITLE
STORM WATER SYSTEM
SWRS – DRAINAGE PLAN
PHASE 1

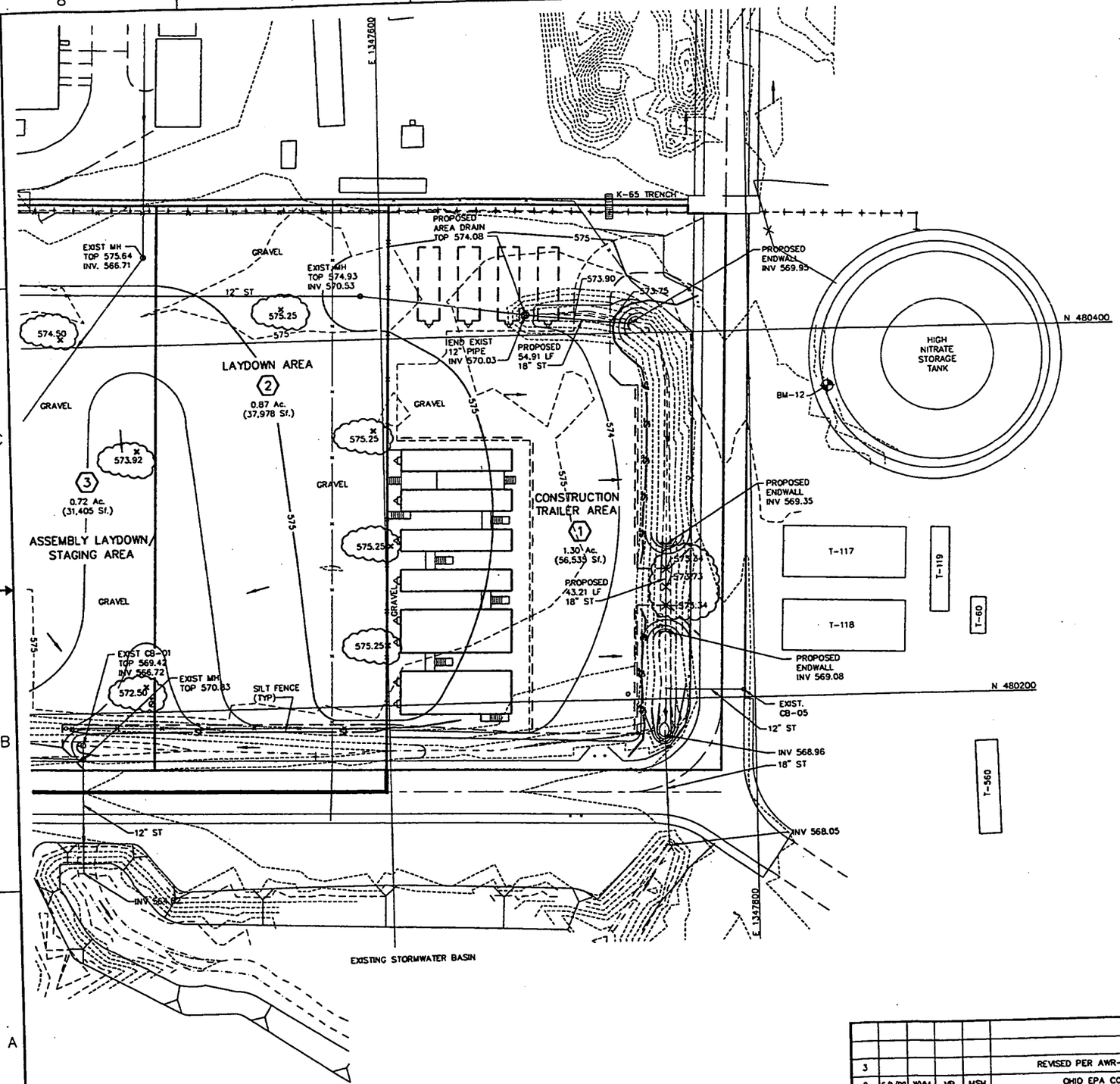
SIZE	SCALE:	DWG. NO.	REV
D	1"=30'	66FCD002	3

FILENAME: 66FCD002.DWG

XREF DRAWINGS: 40-

A19 of A21

3387



NOTES:

1. SEE DRAWING 05FCD011 FOR GENERAL NOTES AND LEGEND.
2. SILT FENCE TO BE INSTALLED AT THE BOTTOM OF ALL DISTURBED SLOPES, AND FOLLOW CONTOUR.
3. CULVERT ENTRANCES AND EXITS TO BE PROTECTED BY COIR MATTING AND NATURAL VEGETATION.
4. AREAS DISTURBED BY EXCAVATION ACTIVITIES ARE TO BE SEEDED AND MULCHED WITHIN 7 DAYS, REFER TO SPEC SECTION 02924.
5. OVERSEEDING AND RESEEDING ARE TO BE PERFORMED AS NECESSARY UNTIL VEGETATION IS ESTABLISHED.
6. SILT IS TO BE REMOVED FROM DIVERSION DITCHES AND SILT FENCE INSTALLED AS REQUIRED BY THE SPECIFICATIONS AND AT THE END OF CONSTRUCTION.
7. REINFORCED SILT FENCING TO BE INSTALLED AROUND CATCH BASINS AS SPECIFIED ON PAGE 125 OF THE ODNR RAINWATER AND LAND DEVELOPMENT MANUAL
8. EROSION CONTROL MEASURES ARE TO BE INSPECTED WEEKLY AND WITHIN 24 HOURS OF A 0.5 INCH RAINFALL.
9. REMEDIATION OF PROBLEMS IDENTIFIED IN THE INSPECTION ARE TO BE COMPLETED WITHIN 24 HOURS.
10. AWR PROJECT ACTIVITIES DO NOT SIGNIFICANTLY ALTER EXISTING DRAINAGE PATTERNS.
11. SEE 66FCD007 FOR STORM DRAIN PROFILES.
12. ALL EROSION CONTROL MEASURES WILL BE BE INSTALLED AT THE BEGINNING OF EXCAVATION AND MAINTAINED FOR THE DURATION OF THE PROJECT.

STORMWATER LEGEND:

- (1) DRAINAGE AREA
- DRAINAGE AREA BOUNDARY
- FLOW DIRECTION
- PROPOSED AREA DRAIN
- PROPOSED ENDWALL
- SF — SILT FENCE

STATE OF OHIO NORTH (NAD 83)

000224

LETTER OR NUMBER OF SECTION OR DETAIL
DRAWING ON WHICH SECTION OR DETAIL IS TAKEN
DRAWING ON WHICH SECTION OR DETAIL IS SHOWN

SECTION & DETAIL KEY

30 0 30 60
SCALE IN FEET

REV	DATE	BY	CHK'D	APR'VD	DESCRIPTION/ISSUE
3					REVISED PER AWR-DCN-C-0008
2	6/1/00	WVM	VB	MSH	OHIO EPA COMMENTS
1	4/20/00	WVM	VB	MSH	AREA'S 1 AND 2 NOW GRAVEL
0	3/6/00	WVM	VB		CERTIFIED FOR CONSTRUCTION

THE ORIGINAL DRAWING AND SUBSEQUENT REVISIONS THEREOF, WITH APPROVAL NAMES, INITIALS, AND THE PE SEAL, IF APPLICABLE, ARE MAINTAINED IN THE FILES OF FHDNC.

PE

DRAWN BY W. MARVIN	DATE 3/6/00	
DESIGNED BY M. HUGHES	DATE 3/6/00	
CHECKED BY V. BHATT	DATE 3/6/00	
APPROVED BY M. HUGHES	DATE 3/6/00	
APPROVED BY JOHN LAWSON	DATE 3/6/00	

DEPARTMENT OF ENERGY
FERNALD ENVIRONMENTAL MANAGEMENT PROJECT
SILOS 1 AND 2 ACCELERATED WASTE RETRIEVAL PROJECT
FERNALD, OHIO
FDF CONTRACT NO. FSC 624

FOSTER WHEELER
FOSTER WHEELER ENVIRONMENTAL CORPORATION

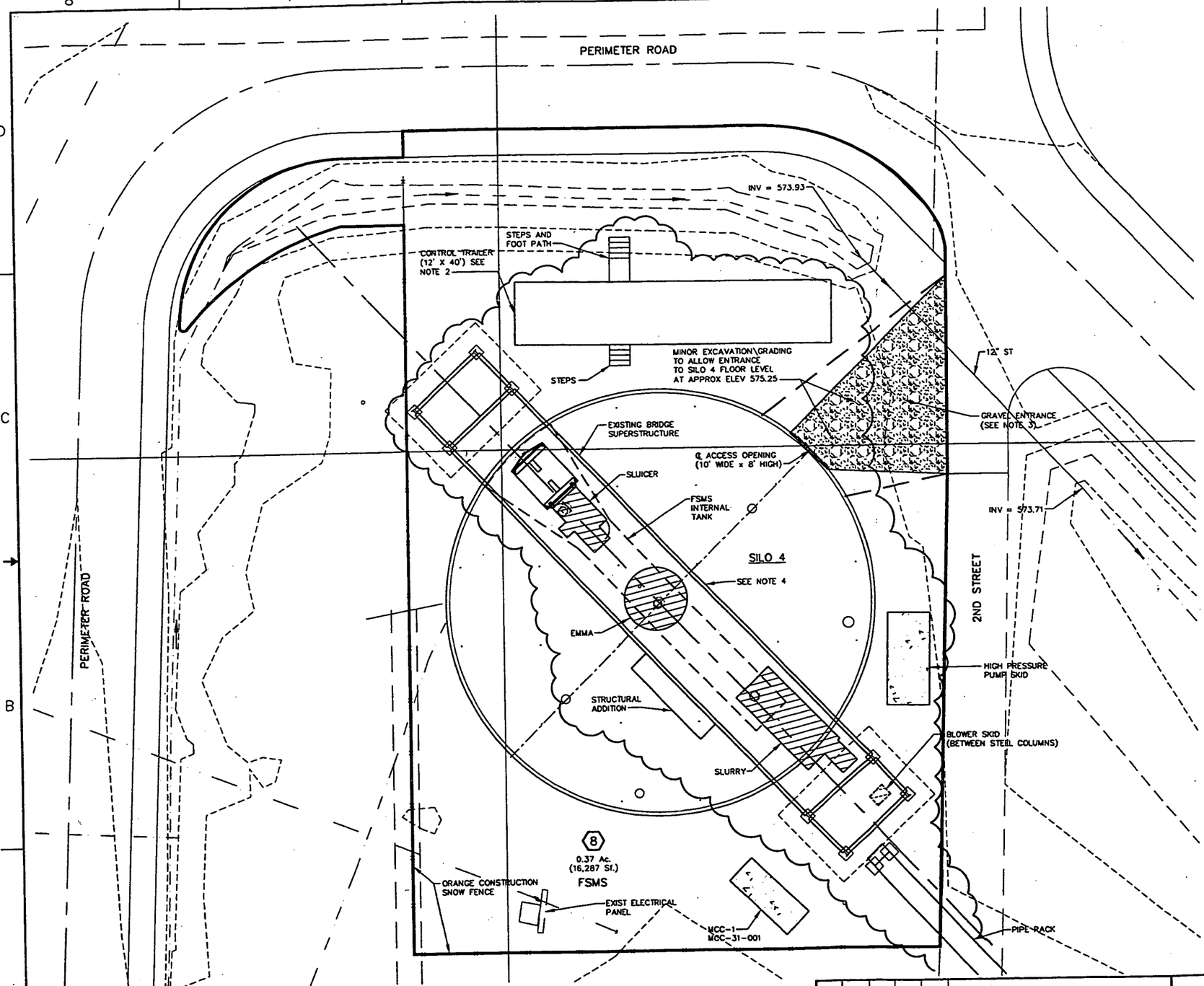
TITLE
STORM WATER SYSTEM
TRAILER AREA – DRAINAGE PLAN

SIZE D | SCALE: 1"=30' | DWG. NO. 66FCD003 | REV 3

FILENAME: 66FCD003.DWG

XREF DRAWINGS: 30A-EX, 30A-PR.DWG

000213



LETTER OR NUMBER OF SECTION OR DETAIL
DRAWING ON WHICH SECTION OR DETAIL IS TAKEN
DRAWING ON WHICH SECTION OR DETAIL IS SHOWN

SECTION & DETAIL KEY

* THIS DRAWING IS PART OF ATTACHMENT A, SHEET ~~A18 OF A19~~ OF CALCULATION NO. CA-FSC624-FC-001

Acc. of A21

3387

NOTES:

1. SEE DRAWING 05FCD011 FOR GENERAL NOTES AND LEGEND.
2. SEE DRAWINGS 10FSD001 THROUGH 10FSD005 FOR SUPERSTRUCTURE DEMOLITION AND MODIFICATIONS.
3. SILT FENCE TO BE INSTALLED AT THE BOTTOM OF ALL DISTURBED SLOPES, AND FOLLOW CONTOUR.
4. CULVERT ENTRANCES AND EXITS TO BE PROTECTED BY COIR MATTING AND NATURAL VEGETATION.
5. AREAS DISTURBED BY EXCAVATION ACTIVITIES ARE TO BE SEEDED AND MULCHED WITHIN 7 DAYS.
6. OVERSEEDING AND RESEEDING ARE TO BE PERFORMED AS NECESSARY UNTIL VEGETATION IS ESTABLISHED.
7. SILT IS TO BE REMOVED FROM DIVERSION DITCHES AND SILT FENCE INSTALLED AS REQUIRED BY THE SPECIFICATIONS AND AT THE END OF CONSTRUCTION.
8. REINFORCED SILT FENCING OS TO BE INSTALLED AROUND CATCH BASINS AS SPECIFIED ON PAGE 125 OF THE ODNR RAINWATER AND LAND DEVELOPMENT MANUAL.
10. EROSION CONTROL MEASURES ARE TO BE INSPECTED WEEKLY AND WITHIN 24 HOURS OF A 0.5 INCH RAINFALL.
11. REMEDIATION OF PROBLEMS IDENTIFIED IN THE INSPECTION ARE TO BE COMPLETED WITHIN 24 HOURS.
12. AWR PROJECT ACTIVITIES DO NOT SIGNIFICANTLY ALTER EXISTING DRAINAGE PATTERNS.
13. THE TTA BUILDING AREA ROOF DRAINAGE WILL BE DIRECTED TO THE EXISTING 12" STORM DRAIN SYSTEM AT THE NORTHEAST SECTION OF THE BUILDING.
14. EROSION AND SILTATION INTO THE CONCRETE CHANNEL IS TO BE PREVENTED.
15. ALL EROSION CONTROL MEASURES WILL BE BE INSTALLED AT THE BEGINNING OF EXCAVATION AND MAINTAINED FOR THE DURATION OF THE PROJECT.

STORMWATER LEGEND:

- (1) DRAINAGE AREA BOUNDARY
- DRAINAGE DIVIDE
- FLOW DIRECTION

STATE OF OHIO NORTH (NAD 83)

000225

10 0 10 20
SCALE IN FEET

REV	DATE	BY	CHK'D	APR'VD	DESCRIPTION/ISSUE
2					REVISED PER AWR-DCN-C-0008
1	6/1/00	WVD	VB	MSH	OHIO EPA COMMENTS
0	4/20/00	WVD	VB	MSH	CERTIFIED FOR CONSTRUCTION

THE ORIGINAL DRAWING AND SUBSEQUENT REVISIONS THEREOF, WITH APPROVAL NAMES, INITIALS, AND THE PE SEAL, IF APPLICABLE, ARE MAINTAINED IN THE FILES OF FWENC.

PE

		DATE
DRAWN BY	W. MARVIN	4/20/00
DESIGNED BY	M. HUGHES	4/20/00
CHECKED BY	V. BHATT	4/20/00
APPROVED BY	M. HUGHES	4/20/00
APPROVED BY	JOHN LAWSON	4/20/00

DEPARTMENT OF ENERGY
FERNALD ENVIRONMENTAL MANAGEMENT PROJECT
SILOS 1 AND 2 ACCELERATED WASTE RETRIEVAL PROJECT
FERNALD, OHIO
FDF CONTRACT NO. FSC 624

FOSTER WHEELER
FOSTER WHEELER ENVIRONMENTAL CORPORATION

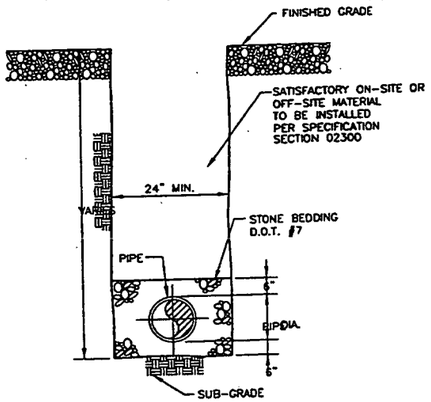
TITLE
STORM WATER SYSTEM
FSMS – DRAINAGE PLAN

SIZE	SCALE:	DWG. NO.	REV
D	1"=10'	66FCD004	2

FILENAME: 66FCD004.DWG

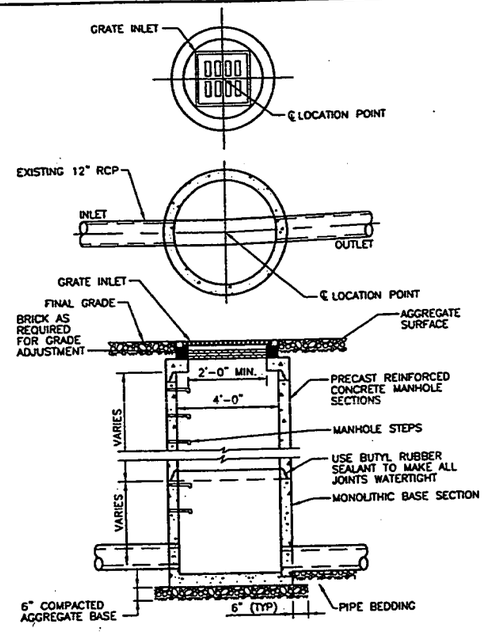
A21 of A21

3387



STORM PIPE BEDDING DETAIL

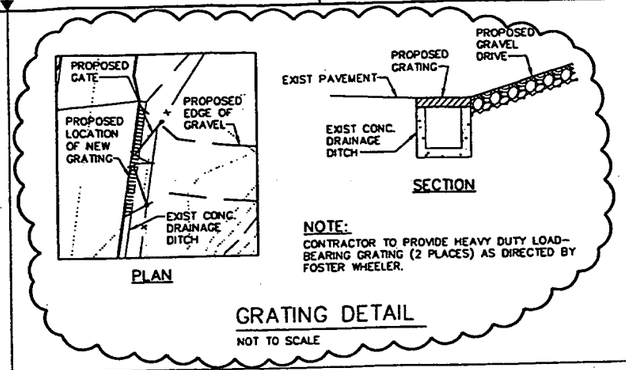
NOT TO SCALE



NOTE:
GROUT ANNULAR SPACE BETWEEN WALL AND PIPE WITH NON-SHRINK MORTAR TO ENSURE A WATERTIGHT SEAL OR USE NEOPRENE BOOT WITH COMPRESSION RING; CLAMP BOOT TO PIPE WITH STAINLESS STEEL CLAMP.

PRECAST CONCRETE AREA DRAIN DETAIL

NOT TO SCALE



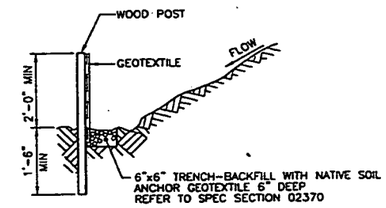
NOTE:
CONTRACTOR TO PROVIDE HEAVY DUTY LOAD-BEARING GRATING (2 PLACES) AS DIRECTED BY FOSTER WHEELER.

GRATING DETAIL

NOT TO SCALE

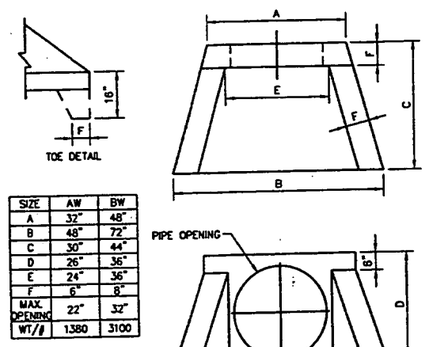
NOTES:

1. ALL EROSION CONTROLS ARE TO BE INSTALLED AT THE BEGINNING OF CONSTRUCTION AND MAINTAINED FOR THE DURATION.
2. ALL SITE WORK MUST CONFORM TO APPLICABLE CFC DRAWINGS AND CONSTRUCTION SPECS, WHICH INCORPORATE ODNR RAINWATER AND LAND DEVELOPMENT STANDARDS.
3. FWENC WILL CONDUCT WEEKLY SITE INSPECTIONS DURING CONSTRUCTION ACTIVITIES OF ALL EROSION CONTROLS, GENERAL HOUSEKEEPING PRACTICES, AND STORM WATER CHANNELS AS SET FORTH IN THE ENVIRONMENTAL CONTROL PLAN, DOCUMENT NO. 624-P621-10.
4. AT CULVERT INLETS AND OUTLETS, EROSION CONTROL BLANKETS (MATTING) AND SEEDING MAY BE SUBSTITUTED FOR RIP-RAP. REFER TO SPECIFICATION SECTION 02370, SLOPE PROTECTION AND EROSION CONTROL, AND SECTION 02924, SEEDING.



SILT FENCE DETAIL

NOT TO SCALE



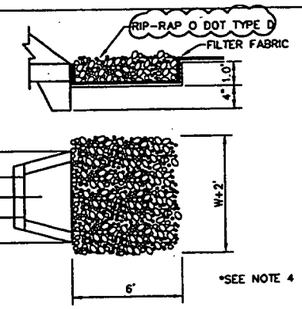
SIZE	AW	BW
A	32"	48"
B	48"	72"
C	30"	44"
D	26"	36"
E	24"	36"
F	6"	8"
MAX. OPENING	22"	32"
WT/#	1380	3100

NOTE:
1. MINIMUM REINFORCING WIRE REINFORCEMENT 4x4 W7xW7.
2. f'c = 4,500psi.
3. fy = 60 Ksi.
* 0" ON AW HEADWALL

PRECAST HEADWALL DETAIL BY SHERMAN DIXIE OR EQUIVALENT

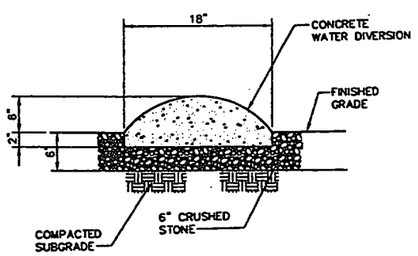
ENDWALL DETAIL

NOT TO SCALE



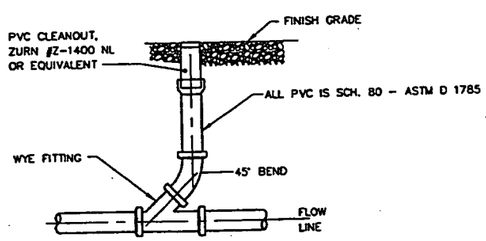
CULVERT INLET & OUTLET PROTECTION DETAIL

NOT TO SCALE



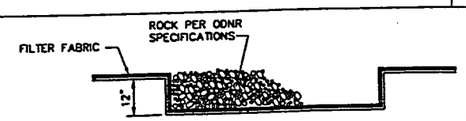
WATER DIVERSION DETAIL

NOT TO SCALE



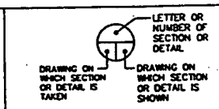
STORM DRAINAGE CLEANOUT DETAIL

NOT TO SCALE



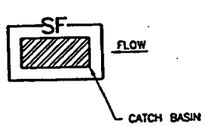
SEDIMENT TRAP DETAIL

NOT TO SCALE



SECTION & DETAIL KEY

CATCH BASIN IS TO BE PROTECTED FROM SEDIMENTATION.



CATCH BASIN PROTECTION DETAIL

NOT TO SCALE

THE ORIGINAL DRAWING AND SUBSEQUENT REVISIONS THEREOF, WITH APPROVAL NAMES, INITIALS, AND THE PE SEAL, IF APPLICABLE, ARE MAINTAINED IN THE FILES OF FWENC.

REV	DATE	BY	CHK'D	APR'VD	DESCRIPTION/ISSUE
2					REVISED PER AWR-DCN-C-0008
1	4/20/00	WVM	VB	MSH	ADDED DIVERSION DETAIL, MINOR DETAIL EDIT
0	3/6/00	WVM	VB		CERTIFIED FOR CONSTRUCTION

PE

DRAWN BY W. MARVIN	DATE 3/6/00	
DESIGNED BY M. HUGHES	DATE 3/6/00	
CHECKED BY V. BHATT	DATE 3/6/00	
APPROVED BY M. HUGHES	DATE 3/6/00	
APPROVED BY JOHN LAWSON	DATE 3/6/00	

DEPARTMENT OF ENERGY
FERNALD ENVIRONMENTAL MANAGEMENT PROJECT
SILOS 1 AND 2 ACCELERATED WASTE RETRIEVAL PROJECT
FERNALD, OHIO
FDF CONTRACT NO. FSC 624

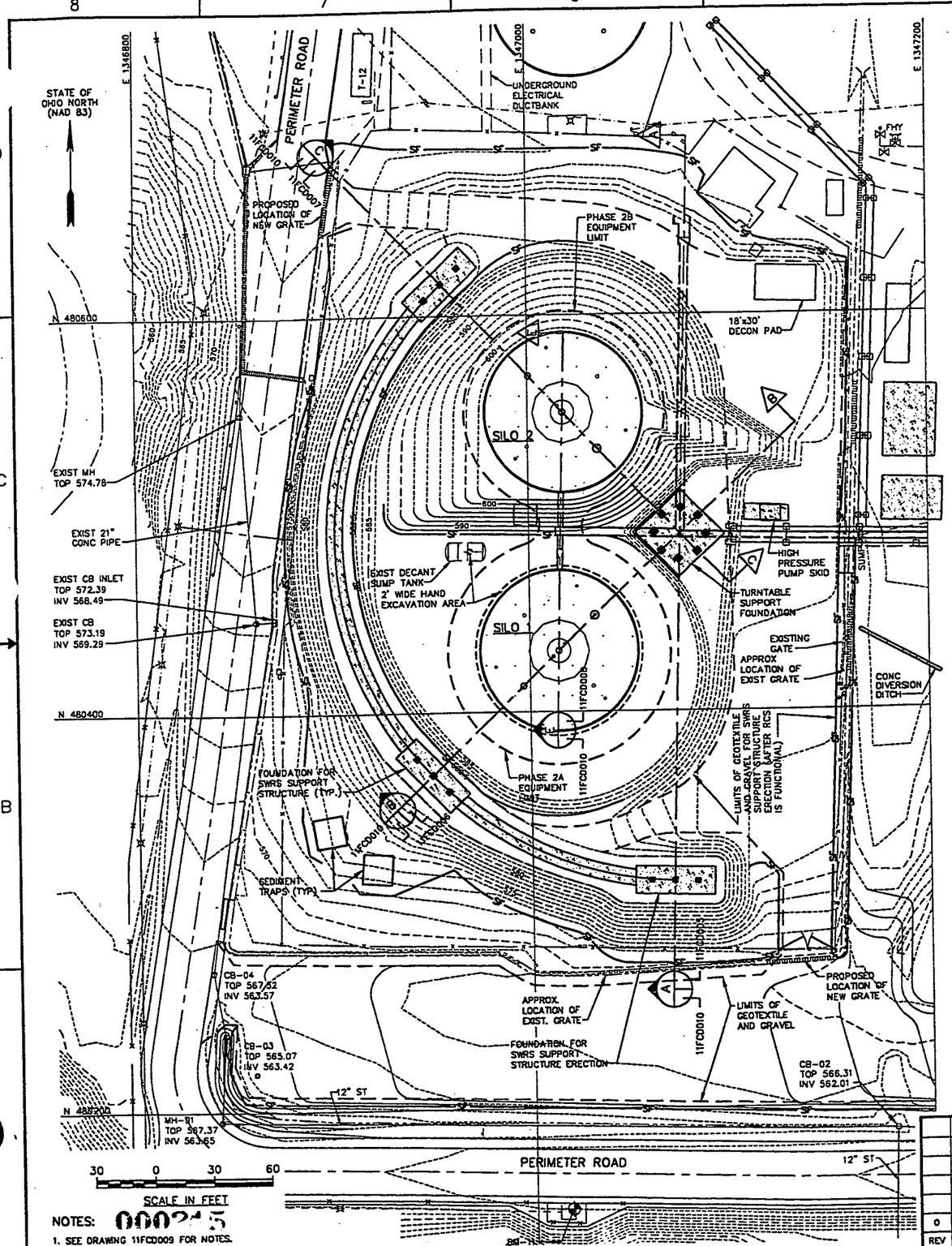
FOSTER WHEELER
FOSTER WHEELER ENVIRONMENTAL CORPORATION

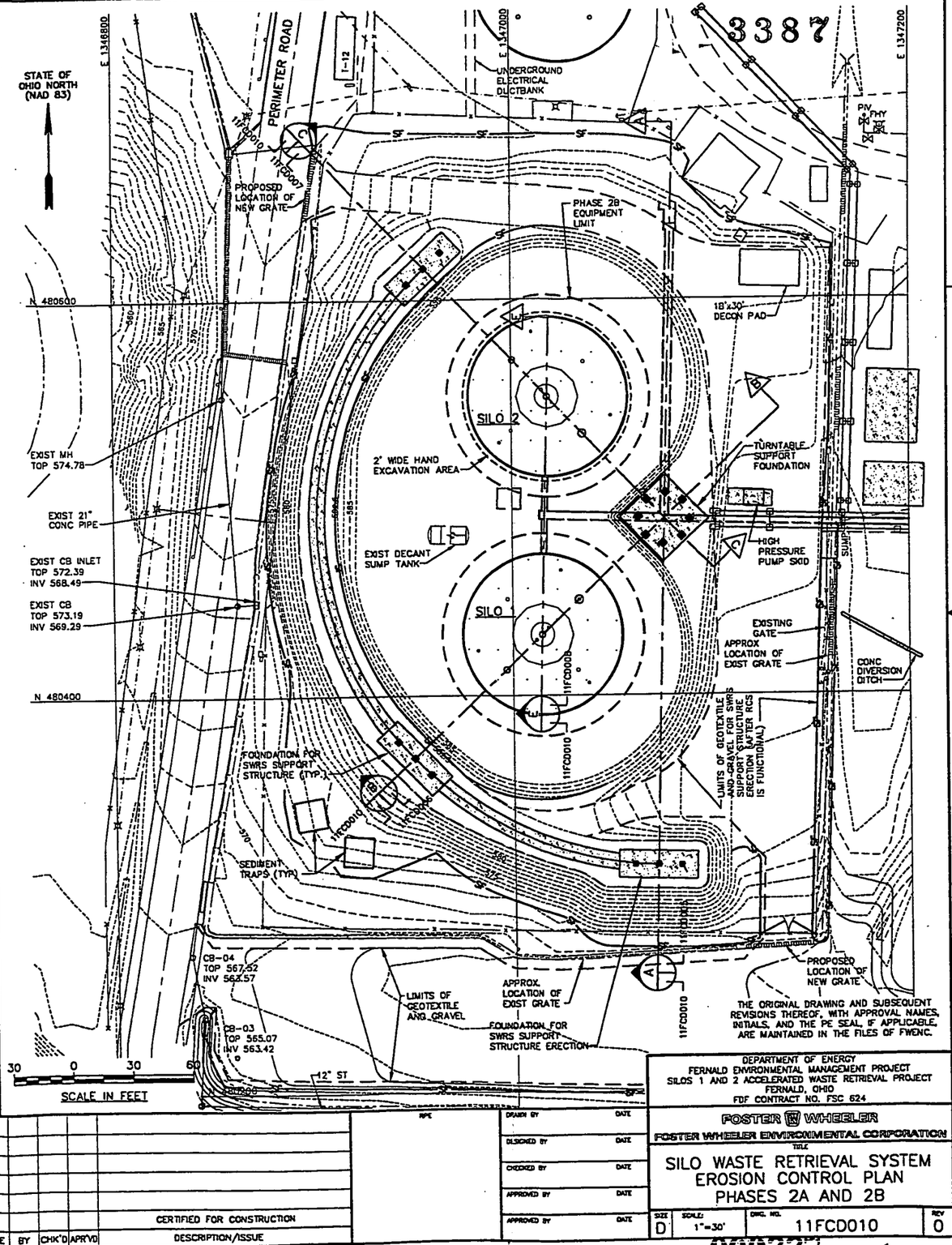
TITLE
STORM WATER SYSTEM
MISC DETAILS
SHEET 1

SIZE	SCALE:	DWG. NO.	REV
D	AS SHOWN	66FCD006	2

FILENAME: 66FCD006.DWG

000226





THE ORIGINAL DRAWING AND SUBSEQUENT REVISIONS THEREOF, WITH APPROVAL NAMES, INITIALS, AND THE PE SEAL, IF APPLICABLE, ARE MAINTAINED IN THE FILES OF FWENC.

NOTES: 000215

1. SEE DRAWING 11FCD009 FOR NOTES.

REV	DATE	BY	CHK'D	APR'VD	DESCRIPTION/ISSUE
0					CERTIFIED FOR CONSTRUCTION

DEPARTMENT OF ENERGY
FERNALD ENVIRONMENTAL MANAGEMENT PROJECT
SILOS 1 AND 2 ACCELERATED WASTE RETRIEVAL PROJECT
FERNALD, OHIO
FDF CONTRACT NO. FSC 624

FOSTER WHEELER
FOSTER WHEELER ENVIRONMENTAL CORPORATION

TITLE
SILO WASTE RETRIEVAL SYSTEM
EROSION CONTROL PLAN
PHASES 2A AND 2B

SIZE	SCALE:	DWG. NO.	REV
D	1"=30'	11FCD010	0

000227

FILENAME: 11FCD010.DWG

3387

APPENDIX 5.4

WASTE HANDLING WORK PLAN

3387

FOSTER WHEELER

FOSTER WHEELER ENVIRONMENTAL CORPORATION

WASTE HANDLING WORK PLAN

DOCUMENT NO.
624-ACR007-01, Rev. 0

FOR THE

SILOS 1 AND 2 ACCELERATED WASTE RETRIEVAL (AWR) PROJECT

SUBMITTED TO:

FLUOR FERNALD, INC.

CONTRACT NO. FSC 624

November 7, 2000

3387

FOSTER WHEELER ENVIRONMENTAL CORPORATION

WASTE HANDLING WORK PLAN
Revision 0

Recommended by:

Foster Wheeler Engineering Manager

11/10/00
Date

Approved by:

Foster Wheeler Project Manager

11-13-00
Date

000216

3387

TABLE OF CONTENTS

1.0 INTRODUCTION 1
1.1 Organization of Plan 1
1.2 Background 1
1.3 Key Assumptions 1
2.0 SCOPE OF WORK 3
2.1 General 3
2.2 Summary of Approach 3
3.0 WASTE STREAMS 5
3.1 Primary Waste 5
3.1.1 K-65 material 5
3.1.2 K-65 Debris 5
3.1.3 Excavated Soils 5
3.1.4 Buried Drums 6
3.2 Secondary Waste 6
3.2.1 Wastewater 6
3.2.2 Personal Protective Equipment 6
3.2.3 Surrogate Waste 6
3.2.4 Surrogate Solids 6
3.2.5 HEPA Filters 7
3.2.6 Petroleum, Oils and Lubricants 7
3.2.7 Vehicle and Equipment Air, Fuel and Oil Filters 7
3.2.8 Anti-Freeze and Engine Coolant 7
3.2.9 Fixative Spray Paint 7
3.2.10 Sampling Equipment 7
3.2.11 Decontamination Fluids/Materials 7
3.2.12 Miscellaneous Waste 8
3.3 Clean Construction Waste 8
3.3.1 Clean Debris 8
3.3.2 Scrap Metal 8
3.3.3 Wood/Paper Products 8
3.3.4 Sanitary Wastewater and Gray Water: 8
4.0 WASTE HANDLING AND DISPOSITION 9
4.1 Waste Segregation Containerization/Accumulation 9
4.2 Temporary Waste Staging Areas 11
4.3 Spill/Discovery Notification 11
5.0 EQUIPMENT TRANSPORTATION IN THE CONSTRUCTION ZONE 12

000217

ACRONYMS AND ABBREVIATIONS

3387

AEA	Atomic Energy Act
AWR	Accelerated Waste Retrieval
AWWT	Advanced Waste Water Treatment System
BMP	Best Management Practice
CFR	Code of Federal Regulations
D&D	Decontamination and Decommissioning
DOE	U.S. Department of Energy
DOT	U.S. Department of Transportation
DWRS	Decant Sump Waste Retrieval System
EPA	U.S. Environmental Protection Agency
FEMP	Fernald Environmental Management Project
Fluor Fernald	Fluor Fernald, Inc.
Foster Wheeler	Foster Wheeler Environmental Corporation
FSMS	Full-Scale Mock-Up System
HP	Health Physics
O&M	operation and maintenance
OSDF	Onsite Disposal Facility
PPE	personal protective equipment
PWID	Project Waste Identification and Disposition
RCRA	Resource Conservation and Recovery Act
RCS	Radon Control System
SP	Stockpile
SWRS	Silos Waste Retrieval System
TLCP	Toxicity Character Leaching Procedure
TTA	Transfer Tank Area
TWRS	Transfer Tank Waste Retrieval System
UN	United Nations
WAC	waste acceptance criteria
WHWP	Waste Handling Work Plan

000248

3387

1.0 INTRODUCTION

This Waste Handling Work Plan (WHWP) summarizes activities and compliance requirements associated with the management of wastes generated during construction, testing, and operation and maintenance (O&M) of the Accelerated Waste Retrieval (AWR) Project activities at the U.S. Department of Energy (DOE) Fernald Environmental Management Project (FEMP) site. Foster Wheeler Environmental Corporation (Foster Wheeler) is performing the work under Fluor Fernald, Inc. (Fluor Fernald) Contract No. FSC 624.

1.1 Organization of Plan

Section 1 provides and overview of the WHWP, including background and key assumptions supporting the development of this WHWP. Section 2 summarizes the AWR Project scope of work covered by this WHWP. Section 3 identifies applicable waste streams that will be generated and the anticipated waste characterization. Section 4 addresses the handling, segregation, containerization, and movement of waste containers within the AWR Project construction zone and disposition of the waste streams, both onsite and offsite. Section 5 covers documentation, weighing and labeling of waste containers, and transportation issues associated with waste management.

1.2 Background

The FEMP site, owned by the DOE and managed by Fluor Fernald, is located approximately 30 miles northwest of Cincinnati, Ohio. During 1951 to 1960, DOE produced approximately 6,800 cubic meters of material known as K-65 material from processing high-grade uranium ores. Silos 1 and 2 were erected to provide the storage of the material. The silos material contains radionuclides including radium (the contaminant of concern) and thorium. The silos material is classified as 11(e)(2) by-product material in accordance with the Atomic Energy Act (AEA). Therefore, it is excluded from regulation as a solid or hazardous waste under the Resource Conservation and Recovery Act (RCRA) and Title 40 of the *Code of Federal Regulations* (*CFR*) Part 261.4(a)(4).

1.3 Key Assumptions

Waste management activities and compliance practices summarized in the WHWP are based on the following key assumptions:

- **Definition of AWR Project Construction Zone –** The terms "construction zone" for the AWR Project applies to the following areas: (1) the existing Silos 1 and 2 Area; (2) the existing Silo 4; and (3) areas in close proximity to the Silos 1 and 2 where support facility trailers for construction and O&M activities will be located.

- **Transportation in the AWR Project Construction Zone –** Foster Wheeler will containerize as required and move the waste to a Fluor Fernald-specified location within the construction zone for pickup and transportation by Fluor Fernald to the designated disposal location. Most waste identified for the OSDF or SP-7 will be managed in bulk rather than being containerized.

000219

- **Transportation "Onsite"** – Transportation of waste from the AWR Project construction zone to other facilities is considered an "onsite" activity. Fluor Fernald will be responsible for this onsite transportation.

3387

- **Fluor Fernald Hazardous Waste Determination** – Fluor Fernald will be responsible for determining whether or not the waste is regulated as hazardous waste under RCRA in accordance with 40 CFR 261.3 or Ohio Administrative Code (OAC) 3745-51-03.

- **Waste Sampling** – The plan for sampling silo residues, including the sampling method, size and number of samples, and container/storage requirements, will be detailed in Remedial Action documentation. All containers of Silo 1 and 2 material will be stored in accordance with RCRA applicable or relevant and appropriate requirements (ARARs) and other applicable storage requirements. Also, any additional sampling and radiological surveys required for berm soils and buried drums (if found) will be performed by Fluor Fernald and disposed of as determined by Fluor Fernald on the basis of the results of the sample analysis and survey.

- **Equipment Decontamination** – Decontamination of equipment, tools and facility components smaller than 18 feet by 30 feet will be performed in a portable, truck-mounted decontamination facility. In addition, a decontamination pad will be constructed within the construction zone to decontaminate larger equipment. The location of this pad and associated run-on/runoff controls are illustrated on Drawing 05FCD012, *Miscellaneous Facilities, Civil Site Layout.* Foster Wheeler personnel will provide initial surveys and will present equipment and survey results to Fluor Fernald for a verification survey.

000220

3387

2.0 SCOPE OF WORK

This section provides a general overview and summary of approach to waste handling activities associated with the AWR Project.

2.1 General

Foster Wheeler will design, construct, operate, and maintain the Radon Control System (RCS), the Pivoting Bridge Support System, the glide track portions of the Silos Waste Retrieval System (SWRS), Decant Sump Waste Retrieval System (DWRS), Full-Scale Mock-Up System (FSMS), the TTA, and the TTA Waste Retrieval System (TWRS). Foster Wheeler will also perform the silo berm removal and spray a fixation agent inside the silos upon completion of waste retrieval.

2.2 Summary of Approach

The Foster Wheeler approach to the AWR Project employs demonstrated technology to safely and effectively remove radioactive decay gases, K-65 waste residues and bentonite, and debris from Silos 1 and 2. The major elements planned for the execution of the AWR Project are:

1. Mobilization and construction of RCS, FSMS, and TTA,
2. Training for and operation of FSMS and RCS,
3. Construction of SWRS,
4. Waste Retrieval Operation at Silo 1,
5. Waste Retrieval Operation at Silo 2,
6. DWRS Operation, and
7. Decontamination and Decommissioning (D&D) and Demobilization.

During the first phase of operations, the accumulated concentration of radon gas in the silo headspaces will be reduced by approximately 75% during the operation of the RCS. Parallel to the operation of FSMS, construction of a pivoting bridge structure will be performed. This bridge structure, which will straddle the existing silos, is to provide a work platform that precludes the placement of unnecessary loads on the silo domes or walls during the operations phase. Only upon successful operation of FSMS and personnel training, Foster Wheeler will start retrieval of waste from the silos.

Retrieval of the waste solids is accomplished remotely with a small number of versatile tools supported from a work platform on the pivoting bridge structure. Four new tanks in a shielded structure (i.e., TTA) erected to the east of the silos will receive and store the solids for future disposition. The debris from the bottom of the silos will be removed remotely using a basket attached to a cable. The basket will be pulled into the air-controlled containment box on the bridge work platform and remotely placed in a 30-gallon drum. Accumulated radon from these tanks will also be constantly exhausted to the on-line RCS. Initially, Silo 1 will be emptied. At the completion of the retrieval operations in Silo 1, the work platform will be pivoted into position

over the Silo 2, thereby eliminating the need for a second bridge structure. The berm soil around the silos will be removed concurrently with the waste removal, such that a berm soil height at least 5 feet higher than the waste level in silos is maintained continuously. The final step for each silo is to spray a fixative on the interior walls, ceiling, and floor to prevent any residual contamination from becoming airborne. After both silos are emptied, the Decant Sump—located west of and between the silos—will be emptied using a similar technique. The berm soil above the sump will be excavated to the extent necessary to allow access into the tank and will be managed in the same manner as other berm soil.

Upon completion of waste removal activities, D&D of facilities and equipment installed for the AWR Project and demobilization activities will be initiated by FWENC. The permanent facilities erected during the AWR Project will be decontaminated before beginning demolition of the facilities. Equipment, tools, and temporary facilities will be decontaminated and surveyed before removal from the FEMP site.

3387

3.0 WASTE STREAMS

The waste streams for the AWR Project are divided into three categories: (1) existing primary waste (i.e., the main scope of work for which Foster Wheeler is responsible to retrieve and store in aboveground storage tanks); (2) secondary waste generated by Foster Wheeler during retrieval and storage of the primary waste; and (3) clean construction waste generated during construction and O&M of the facilities required to retrieve the primary waste. All secondary waste will be segregated, characterized, packaged, and dispositioned in accordance with site procedures.

Based upon the Final Design, a Project Waste Identification and Disposition (PWID) Report will be prepared in accordance with procedure EW-1021, *Preparation of the PWID Report.* The PWID report will document the anticipated waste streams, generation rates, and disposition for secondary waste resulting from AWR operations. FWENC will provide data on tracking of secondary waste generated to Fluor Fernald for updating of the appropriate inventory database. As waste is generated, the volumes of each waste stream will be tracked against the PWID Report, and the PWID Report will be updated as necessary due to any changes from the initial estimates.

Anticipated generation volumes, potential container requirements and proposed disposition methods for each waste stream are summarized in Table 4-1. The final disposition determination (e.g., offsite, OSDF, SP-7) and resulting container requirements will be determined during development and review of the PWID. The containers and disposition methods identified in Table 4-1 will be updated as required based on the approved PWID.

3.1 Primary Waste

This section provides an overview of the various primary waste streams associated with the AWR Project.

3.1.1 K-65 Material

As discussed earlier, this solid waste material contain radionuclides, including radium-226 (the contaminant of concern) thorium-230, lead-210, bismuth-210, and polonium-210.

3.1.2 K-65 Debris

The debris found in the silos and the Decant Sump will be removed using baskets and a remote arm equipped with a grapple and remotely placed into 30-gallon drums and overpacks and disposed offsite.

3.1.3 Excavated Soils

The AWR Project requires excavation of berm soils around the silos and excavation required to construct the foundations for the bridge structure. These soils may contain radiological contamination. During excavation, a working soil pile will be configured by Foster Wheeler within the AWR Project construction zone to support hauling and placement of soil by Fluor Fernald. The soil pile will be large enough to support two days of hauling. Fluor Fernald will take any necessary samples and radiological surveys of the soil and will direct the disposition of the soil. Excavation and management of the berm soil is discussed in detail in the *Berm Excavation Plan*, Document 624-P621-11.

3.1.4 Buried Debris

The possibility exists that buried debris (drums, piping, conduit, etc.) could be encountered during excavation of the bridge structure foundations or berm material excavations at the AWR Project site. If buried debris is found, then Foster Wheeler will notify Fluor Fernald. On approval, Foster Wheeler would excavate in accordance with Fluor Fernald direction and uncover the debris. Fluor Fernald will perform the any required sampling and analysis and will direct disposition of the debris.

3.2 Secondary Waste

During the execution of the AWR Project, additional secondary waste streams will be generated. Also, wastes may be encountered that are not related to site contamination (e.g., heating or fuel oils, lubrication oils, etc.). The following paragraphs give summary data for each of the waste streams anticipated. The container and disposal methods identified in this section are preliminary, and will be finalized during development and review of the PWID Report. The approved PWID Report will document the Fluor Fernald-approved container requirements and disposal method for each secondary waste stream.

3.2.1 Wastewater

Water must be added to the silo waste to mobilize and transfer the waste to the TTA. The waste slurry will pass through a settle and decant chamber to minimize water used to transfer waste. The RCS will be equipped with chillers that will produce condensate that has a capacity to absorb radon. The design will minimize the volume of wastewater by recycling to TTA. It is estimated that, upon completion of AWR operations, approximately 150,000 gallons of excess wastewater will be discharged to the FEMP Advanced Wastewater Treatment System (AWWT) facility after demonstrating compliance with the applicable waste acceptance criteria (WAC). Management of this excess wastewater, including the criteria for discharge to AWWT, is discussed in detail in the *Environmental Control Plan*, Document No. 624-P621-10.

3.2.2 Personal Protective Equipment

Personal protective equipment (PPE) associated with the AWR Project includes gloves, tyvek suits, coveralls, respirators, and boot covers. The recyclable PPE will be placed in plastic bags and stored in an assigned area in the Health Physics (HP) trailer. The disposable PPE will be placed in plastic bags and stored in a roll-off box (until it is full) located near HP trailer and within a posted radiological area. It is anticipated that the majority of the disposal PPE will be disposed as Category 4 material in the OSDF.

3.2.3 Surrogate Waste

During operation of the FSMS, nonradioactive surrogate wastes will be used at the Silo 4. Using the TWRS slurry pump, the settled surrogate in the TTA tank is sluiced from the tank through the existing TTA pipeline and diverted to Surrogate Settling Tank for slurry dewatering.

After the surrogate material dewatering requirements have been satisfied, the material is evaluated in accordance with the FEMP Free Release Policy to determine acceptability for free release. Since the surrogate material will be staged, mixed, stored, transferred, and containerized in new, uncontaminated equipment, it will be possible to utilize process knowledge to support the free release determination. The basis for this determination, and

necessary verification that the surrogate has not been contaminated, will be documented in the PWID Report.

3387

3.2.4 Surrogate Solids

As discussed in Section 3.2.3, nonradioactive surrogate wastes, including solids, will be used for the operation of FSMS at Silo 4. It is anticipated that this clean waste will be certified for free-release by Fluor Fernald and removed from the site by Foster Wheeler.

3.2.5 HEPA Filters

The RCS will be equipped with two parallel banks of high-efficiency particulate air (HEPA) filters. The life of the filters is extended by adding a prefilter in front to remove coarse solids. The used filters and elements will be placed in plastic bags and will be stored in an appropriate container for disposal.

3.2.6 Petroleum, Oils and Lubricants

This waste stream would be generated as a result of vehicle and equipment maintenance, accidental discharge, or failure of equipment. Liquid residue from this waste will be collected and drummed for disposal or recycling.

3.2.7 Vehicle and Equipment Air, Fuel and Oil Filters

When possible, routine vehicle maintenance will be performed offsite or outside the controlled area. Filters being discarded during any onsite maintenance of vehicles or equipment will be drained, crushed, and either certified for free release or bagged for disposal as Category 4 material in the Onsite Disposal Facility (OSDF).

3.2.8 Anti-Freeze and Engine Coolant

If generated as a result of spill, accident, or equipment malfunction located on soil or gravel, then the area of the spill is to be over-excavated and stockpiled or hauled to the FEMP OSDF or staged at Stockpile SP–7 for offsite disposal.

3.2.9 Fixative Spray Paint

An accidental spill on soil or gravel is to be over-excavated and stockpiled or hauled to the OSDF or staged at Stockpile SP–7 for offsite disposal.

3.2.10 Sampling Equipment

Equipment used during sampling of K-65 material, soils, and drum contents will be decontaminated, surveyed, and released for onsite either onsite reuse or for free release. If the equipment cannot be re-used or free released, the equipment will be inventoried and staged for disposal as Category 2 or 3 material in the OSDF according to the Material Segregation and Containerization Criteria (MSCC). Proposed temporary waste staging areas are identified on Drawing No. 05FCD014, *Miscellaneous Facilities, Site Space Allocation.*

000225

3387

3.2.11 Decontamination Fluids/Materials

Rinse water from vehicles and equipment decontamination activities and gray water from shower facility will be collected, sampled, and disposed as wastewater as described in Section 3.2.1.

3.2.12 Miscellaneous Waste

Miscellaneous waste includes plastic materials and paper wipes from decontamination trailers. If this waste is contaminated, then it will be stored in an appropriate container for disposal as Category 4 material in the OSDF.

3.3 Construction Waste

During construction activities, construction waste will be generated as described below. Each category of the construction waste (except gray water) will be segregated by placing in separate containers or stockpiles. The containers will be locked except when waste is being placed in them. The AWR Project Construction Manager or designee will be responsible for maintaining these containers.

3.3.1 Clean Debris

Clean debris such as concrete waste, and unused aggregate will be stockpiled within the AWR Project construction zone but outside the contaminated area. After confirmation that it meets free release requirements, clean debris will be loaded into roll-off boxes for free release and transported to an approved sanitary landfill.

3.3.2 Scrap Metal

Scrap metal generated during fabrication and erection of the steel structures will be collected and placed in a separate container for a free-release survey. If decontamination is required, then the metal will be undergo a second free-release survey. Once material has successfully passed this survey, it will be turned over to Fluor Fernald for a verification survey. Scrap metal not able to be free released will be size-reduced as necessary and staged for disposal as Category 2 material in the OSDF.

3.3.3 Wood/Paper Products

Waste minimization measures such as removal of packaging before entering the controlled area will be employed to minimize the generation of contaminated waste. Wood pallets, cardboard boxes, or similar material will be collected and placed in separate containers for a free release survey.

3.3.4 Sanitary Wastewater and Gray Water

Sanitary wastewater from toilet facilities and gray water from shower facilities at the AWR Project site will be pumped or otherwise conveyed to the FEMP wastewater collection and treatment system for treatment prior to final discharge from the FEMP site via a permitted outfall.

3387

4.0 WASTE HANDLING AND DISPOSITION

This section of the WHWP summarizes how each of the waste streams described in Section 3 must be segregated, containerized, labeled, accumulated, stored, and disposed.

4.1 Waste Segregation Containerization/Accumulation

Table 4-1 summarizes the waste streams, generation volumes, and proposed container and disposition methods established for the AWR Project. Fluor Fernald will provide appropriate containers for each waste category as identified in Table 4-1. The container and disposal methods identified in Table 4-1 are preliminary, and will be finalized during development and review of the PWID Report. The points of generation for K-65 material and debris are Silos 1 and 2. The point of generation for the surrogate waste and debris is Silo 4. The point of generation for the wastewater will be the RCS Building and change trailers. The point of generation for the decontamination wastes is the location where the decontamination operations (near the TTA) will be performed. The point of generation for the remaining primary and secondary waste streams will vary across the AWR Project site. The clean construction waste will be maintained outside the contaminated area but within the AWR Project construction zone. The point of generation for sanitary water and gray water will be near the AWR Project support trailers.

Containers or drums used for the primary and secondary waste and the staging/storage areas will meet the following criteria:

- Containers will be U.S. Department of Transportation (DOT) United Nations (UN) specification drums (e.g., 1A2 for open-top steel drums) and will be inspected for leaks at least once each week during the staging/storage period.
- Containers will be labeled prior to removal from the staging area to indicate the contents and date the first amount of material was put into the container.
- Containers will be labeled "Caution, contains K-65 debris..." prior to removal from the staging area.
- Staging and storage areas will be delineated and marked with a sign indicating the Fluor Fernald-required wording: "Caution, contains K-65 debris...."
- All containers of Silo 1 and 2 material or Silo 1 and 2 sampling residue will be stored in accordance with applicable RCRA ARARs.

Additional Best Management Practices (BMPs) for the drum storage areas containing primary and secondary waste will be employed as follows:

- For drum storage area, the containers will be covered with an anchored poly tarp and will be placed within a minimum 6-inch curb to minimize spread of contamination.
- The drums will be on wooden pallets, within a locked, fenced-in area for overnight storage (to prevent unauthorized access).
- A written record will be kept which includes (at a minimum: the number of drums, contents of each drum, and dates placed/removed from the storage area).

Table 4-1. AWR Project Waste Handling Summary

TASK NUMBER (SEE DESCRIPTIONS BELOW)	WASTE STREAM / ESTIMATED QUANTITIES	POTENTIAL CONTAINERS[2]							
		LARGE METAL BOX (TOP LOADER)	SMALL METAL BOX		ISO	DRUM	ROLL-OFF BOX	NO CONTAINERS (BULK)	ANTICIPATED DISPOSITION
			B-12	B-25					
4, 5, 6	K-65 Material (Category C)							X	TTA Tanks
4, 5, 6	K-65 Debris (Category C)					X			Offsite (NTS, etc.)
1, 3, 4, 5	Excavated Soils (Berm Soil) / 11,000 cubic yards							X	OSDF Cat. 1
1, 3	Buried Debris							X	OSDF Cat. 2
1, 2, 3, 4, 5, 6, 7	Wastewater (Category C) / 150,000 gallons[1]							X	AWWT
1, 2, 3, 4, 5, 6, 7	PPE / 100 cubic yards	X						X	OSDF Cat. 4
2	Surrogate Waste / 200 cubic yards (includes debris *)						X		Free release
2	Surrogate Debris *							X	Free release
1, 2, 3, 4, 5, 6, 7	Petroleum, oils and Lubricants / 200 gallons (includes ** items)					X			Offsite / OSDF
1, 2, 3, 4, 5, 6, 7	Air, Fuel and Oil Filter / **					X			Free release, OSDF Cat. 4 or SP-7
1, 2, 3, 4, 5, 6, 7	Anti Freeze /Engine Coolant Spill material / **							X	OSDF Cat. 4 or SP-7
4, 5	Fixative Spray Paint Spill material							X	OSDF Cat. 4 or SP-7
1, 2, 3, 4, 5, 6, 7	Sampling Equipment	X						X	Free release or OSDF Cat. 2/3
3, 4, 5, 6, 7	Decontamination Fluids and Material / 15,000 gallons water ,50 cubic yards debris							X	AWWT facility (fluid) OSDF Cat 4
1, 2, 4, 5, 6, 7	HEPA Filters / 12 cubic yards	X							OSDF / offsite
1, 2, 3, 4, 5, 6, 7	Miscellaneous Waste / 10 cubic yards						X		OSDF Cat. 4
1, 2, 3, 4, 5, 6, 7	Scrap Metal / 300 cubic yards						X		Free release/ OSDF Cat 2
1, 2, 3, 4, 5, 6, 7	Wood Paper Product / 300 cubic yards	X					X		Free release/ OSDF Cat 4
1, 2, 3, 4, 5, 6, 7	Clean Debris / 110 cubic yards						X		Free release
1, 2, 3, 4, 5, 6, 7	Sanitary Wastewater and Gray Water							X	AWWT facility

Notes: [1] Potable water used for testing of the TTA tanks will be held for use during FSMS testing and subsequent waste retrieval operations. Approximately 150,000 gallons of excess water will be directed to the AWWT facility at the end of AWR Project operations.
[2] Final container requirements and disposal locations will be directed by Fluor Fernald and documented in the approved PWID Report.

Task Numbers and Descriptions

No.	Description	No.	Description
1	Mobilization and construction of RCS, FSMS, and TTA	5	Waste Retrieval Operation at Silo 1
2	Training for and operation of FSMS and RCS	6	DWRS Operation
3	Construction of SWRS	7	D&D and Demobilization
4	Waste Retrieval Operation at Silo 2		

000242

3387

- For RCRA-regulated hazardous wastes, a "Hazardous Waste" label will be used. The label must include the generator's name, accumulation start date, waste code(s), DOT proper shipping name, and DOT Identification number.

- For hazardous wastes (e.g., oils, fuels), all applicable labeling requirements will be satisfied, including assignment of specific waste codes if applicable.

PPE associated with the AWR Project will be accumulated in plastic bags for pickup by Fluor Fernald personnel. Separate bags will be used for cloths, gloves, and booties. Disposable PPE will be placed in roll-off boxes until full.

4.2 Temporary Waste Staging Areas

After being packaged and labeled as described above, secondary waste will be staged in the AWR Project area for pickup and transportation to the appropriate storage or disposal location. Pick-up and transportation will be coordinated to assure that waste is removed from the AWR Project area as soon as possible and to avoid accumulation of waste. Appropriate marking, containment, access control, and inspection of waste containers being staged in the AWR Project area will be provided in accordance with applicable ARARs and FEMP site procedures. As discussed previously, dumpsters and roll-off boxes containing clean debris will be locked, and loading/unloading will be supervised to prevent accidental disposal of the contaminated waste.

4.3 Spill/Discovery Notification

A release/spill of waste will be properly contained as soon as practical after the release occurs. As a proactive measure, spill response kits and equipment will be available at temporary staging locations, including near the Silos 1 and 2 in the contaminated area, Silo 4 area, and the construction staging area (clean area). (See the *Contingency Plan and Emergency Response,* AWR Project Document No. 624-P621-09, regarding the contents of the spill response kits and type of equipment required).

As a preventive measure, drip pans and other precautionary measures will be employed during routine maintenance of vehicle and equipment. These measures serve to minimize the impact of an oil or lubricant released from vehicles or equipment. If oil or hazardous materials not related to site contamination are discovered (e.g., soils, solvents, etc.), then the Fluor Fernald Project Manager will be notified.

3387

5.0 EQUIPMENT TRANSPORTATION IN THE CONSTRUCTION ZONE

The major pieces of equipment that will be used to move drums and dumpsters and to load or unload stockpiles in the AWR Project construction zone are as follows:

- **Drums** – The drums containing K-65 debris and surrogate debris from silos will be loaded in a trolley on the bridge, lowered down to the ground using a hoist and then moved to the drum storage area by a forklift.

- **Dumpsters** – Clean dumpsters and roll-off boxes will be placed at designated locations only. Fluor Fernald will use special equipment to load and unload waste from these containers.

- **Stockpile** – A backhoe, loader, and dump truck will be used to load and unload excavated material and debris from the stockpile area.

3387

3387

APPENDIX 5.5

SILOS PROJECTS ENVIRONMENTAL MONITORING PLAN

SILOS PROJECTS

ENVIRONMENTAL MONITORING PLAN
40000-PL-0010

Revision 1

Signature Page

Approved by:

Karen Wintz	10/26/00
K. Wintz, Silo 3 Project Team Coach	Date
Robert Fellman	10/26/00
R. Fellman, Silos 1 and 2 AWR Project Team Coach	Date
Dale Paine	10/28/00
D. Paine, FDF, Vice President, Silos Project	Date

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RECORD OF ISSUE/REVISIONS

3387

Issue Authorization Date	Effective Date	PCN No.	Rev. No.	Description
	May 17, 2000		0	Initial issue
	November 1, 2000		1	Minor revision in response to comments on AWR RD package – Monitoring station designations in Sections 3.1.3 and 3.1.4 and Attachment A corrected to agree with new light pole numbers; IEMP reporting clarified in Section 4.

000233

000248

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3387

SILOS PROJECTS

ENVIRONMENTAL MONITORING PLAN
40000-PL-0010

Revision 1

TABLE OF CONTENTS

SECTION

1.0 General 1
2.0 Integrated Environmental Monitoring 1
3.0 Project-Specific Environmental Monitoring 1
3.1 Environmental Radiological Air Emissions Monitoring 2
3.1.1 The Silo 3 Stabilization Project and AWR Stack Monitoring Program 2
3.1.2 The IEMP Air Monitoring Program 2
3.1.3 The IEMP Environmental Radon Monitoring Network 3
3.1.4 Project-Specific Air Particulate Monitoring Program 4
3.2 Direct Radiation Monitoring 5
3.3 Wastewater Monitoring 5
3.4 Groundwater Monitoring 6
4.0 Reporting 6
5.0 References 6

ACRONYM LIST

3387

ALARA	As Low As Reasonably Achievable
ARAR	Applicable, Relevant, and Appropriate
ASL	Analytical Support Level
AWR	Accelerated Waste Retrieval
AWWT	Advanced Waste Water Treatment
CERCLA	Comprehensive Environmental Response, Compensation and Liability Act
DOE	Department of Energy
FEMP	Fernald Environmental Management Project
HAMDC	Highest allowable minimal detectable concentration
IEMP	Integrated Environmental Management Plan
ISER	Integrated Site Environmental Report
OU4	Operable Unit 4
pCi	pico curie
SCQ	Sitewide CERCLA Quality assurance plan
TLD	Thermoluminescent Dosimeter
WAC	Waste Acceptance Criteria
WPRAP	Waste Pits Remedial Action Plan

000226

000251

SILOS PROJECTS ENVIRONMENTAL MONITORING PLAN

3387

1.0 General

The current focus of environmental monitoring at the Fernald Environmental Management Project (FEMP) is the implementation of site-wide environmental monitoring and project-specific environmental monitoring. Site-wide environmental monitoring is addressed in the Integrated Environmental Monitoring Plan (IEMP) while project-specific requirements are addressed within the environmental control plans, process control plans, and other design documents which constitute the project's remedial design package. For the Silo 3 Stabilization Project and the Silos 1 and 2 Accelerated Waste Retrieval Project (AWR Project), modifications to the site-wide environmental program are necessary to support project activities. Therefore, the focus of this plan is to establish the integrated environmental monitoring requirements for Operable Unit 4 (OU4) during the conduct of both projects.

2.0 Integrated Environmental Monitoring

The IEMP focuses on monitoring air, direct radiation, groundwater, and surface water to ensure protection of human health and the environment during the conduct of site-wide remediation activities. The IEMP incorporates regulatory requirements for site-wide monitoring, trending, reporting, and it serves as the central reporting mechanism to the regulators and stakeholders for the ongoing emission control/ monitoring activities at the FEMP. It is important to note that Site-wide reporting under the IEMP does not preclude project-specific reporting for the Silo 3 Stabilization Project or the AWR Project.

3.0 Project-Specific Environmental Monitoring

Project-specific environmental monitoring requirements are identified in the applicable design documentation for both the Silo 3 Project and the AWR Project (References 1 and 2). Fluor Fernald Inc. has identified additional enhancements to the existing site monitoring program that are integral to both projects. As a result, this project-specific environmental monitoring plan documents the additional requirements addressing air, direct radiation, and project wastewater (i.e., slurry wastewater and decontamination wastewater) monitoring within and surrounding specified project boundaries that will be established by Fluor Fernald, Inc. The need and extent of project-specific monitoring has been evaluated based on the following criteria:

- Project complexity, extent of contamination, and scope;
- Applicable, Relevant, and Appropriate Requirements (ARARs) compliance strategy;
- DOE Orders compliance strategy; and,
- Existing monitoring data, modeling, and monitoring programs.

000227

This project-specific environmental monitoring plan considers the location of the Operable Unit 4 (OU4) projects with respect to other remediation activities (e.g. the Waste Pit Remedial Action Plan (WPRAP) project) and the FEMP boundary. The plan also considers project-specific constraints such as the contaminants of concern; the characteristics of the OU4 wastes; and the material transfer, handling, and storage processes. Project-specific emission modeling of both normal and upset conditions have provided the basis for identifying and instituting process emission controls that are protective to the workers, public, and the environment (References 6 and 7). The effectiveness of the project-specific emission controls will be evaluated through analysis of monitoring results to identify whether increased or altered emission control methods are necessary. Project-specific environmental monitoring summary results will be provided in project completion reports.

3.1 Environmental Radiological Air Emissions Monitoring

Environmental radiological air monitoring during the Silo 3 and AWR Projects will consist of three programs: 1) the Silo 3 and AWR stack monitoring programs; 2) the IEMP Air Monitoring Program including the environmental radon monitoring network; and 3) the project-specific air monitoring program.

3.1.1 The Silo 3 Stabilization Project and AWR Stack Monitoring Program

The Silos 1 and 2 AWR Project stack monitoring requirements are described in the *Silos 1 and 2 Accelerated Waste Retrieval Project Remedial Design Package (Reference 2) and Operational Environmental Control Plan (Reference 3)*. The Silo 3 Stabilization Project stack-monitoring program is described in, RMR-0445-ENG-015-000, *Operational Environmental Control Plan* (Reference 4) and RMR-0445-ENG-024-000, *ARAR Compliance* Strategy (Reference 5). Both projects will deploy isokinetic sampling for particulate radionuclides, monitoring, and recording of stack exhaust that is compliant with Title 40 of the Code of Federal Regulations (CFR), Part 61, Subpart H, and DOE Order 5400.5, Section IV.6.B. Additionally, the stack exhaust from both projects will be continuously monitored for radon to verify that emissions are controlled in a manner that will not cause the point source to result in a contribution to the fence line radon concentration of greater than 0.5 pCi/L, as an annual average above background. Radiological contaminants represent the primary contaminants of concern, therefore the focus of stack air monitoring will be for radionuclides; however, monitoring for other contaminants of concern will be added, as warranted.

3.1.2 The IEMP Air Monitoring Program

The IEMP Air Monitoring Program is an established program that will continue throughout remediation. Within the IEMP Air Monitoring Program, the radiological air particulate monitoring program provides a fenceline monitoring network for assessing the collective site-wide impact of FEMP multiple concurrent remediation activities. This program demonstrates FEMP compliance with all ARARs and provides early warning feedback regarding the

cumulative sitewide effectiveness of project-specific emission controls. The radiological air particulate monitoring program is reviewed annually in order to account for changes in remediation projects at the FEMP.

Additionally, within the IEMP Air Monitoring Program, the radon monitoring network has been designed to focus on monitoring Silos 1 and 2 headspaces, environmental radon levels in the vicinity of the silos, as well as radon levels at the site fenceline. In support of the Silo 3 and AWR projects and in anticipation of treatment of Silo1 and 2 material, the IEMP environmental radon monitoring network is being modified as described below.

3.1.3 The IEMP Environmental Radon Monitoring Network

During the Silo 3 Stabilization Project and the AWR Project, remediation activities directed toward the removal, processing, and storage of radon-generating wastes create the potential for the release of radon to the environment. Modifications and additions to the existing IEMP environmental radon monitoring network are necessary to accommodate construction activities associated with the AWR Project and to better monitor levels around the Silo 1 and 2 area during the OU4 remediation.

Three present radon monitoring stations near the K-65 Silos are to be re-located to accommodate construction activities. The monitoring stations to be re-located are as follows:

- KNW at the K-65 exclusion fence will be moved to the western side of the road, re-designated KNW-A.
- KSW at the K-65 exclusion fence will be moved to the western side of the road, re-designated KSW-A.
- T28 northeast of the K-65 exclusion fence will be moved across the road, in the prevailing wind direction from the K-65 Silos, re-designated T28A.

To better monitor radon levels in the K-65 area, five radon monitoring locations will be added to the existing IEMP radon network. The monitors will provide additional monitoring of radon levels in the vicinity of the silos during the Silo 3 and AWR projects and subsequent treatment operations for the Silos 1, 2, and 3 material. The tentative locations and designations for the monitors are:

- North of Silo 2 at the K-65 exclusion fence, designated KNO.
- South of Silo 1 near the new south camera tower, designated KSO.
- East of Silo 4 and in the prevailing wind direction from Silo 3, designated LP2.
- Southwest of the High Nitrate Storage Tank, near pole #543 at Trailer #117 designated T117.

- An additional station was selected on the FEMP's west fenceline to supplement the established IEMP monitoring network. The monitor (PR-1) will be co-located with the WPTH-2 air particulate monitor, on the western perimeter of the facility.

The detail of the OU4 radon monitoring locations is shown on Dwg. 94X-5500-SK-5527 (Attachment A). The map of the entire IEMP radon monitoring network is shown Attachment B.

Data from selected radon monitors will be accessible via a secure Internet address. The data will include the date and time of the most recent transmission, location, and latest radon concentration. This data will be sent from the monitoring instrumentation without review or validation. Data review and validation will be conducted in a manner consistent with the current methods used under the IEMP Fluor Fernald Inc. radon monitoring program.

3.1.4 Project-Specific Air Particulate Monitoring Program

The IEMP air particulate monitoring program, which is based on air monitors located at the FEMP's perimeter fenceline, provides early warning feedback regarding the cumulative sitewide effectiveness of all remediation project emission controls. The project-specific air particulate monitoring program will provide data that confirms the performance of the emissions controls used for the Silo 3 Stabilization Project and AWR Project. In addition to providing confirmatory data, the monitoring program will also provide data to quantify the nature and extent of releases from both projects in the event of an upset condition. The program will consist of four high-volume particulate air samplers that will be co-located with the radon monitors at the Bio-surge lagoon, LP2, T117, and KNW-A locations shown on Attachment A. These samplers maintain a consistent air sample flow rate between 40 and 50 cubic feet per minute through an 8 by 10-inch filter.

The sampling and analysis program will consist of bi-weekly isotopic thorium, radium-226, and total particulate analyses. Results from the isotopic thorium analysis (thorium-228, thorium-230, and thorium-232) will be used to specifically monitor Th-230, the primary isotope of concern within the Silo 3 residues. The radium-226 analysis will be used to assess the effectiveness of process-control measures during the Silo 3 and AWR projects. Total particulate analysis will be used to determine if the results are indicative of project emissions or reflect the measurement of fugitive emissions from other sources (e.g. dust from construction vehicle traffic).

Samples will be analyzed according to the requirements for Analytical Support Level (ASL) B in the Sitewide CERCLA Quality (SCQ) assurance plan. The highest allowable minimal detectable concentrations (HAMDCs) for ASL B are 9.0 pCi/filter for isotopic thorium analyses and 4.0 pCi/filter for radium-226 analysis.

3.2 Direct Radiation Monitoring

In addition to airborne emissions, exposure to direct radiation is also a radiological hazard at the FEMP, particularly in the vicinity of Silo 1 and Silo 2. Direct, (a.k.a. penetrating) radiation is emitted from the radioactive materials stored onsite. The largest source of penetrating radiation at the FEMP results from the transformation of radium-bearing materials stored in Silos 1 and 2.

The IEMP environmental monitoring network includes thirty-two locations that monitor direct radiation levels associated with the storage of radionuclides at the FEMP. The monitoring is conducted using thermoluminescent dosimeters (TLDs). The monitoring network is well established and the locations were strategically chosen to ensure a monitoring envelope for each radiation source. During the AWR Project, major sources of direct radiation at the FEMP will undergo change. The operation of the Radon Control System (RCS) will result in elevated direct radiation adjacent to the carbon beds. The removal of the berm surrounding Silos 1 and 2 will result is changes to existing radiation shielding. These processes, together with the removal and relocation of the silo wastes to the Transfer Tank Area (TTA) will require an expansion of the IEMP TLD network to ensure adequate coverage of direct radiation sources.

The existing IEMP TLD monitoring network will be modified to take into account the relocation of the wastes stored in the K-65 silos. As necessary, current TLD locations will be adjusted and new TLD locations will be added to adequately characterize and monitor the direct radiation in the vicinity of the AWR project and the site fenceline. The background and technical justification for modifications to the IEMP TLD monitoring network will be provided through the IEMP annual review process.

3.3 Wastewater Monitoring

All wastewater from the Silo 3 Stabilization Project and AWR Project will be discharged to the FEMP Advanced Wastewater Treatment (AWWT) facility, if the wastewater characterization indicates the wastewater stream meets the AWWT WAC. If the WAC is not met, then pretreatment of the wastewater stream will be performed prior to discharge to the AWWT.

3.4 Groundwater Monitoring

Groundwater monitoring is currently managed by the Aquifer Restoration Project (ARP). The ARP provides the monitoring necessary to identify the effect of FEMP remediation activities. This monitoring is adequate for assessing potential impacts on groundwater quality due to the Silo 3 and AWR projects. In the event that collection of groundwater samples is needed to support the projects (or to assess any incidental releases), ARP managers will be notified to coordinate the appropriate groundwater monitoring activity.

4.0 Reporting

All project-specific environmental monitoring will be reported in the Silo 3 Stabilization and AWR Project Completion Reports, which will include a summary of the results generated during the projects. For radon monitoring, the report will identify each of the radon monitoring locations and the minimum, maximum, and average radon levels at each of those locations. For project-specific air monitoring, the report will identify each of the monitoring locations and the minimum, maximum, and average levels of each analyte at each of the locations. For direct radiation monitoring, the report will include TLD locations and a summary of quarterly results.

Data from the new radon and particulate monitors discussed in Sections 3.1.3 and 3.1.4 will be reported in the IEMP quarterly status and the Integrated Site Environmental Report (ISER). In addition, other project-specific data may be reported as necessary in IEMP quarterly status reports and the ISER to explain significant changes in the data from the fenceline IEMP environmental monitoring program.

5.0 References

1) Fernald Silo 3 Project Remedial Design Package, RMR-0445-0081-000, Rocky Mountain Remediation Services, May 2000.

2) Silos 1 and 2 Accelerated Waste Retrieval Project Remedial Design Package, June 2000

3) Operational Environmental Control Plan for the Silos 1 and 2 Accelerated Waste Retrieval Project, June 2000.

4) Operational Environmental Control Plan, RMR-0445-ENG-015-000, Rocky Mountain Remediation Services, May 2000.

3387

5) Applicable, Relevant, and Appropriate, Requirements Strategy, RMR-0445-ENG-224-000, Rocky Mountain Remediation Services, May 2000.

6) Preliminary Hazards Analysis Report for Silo 3, RMR-0445-0056-002, Rocky Mountain Remediation Services, January 2000.

7) Preliminary Hazards Analysis Report for the Silos 1 and 2 Accelerated Waste Retrieval Project, 624-P622-50, Foster Wheeler Environmental Corporation, January 2000.

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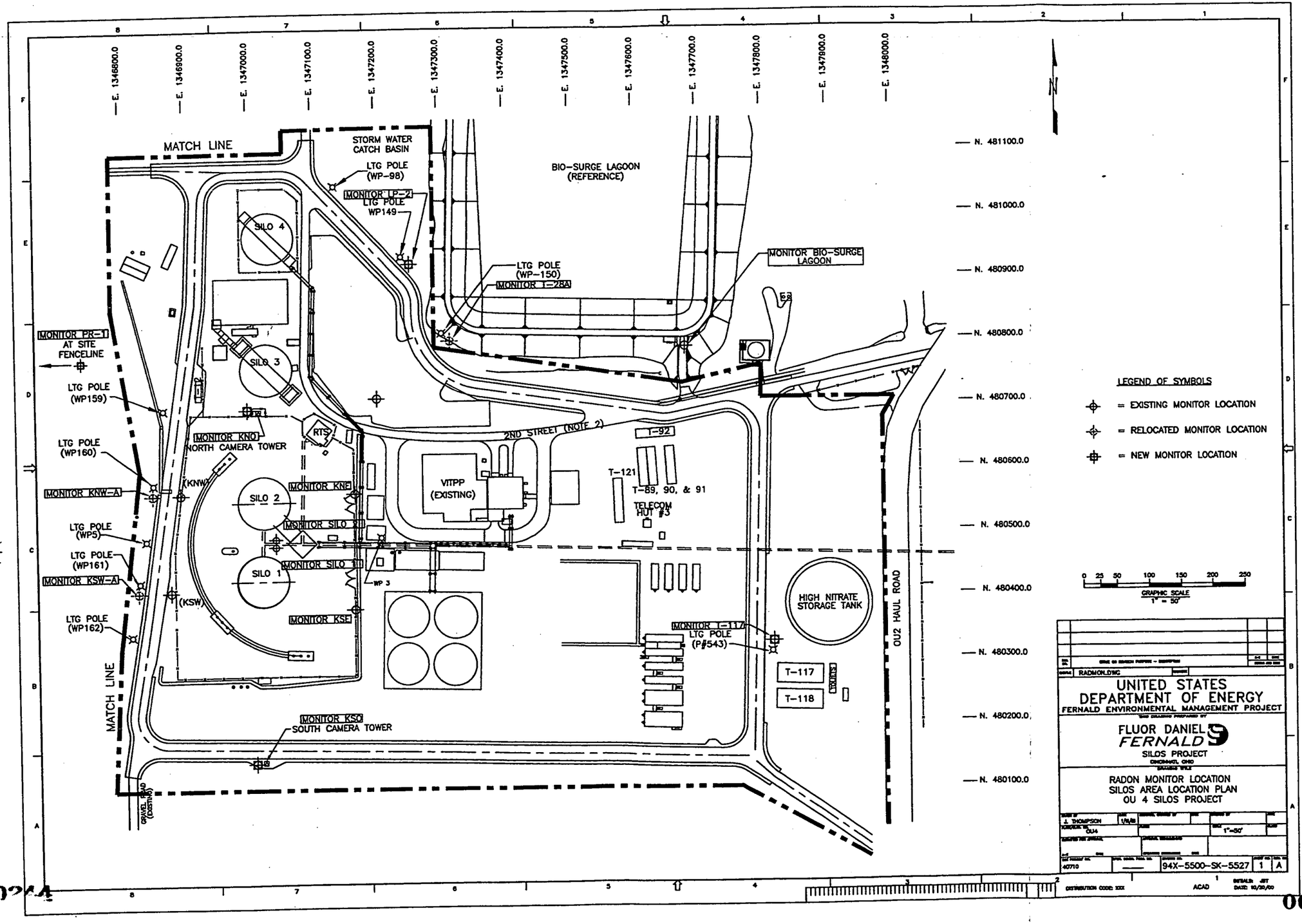
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MATCH LINE
STORM WATER CATCH BASIN
LTG POLE (WP-98)
MONITOR LP-2
LTG POLE WP149
BIO-SURGE LAGOON (REFERENCE)
SILO 4
LTG POLE (WP-150)
MONITOR 1-28A
MONITOR BIO-SURGE LAGOON
MONITOR PR-1 AT SITE FENCELINE
SILO 3
LTG POLE (WP159)
MONITOR KNO
NORTH CAMERA TOWER
RTS
2ND STREET (NOTE 2)
T-92
LTG POLE (WP160)
(KNW)
VITPP (EXISTING)
T-121
T-89, 90, & 91
TELECOM HUT #3
MONITOR KNW-A
SILO 2
MONITOR KNE
MONITOR SILO 2
LTG POLE (WP5)
LTG POLE (WP161)
MONITOR SILO 1
WP 3
MONITOR KSW-A
SILO 1
(KSW)
MONITOR KSE
LTG POLE (WP162)
HIGH NITRATE STORAGE TANK
OU2 HAUL ROAD
MONITOR 1-117
LTG POLE (P#543)
T-117
T-118
TRUCKS
MATCH LINE
MONITOR KSO
SOUTH CAMERA TOWER
GRAVEL ROAD (EXISTING)
LEGEND OF SYMBOLS
= EXISTING MONITOR LOCATION
= RELOCATED MONITOR LOCATION
= NEW MONITOR LOCATION
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GRAPHIC SCALE 1" = 50'
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UNITED STATES DEPARTMENT OF ENERGY
FERNALD ENVIRONMENTAL MANAGEMENT PROJECT
FLUOR DANIEL FERNALD
SILOS PROJECT
CINCINNATI, OHIO
RADON MONITOR LOCATION
SILOS AREA LOCATION PLAN
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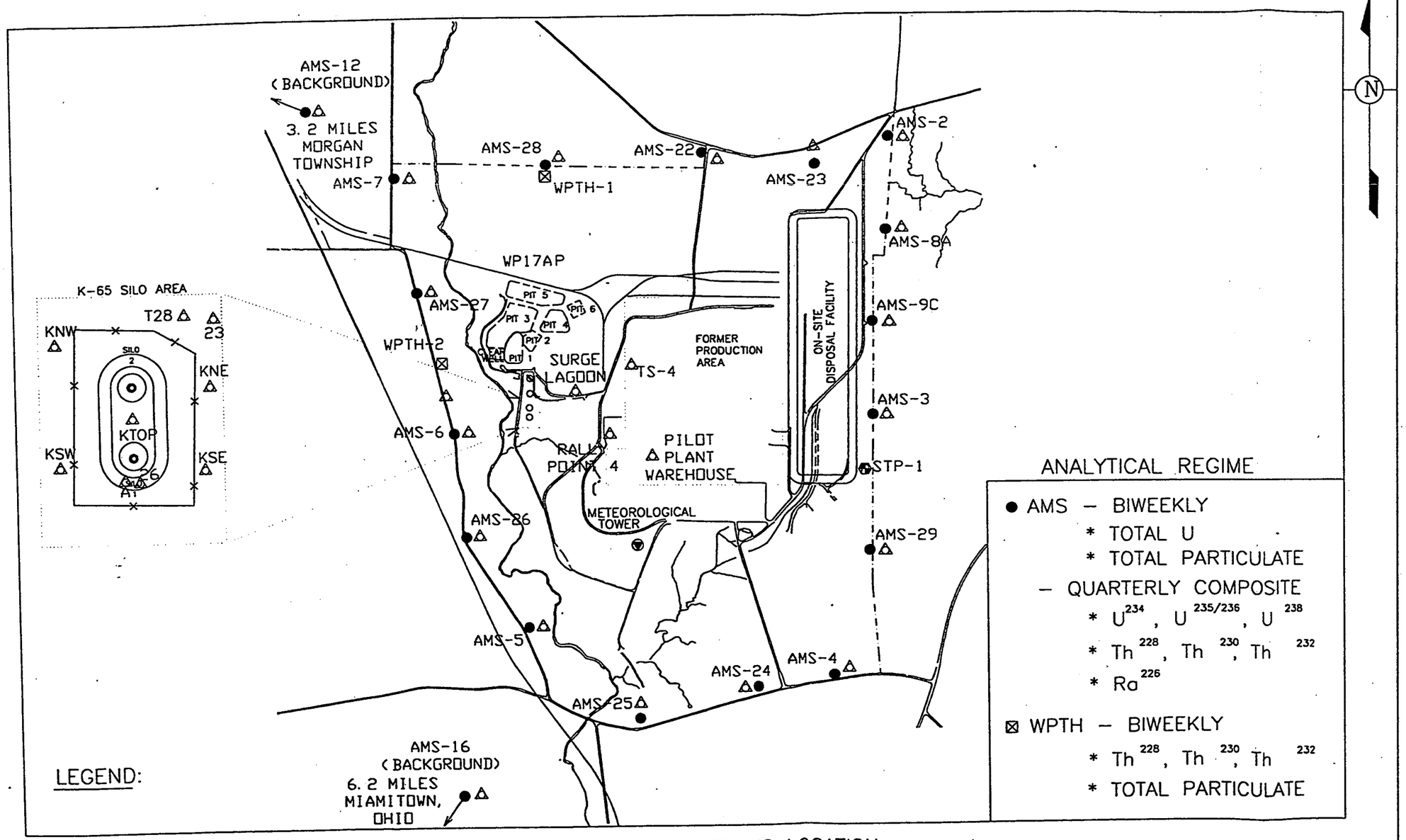
Attachment B

RADIOLOGICAL AIR MONITORING LOCATIONS



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Mar. 27, 2000

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STATE PLANAR COORDINATE SYSTEM 1927

LOCATION MAP FOR AIR MONITORING LOCATIONS

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SILOS 1 AND 2 ACCELERATED WASTE RETRIEVAL PROJECT

Health And Safety Controls

May 12, 2000

Table of Contents

ACRONYMS AND ABBREVIATIONS.....iii

1.0 PURPOSE.....1

2.0 REFERENCES.....2

Acronyms and Abbreviations

ALARA	as low as reasonably achievable
H&SC	health and safety controls
IHA	Integrated Hazard Analysis
PHAR	Preliminary Hazard Analysis Report
PPE	personal protective equipment
PSHASP	Project-Specific Health and Safety Plan
PSHPP	Project-Specific Health Physics Plan
PSHSRM	Project-Specific Health and Safety Requirements Matrix
SBDIP	Safety Basis Documentation Implementation Plan

1.0 PURPOSE

The Health and Safety Controls (H&SC) section, of the Remedial Design Package, describes the overall process for the development of the safety documentation to support the operations phase of the Accelerated Waste Retrieval (AWR) Project. The H&SC is an upper-tier document that identifies specific AWR documents that detail the preventative measures, safety controls, and actions to be taken to mitigate the consequences of occupational, public and environmental hazards associated with the operations phase of the AWR Project. The flow down documents used to develop the H&SC that are referenced for the AWR Project overall safety process will be revised as the project moves into phases prior to operations.

The AWR Project has five elements that identify the projects preventative measures, safety controls and actions to be taken for occupational hazards. The elements are:

- Overall safety
- Occupational safety
- Radiological safety
- Industrial safety
- Safety implementation

The Safety Basis Document Implementation Plan (SBDIP) (624-P622-47) provides the basis for the establishment of hazard controls necessary for the safe operation of the AWR Project. Hazards for the AWR Project are identified in the Integrated Hazard Analysis (IHA) (624-P622-48). The IHA identifies hazards and accident scenarios, and provides a qualitative evaluation of consequences, probabilities, and the risks from potential accidents from the AWR Project. The IHA is preliminary, and consequences of the potential accidents are analyzed in the project Preliminary Hazards Analysis Report (PHAR) (624-P622-50). The IHA process will continue through final design and will be presented in the Final Hazards Analysis Report.

Occupational safety, for the AWR Project is described in the Project-Specific Health and Safety Plan (PSHASP) (624-P8B21-01). The AWR Project Environmental, Health and Safety/Training Requirements Matrix (EHS/TRM) is an attachment to the PSHASP, that identifies the activities and tasks, potential hazards, monitoring requirements, personal protective equipment (PPE), training, medical monitoring, administrative and engineering controls, permits, and decontamination and disposal procedures. The PSHASP is for the pre-operational, operational, and shutdown and dismantlement phases of the AWR Project. The PSHASP incorporates the results obtained from the PHAR and the IHA. The PSHASP will be revised as the project moves into phases prior to operations.

Radiological Safety for the AWR Project is described and analyzed in the As Low As Reasonably Achievable (ALARA) Plan (624-P622-10) and the ALARA Analysis (624-P622-10A). Implementation of radiological safety is accomplished through the AWR Project Health Physics Plan (HPP) (appendix D to 624-P8B21-01). The HPP will be revised as the project moves into phases prior to operations. The ALARA Plan outlines the major hazards/tasks and assembles the radiation protection requirements and existing radiological conditions that pertain to the AWR Project. The ALARA Analysis analyzes the AWR Project tasks to ensure the process is designed and specified in a manner that will keep workers and co-located worker radiation doses ALARA. The ALARA Analysis will be revised as the project moves into phases prior to operations and will be presented in the Final Hazards Analysis Report.

Industrial safety for the AWR Project is described in two documents. One, the Preliminary Fire Hazards Analysis (624-P622-45) evaluated the AWR Project, in accordance with the proposed design documents, to determine what, if any, design modifications, or enhancements, would be necessary for the fire safety and life safety elements of the project. Two, the Human Factors Evaluation (624-P622-56) assesses a variety of areas important to the safe operation of the AWR Project with the goal of reducing the risk to employees, the public, and the environment due to operator error, by addressing stress, ergonomic, procedural, design, and training issues.

Safety implementation for the AWR Project will be administratively addressed in Safe Work Plans and permits for construction and decontamination and decommissioning. Operating Procedures, the Task Order System and the required Fluor Fernald, Inc. permits will be used during operations.

2.0 REFERENCES

624-P622-47, Safety Basis Document Implementation Plan

624-P8B21-01, Project-Specific Health and Safety Plan

624-P622-48, Integrated Hazard Analysis

624-P622-50, Preliminary Hazard Analysis Report for Silo 1 & 2 AWR Project

624-P622-56, Human Factors Evaluation

624-P622-45, Preliminary Fire Hazards Analysis

624-P622-10A0, ALARA Analysis

624-P622-10, Environmental and Occupational ALARA Plan

624-P8B21-01 (Appendix D), AWR Project Health Physics Plan

3387

FOSTER WHEELER 3387

FOSTER WHEELER ENVIRONMENTAL CORPORATION

CONTINGENCY PLAN AND EMERGENCY RESPONSE
Revision 0

Recommended by:

K. Eger

Foster Wheeler ESQ Manager

4-21-00

Date

Approved by:

R. H. Mackay

Foster Wheeler Project Manager

4/21/00

Date

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CONTENTS

3387

1.0 INTRODUCTION 1
- 1.1 Organization, Purpose, and Revision of Plan 1
- 1.2 AWR Project Description and Scope of Work 1
- 1.3 Hazard Survey and Hazards Assessment 3
- 1.4 Contractors 3
- 1.5 Physical Attributes of the Site 4
  - 1.5.1 Geography, Topography and Geology 4
  - 1.5.2 Population Distribution 4
  - 1.5.3 Meteorology 4
  - 1.5.4 Natural Phenomena 6
  - 1.5.5 Transportation, Utility and Security Systems 6

2.0 EMERGENCY RESPONSE ORGANIZATION 7
- 2.1 Organizational Structure 7
- 2.2 Emergency Direction and Control 8
  - 2.2.1 Responsibilities of the Foster Wheeler EC 8
  - 2.2.2 Responsibilities of the Foster Wheeler PM 8
  - 2.2.3 Responsibilities of AWR Project Personnel 9
- 2.3 Emergency Management Operations 9

3.0 OFFSITE RESPONSE INTERFACES 10

4.0 EMERGENCY CLASSIFICATION 11
- 4.1 Definitions 11
- 4.2 Criteria for Operational Emergencies 11

5.0 NOTIFICATIONS AND COMMUNICATIONS 12
- 5.1 Offsite Notifications 12
- 5.2 Onsite Notifications 12
- 5.3 Foster Wheeler Notifications 12
- 5.4 Communications 13

6.0 CONSEQUENCE ASSESSMENT 15
- 6.1 Consequence Determination 15
  - 6.1.1 Severe Weather and Earthquakes 15
  - 6.1.2 Radiological Release 16
  - 6.1.3 Fire 16
  - 6.1.4 Onsite Vehicle Accidents 17
  - 6.1.5 Bomb Threats/Suspicious Devices 17
- 6.2 Continuous Assessment and Coordination 17

7.0 PROTECTIVE ACTIONS AND REENTRY 18
- 7.1 Protection of Onsite Personnel 18
  - 7.1.1 Severe Weather and Earthquakes 18
  - 7.1.2 Radiological Release 20
  - 7.1.3 Fire 21
  - 7.1.4 Onsite Vehicle Accidents 22
  - 7.1.5 Bomb Threats/Suspicious Devices 22
- 7.2 Protection of Offsite Personnel 23
- 7.3 Protective Action Guides (PAGs) 23
- 7.4 Emergency Response Planning Guides (ERPGs) 23
- 7.5 Records 24
- 7.6 Personnel Accountability/Evacuation 24
- 7.7 Reentry 24

7.8 Emergency Planning Zone (EPZ) 24
7.9 Communication 25
7.10 Termination of Protective Actions 25
7.11 Shutdown of Operations 25
8.0 EMERGENCY MEDICAL SUPPORT 26
8.1 AWR Project Site 26
8.2 FEMP Site 26
8.3 Offsite 27
9.0 EMERGENCY TERMINATION AND RECOVERY 28
9.1 Emergency Termination 28
9.2 Recovery 28
9.2.1 Silo Dome Collapse 28
9.2.2 TTA Tank Rupture or Leak 29
10.0 PUBLIC INFORMATION 31
11.0 EMERGENCY FACILITIES AND EQUIPMENT 32
11.1 FEMP Emergency Facilities 32
11.2 FEMP Emergency Equipment 32
11.3 AWR Project Area Emergency Equipment and Facilities 33
12.0 PROGRAM ADMINISTRATION 34
12.1 Emergency Management Program Administrator 34
12.2 Drills, Exercises, and Training 34
12.3 Document Control 35
13.0 REFERENCES 36

APPENDICES

3387

ACRONYMS

AEDO	Fluor Fernald Assistant Emergency Duty Officer
AIHA	American Industrial Hygiene Association
API	American Petroleum Institute
AWR	Accelerated Waste Retrieval
BMP	Best Management Practices
CCTV	closed circuit television
CFR	Code of Federal Regulations
CPR	cardiopulmonary resuscitation
DED	Fluor Fernald Deputy Emergency Director
DOE	U.S. Department of Energy
DWRS	Decant Sump Waste Retrieval System
EAL	Emergency Action Levels
EC	Foster Wheeler Emergency Coordinator
EDO	Fluor Fernald Emergency Duty Officer
EMS	Emergency Management System
EMT	Emergency Medical Technician
EOC	Emergency Operations Center
EPA	U.S. Environmental Protection Agency
EPZ	Emergency Planning Zone
ERPG	Emergency Response Planning Guide
ERT	Fluor Fernald Emergency Response Team
ESQ	Environmental Safety and Quality
EVAC	Emergency Voice Alarm and Evacuation
EZ	exclusion zone
FAT&LC	Fernald Atomic Trades and Labor Council
Fluor Fernald	Fluor Fernald, Inc.
FDS	Facilities Decontamination System
FEMP	Fernald Environmental Management Project
FHA	Fire Hazard Analysis
FSM	Full Scale Mock-up
FSMS	Full Scale Mock-up System
FWENC	Foster Wheeler Environmental Corporation
GCBCTC	Greater Cincinnati Building and Construction Trades Council
GET	General Employee Training
HASP	Health and Safety Plan
HazCat	Hazard Category
HAZMAT	hazardous materials
ICAT	Integrated Construction Acceptance Test
INZ	Immediate Notification Zone
JIC	Joint Information Center
LEPC	Local Emergency Planning Committee
LOC	level of concern
mrem	millirem
MSDS	Material Safety Data Sheet
NFPA	National Fire Protection Association
NIS	not in scope
NPDES	National Pollutant Discharge Elimination System

ACRONYMS

OSHA	Occupational Safety and Health Administration
OU	Operable Unit
PAG	Protective Action Guide
PCM	personal contamination monitor
PEL	Permissible Exposure Limit
PESM	Project Environmental and Safety Manager
PLC	programmable logic control
PHA	Preliminary Hazards Analysis
PM	Project Manager
PPE	personal protective equipment
QF	quality factor
RCRA	Resource Conservation and Recovery Act
RCS	Radon Control System
RQ	Reportable Quantity
RSO	Radiation Safety Officer
RTS	Radon Treatment System
S&H	Safety and Health
SOT	System Operability Test
STEL	Short-Term Exposure Limit
SWPPP	Storm Water Pollution Prevention Plan
SWRS	Silos Waste Retrieval System
SZ	support zone
TEDE	total effective dose equivalent
TRD	Technical Requirements Document
TSS	Tension Support Structure
TTA	Transfer Tank Area
TWRS	Tank Waste Retrieval System
UL	Underwriters Laboratories
VitPP	Vitrification Pilot Plant

3387

1.0 INTRODUCTION

This Contingency Plan is prepared for the scope of work activities associated with the Accelerated Waste Retrieval (AWR) Project at the U.S. Department of Energy (DOE) Fernald Environmental Management Project (FEMP) site. It addresses the appropriate emergency response requirements contained in DOE Order 151.1 (DOE 1996), and to complement, interface, and reference, as appropriate, the *FEMP Emergency Plan*, PL-3020, Revision Number 4.

Emergency response related to the AWR Project is a shared responsibility between Fluor Fernald, Inc. (Fluor Fernald) and Foster Wheeler. The Fluor Fernald Emergency Response Team (ERT) will implement the FEMP Emergency Plan in response to an emergency situation in the AWR Project area. These situations include, but are not limited to, fire, personnel injury, or spills. The Foster Wheeler Emergency Coordinator (EC) is to inform the Fluor Fernald Emergency Duty Officer (EDO) or the Fluor Fernald Assistant Emergency Duty Officer (AEDO) in the event of an emergency.

1.1 Organization, Purpose, and Revision of Plan

This Contingency Plan is organized similar to *DOE Emergency Management Guide 151.1-1*, Volume V, Operational Emergency Hazardous Materials Program Emergency Plan, with appropriate DOE Order 151.1 guidance provided in quotations at the beginning of each of the following sections of this plan. This Plan is intended to primarily address specific AWR Project area emergency situations, and reference, as appropriate, the FEMP Emergency Plan for further information related to emergency evacuations and notifications. Revisions to the FEMP Emergency Plan need to be evaluated with respect to the contents of this Contingency Plan, and therefore, Foster Wheeler needs to be on controlled distribution of the FEMP Emergency Plan prior to commencement of field activities.

This Contingency Plan is required to be kept current and is the responsibility of the Foster Wheeler Project Manager (PM) to ensure its accuracy over the course of the AWR Project within Foster Wheeler's scope of work. Controlled copies of this Plan are to be distributed among appropriate AWR Project personnel according to AWR Project plans and procedures. Fluor Fernald is responsible for distribution to appropriate FEMP personnel and offsite agencies and response organizations. Emergency response information is also provided in the *Project Specific Health and Safety Plan* (HASP) for the AWR Project (Document No. 624-P8B21-01), and therefore, modifications to this Contingency Plan need to be reviewed concurrently with the Project Specific HASP as well.

1.2 AWR Project Description and Scope of Work

Silos 1 and 2 at the FEMP contain K-65 material, a residue that contains radionuclides, including radium (the primary contaminant of concern), generated from the processing of high-grade uranium ores. Silos 1 and 2 are part of Operable Unit (OU) 4 at the site. The purpose of the AWR Project is to: extract the material from Silos 1 and 2; segregate discrete objects; transfer the residue to transfer tanks for staging prior to final remediation; reduce the radon concentration in each of the silos' headspace; provide radon control during retrieval and material storage; clean the silos and equipment for system closure; and handle secondary waste generated during the AWR Project.

000258

As the contractor to Fluor Fernald for this work, Foster Wheeler is designing, constructing, testing and directing the operation and maintenance of the AWR Project. Fluor Fernald is providing labor for operations and maintenance. The Project consists of four stages:

- **Stage 1.** Radon Control System (RCS) installation, operation, and maintenance to reduce the radon concentration of each of the silos headspace prior to silo retrieval operations;
- **Stage 2.** Demonstration of the Full Scale Mock-up System (FSMS) and residue retrieval from the Transfer Tank Area (TTA) to support future processing (the future silos residue processing facility is not in scope [NIS] for the AWR Contract);
- **Stage 3.** Residue material retrieval from the silos, material segregation, transfer of residue to the TTA, and placement of discrete objects in drums for processing by others; and
- **Stage 4.** Staging and storage of the residue in the TTA.

These stages differ slightly from the stages defined in the *Technical Requirements Document* (TRD) of the AWR Contract, but more accurately reflect Foster Wheeler's approach to managing the AWR Project. The AWR Project includes seven major systems listed below.

- **Silos Waste Retrieval System (SWRS).** The SWRS retrieves material from the silos; transfers residues, BentoGrout™, and heel material to the transfer tanks; retrieves and packages discrete objects; and performs gross decontamination of the silos.
- **Decant Sump Waste Retrieval System (DWRS).** The DWRS retrieves materials from the decant sump (liquids from the silos and approximately 1,000 gallons of sludge/solids in a heel), segregates materials and transfers/packages them, and performs gross decontamination of the decant sump.
- **TTA.** The TTA consists of transfer tanks to be used as a storage area for residues and combined BentoGrout™ for future transfer to the future remediation facility. Provisions will be made for sampling and sample storage.
- **Transfer Tank Waste Retrieval System (TWRS).** In the future, the TWRS will retrieve the residues and combined BentoGrout™ from the TTA and transfer them for processing at a future waste treatment facility (NIS).
- **RCS, Phase 1 and 2.** RCS Phase 1 controls and reduces radon concentrations in the silos headspace. RCS Phase 2 ensures radon control during retrieval, transfer, and storage of the silos material.
- **FSMS.** A Full Scale Mock-up (FSM) Integrated Construction Acceptance Test (ICAT)/ System Operability Test (SOT) is to be performed with the Silo 4 FSMS. Foster Wheeler will incorporate the lessons learned from the FSM ICAT/SOT into the AWR Project prior to beginning operations and use the FSMS for training and troubleshooting during SWRS operations.

3387

- **Facilities Decontamination System (FDS).** The Facilities Decontamination System functions to remove gross contamination from the silos, decant sump tank, and contaminated process equipment as part of facility demobilization and closure. Two categories of gross decontamination activities are provided by the FDS. First, the gross decontamination of silos, decant sump tank, and process equipment, as well as permanent facilities erected during the project is part of the FDS. The second type is decontamination of temporary tools, equipment, and facilities used on the project.

Upon completion of the AWR Project, material from Silos 1 and 2 will have been conveyed to transfer tanks for staging prior to final remediation; discrete objects will have been segregated and disposed; and the silos will have undergone gross decontamination. As a result, K-65 residue material is stored in a stable configuration (with radon control) awaiting ultimate disposition.

1.3 Hazard Survey and Hazards Assessment

Hazard Category Calculations have been prepared to quantify the risk of potential hazards associated with the construction and operation of the AWR Project and to confirm that the hazards are correctly categorized. As described in the *Hazard Category Calculations*, Document No. 624-P622-49, for the AWR Project, the most significant (bounding) hazard from the Preliminary Hazards Analysis (PHA) is the "loss of silo containment" as a result of the collapse of a silo dome or other major breach of a silo dome. The radon in the headspace may be released instantaneously in a puff release, followed by a continuous (but lower concentration) release of radon on the basis of the emanation rate from the waste in the silo.

The loss of silo integrity for either Silo 1 or 2 would result in the immediate release of approximately 14 or 18 curies, respectively, of radon and its decay products. A bentonite clay covering placed over the residues initially lowered the headspace radon inventory and minimized the potential for generating airborne releases. However, the clay covering is drying and cracking, and its effectiveness is diminished. The releasable radon inventory in each silo headspace is increasing and may eventually exceed 30 curies.

The calculation results, as presented in Document No. 624-P622-49, confirm that the releasable inventory of either or both silos exceeds the Hazard Category (HazCat) 3 threshold, but does not exceed the HazCat 2 threshold. Thus, the silo facilities and the AWR Project facilities are defined as HazCat 3 facilities.

1.4 Contractors

Foster Wheeler, and its subcontractors, are performing AWR Project work for Fluor Fernald under Contract No. FSC 624. The *Project Management Plan*, Document No. 624-P621-01, describes the Foster Wheeler and Fluor Fernald interfaces for the AWR Project. Other contractors are performing work in areas adjacent to the AWR Project work site. These areas include the Waste Pit Remedial Action Project, the Silo 3 Waste Project, and the OU 2 Haul Road Project. Foster Wheeler is to participate in Fluor Fernald work coordination meetings and will coordinate any interference with another contractor through Fluor Fernald.

1.5 Physical Attributes of the Site

This section provides a brief overview of some of the physical attributes of the FEMP site (including the Silos Area) and its local surroundings. These features or physical attributes are

discussed since they can impact decisions related to emergency planning, preparedness, and response. They include geography, topography, geology, population distribution, meteorology, natural phenomena such as tornados, earthquakes and excessive precipitation events, and transportation and utility systems.

1.5.1 Geography, Topography and Geology

Geography. The FEMP is located on 1,050 acres in a rural area of the southwestern Ohio counties of Hamilton and Butler, near the Indiana border (see Exhibit 1-1). Scattered residences and villages such as Fernald, New Baltimore, New Haven, Ross, and Shandon are located near the FEMP. Downtown Cincinnati is approximately 18 miles southeast of the FEMP, and the cities of Fairfield and Hamilton are 6 and 8 miles to the northeast, respectively (Fluor Fernald 1999). The silos are located at the western edge of the FEMP site (also see Exhibit 1-1).

Topography. The FEMP site is situated on a relatively level plain, about 580 feet above sea level. The land rises to 698 feet at the northern boundary, and slopes downward to 550 feet at Paddy's Run, which is a small creek on the western boundary running roughly north to south through the FEMP. The site is located within the Great Miami River drainage basin. Storm water from the FEMP flows to the Great Miami River primarily via Paddy's Run. The Silos Area is above the 2,000-year floodplain (Fluor Fernald 1998). Storm water runoff from the Silos Area is appropriately controlled and discharged in accordance with the requirements of the FEMP's National Pollutant Discharge Elimination System (NPDES) permit.

Geology. The FEMP is located in the ancestral valley of the Great Miami River. This valley is about 2 miles wide at the FEMP, with the floor about 200 feet below the present topography. The geology of the FEMP and its surrounding areas can be divided into three primary stratigraphic units: the bedrock, the sands and gravels of the Great Miami Aquifer, and the unconsolidated glacial overburden deposits. All of these geologic units occur within the FEMP boundaries to some degree (Fluor Fernald 1998).

1.5.2 Population Distribution

The residential population within a 5-mile radius of the FEMP includes approximately 22,900 people. The heaviest population concentration lies in a corridor extending east-northeast to the southeast of the FEMP. Daytime residential/employment population within a 5-mile radius of the center of the FEMP was approximately 17,900 in 1990 and increases to approximately 21,250 when enrollment of the schools in the area is included. However, the current site population varies daily due to temporary labor forces (Fluor Fernald 1998).

1.5.3 Meteorology

In 1998 the precipitation measured at the FEMP was over 48 inches, which is above the average annual precipitation of almost 41 inches for 1948 through 1997. The prevailing winds at the site during 1998 were from the west through south-southwest approximately 30 to 40 percent of the time, measured at both the 33-foot and 197-foot levels above the ground surface (Fluor Fernald 1999). The average monthly wind speeds range from seven miles per hour (mph) in August to 11 mph in March (Fluor Fernald 1998).

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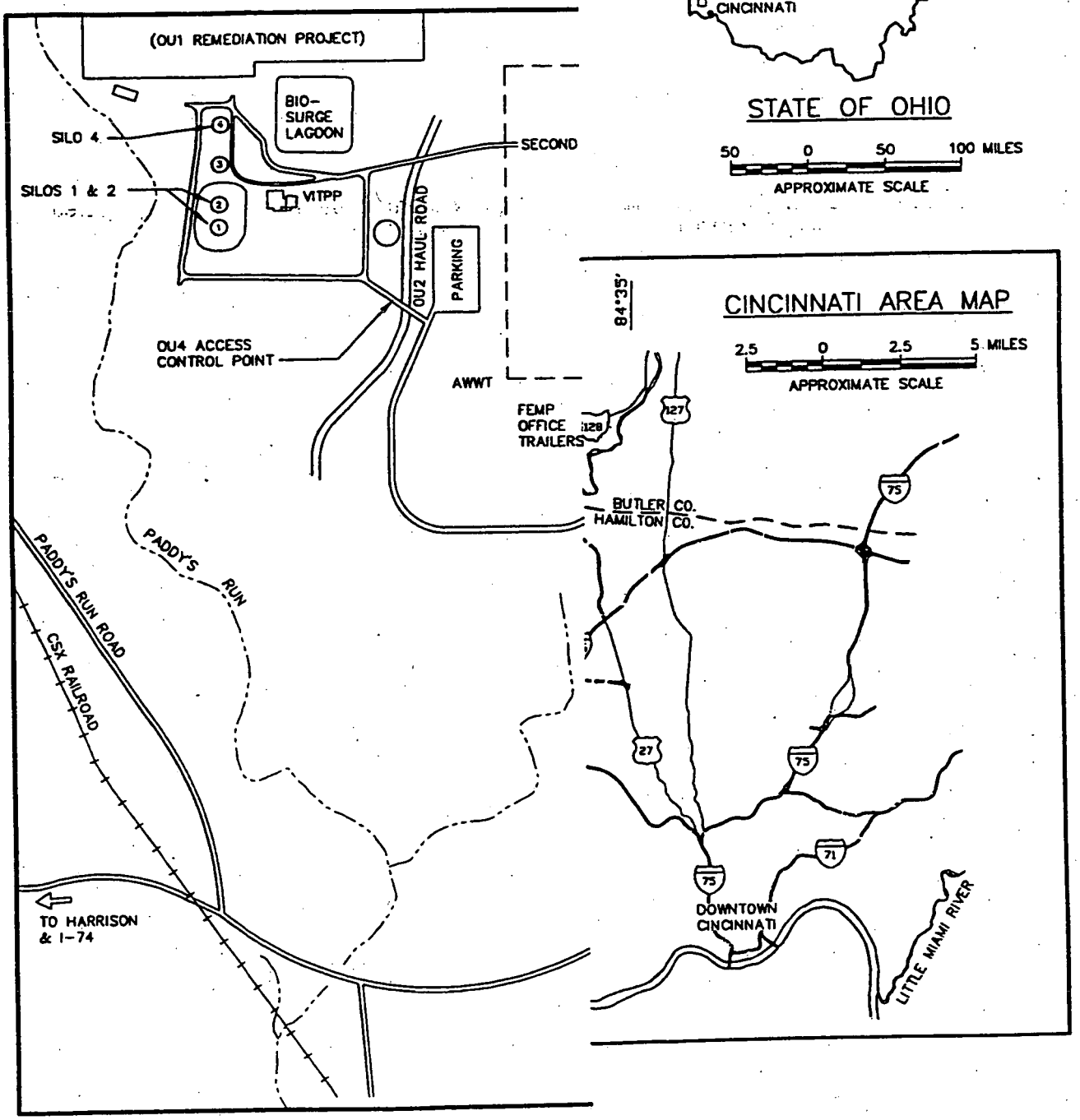

Exhibit 1-1. FEMP Site and Vicinity

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1.5.4 Natural Phenomena

Tornado. An annual probability of tornado occurrence per square mile within Ohio was calculated to be 1.25×10^{-4} for the years 1978 through 1990 (Fluor Fernald 1998).

Earthquake. On a scale of less than one to four, a seismic risk zone (measurement of earthquake intensity) of two has been assigned to the FEMP. The historical record of seismic events and the absence of post-Wisconsin faults show that significant damage of local earthquakes at the FEMP is highly unlikely (Fluor Fernald 1998). The Design Basis accident used for new facilities at FEMP is based on an exceedance probability of 1×10^{-3}.

Precipitation. The highest 24-hour rainfall event on record occurred in March 1964, when approximately 5 inches fell. The highest monthly record of snowfall was approximately 32 inches and occurred in January 1978. The recorded maximum snowfall over a 24-hour period occurred in March 1968, when approximately 10 inches were recorded (Fluor Fernald 1998).

1.5.5 Transportation, Utility and Security Systems

A railroad spur serves the FEMP from the CSX Transportation line that runs along the site's western border. Ohio Route 128 runs north and south near the eastern boundary, while Ohio Route 126 runs east and west at the north boundary line (Fluor Fernald 1999). Public access is controlled through the north and south access points at the FEMP site.

The Silos Area utility distribution systems include electrical power and fire protection water. Electrical power for the Silos Area loads is distributed from a substation west of Silo 3 (Fluor Fernald 1998). Fire protection water is provided in the Silos Area via an 8-inch non-looped fire main that ties into the existing 12-inch underground site fire water header. Four hydrants are located in the area to assist fire protection. Each hydrant is capable of delivering 1,000 gallons per minute of water at a residual pressure of not less than 10 pounds per square inch (Fluor Fernald 1998).

Security systems in the Silos Area include fencing, gates, and video cameras. Perimeter fencing and locked gates are used to restrict unauthorized access to the site. Two video cameras are located on the north and south sides of Silos 1 and 2. These cameras allow visual surveillance of the silos domes from the communication center manned by Fluor Fernald personnel.

2.0 EMERGENCY RESPONSE ORGANIZATION

"This organization shall be established and maintained for each site/facility with overall responsibility for the initial and ongoing response to and mitigation of an emergency..."

2.1 Organizational Structure

The Foster Wheeler individual ultimately responsible for emergency planning, preparedness, and response is the AWR Project Environmental Safety and Quality (ESQ) Manager; however, the Foster Wheeler EC, as described in Section 2.2.1, has the day-to-day responsibilities of emergency direction and control prior to Fluor Fernald arrival at the AWR Project site. The AWR Project ESQ Manager, although not located onsite, oversees the preparation of and recommends approval of this Contingency Plan and performs assessments to determine that this Plan is in effect and that pre-emergency requirements are met. He also acts as a liaison to Fluor Fernald regarding regulatory issues and notifies the Occupational Safety and Health Administration (OSHA) of reportable accidents, as described in Section 5.1 of this Contingency Plan.

As depicted in Exhibit 3-2 of the *Project Management Plan* (Document No. 624-P621-01) for the AWR Project, safety and health, radiation safety, and quality are line management responsibilities. The Site Safety and Health (S&H) Representative, the Radiation Safety Officer (RSO), and the Quality Manager support line management in establishing and maintaining safety, radiological control, and quality control programs. They report, functionally, to the Foster Wheeler PM, but to prevent any potential for conflict of interest, these personnel report directly to Foster Wheeler's AWR Project ESQ Manager.

During the construction and operations/maintenance/systems closure phases of the AWR Project, principal work activities are to be performed within the Silos Area at the FEMP site. Construction activities are to be performed by Greater Cincinnati Building and Construction Trades Council (GCBCTC) personnel and managed by the Foster Wheeler Construction Manager. The Foster Wheeler Project Field Engineer is present at the site to assist and provide technical support for construction activities. Operations/maintenance/system closure activities are to be directed by Foster Wheeler and performed by Fernald Atomic Trades and Labor Council (FAT&LC) personnel and managed by the Operations/Maintenance/Systems Closure Manager.

The primary interface between Fluor Fernald and FWENC is between Foster Wheeler's AWR Project Manager and the Fluor Fernald Project Manager, although, for contractual issues the Fluor Fernald Contract Administrator communicates directly with the Foster Wheeler PM. Working interfaces also exist at the manager level. The primary construction interface is between Fluor Fernald's Construction Contracts Manager and Foster Wheeler's Construction Manager. The primary operations and maintenance interface (including systems closure) is between Fluor Fernald's Operations Maintenance Manager (or the appointed maintenance supervisor) and Foster Wheeler's Operations/Maintenance/Systems Closure Manager. The primary safety interface between Foster Wheeler and Fluor Fernald is established to work critical issues over the course of the AWR Project. This safety interface is between Fluor Fernald's S&H Manager and Foster Wheeler's ESQ Manager.

The management of the craft labor for construction is a cooperative effort between the Foster Wheeler Management Team and the GCBCTC Craft Foremen. The Craft Foremen are utilized as the liaison between the Foster Wheeler Supervisory and Management personnel and th

GCBCTC personnel. Fluor Fernald Team Leaders have the responsibility for managing FAT&LC personnel. Fluor Fernald Team Leaders are utilized as the liaison between the Foster Wheeler Supervisory and Management personnel and the FAT&LC personnel.

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2.2 Emergency Direction and Control

This section describes the responsibilities of various AWR Project personnel regarding emergency direction and control in the event of an emergency at the AWR Project site. As previously mentioned, emergency response related to the AWR Project is a shared responsibility between Fluor Fernald and Foster Wheeler. The Fluor Fernald ERT will implement the *FEMP Emergency Plan* in response to an emergency situation in the AWR Project area. The Foster Wheeler EC is to inform the Fluor Fernald EDO or the Fluor Fernald AEDO in the event of an emergency.

2.2.1 Responsibilities of the Foster Wheeler EC

The Senior Shift Supervisor (during the construction phase) or the Shift Supervisor on duty (during the operations/maintenance/systems closure phase) serves as the Foster Wheeler EC for the AWR Project. The Foster Wheeler EC is required to immediately notify the Fluor Fernald EDO or AEDO and AWR Project personnel in the event of an emergency. The Foster Wheeler EC is also responsible for personnel safety and machinery and processes in the event of an emergency or a stop work order prior to Fluor Fernald arrival.

In the event of an emergency at the AWR Project site, the Foster Wheeler EC reports immediately to the scene of the emergency to assess the seriousness of the situation and immediately notifies the Fluor Fernald EDO or AEDO and the Foster Wheeler PM. The Foster Wheeler EC then directs whatever efforts are necessary until the Fluor Fernald ERT arrives. At his discretion, the Foster Wheeler EC may also order closure of the AWR Project site for an indefinite period.

The Foster Wheeler EC responsibilities during an emergency situation include:

- Informs the Fluor Fernald AEDO of existing conditions and cooperates with the AEDO to resolve the emergency situation,
- Directs the activities of AWR Project personnel in emergency situations, including assigning employee/alternate to turn off equipment and utilities, and other related tasks in the event of an emergency shutdown, until the Fluor Fernald AEDO arrives,
- Provides for assistance of physically challenged employees during evacuations, as necessary, and
- Conducts a Rally Point headcount, or designates an alternate to do so, when the AWR Project area is evacuated.

000265

In addition, the Foster Wheeler PM, the Construction Manager, or the Operations/Maintenance/ Systems Closure Manager may assume the responsibilities of the Foster Wheeler EC upon arrival at the scene.

2.2.2 Responsibilities of the Foster Wheeler PM

Throughout all project phases, the Foster Wheeler PM has complete authority and responsibility for Foster Wheeler and subcontractor personnel performance. The PM ensures that Foster Wheeler resources are available and committed to emergency response at the AWR Project site. The PM also notifies the Foster Wheeler corporate ESQ Manager and the Vice President of Remediation in the event of an emergency:

2.2.3 Responsibilities of AWR Project Personnel

Each AWR Project person has the following responsibilities related to emergency response actions to be taken during abnormal situations at the AWR Project site:

- Notifies nearby personnel to evacuate dangerous areas in the event of an emergency,
- Proceeds in accordance with this Contingency Plan in emergency situations,
- Responds to emergency signals, and
- Supports the Foster Wheeler EC and the Fluor Fernald EDO or AEDO as necessary.

2.3 Emergency Management Operations

Emergency response related to the AWR Project is a shared responsibility between Fluor Fernald and Foster Wheeler. The Fluor Fernald ERT will use the *FEMP Emergency Plan* and related emergency procedures in response to an emergency situation in the AWR Project area. These situations include, but are not limited to, fire, personnel injury, or spills. The Foster Wheeler EC is to inform the Fluor Fernald EDO or the AEDO in the event of an emergency. Fluor Fernald emergency management operations at FEMP are implemented according to the *FEMP Emergency Plan.*

3.0 OFFSITE RESPONSE INTERFACES

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"Coordination with State, Tribal, and local agencies and organizations responsible for offsite emergency response and for protection of the health and safety of the public..."

Foster Wheeler may support Fluor Fernald in external communications, however, communications for the AWR Project related to emergency response notifications with outside individuals, agencies, or other stakeholders must go through Fluor Fernald, as depicted in Exhibit 3-1. When implemented, the *FEMP Emergency Plan* is used as the basis for offsite response interfaces for the FEMP site.

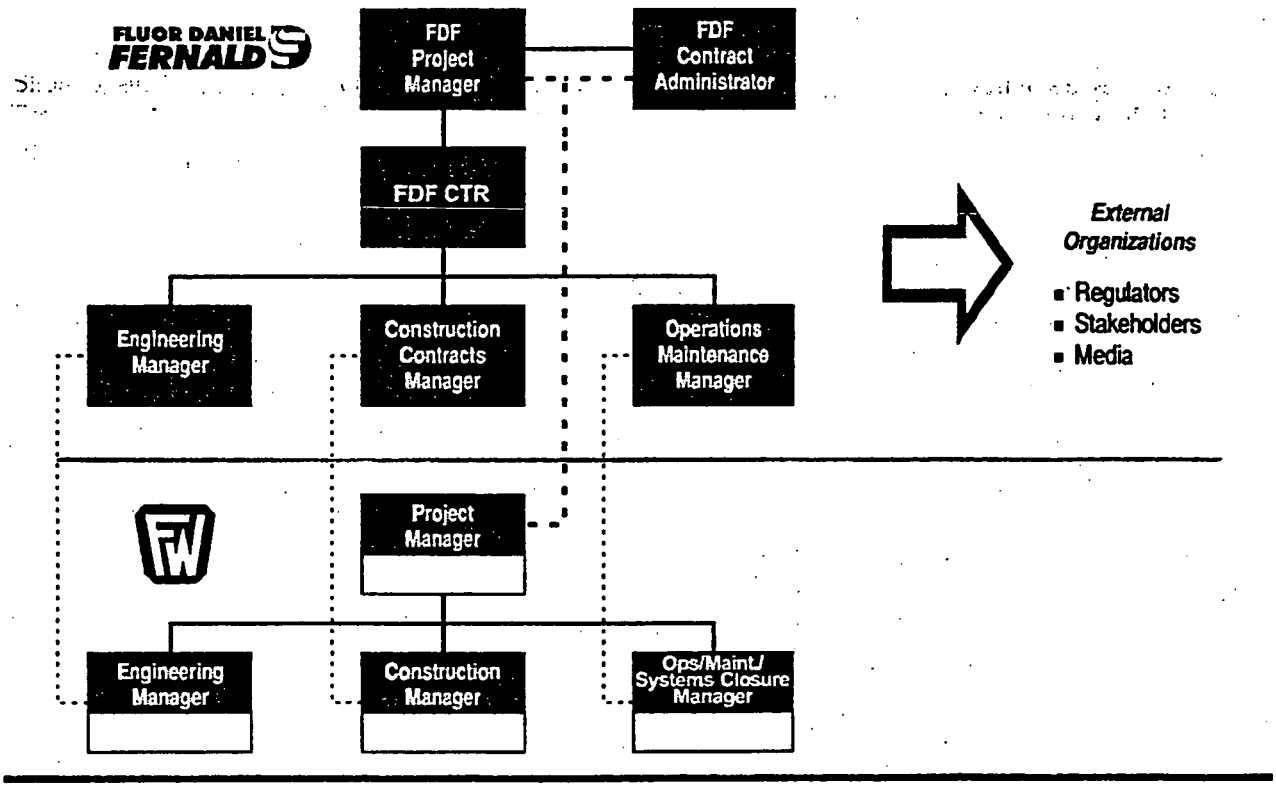

Exhibit 3-1. AWR Project Interfaces

(Note: Fluor Daniel Fernald (FDF) is the equivalent of Fluor Fernald for use in this exhibit.)

The FEMP maintains mutual aid agreements with local authorities for fire, ambulance, law enforcement, and medical services. The Fluor Fernald AEDO, with assistance of Fluor Fernald division commanders, determines the need to invoke these agreements during an emergency (Fluor Fernald 1999).

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4.0 EMERGENCY CLASSIFICATION

"Provisions shall be established to categorize and classify emergency events..."

Classification aids in the rapid communication of critical information and the initiation of appropriate time-urgent emergency response actions. The *FEMP Emergency Plan* defines the emergency categories that are applied to the FEMP site as well as the AWR Project. The Fluor Fernald EDO or AEDO will classify each emergency based on information provided by the Foster Wheeler EC and other sources of information available.

4.1 Definitions

Events that operationally involve or effect the FEMP are grouped into four categories, by relative ranking of status, to ensure that the urgency of notification is readily identifiable and appropriate response actions are directed immediately. The four categories in order of increasing severity are defined as follows:

- ***Loggable Event*** – Non-routine event not significant enough to warrant reporting to any outside agency, but is documented for trend or other analysis.

- ***Off-Normal Occurrence*** – Abnormal or unplanned events or conditions that adversely affect, potentially affect, or are indicative of degradation in the safety, security, environmental or health protection performance or operation at a facility.

- ***Unusual Occurrence*** – A non-emergency occurrence that has significant impact or potential for impact on safety, environment, health, security or operations of a facility.

- ***Operational Emergency*** – An unplanned, significant event or condition that requires time-urgent response from outside the immediate/affected site/facility or area of the incident. Such events are included in the *FEMP Emergency Plan* but may also be classified as a Level I Emergency Condition Level under criteria established by Local Emergency Planning Committee (LEPC) guidance.

4.2 Criteria for Operational Emergencies

An operational emergency shall be declared when events occur that represent a significant degradation in the level of safety at a site/facility and that require time-urgent response efforts from outside the site/facility. Operational emergencies shall be further classified as either an Alert, Site Area Emergency, or General Emergency (in order of increasing severity) when events occur that represent a specific threat to workers and the public due to the release or potential release of significant quantities of radiological/non-radiological hazardous materials. FEMP general emergency response procedures to operational emergencies are summarized in Emergency Action Level (EAL) Guides (see Appendix A to this Contingency Plan).

During off-normal events, Fluor Fernald will take over control of the AWR Project work area and implement appropriate actions, with direct input from the Foster Wheeler. The Fluor Fernald EDO or AEDO and the ERT then direct the appropriate emergency actions at the remainder of the site. Foster Wheeler will also notify Fluor Fernald of unplanned, non-life threatening events such as a pipe or valve leak. For additional discussion regarding notifications, see Section 5.0 of this Contingency Plan.

5.0 NOTIFICATIONS AND COMMUNICATIONS

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"Provisions shall be established for prompt initial notification of workers and emergency response personnel and organizations..."

5.1 Offsite Notifications

The Foster Wheeler EC shall notify the Fluor Fernald EDO or AEDO in the event of an emergency, in which the Fluor Fernald ERT will provide emergency response at the AWR Project site. The AEDO and EDO assess and categorize/classify the event. Fluor Fernald records all events in a daily log, and the appropriate notifications and reports made for only those events categorized as Off-Normal Occurrences or higher.

In the event of an emergency at the FEMP site, all offsite notifications are handled by Fluor Fernald and DOE in accordance with the *FEMP Emergency Plan*, except in cases of a fatality or catastrophe in which three or more workers are injured and hospitalized. In these cases, the Foster Wheeler EC is required to notify the AWR Project ESQ Manager immediately, and the AWR Project ESQ Manager is required to notify OSHA in accordance with Foster Wheeler corporate procedures.

5.2 Onsite Notifications

The Foster Wheeler EC is required to notify the Fluor Fernald EDO or AEDO in the event of an emergency. These notifications will be made either by radio, telephone, or pager.

> ***NOTE: In an emergency situation, the health and safety of an employee takes precedence over radiological controls.***

Radiological incidents or abnormal events shall be immediately reported to Fluor Fernald. Examples include, but are not limited to, skin or clothing (other than personal protective equipment [PPE]) contamination, situations where radioactive material uptake is suspected and situations where contamination is spread to a controlled area or clean area. If such an event occurs, then the Foster Wheeler EC (or designee) shall document the event or condition in writing. This documentation shall include enough information to reconstruct the event, its associated consequences, corrective or recovery actions, and the estimated dollar amounts of damage to property or cost of the corrective actions taken.

5.3 Foster Wheeler Notifications

As soon as first aid and/or emergency response needs have been met, the following Foster Wheeler personnel are to be contacted by telephone:

- Project Manager,
- Project S&H Representative,
- Project RSO (for radiological events), and
- The employer of any injured worker who is not a Foster Wheeler employee.

000269

Written confirmation of verbal reports are to be submitted within 24 hours. The Foster Wheeler accident/incident report forms are provided in Appendix B to this Contingency Plan. If the employee is not a Foster Wheeler employee, then his employer will also receive a copy of the report.

5.4 Communications

The FEMP maintains a communications system to ensure adequate control over both normal plant operations and emergency operations. The communications used for the AWR Project will be compatible and tie into the FEMP system. The following types of communications will be used at the AWR Project site in the event of an emergency:

- **Evacuation Alarms** – Local evacuation alarms are provided in the Vitrification Pilot Plant (VitPP) Control Room for the AWR Project. These alarms can be activated if the RCS stack alarm or TTA secondary containment leak detection alarms are activated. All emergency voice and evacuation alarm devices will be compatible with the FEMP Honeywell Emergency Voice Alarm and Evacuation (EVAC) System, with the master control at the FEMP Emergency Operations Center (EOC).

- **Fire Detection and Annunciation** – Foster Wheeler will provide and connect an emergency alarm system that complies with National Fire Protection Association (NFPA) 72-1999 and is compatible with the existing FEMP Honeywell Delta 1000, Environmental and Fire and Safety Alarm System. Also, manual fire alarm stations, audible and visual fire alarm notification devices, smoke detection alarms (for indoor locations), and monitors/alarms for automatic sprinkler systems (if used) will be appropriately located at the AWR Project site. These alarms will be tied into the FEMP sitewide alarm system so that all emergency alarms report to and terminate in the FEMP EOC.

- **Telephones** – Telephones will be located at the AWR Project support trailers in the support zone (SZ) for communication with emergency support services/facilities. Several cellular telephones and pagers will be issued to AWR Project personnel responsible for emergency communications to provide backup capabilities. To report emergencies onsite by phone, dial 911, or from a cellular phone dial 648-6511. These numbers will be posted at the AWR Project site.

- **Radios** – The primary form of communication during an emergency between field groups in the exclusion zone (EZ) and the Foster Wheeler EC will be radio communications. Each field team within the EZ shall have a two-way radio. **One site radio is required for the express purpose of emergency contact.** During an emergency situation, the lines will be kept clear so that all field teams can receive instructions. The use of radios for the AWR Project will be coordinated with FEMP Site Security and the current FEMP-maintained short-range, government-frequency FM radios. To report emergencies onsite by radio, switch to Channel 7 and call CONTROL. This number will be posted at the AWR Project site.

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- **Hand Signals** – Hand signals along with the buddy system shall be used by field teams. The entire field team shall know these signals before operations commence and their use covered during site-specific training. Typical hand signals include the following:

Hand Signal	Meaning
Hand gripping throat	Out of air, can't breathe.
Grip on partner's wrist or place both hands around partner's waist	Leave the area immediately. No debate.
Hands on top of head	Need assistance.
Thumbs up	Okay. I'm all right. I understand.
Thumbs down	No. Negative.

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6.0 CONSEQUENCE ASSESSMENT

"Provisions shall be established to adequately assess the potential or actual onsite or offsite consequences of an emergency..."

6.1 Consequence Determination

As part of the initial assessment after being notified of an emergency event, the Foster Wheeler EC will assist the Fluor Fernald AEDO, as requested, in data gathering, evaluation of critical factors, and the development of a Tactical Attack Plan for the particular event. Emergency planning at the FEMP is based on detailed hazard and safety analyses, when available, and best engineering judgment for those accidents in which detailed analyses have not been completed. This judgment considers the potential consequences of the event and the probability for that event to occur.

The following events, adapted from the *FEMP Emergency Plan*, are to be considered for emergency planning purposes related to the AWR Project, along with general mitigation measures related to the events. Protective actions and further detail of mitigation measures for these events are summarized in Sections 7 and 9 of this Contingency Plan.

6.1.1 Severe Weather and Earthquakes

Severe weather is the most likely event to occur at the FEMP with tornados presenting a significant enough hazard to warrant the declaration of an emergency. Severe thunderstorm warnings (winds expected at or above 50 knots) occur several times a year and tornados have historically occurred in the vicinity. Personal injury and property damage may result from high winds, differential pressure, or missiles produced by high winds. In severe cases, the integrity of buildings or containers (including Silos 1 and 2 and the TTA tanks) containing hazardous or radiological material may be compromised resulting in a release.

In the event of adverse weather conditions, the Site S&H Representative or designee will work with Fluor Fernald S&H personnel to determine if work can continue without potentially risking the safety of field personnel. Some of the items to be considered include:

- Potential for heat stress and heat-related injuries,
- Potential for cold stress and cold-related injuries,
- Treacherous weather-related working conditions such as hail, rain, snow, ice, high winds, etc.,
- Limited visibility (fog), and
- Potential for electrical storms.

000272

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Site activities will be limited to daylight hours or when suitable artificial light is provided, and when acceptable weather conditions prevail. The Site S&H Representative (or designee) will work with Fluor Fernald S&H personnel to determine the need to cease field operations or observe daily weather reports and evacuate, if necessary, in case of severe inclement weather conditions.

The FEMP is located in a seismic zone where earthquakes do occur periodically. A severe earthquake would result in significant property damage, and could result in mass casualties and disruption of the entire community. The FEMP site could be isolated from additional assistance, especially during the initial hours after such an event. Damage to the silos or AWR Project facilities could cause a radiological release.

6.1.2 Radiological Release

Silos 1 and 2 currently contain residues from earlier site processing activities and a Radon Treatment System (RTS) for removing radon gas that collects in the dome area of the silos. (Note: The RTS is not currently operating and has been disconnected from the silos). As part of the AWR Project, radon from the silos and the new TTA will be collected and treated at the site using the RCS. In addition, a TTA tank or transfer line rupture/ leak would be contained within the secondary containment of the TTA system, with radon collected by the RCS.

The draft *FEMP Hazard Assessment* considered the failure mechanisms including loss of containment (i.e., partial or full dome collapse) due to natural degradation, earthquake, and dome collapse due to high winds. Of these events, loss of containment due to natural degradation is the bounding event for probability of occurrence; however, dome collapse due to earthquake is the bounding event for onsite/offsite consequences (Fluor Fernald 1999a). The worst case for dome collapse due to an earthquake is projected to result in an exposure at the facility boundary of greater than 100 mrem but less than 1 rem total effective dose equivalent (TEDE). This exposure would exceed the decision criteria for an Alert level at the FEMP. Assessment of the need for categorization based on airborne concentrations of radiological isotopes will be made based on actual, measured airborne concentrations for specific isotopes (Fluor Fernald 1999a).

6.1.3 Fire

Potential sources of fire do exist during construction and operations related to the AWR Project. These may include welding, abrasive cutting, lightning strikes, electrical or office accidents, etc. A *Fire Hazard Analysis* (FHA) for the AWR Project (Document No. 624-P622-45) comprehensively and qualitatively assesses individual fire areas and whether applicable DOE Orders are met and that the acceptable level of protection is being incorporated into the design. Adhering to the following precautions can potentially prevent fires:

- Good housekeeping and storage of materials,
- Storage of flammable liquids and gases away from oxidizers,
- No smoking in the EZ or any work area,

000273

- No hot work without a properly executed hot work permit,
- Shutting off engines and allow engines to cool before refueling (Fluor Fernald 1999c),
- Grounding and bonding metal containers during transfer of flammable liquids,
- Use of Underwriters Laboratories (UL) approved flammable storage cans,
- Fire extinguishers, rated at least 10 pounds ABC, located on heavy equipment, in trailers, and near hot work areas, and
- Monthly inspections of fire extinguishers.

6.1.4 Onsite Vehicle Accidents

Vehicle accidents occurring onsite can result in injuries and property damage. Restricted roadways and enforced low speed limits reduce the hazard potential of a vehicle accident onsite. Offsite transportation accidents are addressed in the *FEMP Emergency Plan*.

6.1.5 Bomb Threats/Suspicious Devices

The degradation of safety and security to AWR Project personnel and property by the threat of an explosive or suspicious device is always a possibility. Personnel are to respond conservatively to bomb threats (including biological/chemical threats) and the discovery of suspicious devices.

6.2 Continuous Assessment and Coordination

An initial assessment of an incident is performed by the Fluor Fernald AEDO, with assistance from Foster Wheeler as required, and developed into a tactical attack plan to resolve the incident. When activated, the FEMP EOC can perform a more comprehensive assessment. As events unfold, the situation is reassessed with input from the field teams and the EOC staff.

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7.0 PROTECTIVE ACTIONS AND REENTRY

"Protective actions shall be predetermined for onsite personnel and the public..."

7.1 Protection of Onsite Personnel

The primary methods to protect onsite personnel in emergency situations are notification, sheltering, and evacuation. When an emergency occurs, the Foster Wheeler supervisor may direct sheltering or evacuation of AWR Project personnel in the immediate work area. The nearest permanent shelter for the Silos Area is the VitPP, which currently has been designated as the emergency shelter for the Silos Area. Further evacuation and protective actions are governed by implementation of the *FEMP Emergency Plan.* Appendix C to this Contingency Plan provides an area map indicating the AWR Project site personnel evacuation routes and FEMP Rally Point locations (primary and alternate) to be used in the event of an emergency. The general locations of emergency equipment and facilities and equipment for the AWR Project are also noted on the Appendix C area map.

Once the Foster Wheeler EC notifies the Fluor Fernald AEDO and the initial incident assessment has been conducted, the AEDO directs onsite protective actions. Once the Fluor Fernald EDO is briefed or the FEMP EOC activated, they will assume primary responsibility for recommending onsite protective actions and implement the *FEMP Emergency Plan.* Also, FEMP Site Procedure EM-0004, *Protective Actions,* is implemented in the case of radiological and non-radiological releases and is used by Fluor Fernald in determining the appropriate emergency class, affected area, and protective actions for onsite and offsite personnel.

7.1.1 Severe Weather and Earthquakes

Sheltering is the preferred action for tornados, severe weather emergencies, and earthquakes. In this sense, sheltering is defined as moving personnel into permanent buildings or shelters and out of temporary buildings or trailers. As previously mentioned, the emergency shelter for the Silos Area is the VitPP.

Severe Weather. When the announcement of severe weather approaching is made, do **ONE** of the following:

- **WARNING: AVOID WORKING IN HAZARDOUS SITUATIONS SUCH AS HIGH, UNPROTECTED AREAS OR AREAS WHERE MATERIALS MAY BE BLOWN BY WIND.**
- If in an isolated area, then secure equipment/material and leave the area.
- If in an external storage area, then secure loose materials (e.g., empty drums and boxes) by tying, weighing down, reducing stack height, or sheltering; and move into a permanent structure such as the VitPP.
- If outside, then secure equipment/material and move into nearest permanent structure.

000275

- If in a trailer, smoking shelter, or Tension Support Structure (TSS), then seek shelter in nearest permanent structure such as the VitPP.
- If in a permanent structure, then do the following:
  - ✓ Close and secure windows, doors, other openings in which wind or rain could enter,
  - ✓ Move away from windows,
  - ✓ Shut down equipment that is unsafe to operate during wind or rainstorm,
  - ✓ Move valuable equipment and materials to a sheltered location, and
  - ✓ Cover equipment that cannot be moved but may be damaged.

Earthquakes. In the event of an earthquake, AWR Project personnel will be evacuated and sheltered. **WARNING: RESPONSE SHALL BE IMMEDIATE. DO NOT WAIT FOR INSTRUCTIONS.** Back-up communications and a highly survivable FEMP Mobile EOC operated by Fluor Fernald ensure command and communications capabilities during such an event.

The following steps shall be taken in event of an earthquake:

- Take shelter under a sturdy desk or table. If a desk or table is not available, then go to a supported doorway.
- If possible, kneel down, bend head close to knees, cover sides of head with elbows, and clasp hands firmly behind neck.
- Avoid walls, shelves, and glassed areas. If inside, then do not evacuate while tremors are occurring.
- If outside, then move to an open area away from power lines, piping, buildings, and kneel or lie down.
- After the shock has subsided, then evacuate the facility. **(NOTE: Do not use elevators following an earthquake.)**
- While evacuating, move away from structures, avoid electrical wires, broken/leaking pipes, visible fumes, and other hazards that may be encountered.
- Assemble at Rally Point #4 (see Appendix C to this Contingency Plan) or as directed by the Foster Wheeler EC.

000276

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7.1.2 Radiological Release

Possible indications of a radiological release in the Silos Area, as adapted from FEMP Site Procedure EM-0030, *Silos Area Emergency Procedure* (Fluor Fernald 1999b), include the following:

- Visual verification during routine inspections of AWR Project operations,
- Visual verification by installed cameras providing surveillance of Silos 1 and 2,
- Abnormally high radon levels as indicated by the continuous environmental radon monitors surrounding the EZ, or
- Activation of remote RCS stack alarms or TTA leak detection alarms.

Silo Dome Collapse. In the event of a silo failure, the *Silos Area Emergency Procedure*, FEMP Site Procedure EM-0030, would be implemented immediately to provide protection to the workforce (Fluor Fernald 1997b). Initial emergency actions, adapted from Site Procedure EM-0030, are summarized below:

- Cease Silos Area operations,
- Notify personnel in immediate area,
- Activate local evacuation alarms from the VitPP control room,
- Evacuate the area **(NOTE: When an emergency occurs and evacuation is ordered, personnel will bypass the personal contamination monitors [PCMs]),**
- Proceed to Rally Point #4,
- Notify the Facility Owner or designee of the event and its estimated magnitude, and
- Notify the AEDO.

Potential recovery actions are described in *Operable Unit 4 (OU4): An Analysis of Emergency Recovery Actions – Phase II* (Fluor Fernald 1998c) and are summarized in Section 9 of this Contingency Plan.

TTA Tank Rupture or Leak. Possible indications of a TTA tank rupture or release are detected primarily by way of either (1) indications from the level instruments in the containment sump, or (2) visual indication via the closed circuit television (CCTV) system.

000297

The following steps are the initial emergency actions to be performed in the event a TTA tank leak is detected:

1. Stop transfer of material from the silos. This action occurs automatically via the Programmable Logic Control (PLC) system if the containment sump leak detection system alarms.

2. Perform a radon survey on the TTA deck first, and then survey around the base of the TTA. If a tank leak has occurred, then some radon (in proportion to the fraction of the waste leaking) will be released to the TTA plenum, and may escape from the plenum even though the penetrations to the TTA deck are sealed. Since no penetrations are located in the shield wall of the TTA, minimal radon leakage would occur through the sides.

3. Control personnel access to the TTA area based on the results of the surveys described above.

4. Ascertain which tank is leaking by use of the CCTV and by monitoring the tank level indicators.

5. If openings are detected between the plenum and TTA deck, then seal with foam or caulking.

6. Establish a connection between the plenum and the RCS to generate a slight negative pressure in the plenum so that radon released is exhausted through the carbon beds.

For a description of potential recovery operations related to the TTA tank rupture or leak scenario, refer to Section 9 of this Contingency Plan.

7.1.3 Fire

In the event of a fire or explosion, AWR Project personnel are to immediately evacuate the AWR Project site and meet at Rally Point #4 for accountability. No personnel are to fight a fire beyond the stage where it can be put out with a portable fire extinguisher.

For additional clarification, the following steps should be taken in case of a fire:

- Pull lever on the nearest FEMP Fire Alarm Box. If an alarm box is not nearby, dial 911 on a telephone to directly connect to the FEMP Communications Center (cellular phone, dial 648-6511), or use a portable radio by switching to Channel 7 and calling CONTROL. **WARNING: USING THE WRONG TYPE OF FIRE EXTINGUISHER CAN BE HAZARDOUS. DO NOT USE WATER TO EXTINGUISH ELECTRICAL, LIQUID, OR METAL FIRES.**

- If trained to use fire-fighting equipment (and can do so without endangering self), then combat the fire cautiously until ERT arrives. **(NOTE: Use METL-X for burning metal fires. Use CO_2, ABC, or dry chemical for electrical or flammable liquid fires. Use Class "A" (water) extinguisher or ABC fire extinguisher for trash, wood, and paper fires.)**

000278

- If possible and safe, shut off gas, electrical power, and operating equipment. Remove combustible or other hazardous material to secure location.

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- If it becomes evident that the fire cannot be controlled by local action, then immediately notify personnel to evacuate the facility/area by contacting the FEMP Communication Center by telephone or portable radio. **WARNING: DO NOT LOCK FIRE OR EXIT DOORS.**

- Close Fire and Exit doors after facility has been evacuated.

- After evacuation, report to Rally Point #4 (see Appendix C to this Contingency Plan). **(NOTE: Instruct persons in transit to avoid the facility and surrounding area.)**

7.1.4 Onsite Vehicle Accidents

Restricted roadways and enforced low speed limits reduce the hazard potential of a vehicle accident onsite. If a spill or leak of hazardous/radiological material results from such an accident or during vehicle refueling operations, then the Foster Wheeler EC will perform the following steps when responding to a spill or leak that may potentially be an environmental release:

- Determine the nature and major component of the spill or leak,

- Make sure unnecessary persons are removed from the spill area,

- Notify the Fluor Fernald AEDO/EDO,

- Don proper PPE,

- Remove ignition sources if a flammable liquid, gas, or vapor is involved,

- Try to stop the leak with appropriate spill control materials that are kept on hand for temporary repairs, if possible,

- Remove surrounding materials that could react with the materials in the spill, and.

- Assist the Fluor Fernald ERT as requested.

7.1.5 Bomb Threats/Suspicious Devices

Personnel are to respond conservatively to bomb threats and the discovery of suspicious devices. For the purpose of this Contingency Plan, bomb threats and discovery of suspicious devices also include those related to biological/chemical threats and devices. Actions to respond to such an event are addressed in FEMP Site Procedure EM-0023, *Bomb Threat Procedure* (Fluor Fernald 1997a) and Site Procedure EM-0020, *Building Emergency Procedure* (Fluor Fernald 1998b).

000289

Alert the Fluor Fernald AEDO/EDO immediately. Complete the bomb threat checklist, or equivalent, as provided in Appendix D to this Contingency Plan. An equivalent form is contained in the FEMP site phonebook. **NOTE: Anyone who receives a threat or finds a suspicious object in his/her area shall immediately notify FEMP Security by calling (or have someone else call) the FEMP Communications Center (648-6511 or 911).**

7.2 Protection of Offsite Personnel

Protective action recommendations are issued by FEMP when an event at the FEMP has or will have a potential offsite impact (i.e., General Emergency). Protective actions can either include sheltering, evacuation, or other protective actions for the 2-mile Immediate Notification Zone (INZ). The INZ was established with the concurrence of state and local officials and follows geographic boundaries. Protective actions for offsite personnel are implemented in accordance with FEMP Site Procedure, EM-0004, *Protective Actions.*

7.3 Protective Action Guides (PAGs)

DOE Order 151.1 specifies that the PAGs published by the U.S. Environmental Protection Agency (EPA) are to be used for comparison with exposures resulting from radiological releases to determine the appropriate emergency class. FEMP site-specific PAGs, and the related criteria for radiological releases, are implemented in accordance with FEMP Site Procedure, EM-0004, *Protective Actions*, and are summarized in Exhibit 7-1.

Exhibit 7-1. EPA PAGs for the Early Phase of Emergency

Protective Action	PAG (Projected Dose)	Comments
Evacuation (or Sheltering [a])	1-5 rem [b]	Evacuation (or for some situations sheltering) should normally be initiated at 1 rem.

[a] Sheltering may be the preferred protective action when it will provide protection equal to or greater than evacuation, based on consideration of factors such as source term characteristics and temporal or other site-specific conditions.
[b] The sum of the effective dose equivalent resulting from the exposure to external sources and the committed effective dose equivalent incurred from all significant inhalation pathways during the early phase. Committed dose equivalents to the thyroid and to the skin may be five and fifty times larger, respectively.

7.4 Emergency Response Planning Guides (ERPGs)

DOE Order 151.1 specifies that ERPGs developed and approved by the American Industrial Hygiene Association (AIHA) are to be used for comparison with exposures resulting from non-radiological releases to determine the appropriate emergency class. The AIHA ERPGs should be used as the basis for protective action criteria for non-radiological releases.

If no suitable exposure criterion can be found for a substance of interest, then the FEMP will use EPA level of concern (LOC) values in place of ERPGs as the basic protective action criteria for non-radiological releases. It is not anticipated that the AWR Project will use the chemicals listed in FEMP Site Procedure EM-0004 of type or quantity to invoke the use of ERPGs.

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7.5 Records

Records associated with the AWR Project are maintained in accordance with the *Records Management Plan*, Document No. 624-P621-04, and related AWR Project procedures. FEMP records, including the log of emergency events, are managed by Fluor Fernald. All events are recorded in a daily log by Fluor Fernald, and the appropriate notifications and reports are made for only those events categorized as Off-Normal Occurrences or higher.

7.6 Personnel Accountability/Evacuation

Evacuation is the preferred protective action for most types of emergencies. Most events are localized and distance ensures safety. Rally Points are provided near the AWR Project work area to provide for the assembling of, control of, and communications with evacuated personnel (see Appendix C to this Contingency Plan). Regardless of whether sheltering or evacuation is ordered, it is essential that personnel in evacuated facilities be accounted for to determine if anyone is missing and still in danger.

After evacuation, AWR Project personnel will assemble at the Rally Point and be counted. The Foster Wheeler EC will designate an employee to log the head count and report unaccounted personnel back to the Foster Wheeler EC, who in turn, will attempt to reconcile the head count report, as needed. Attempts will be made to locate unaccounted personnel as long as it does not endanger the lives of others by reentry into the emergency area.

7.7 Reentry

Each accident is a unique event and the requirement for reentry activities will depend on the nature of the specific accident. Therefore, the response structure for conducting reentry activities must be flexible and capable of responding to a wide range of conditions. Reentry activities will often involve high risk, time-urgent actions. Fluor Fernald Emergency Response management may be called upon to make a rapid risk versus benefit type decision and then establish priorities for selected activities. Foster Wheeler will assist Fluor Fernald in this area as requested.

The Fluor Fernald AEDO, as the FEMP's Incident Commander for emergency response, will be the identified person within the FEMP Emergency Response Organization with the authority and responsibility to authorize reentry activities. Reentry of AWR Project personnel to the AWR Project area will be allowed only after the Foster Wheeler EC (or designee) makes this announcement and gives appropriate reentry instructions.

7.8 Emergency Planning Zone (EPZ)

The EPZ is the geographic area surrounding the FEMP for which planning and preparedness efforts are carried out to ensure that prompt and effective protective actions can be taken to reduce adverse effects of an emergency at the FEMP. Protective actions for the five-mile EPZ are implemented in accordance with FEMP Site Procedure EM-0004, *Protective Actions*.

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7.9 Communication

Other than the initial notification to onsite AWR Project personnel and the Fluor Fernald AEDO, all other emergency communications are the responsibility of Fluor Fernald. These communications include those made to offsite response agencies, as needed, and are performed by DOE and Fluor Fernald in accordance with the *FEMP Emergency Plan*.

7.10 Termination of Protective Actions

The decision related to the termination of protective actions rests with the Fluor Fernald Deputy Emergency Director (DED), in consultation with other FEMP EOC staff, as is the case with terminating the emergency event itself (see Section 9.1 of this Contingency Plan).

7.11 Shutdown of Operations

In the event of an emergency, safe shutdown of AWR Project operations will be conducted in accordance with applicable operations procedures for each facility/operation. Safe shutdown is also addressed in the training associated with AWR Project personnel involved in operations and maintenance at the facilities. In addition, AWR Project operations are alarmed remotely to the VitPP Control Room and operations can be safely and remotely shutdown from the AWR Project Control Trailer, as necessary.

8.0 EMERGENCY MEDICAL SUPPORT

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"Medical support shall be planned in accordance with DOE Orders for workers contaminated by hazardous material..."

8.1 AWR Project Site

Procedures and rules designed to prevent employee injury are provided in the AWR Project Specific HASP. During the site safety briefing of each employee, AWR Project personnel will be informed of the emergency medical procedures for the AWR Project.

Should an injury occur at the AWR Project site, no matter how slight, it will be reported to the Foster Wheeler Site S&H Representative immediately. Unless they are in immediate danger, severely injured persons will not be moved until Emergency Medical Technicians (EMTs) can attend to them. Some injuries, such as severe cuts and lacerations or burns, may require immediate treatment. Any first aid instructions that can be obtained from doctors or EMTs before the Fluor Fernald ERT arrives at the site or before the injured person can be transported to the hospital will be followed closely.

As a standard safety precaution, Foster Wheeler will provide at least two personnel with current First Aid and Cardiopulmonary Resuscitation (CPR) certification on each active work shift for the AWR Project. When personnel are transported to the hospital, the Site S&H Representative will provide a copy of the employee's Medical Data Sheet to the paramedics and treating physician. Only in non-emergency situations will an injured person be transported to the hospital by means other than an ambulance.

8.2 FEMP Site

The FEMP site Medical Section is located in the Safety & Health Building (Building 53) and uses a variety of analytical, diagnostic, testing, and treatment resources to support the health and medical needs of the site population. The FEMP also maintains immediate, onsite first aid and emergency medical treatment capability through the Medical and the Fire Protection and Emergency Response groups. Triage can also be established onsite in the case of mass casualty events. The FEMP Medical Division is responsible for the establishment and management of a treatment area when the need for triage is determined by the FEMP Incident Commander (Fluor Fernald 1999a).

During normal working hours (Monday – Friday, 7:00 AM to 3:30 PM, excluding holidays), the Medical Staff includes, at a minimum, two doctors, five nurses, and several EMTs. The FEMP Fire Protection and Emergency Response group provides coverage 24 hours, 7 days a week for the site ambulance that is staffed by a minimum of two EMTs, with support of the entire medical staff. The FEMP Fire Protection and Emergency Response group operates two fully equipped ambulances designed to federal standards.

Decontamination and treatment facilities for injured and/or contaminated personnel are available at all times. These facilities are located at the rear of FEMP Building 53 near the Medical Treatment Area. The FEMP maintains many safety showers, eye wash stations, and radiological control points throughout the site and project areas where decontamination may be provided prior to, or in conjunction with, emergency medical treatment.

000293

8.3 Offsite

In addition to onsite medical support, emergency transportation of injured personnel to offsite medical facilities can be accomplished by either FEMP ambulance, local (mutual aid) ambulance, or AirCare helicopter. Mutual agreements have established criteria and response protocols for interaction with offsite agencies for medical emergencies at or around the FEMP. These agreements are reviewed on a regular basis to ensure that the needs of the FEMP, as well as those of the surrounding community, are being adequately met.

9.0 EMERGENCY TERMINATION AND RECOVERY

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"Detail notifications associated with termination of an operational emergency and the criteria for resumption of normal operations..."

9.1 Emergency Termination

The primary responsibility for event termination rests with the Fluor Fernald DED upon receiving concurrence from DOE, Butler and Hamilton Counties, and the State of Ohio. The DOE Headquarters EOC may review and approve classification changes to event termination and the recovery plan for all emergencies. Fluor Fernald uses the criteria provided in FEMP Site Procedure EM-0003, *Reentry and Recovery* (Fluor Fernald 1998a), in determining whether or not an emergency can be terminated.

9.2 Recovery

The objective of recovery is to return the facility/area to normal operations. The manner to accomplish recovery and the level of effort required will be determined by the nature and magnitude of the event. Prior to the termination of any emergency, the Fluor Fernald DED will establish the recovery organization and determine the resources needed to begin recovery operations. Recovery operations can be categorized into three general areas of recovery:

- Accident Assessment and Investigation,
- Planning and Scheduling, and
- Facility/Site/Environmental Restoration.

Fluor Fernald will conduct recovery operations in accordance with FEMP Site Procedure EM-0003 (Fluor Fernald 1998a). Foster Wheeler will assist Fluor Fernald, as requested, in emergency termination and recovery operations. In general, subsequent to an emergency event in which operations/facilities may have been impacted, the following warnings are to be observed prior to restart:

- If hazardous materials were released, then do not enter building or area until FEMP Industrial Hygiene has conducted monitoring.
- If propane or natural gas were involved when equipment was damaged, then do not start equipment until FEMP Fire and Safety has checked for explosive gas.
- If radioactive materials were released, then do not enter the building or area until FEMP Radiological Safety has conducted a check for radioactive contamination.

9.2.1 Silo Dome Collapse

Fluor Fernald has developed an Emergency Recovery Action Plan describing both immediate and subsequent actions that are to be taken in the unlikely event of a catastrophic failure of

000295

Silos 1, 2, or 3 at the FEMP (Fluor Fernald 1998c). The immediate actions were previously described in Section 7 of this Contingency Plan, and are implemented at the FEMP in accordance with FEMP Site Procedure EM-0030, *Silos Area Emergency Procedure*, and the FEMP ERT Fire Preplan. Four types of recovery actions, depending on the size and mode of failure, are identified in the *OU 4 Silos: An Analysis of Emergency Recovery Actions – Phase II* report (Fluor Fernald 1998c), and are summarized below:

1. Cover leak from small crack in silo dome with encapsulant material;
2. Cover small hole or large crack in silo dome with encapsulant material;
3. Cover large hole or partial failure of silo with synthetic membrane and spray encapsulant material; and
4. Cover silo with synthetic membrane and spray with encapsulant material.

A white metal box containing tarps (i.e., synthetic membrane) and anchors for silo containment that is marked "K-65 Emergency Equipment" is located adjacent to the emergency diesel generator, northeast of the K-65 Silos. In the event of a partial dome collapse, the Fluor Fernald AEDO will evaluate the placing of tarps over the collapsed area. Foster Wheeler and Fluor Fernald will work together to resolve any potential interferences caused from AWR Project activities, equipment, or facilities with the four types of recovery actions identified above.

9.2.2 TTA Tank Rupture or Leak

In the unlikely event that a rupture or leak occurs in a TTA Transfer Storage Tank, the following is provided as a potential scenario for tank repair and recovery. These actions will only be taken after the appropriate notifications and upon concurrence from Fluor Fernald.

1. After identifying which tank is leaking, operators will lower a sump pump from the TTA equipment deck into the containment sump. The sump pump is sized to remove the maximum volume of free liquid contained in any tank within 24 hours. The system is designed to allow the sump contents to be pumped to any of the four tanks.
2. A leak could be postulated in the tank bottom, or at any location in the shell from top to bottom. Depending upon where the tank may be leaking, and since the residues are stored at approximately 39-weight % water, it is not possible to conclude that all the free liquid above the leak will drain to the sump in 24 hours. If a tank is leaking from the bottom, then repair of the tank will not be possible and removal of the contents cannot be accomplished in 24 hours. However, since potential leaks are contained within the containment structure, no immediate danger exists to human health or the environment.
3. As a worst case scenario, Foster Wheeler assumes that storage tank TTA_{1A} is full and starts leaking from its bottom. The 633,159 gallons of residues and water, which includes the two feet of shield water stored in the tank, can be removed and stored in the unused portions and freeboard area of the remaining three storage tanks. The available volume for the remaining tanks is 687,158 gallons. But to make this space available, the 150,000 gallons of shield water in the three remaining tanks would have to be removed.

4. The residues would be removed to a level below where the tank is leaking by implementation of the TWRS. If an identified leak is in the tank shell, then an investigation will determine if the leak is repairable by welding. The following steps are required to implement a weld repair: 3387

   a) The residue level in the tank has been lowered below the affected area.

   b) Visual inspection (by CCTV) from inside and outside the tank is made to determine the extent of damage.

   c) If deemed repairable, then an opening is cut in the TTA equipment deck above the affected area.

   d) Radiological surveys are performed to assess variations of repair scenarios.

   e) A decision is required as to whether the tank containment area must be connected to the RCS. If it is necessary to ventilate the containment area, then additional openings must be cut in the TTA equipment deck, and ducting provided to the RCS.

   f) Repair is performed by grinding the affected area and welding directly, or a plate is "scabbed" over the area and seal welded. In any case, the weld repair must be done in accordance with American Petroleum Institute (API) 650 requirements and certified by a professional engineer.

   g) Following repair, a tightness test is performed by adding clean water to a level above the repair to check for leaks.

   h) If repaired successfully, then the tank will be returned to service. If not, then the tank will be abandoned in place.

000287

10.0 PUBLIC INFORMATION

"Public affairs policy and planning requirements apply for all emergencies..."

The dissemination of public information that relates to emergencies at the FEMP site is the responsibility of Fluor Fernald and DOE. This information dissemination will be conducted in accordance with of the *FEMP Emergency Plan.* The Fluor Fernald Director of Public Affairs has the overall responsibility for the emergency public information program and serves as the designated spokesperson at the FEMP during emergencies.

News and information about an emergency is provided to the media through either the Fluor Fernald Public Affairs Division offices, or the Joint Information Center (JIC) if it is activated for a major event. The role of Foster Wheeler is to solely provide technical support to Fluor Fernald, as requested, in accordance with the interfaces described in Section 3 of this Contingency Plan.

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11.0 EMERGENCY FACILITIES AND EQUIPMENT

"Facilities and equipment adequate to support emergency response shall be available and maintained..."

11.1 FEMP Emergency Facilities

Dedicated facilities give emergency responders necessary resources for controlling an incident and emergency equipment is essential for effective event mitigation and control. These facilities and equipment for the FEMP site are fully described in the *FEMP Emergency Plan*. The FEMP emergency facilities include, but are not limited to, the following:

- EOC (located in the FEMP Administration Building),
- JIC (located offsite in the Delta Building),
- FEMP Communications Center (staffed onsite 24-hours a day),
- Mobile EOC (i.e., FEMP's Alternate EOC),
- Decontamination facilities (at the rear of Building 53), and
- Medical facilities (located in the Safety & Health Building, i.e., Building 53).

11.2 FEMP Emergency Equipment

FEMP maintains the equipment listed in FEMP Site Procedure EM-0001, *Equipment Inventory for Emergency Preparedness*. Some of the emergency equipment at FEMP includes:

- Communication and warning systems such as telephones, onsite and offsite Emergency Management System (EMS), FM radios, high frequency/single-side band radios, and pagers,
- Fire/rescue equipment such as fire pumpers, rescue vehicle, hazardous materials (HAZMAT) unit and trailer, water tanker, mobile air supply trailer, and ambulance/life squads,
- Monitoring equipment for both chemical and radiological contaminants,
- Emergency power system for lighting, communications, and certain plant operations,
- Decontamination equipment for both personnel and equipment, and
- Miscellaneous equipment such as respirators, PPE, shower/eyewash stations, emergency lighting, man-lift baskets and cranes, etc.

000289

11.3 AWR Project Area Emergency Equipment and Facilities

Foster Wheeler will be supported in emergency response situations by Fluor Fernald through the use of the FEMP emergency facilities and equipment described above. In conjunction with the FEMP emergency capabilities, emergency equipment will be available at various locations in and around the AWR Project site, consisting of emergency eye wash stations and drench showers (see Appendix C to this Contingency Plan). Fire extinguishers, rated at least 10 pounds ABC, will be located on heavy equipment, in trailers, and near hot work areas. Other AWR Project site-specific emergency equipment includes:

- Respirators and other PPE,
- Material Safety Data Sheets (MSDSs),
- Absorbent material,
- Signal flags and traffic vests, and
- Laminated postings of emergency telephone numbers, equipment locations, and evacuation routes and staging areas.

As identified in the *Silos Area Emergency Procedure*, FEMP Site Procedure EM-0030, emergency equipment in the Silos Area includes the following:

- Fire and evacuation alarm system controls,
- Fire extinguishers and safety showers/eye bubblers,
- Portable radios,
- Continuous environmental radon monitors surrounding the Silo 1 and 2 EZ, and
- A white metal box containing tarps and anchors for silo containment that is marked "K-65 Emergency Equipment" is located adjacent to the emergency diesel generator, northeast of the K-65 Silos, and is maintained by Fluor Fernald.

In addition, local evacuation alarms are provided in the VitPP Control Room for the AWR Project. These alarms will annunciate if the RCS stack alarm is activated. Additional types of emergency communications are available at the AWR Project site such as telephones (e.g., office, cellular, and pagers) and radios, as described in Section 5.4 of this Contingency Plan. Emergency communications for the AWR Project must be consistent with and tie into the FEMP site emergency communications system.

12.0 PROGRAM ADMINISTRATION

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"Each facility subject to this Order shall designate an individual to administer emergency management..."

12.1 Emergency Management Program Administrator

The AWR Project ESQ Manager is responsible for developing and maintaining this Contingency Plan for the AWR Project. The AWR Project ESQ Manager will review this Contingency Plan biannually for appropriateness and to check its consistency with the FEMP Emergency Plan. These self-assessments will be conducted to ensure that this Contingency Plan is in effect and that all pre-emergency requirements are met.

The AWR Project ESQ Manager acts as a liaison to Fluor Fernald regarding regulatory issues and notifies the OSHA of reportable accidents (see Section 5.1 of this Contingency Plan). The Foster Wheeler Senior Supervisor (during Construction phase) or the Shift Supervisor on duty (during Operations/Maintenance/Systems Closure phase) serves as the Foster Wheeler EC for the AWR Project. This person reports directly to the Foster Wheeler PM, and is responsible for the effective implementation of this Contingency Plan at the AWR Project site.

12.2 Drills, Exercises, and Training

Drills and exercises help to ensure effective emergency response by bringing together trained personnel under simulated emergency conditions for practice and evaluation. AWR Project personnel will participate in FEMP drills and exercises as determined by the Fluor Fernald Emergency Preparedness Section. The frequency of a Building Specific Emergency Drill, which can be correlated to the AWR Project area requirements, is once annually. This drill would test emergency program elements such as protective actions, facilities, and equipment (Fluor Fernald 1999a). Foster Wheeler will also support the FEMP Lessons Learned program for emergency preparedness as requested by Fluor Fernald.

Prior to performing work onsite, AWR Project personnel will each receive FEMP General Employee Training (GET) that provides an overview of the emergency management requirements at FEMP. The FEMP Centralized Training Section conducts this training. In addition, AWR Project personnel will be trained on the AWR *Project Specific HASP*, which includes the specific actions to be taken at the site in the event of an emergency. Topics relating to emergency response are discussed in the daily safety briefings at the AWR Project site. The Foster Wheeler EC is responsible for providing training and briefings to the AWR Project personnel, such as:

- Conducts periodic training of assigned employees in the location and use of fire and evacuation alarm system controls and emergency procedures,
- Conducts periodic training of new and newly relocated employees in the location and basic use of fire extinguishers and safety shower/eye bubblers in their immediate work area, and
- Conducts periodic training of employees with regard to immediate actions to be taken for credible types of emergencies that could occur at the site.

000291

AWR Project personnel will also be instructed on proper emergency response procedures an locations of emergency telephone numbers during their initial site safety meeting. Foste Wheeler will abide by the Employee Bill of Rights and will inform AWR Project personnel of these rights in accordance with Parts 7 and 8 of the AWR Contract. Foster Wheeler will honor the right of any employee to refuse work, which the employee reasonably believes to be hazardous.

Employees have the right to STOP WORK for which they reasonably believe controls are inadequate for radiological and other hazards. Reprisals will not be taken against employees for exercising their rights in a responsible manner, and responsibly stopped work will not resume until proper controls are established with concurrence by Fluor Fernald.

Each AWR Project person is also required to:

- Become familiar with the provisions of this Contingency Plan for reporting emergencies,
- Become familiar with the location and use of emergency items,
- Participate in emergency drills and training as required, and
- Immediately notify the supervisor or Foster Wheeler EC of emergency or non-routine events.

12.3 Document Control

Documentation and record keeping of training provided to AWR Project personnel are to be kept current. Document control and records management will be conducted in accordance with AWR Project plans and procedures. Training information will be documented and tracked for each trained employee.

13.0 REFERENCES

3387

(AHIA 1992) American Industrial Hygiene Association, *Emergency Response Planning Guides*, 1992.

(DOE 1996) U.S. Department of Energy Order 151.1, *Comprehensive Emergency Management*, Change 2, August 21, 1996.

(Fluor Fernald 1997) FEMP Site Procedure EM-0004, *Protective Actions*, Rev. 1, November 27, 1997.

(Fluor Fernald 1997a) FEMP Site Procedure EM-0023, *Bomb Threat Procedure*, Rev. 2, November 21, 1997.

(Fluor Fernald 1997b) *Operable Unit 4 (OU4) Silos: An Analysis of Emergency Recovery Actions – Phase I*, 40000-RP-0018, Rev. 1, June 11, 1997.

(Fluor Fernald 1998) *Hazards Analysis Report for Operable Unit 4 (OU4) Silos*, Rev. 0, May 26, 1998.

(Fluor Fernald 1998a) FEMP Site Procedure EM-0003, *Reentry and Recovery*, Rev. 3, April 24, 1998.

(Fluor Fernald 1998b) FEMP Site Procedure EM-0020, *Building Emergency Procedure*, Rev. 5 (PCN1), February 17, 1998.

Fluor Fernald 1998c) *Operable Unit 4 (OU4) Silos: An Analysis of Emergency Recovery Actions – Phase II*, 40000-RP-0029, Rev. 0, April 30, 1998.

(Fluor Fernald 1999) *1998 Integrated Site Environmental Report*, Fluor Daniel Fernald, June 1999.

(Fluor Fernald 1999a) *FEMP Emergency Plan*, Rev. 4, May 25, 1999.

(Fluor Fernald 1999b) FEMP Site Procedure EM-0030, *Silos Area Emergency Procedure*, Rev. 3, March 24, 1999.

(Fluor Fernald 1999c) FEMP Site Requirements Manual RM-0021, *Safety Performance Requirements Manual*, Rev. 22, November 12, 1999.

000293

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APPENDICES

000294

3387

APPENDIX A

FEMP Emergency Action Level (EAL) Guides Adapted from the *FEMP Emergency Plan* for the AWR Project

000295

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RADIOLOGICAL EVENTS			
Radiological Events	**Alert**	**Site Area**	**General**
Criteria	Loss of accountable special nuclear material. Unplanned release of radioactive material projected to result in an exposure at the facility boundary ≥ 100 mrem TEDE but < 1 rem TEDE.	Unplanned release of radioactive material projected to result in an exposure at the facility boundary ≥ 1 rem TEDE.	Unplanned release of radioactive material projected to result in an exposure at the site boundary ≥ 1 rem TEDE or ≥ 5 rem thyroid.
Onsite Protective Actions	• Shelter in place, if possible, evacuate immediate danger area. • Rally point accountability. • Employee announcement. • Bioassay at termination.		
Offsite Protective Actions	• Update counties and state regularly. • Monitoring onsite and/or offsite.		• Activate offsite warning system. • Issue Protective Actions Recommendations. • Implement applicable Resource Conservation and Recovery Act (RCRA) plan.
Event Mitigation Actions	• Contain event, • Isolate area, • Terminate release, • Monitor onsite/offsite, and • Clean up.		
Response Groups	• Emergency Duty Officers, • Emergency Operations Center, • Joint Information Center, • Monitoring teams, • Security (Recall), • Medical (Recall), • Emergency Response Team (Recall), and • Mutual Aid (as needed).		

000296

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HAZARDOUS MATERIAL EVENTS			
Hazardous Material Events	**Alert**	**Site Area**	**General**
Criteria	Unplanned release of hazardous substance resulting in a projected airborne concentration at the facility boundary ≥ ERPG-1 and < ERPG- 2 (AIHA 1992). If ERPG values are not available, projected airborne concentration at the facility boundary ≥ Permissible Exposure Limit (PEL)-Short-Term Exposure Limit (STEL) and < EPA LOC values.	Unplanned release of a hazardous substance resulting in a projected airborne concentration between the facility boundary and the site boundary is ≥ ERPG-2. If ERPG values are not available, ≥ EPA LOC values.	Unplanned release of a hazardous substance resulting in a projected airborne concentration at the site boundary is ≥ ERPG-2. If ERPG values are not available, ≥ EPA LOC values.
Onsite Protective Actions	• Shelter in place, if possible, evacuate immediate danger area. • Rally point accountability. • Employee announcement. • Bioassay at termination.		
Offsite Protective Actions	• Update counties and state regularly. • Monitoring onsite and/or offsite.		• Activate offsite warning system. • Issue Protective Action Recommendations.
Event Mitigation Actions	• Contain event, • Isolate area, • Terminate release, • Monitor onsite/offsite, • Implement applicable RCRA plan, and • Clean up.		
Response Groups	• Emergency Duty Officers, • Emergency Operations Center, • Joint Information Center, • Monitoring teams, • Security (Recall), • Medical (Recall), • Emergency Response Team (Recall), and • Mutual Aid (as needed).		

3387

HEALTH AND SAFETY EVENTS			
Health & Safety Events	**Alert**	**Site Area**	**General**
Criteria	The following events or conditions represent, cause, or have the potential to cause serious health and safety impacts to workers or members of the public. • Radioactive or other hazardous material contamination that is causing or may reasonably be expected to cause uncontrolled personnel exposures exceeding protective action criteria. • An offsite hazardous material event not associated with DOE operation that is observed to have or is predicted to have an impact on a DOE site such that protective actions are required for onsite DOE workers. • An occurrence that causes or can reasonably be expected to cause significant structural damage to DOE facilities, with confirmed or suspected personnel injury or death or substantial degradation of health and safety. • Any facility evacuation in response to an actual occurrence that requires time-urgent response by specialist personnel, such as hazardous material responders or mutual aid groups not normally assigned to the affected facility. • An unplanned nuclear criticality resulting in actual or potential facility damage and /or release of radioactive material to the environment. • Any onsite transportation-related mass casualty event.		
Onsite-Protective Actions	• Shelter in place if possible, evacuate immediate danger area, • Rally point accountability, • Employee announcement, and • Bioassay at termination.		
Offsite-Protective Actions	• Update counties and state regularly. • Monitoring onsite and/or offsite.		• Activate offsite warning system. • Issue Protective Action Recommendations. • Implement applicable RCRA plan.
Event Mitigation Actions	• Contain event, • Isolate area, • Terminate release, • Monitor onsite/offsite, and • Clean up.		
Response Groups	• Emergency Duty Officers, • Emergency Operations Center, • Joint Information Center, • Monitoring teams, • Security (Recall), • Medical (Recall), • Emergency Response Team (Recall), • Mutual Aid (as needed).		

000298

000312

ENVIRONMENTAL EVENTS			
Environmental Events	**Alert**	**Site Area**	**General**
Criteria	The following events or conditions represent, cause, or have the potential to cause serious detrimental effects on the environment. • Any actual or potential release of dispensable, material or regulated pollutant to the environment, in a quantity greater than five times the Reportable Quantity (RQ) specified for such material in Title 40 of the Code of Federal Regulations (CFR) Part 302, that could on a case-specific basis result in significant offsite consequences such as major wildlife kills, wetland degradation, aquifer contamination, or the need to secure downstream water supply intakes. • Any release of greater than 1,000 gallons (24 barrels) of oil to inland waters; greater than 10,000 gallons (238 barrels) of oil to coastal waters; or a quantity of oil that could result in significant offsite consequences (e.g., need to relocate people, major wildlife kills, wetland degradation, aquifer contamination, need to secure downstream water supply intakes, etc.). [Oil as defined by the Clean Water Act (33 U.S.C. 1321) means any kind of oil and includes petroleum.] • For the AWR Project, the most restrictive substance to be considered for a release is "lead and lead compounds" in the K-65 material. A "5 x RQ" value for this substance is approximately 25 pounds of undiluted K-65 material.		
Onsite- Protective Actions	• Shelter in place, if possible, evacuate immediate danger area. • Rally point accountability, • Employee announcement, and • Bioassay at termination.		
Offsite-Protective Actions	• Update counties and state regularly. • Monitoring onsite and/or offsite.		• Activate offsite warning system. • Issue Protective Action Recommendations. • Implement applicable RCRA plan.
Event Mitigation Actions	• Contain event, • Isolate area, • Terminate release, • Monitor onsite/offsite, and • Clean up.		
Response Groups	• Emergency Duty Officers, • Emergency Operations Center, • Joint Information Center, • Monitoring teams, • Security (Recall), • Medical (Recall), • Emergency Response Team (Recall), and • Mutual Aid (as needed).		

3387

APPENDIX B

AWR Project
Foster Wheeler Accident/Incident Report Forms

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CORPORATE ESQ REPORT #

3387

FOSTER WHEELER ENVIRONMENTAL CORPORATION

AWR PROJECT

INCIDENT/NEAR MISS REPORT AND INVESTIGATION

TYPE OF INCIDENT - CHECK ALL THAT APPLY

☐ INJURY/ILLNESS ☐ VEHICLE DAMAGE ☐ PROPERTY DAMAGE ☐ FIRE
☐ SPILL/RELEASE ☐ PERMIT EXCEEDENCE ☐ HIGH LOSS POTENTIAL ☐ OTHER
☐ (NEAR MISS)

GENERAL INFORMATION

AWR PROJECT REPORT #: DATE OF REPORT:

DATE OF INCIDENT: MILITARY TIME: ____ DAY OF WEEK: ____

FW SUPERVISOR ON DUTY: AT SCENE OF INCIDENT: ☐ YES ☐ NO

LOCATION OF INCIDENT:

WEATHER CONDITIONS: ADEQUATE LIGHTING AT SCENE: ☐ YES ☐ NO ☐ N/A

DESCRIBE WHAT HAPPENED (STEP BY STEP - use additional pages if necessary)

AFFECTED EMPLOYEE INFORMATION

NAME: FWENC EMPLOYEE: ☐ YES ☐ NO

EMPLOYEE #: OFFICE PHONE #:

JOB CLASSIFICATION: YEARS IN JOB CLASSIFICATION:

HOURS WORKED ON SHIFT PRIOR TO INCIDENT: YEARS WITH FWENC: AGE:

DID INCIDENT RELATE TO ROUTINE TASK FOR JOB CLASSIFICATION: ☐ YES ☐ NO

INJURY/ILLNESS INFORMATION

NATURE OF INJURY OR ILLNESS:

OBJECT/EQUIPMENT/SUBSTANCE CAUSING HARM:

FIRST AID PROVIDED: ☐ YES ☐ NO

IF YES, WHERE WAS IT GIVEN: ☐ ON SITE ☐ OFF SITE

IF YES, WHO PROVIDED FIRST AID:

WILL THE INJURY/ILLNESS RESULT IN: ☐ RESTRICTED DUTY ☐ LOST TIME ☐ UNKNOWN

MEDICAL TREATMENT INFORMATION

WAS MEDICAL TREATMENT PROVIDED?: ☐ YES ☐ NO

IF YES, WAS MEDICAL TREATMENT PROVIDED: ☐ ONSITE ☐ DR.'S OFFICE ☐ HOSPITAL

NAME OF PERSON(S) PROVIDING TREATMENT:

ADDRESS WHERE TREATMENT WAS PROVIDED:

TYPE OF TREATMENT:

AWR PROJECT
INCIDENT/NEAR MISS REPORT AND INVESTIGATION

VEHICLE AND PROPERTY DAMAGE INFORMATION

VEHICLE/PROPERTY DAMAGED:

DESCRIPTION OF DAMAGE:

SPILL AND AIR EMISSIONS INFORMATION

SUBSTANCE SPILLED OR RELEASED: FROM WHERE: TO WHERE:

ESTIMATED QUANTITY/DURATION:

CERCLA HAZARDOUS SUBSTANCE? YES ☐ NO ☐ RQ EXCEEDED? YES ☐ NO ☐ SPECIFY: _____

REPORTABLE TO AGENCY? YES ☐ NO ☐ SPECIFY: _____

WRITTEN REPORT? YES ☐ NO ☐ TIME FRAME: _____

RESPONSE ACTION TAKEN:

PERMIT EXCEEDENCE

TYPE OF PERMIT: PERMIT #:

DATE OF EXCEEDENCE: DATE FIRST KNOWLEDGE OF EXCEEDENCE:

PERMITTED LEVEL OR CRITERIA (e.g., Water quality):

EXCEEDENCE LEVEL OR CRITERIA: EXCEEDENCE DURATION:

REPORTABLE TO AGENCY? YES ☐ NO ☐ SPECIFY: _____

WRITTEN REPORT? YES ☐ NO ☐ TIME FRAME: _____

RESPONSE ACTION TAKEN:

NOTIFICATIONS

NAME(S) OF FWENC PERSONNEL NOTIFIED: DATE/TIME:

CLIENT NOTIFIED: DATE/TIME:

AGENCY NOTIFIED: DATE/TIME: ☐ NOT REQUIRED

CONTACT NAME:

PERSONS PREPARING REPORT

EMPLOYEE'S NAME: (PRINT) SIGN:

EMPLOYEE'S NAME: (PRINT) SIGN:

SUPERVISOR'S NAME: (PRINT) SIGN:

NOTE: Supervisor to forward a copy of Incident Report to immediate supervisor, PESM, ESS or ESC, and other personnel deemed appropriate, as soon as possible but no later then 24 hours.

3387

INVESTIGATIVE REPORT

REPORT #: _____

DATE OF INCIDENT: _____ DATE OF INVESTIGATION REPORT: _____

INCIDENT COST: ESTIMATED: $_____ ACTUAL: $_____

OSHA RECORDABLE(S): ☐ YES ☐ NO # RESTRICTED DAYS_____

DAYS AWAY FROM WORK_____

CAUSE ANALYSIS

IMMEDIATE CAUSES – WHAT ACTIONS AND CONDITIONS CONTRIBUTED TO THIS EVENT? (USE NEXT PAGE)

BASIC CAUSES – WHAT SPECIFIC PERSONAL OR JOB FACTORS CONTRIBUTED TO THIS EVENT? (USE NEXT PAGE)

ACTION PLAN

REMEDIAL ACTIONS – WHAT HAS AND OR SHOULD BE DONE TO CONTROL EACH OF THE CAUSES LISTED? INCLUDE MANAGEMENT PROGRAMS (SEE ATTACHED LIST) FOR CONTROL OF INCIDENTS IF APPLICABLE.

ACTION	PERSON RESPONSIBLE	TARGET DATE	COMPLETION DATE

PERSONS PERFORMING INVESTIGATION

INVESTIGATOR'S NAME: (PRINT) SIGN: DATE:

INVESTIGATOR'S NAME: (PRINT) SIGN: DATE:

INVESTIGATOR'S NAME: (PRINT) SIGN: DATE:

MANAGEMENT REVIEW

PROJECT MANAGER: (PRINT) SIGN: DATE:

COMMENTS:

PESM or ESC: (PRINT) SIGN: DATE:

COMMENTS:

NOTE: Attach additional information as necessary. Supervisor to forward copy of Investigative Report to the PM, PESM, or ESC, as soon as possible but no later then 72 hours after the incident. A copy shall be sent to the Director, Health and Safety Programs within 24 hours of completion of the report.

000303

EXAMPLES OF IMMEDIATE CAUSES	
SUBSTANDARD ACTIONS	SUBSTANDARD CONDITIONS
1. OPERATING EQUIPMENT WITHOUT AUTHORITY	1. GUARDS OR BARRIERS
2. FAILURE TO WARN	2. PROTECTIVE EQUIPMENT
3. FAILURE TO SECURE	3. TOOLS, EQUIPMENT, OR MATERIALS
4. OPERATING AT IMPROPER SPEED	4. CONGESTION
5. MAKING SAFETY DEVICES INOPERABLE	5. WARNING SYSTEM
6. REMOVING SAFETY DEVICES	6. FIRE AND EXPLOSION HAZARDS
7. USING DEFECTIVE EQUIPMENT	7. POOR HOUSEKEEPING
8. FAILURE TO USE PPE PROPERLY	8. NOISE EXPOSURE
9. IMPROPER LOADING	9. EXPOSURE TO HAZARDOUS MATERIALS
10. IMPROPER PLACEMENT	10. EXTREME TEMPERATURE EXPOSURE
11. IMPROPER LIFTING	11. ILLUMINATION
12. IMPROPER POSITION FOR TASK	12. VENTILATION
13. SERVICING EQUIPMENT IN OPERATION	13. VISIBILITY
14. UNDER INFLUENCE OF ALCOHOL/DRUGS	
15. HORSEPLAY	

EXAMPLES OF BASIC CAUSES	
PERSONAL FACTORS	JOB FACTORS
1. CAPABILITY	1. SUPERVISION
2. KNOWLEDGE	2. ENGINEERING
3. SKILL	3. PURCHASING
4. STRESS	4. MAINTENANCE
5. MOTIVATION	5. TOOLS/EQUIPMENT
	6. WORK STANDARDS
	7. WEAR AND TEAR
	8. ABUSE OR MISUSE

MANAGEMENT PROGRAMS FOR CONTROL OF INCIDENTS	
1. LEADERSHIP AND ADMINISTRATION	10. HEALTH CONTROL
2. MANAGEMENT TRAINING	11. PROGRAM AUDITS
3. PLANNED INSPECTIONS	12. ENGINEERING CONTROLS
4. TASK ANALYSIS AND PROCEDURES	13. PERSONAL COMMUNICATIONS
5. TASK OBSERVATION	14. GROUP MEETINGS
6. EMERGENCY PREPAREDNESS	15. GENERAL PROMOTION
7. ORGANIZATIONAL RULES	16. HIRING AND PLACEMENT
8. ACCIDENT/INCIDENT ANALYSIS	17. PURCHASING CONTROLS
9. PERSONAL PROTECTIVE EQUIPMENT	

NOTIFICATION REMINDER

Fatalities or hospitalization (admittance) of three or more individuals requires notification to OSHA within 8 hours. Contact the Director, Health and Safety Programs or Director, ESQ Programs to make the notification. If unavailable, the senior operations person on site should make the notification.

3387

INCIDENT/NEAR MISS REPORT AND INVESTIGATION INSTRUCTIONS

General: The incident report must be completed within 24 hours. Do not delay the report if any information is unknown. It can be provided later by revising the Report.

Type of Incident: Check all that apply. A High Loss Potential (Near Miss) incident is one that does not result in loss, but under slightly different circumstances, could have resulted in an OSHA Recordable injury, spill, release, permit exceedence, fire, or vehicle/property damage in excess of $500. All High Loss Potential (Near Miss) incidents are to be investigated.

General Information

Project/Office: If the incident occurs on a delivery order contract, give the contract/program name, Delivery Order # and location. If the incident occurs on a Consulting and Engineering field project, give the Office location managing the project as well as the project/location.

Report No.: Optional numbering field for offices/projects.

FW Supervisor: The Foster Wheeler (FW) Supervisor responsible for the work effort involving the incident. Do not give a subcontractor supervisor or craft foreman name. If a Foster Wheeler Supervisor was the Affected Employee, this field should contain the name of his or her supervisor. The Supervisor is the project supervisor if the incident happens on a project, or the administrative supervisor if the incident happens in the office (e.g., a geologist, acting as a Field Operations Lead gets injured on a job site, or in a motor vehicle in the course of project work). The FW Supervisor is most likely the Project Manager. If the same geologist gets injured lifting a box in his office, the FW Supervisor is likely the Office Science Lead.

Location of Incident: The specific location on the project, in the office, or offsite location.

Weather Conditions: Temperature, precipitation, approximate wind speed and direction, cloud cover, relative humidity. This information may be included in the description section, and must be given in detail whenever it is a factor in the cause or impact, (e.g., spill, release, heat stress, wind blown material).

Describe What Happened: This section must be completed in sufficient detail to adequately describe the events and conditions leading up to and resulting from the incident. Try to answer the questions who, what, where, when, and how. This information is then used to determine why (cause). Provide details such as work objective, procedure being used, body position, and PPE. Include diagrams or sketches for all incidents involving vehicles/equipment and other incidents where they aid in providing detail or perspective. Consider attaching photographs. Follow the guidelines in Practical Loss Control Leadership, and consider the impact of each of the following:

P – **People**
E – **Equipment**
M – **Material**
E – **Environment**

To do an effective job, a visual inspection of the scene is usually necessary along with private interviews of affected employees and witnesses.

Where appropriate, use terms indicating the type of contact (e.g., struck by; struck against; fall from elevation; fall on same level; caught in; caught between or under; caught on; contact with; overstress; equipment failure; environmental release; fire).

000305

Affected Employee Information

FWENC Employee: Direct hire, whether professional, administrative, or craft; full-time or part-time; permanent or temporary. If the affected employee is not a Foster Wheeler Environmental Corporation (FWENC) employee, give the name of the employer and business relationship (e.g., client, subcontractor, etc.) in the description section above.

Hours Worked on Shift Prior to the Incident: Only include the amount of time the employee worked that shift or day prior to the incident.

Years with FWENC: For FWENC employees, give the number of years employed with FWENC. If the employee has worked for FWENC for less than a year, do not write <1. Give the answer in fraction of year, or specify the number of months.

Injury/Illness Information

Nature of Injury or Illness: If the incident resulted in an injury or illness, give a brief description of the body part affected and type of injury or illness (e.g., fractured thumb, left hand; carpal tunnel syndrome, right hand).

First Aid Provided: First Aid is any treatment that does not have to be provided by a health care professional, even if it is (e.g., a laceration that is cleaned and bandaged in a clinic may constitute first aid, if sutures are not given).

Will the Injury Result In: Do not delay the report if this information is unknown.

Medical Treatment Information

Was Medical Treatment Provided? Medical treatment is that treatment that must be provided by a licensed medical practitioner, e.g., sutures, prescription medication, etc.

Type of Treatment: This information is important in determining OSHA recordability, since some forms of treatment would not constitute a Recordable case (e.g., one-time administration of prescriptions, negative diagnostic exams). Attach a copy of the treating professional's statement/work release.

Vehicle and Property Damage Information

Vehicle/Property Damaged: For vehicles, indicate VIN and whether it is company owned or leased, business trip rental (e.g., Avis) or owned by others.

Description of Damage: Be specific as to the identity of damaged part, location and extent.

Spill and Air Emissions Information

Substance Spilled or Released: For pure substances, list materials by common name/chemical. For wastes, indicate waste code. For mixtures or contaminated media, provide contaminant name, CAS No., concentration.

Reportable Quantity (RQ) Exceeded? Contact your Environmental Safety and Quality (ESQ) representative for guidance. Specify the RQ for the material, whether you answer yes or no.

Reportable to Agency? If yes, specify the federal, state or local agency that must be provided with verbal and/or written notification.

Written Report? Answer yes if the release requires a written report to be filed and note the time frame.

000306

Response Action Taken: Describe the mitigation efforts, as well as any reports made, beyond initial notification.

3387

Permit Exceedence

Type of Permit: List name of permit including the agency name where applicable (e.g., NPDES, State EPA).

Date of Exceedence: Specify date exceedence occurred (e.g., date discharge in excess of permit limits occurred).

Date First Knowledge of Exceedence: Specify date when first knew there was an exceedence (i.e., date analytical received). This date may be different from the date of the exceedence listed above.

Permitted Level or Criteria: List numerical discharge or emission limit or narrative criteria specified in the permit (e.g., 20% opacity limit, Best Management Practices [BMP] implementation per Storm Water Pollution Prevention Plan [SWPPP]).

Exceedence Level or Criteria: Specify actual numerical discharge/emission limit or narrative criteria which was exceeded (e.g., 22% opacity, failure of BMPs [silt fencing collapse] per SWPPP).

Exceedence Duration: Specify time frame by date and hours (using military time) during which exceedence occurred.

See **"Spill/Release Information"** (above) for description of remaining questions.

Persons Preparing Report

Employee's Name: The affected employee should review the report and sign here, as well as other employees witnessing or involved in the incident.

Supervisor's Name: The FWENC Supervisor must review and sign the report indicating agreement. The FWENC Supervisor and the Investigator should be the same person.

Investigative Report

Report No.: This is the same as the project optional report number from page 1 of the Incident/Near Miss Report.

Date of Investigative Report: This date should be within 72 hours of the incident. In cases where the investigation is not completed until a later date, submit the incomplete report within the 72 hours, and a revised report should be submitted when the missing information is obtained.

Incident Cost: For all vehicle/equipment or property damage cases, an estimated or actual loss value must be entered. If an estimated value is entered, the report must be revised when the actual costs are known.

OSHA Recordables: This section should be completed in consultation with the Project Environmental and Safety Manager (PESM). If it cannot be determined at the time of the report, the PESM should consult with the Foster Wheeler Director, Health and Safety Programs and revise the report when a determination is made.

No. of Restricted Days: This relates to days of restricted work activity, not restrictions on motion or physical capability. If the employee is capable of doing his normal job the day after the injury and

000302

thereafter, there are no restricted days, even if the physician indicates a physical restriction. It does not include the day of the injury.

No. of Days Away from Work: The number of days after the day of the injury that the employee was scheduled to work but could not due to an occupational injury. If the treating physician releases an employee to return to work, but the employee chooses not to come to work, do not count those days. In this case, the PESM should contact the Foster Wheeler Director, Health and Safety Programs.

Cause Analysis

Immediate Causes: Determine the immediate causes, using the examples provided. If one or more of the examples fits the circumstance, use those words in the cause description. This facilitates statistical analysis of the incident database for program evaluation/modification. However, do not confine your cause determination to the guide words. Explain, for example, *Improper Lifting – employee attempted to* lift box by bending at the waist and twisting while lifting. Be sure that the incident description is sufficiently detailed to support the causal analysis in this section. An assumption of cause (e.g., improper lifting) from the injury (low back pain) is not acceptable.

Basic Causes: Like the Immediate Causes, use the guide words in the attachment whenever appropriate and explain. For example, improper motivation may be because the correct way takes more time or effort; short cutting standard procedure is tolerated or positively reinforced; or the person thinks there is no personal benefit to always doing the job correctly.

Note: The investigator is encouraged to review the Practical Loss Control Leadership chapters on *Causes and Effects of Loss* and *Accident/Incident Investigation* before doing the causal analysis. As a check, the investigator may refer to the S.C.A.T. Chart available from the PESM.

Remedial Actions: Include all actions taken or those that should be taken to prevent recurrence. Be sure that actions address the causes. For example, training (safety meetings) may be a necessary response for lack of knowledge, but may be inadequate for improper motivation. If completion dates exceed the 72 hours reporting period, a revised report must be submitted when all remedial actions are complete.

Persons Performing Investigation: The primary investigator is the FWENC Supervisor in charge of the work where the incident occurred. Others participating in the investigation, such as the Project Manager, Environmental and Safety Supervisor, Quality Control, site engineer, foreman, etc. should also sign the report.

Management Review: The Project or Office Manager and the PESM or office Environmental and Safety Coordinator (ESC) must sign the report indicating their satisfaction with thoroughness of the investigation and the report, and their concurrence that the action items address the identified causes. This constitutes the peer review, and the report, particularly the description, should be clear to readers not familiar with the project or incident.

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APPENDIX C

AWR Project Area
Personnel Evacuation Routes and Rally Points

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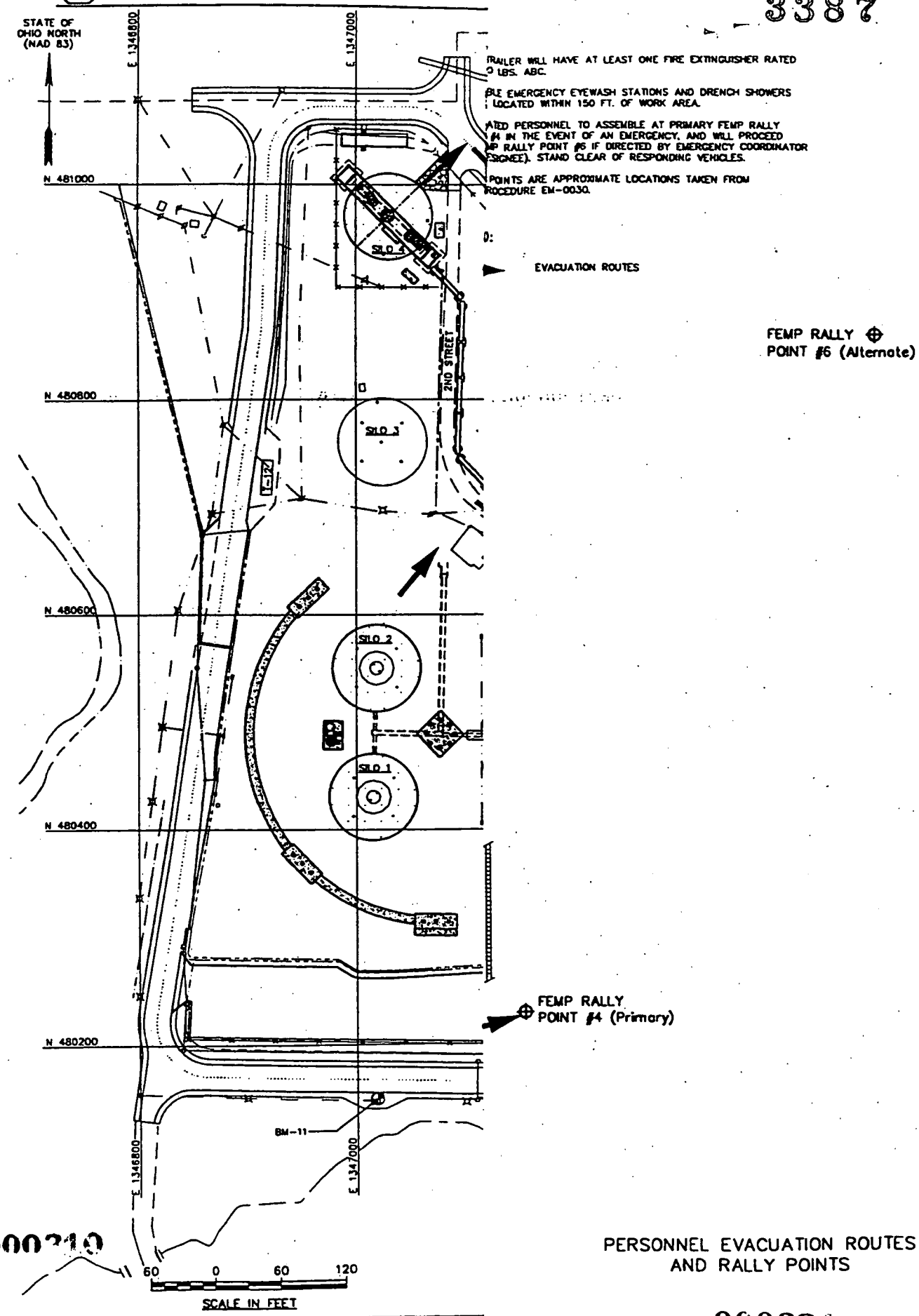

PERSONNEL EVACUATION ROUTES AND RALLY POINTS

3387

APPENDIX D

AWR Project
Bomb Threat Checklist (Typical)

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Bomb Threat Checklist (Typical)

Listen. Do not interrupt the caller.

Your name	Time	Date
Caller's identity	Sex M F	Approximate age (years)

Origin of call
Local ☐ Long Distance ☐ Booth ☐

Voice Characteristics and Background Noises (Circle each appropriate description)

Voice	Speech	Language	Accent	Manner	Background Noises
Loud	Fast	Excellent	Local	Calm	Office machinery
High Pitch	Distinct	Fair	Regional	Rational	Factory machinery
Raspy	Stutter	Good	Eastern	Coherent	Bedlam
Intoxicated	Slurred	Obscene	Midwestern	Deliberate	Animals
Soft	Slow	Poor	New England	Angry	Quiet
Deep	Distorted		Southern	Irrational	Mixed
Pleasant	Nasal		Race	Incoherent	Street traffic
			Foreign	Emotional	Airplanes
			Asian	Laughing	Party atmosphere
			European		Trains
			Spanish		Music
					Voices

Describe any characteristics or noises not listed above: _____

Keep the caller talking.

If the caller is willing to keep talking, ask these questions:

When will it go off: Certain hour: _____ Time remaining: _____

Where is it planted? Building area: _____

What kind of bomb? _____

Where are you now? _____

How do you know so much about the bomb? _____

What is your name and address? _____

Hold on the line while you notify supervisor listed here: _____
Supervisor

Did the caller appear familiar with the site or building by his description of bomb location? _____

Write out the message in its entirety and any other comments below. _____

Action to take immediately after the call. _____

Notify the following persons in the order given:

1. Name _____ Phone No. _____
2. Name _____ Phone No. _____
3. Name _____ Phone No. _____

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3387

APPENDIX E

AWR Project Contingency Plan
Glossary

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GLOSSARY

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Accident (Operational): An event stemming from technological and man-made hazards which presents a potential threat to life, health, property, or the environment.

Assistant Emergency Duty Officer (AEDO): The Fluor Fernald emergency management authority onsite when the EOC is not operational. Incident commander of the FEMP emergency response activities.

Classification Levels –

> **Loggable Event:** A non-routine event, which is not required to be reported to DOE. It must, however, be recorded (along with all events of higher classification) in a log maintained by the operating contractors. This log will be available to DOE and contractor management for trend analysis and review as a part of the functional appraisal process.
>
> **Off-Normal:** Abnormal or unplanned events or conditions that adversely affect, potentially affect, or are indicative of degradation in the safety, security, environmental or health protection performance or operation of a facility.
>
> **Unusual Occurrence:** A non-emergency occurrence that has significant impact or potential for impact on safety, environment, health, security, or operations.

Deputy Emergency Director (DED): The immediate successor to the Fluor Fernald Emergency Director. The DED's primary emergency responsibility is the direction and control of emergency incidents as the manager of the EOC.

Detector: A material or device that is designed to be sensitive and can produce a response suitable for measurement or analysis.

Dose: The amount of energy deposited in tissue (unit = rad).

Dose Equivalent: The dose multiplied by a quality factor (QF). QF for Beta and Gamma is one; for Alpha it is twenty (unit = rem).

Dosimeter: A portable measuring device, normally worn by personnel at a nuclear facility, for measuring and registering the total accumulated exposure to ionizing radiation.

Dosimetry: The theory and application of the principles and techniques involved in the measure and recording of radiation doses. Its practical aspect is concerned with the use of various types of radiation instruments with which measurements are made. These measurements permit records to be kept on each individual exposed to a radiation environment.

Drill: Supervised instruction for testing, developing, and maintaining skills in a particular response operation. A drill may be a component of an exercise.

Effective Dose Equivalent: The summation of organ dose equivalents multiplied by organ-specific weighting factors (unit = rem).

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Emergency: Any significant deviation from planned or expected behavior or course of events, which could endanger or adversely affect people, property, or the environment.

Emergency Chief: The Fluor Fernald shift Safety and Fire Inspector who leads the Emergency Response Team.

Emergency Director (ED): The Fluor Fernald President or his designee has overall authority and responsibility for activities at the FEMP, including emergency management.

Emergency Duty Officer (EDO): Trained Fluor Fernald senior management personnel responsible for the management and oversight of the FEMP emergency response activities until the FEMP EOC is declared operational.

Emergency Equipment: Any equipment that may be required to measure, control, or mitigate the consequences of an emergency.

Emergency Management Organization: The FEMP EOC Staff, Emergency Duty Officers, and Assistant Emergency Duty Officers, and the offsite Emergency Management Organization.

Emergency Operations Center (EOC): The command and control center designed and equipped for directing and coordinating emergency response actions, located in the Administration Building.

Emergency Plan: A clear and concise description of the overall emergency organization, designation of responsibilities, and descriptions of the procedures, including notifications, involved in coping with any or all aspects of a potential credible emergency.

Emergency Planning Zone (EPZ): The geographic area surrounding the FEMP for which planning and preparedness efforts are carried out to ensure prompt and effective protective actions can be taken to reduce adverse effects of an emergency at the FEMP.

Emergency Procedure: Detailed instructions and guidance for carrying out emergency response actions.

Emergency Resources: Any individual or group of individuals, items of equipment or instrumentation, and specialized services which have been assembled, organized, or developed for the purpose of assisting in alleviating the consequences of an emergency.

Emergency Response Team (ERT): A group of professional and volunteer personnel trained for event mitigation, including emergency response to fire, hazardous materials release, radiological release, and medical emergencies. Members must meet specific physical, medical, and training requirements.

Event: Any significant deviation from planned or expected behavior or course of events that could endanger or adversely affect people, property, or the environment.

Exercise: An event that tests the integrated capability and a major portion of the basic elements of emergency preparedness as specified in emergency plans and procedures.

Facility Owner: The Fluor Fernald person designated as building custodian or the senior supervisor on-shift in a plant.

Health Physics: The science concerned with recognition, evaluation, control, and management of health hazards from ionizing radiation.

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Incident: For the purposes of this Contingency Plan, an incident is:

- An injury or illness which meets the OSHA recordability criteria,
- An exposure to a hazardous substance above the allowable exposure unit,
- A property/vehicle/equipment/heavy equipment/truck/passenger damage case which results in damage greater than $500,
- A fire or explosion,
- A spill or release resulting from FWENC, or subcontractor activities, including spills or releases from operations at a client facility of which FWENC employees have become aware,
- A permit exceedence, or
- A "near miss" or an event that has a reasonable probability in resulting in one the outcomes described above if the circumstances were different and for which modifications to management programs will reduce the probability of occurrence or the severity of the outcome.

Joint Information Center (JIC): The Fluor Fernald facility equipped to receive, coordinate, and disseminate emergency information to the media from the state, counties, and the FEMP.

Mutual Aid Agreement: A formal, written understanding between jurisdictions, which covers methods and types of assistance available during all phases of an emergency.

National Warning System: A full period voice telephone circuit used by the National Warning Center for the direct and simultaneous dissemination of warning information.

Natural Radiation: Also called "background," it is found naturally in the environment and includes cosmic rays and radiation from the naturally radioactive elements outside and inside the bodies of humans and animals.

Notification: Communication within mandated time frames of general information on the nature and severity of an emergency event.

Planning Zone: An area for which planning is done to assure that prompt and effective actions can be taken to protect onsite personnel, the public health and safety, and the environment in the event of a major emergency.

Plume: The profile of a gaseous or liquid release as it moves or disperses.

Protective Action: Physical action, such as sheltering or evacuation, taken to prevent potential health hazard from affecting employees or the offsite population potentially impacted form a hazardous materials release.

Rally Point: A designated safe location for personnel assembly when local evacuation is ordered. A number of locations around the FEMP are designated as rally points for the collection of, management of, and communications with personnel from evacuated facilities.

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Reporting: Either (1) communicating, in any medium, further information on any event; or (2) preparing and submitting a written report on event according to established DOE policies and procedures.

Sheltering: An in-place, immediate protective action which calls for people to close all doors and windows, turn off all sources of outside air, listen to radio or television for emergency information, and remain indoors until official notification that it is safe to go out.

Telecommunication: Any transmission, emission, or reception of signs, signals, writings, images, and sounds or intelligence of any nature by wire, radio, visual, or other electromagnetic.

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Section 8
Silo Penetration Plan

The Silo Penetration Plan is being re-evaluated/updated and will be issued in the RCS Remedial Action Work Plan.

Appendix A

Process Flow Diagrams for All Systems

DOCUMENT NO. 624-P622-05

DRAWING NUMBER	DRAWING TITLE	REVISION
10FMD002	FULL-SCALE MOCKUP SYSTEM PROCESS FLOW DIAGRAM RADON CONTROL SYSTEM	2
10FMD003	FULL-SCALE MOCKUP SYSTEM PROCESS FLOW DIAGRAM RADON CONTROL SYSTEM	2
10FMD007	FULL-SCALE MOCKUP SYSTEM PROCESS FLOW DIAGRAM SILO 4 - SWRS MODE	2
10FMD008	FULL-SCALE MOCKUP SYSTEM PROCESS FLOW DIAGRAM SLURRY & WATER PIPING TIE-IN	2
10FMD009	FULL-SCALE MOCKUP SYSTEM PROCESS FLOW DIAGRAM PHASE SEPARATORS	2
10FMD010	FULL-SCALE MOCKUP SYSTEM PROCESS FLOW DIAGRAM HP PUMP SKID SKD-11-250	2
10FMD011	FULL-SCALE MOCKUP SYSTEM PROCESS FLOW DIAGRAM SILO 4 – CATS MODE	2
11FMD003	SILO WASTE RETRIEVAL SYSTEM PROCESS FLOW DIAGRAM SILO 2 – SWRS MODE	2

Process Flow Diagrams for All Systems

DOCUMENT NO. 624-P622-05

DRAWING NUMBER	DRAWING TITLE	REVISION
11FMD004	SILO WASTE RETRIEVAL SYSTEM PROCESS FLOW DIAGRAM DIVERTER BOX ENC-11-001	2
11FMD005	SILO WASTE RETRIEVAL SYSTEM PROCESS FLOW DIAGRAM SLURRY LINE CLEANOUTS	2
11FMD006	SILO WASTE RETRIEVAL SYSTEM PROCESS FLOW DIAGRAM HP PUMP SKID SKD-11-251	2
11FMD007	SILO WASTE RETRIEVAL SYSTEM PROCESS FLOW DIAGRAM SAMPLE VALVE ENCLOSURE	2
11FMD009	SILO WASTE RETRIEVAL SYSTEM PROCESS FLOW DIAGRAM SILO 1 – CATS MODE	2
12FMD001	TRANSFER TANK SYSTEM PROCESS FLOW DIAGRAM DISTRIBUTION ENC-12-001	2
12FMD002	TRANSFER TANK SYSTEM PROCESS FLOW DIAGRAM STORAGE TANK TNK-12-001A	2

Process Flow Diagrams for All Systems

DOCUMENT NO. 624-P622-05

DRAWING NUMBER	DRAWING TITLE	REVISION
12FMD003	TRANSFER TANK SYSTEM PROCESS FLOW DIAGRAM STORAGE TANK TNK-12-001B	2
12FMD004	TRANSFER TANK SYSTEM PROCESS FLOW DIAGRAM STORAGE TANK TNK-12-002A	2
12FMD005	TRANSFER TANK SYSTEM PROCESS FLOW DIAGRAM STORAGE TANK TNK-12-002B	2
12FMD006	TRANSFER TANK SYSTEM PROCESS FLOW DIAGRAM BUILDING SUMP SMP-12-003	2
12FMD007	TRANSFER TANK SYSTEM PROCESS FLOW DIAGRAM ULTRA FILTRATION SKD-12-001	2
12FMD008	TRANSFER TANK SYSTEM PROCESS FLOW DIAGRAM FILTRATE SYSTEM	2
12FMD018	TRANSFER TANK SYSTEM PROCESS FLOW DIAGRAM FILTRATE RECIRC & TRANSFER	A
13FMD002	TRANSFER TANK WASTE RETRIEVAL PROCESS FLOW DIAGRAM STORAGE TANK	2

Process Flow Diagrams for All Systems

DOCUMENT NO. 624-P622-05

DRAWING NUMBER	DRAWING TITLE	REVISION
13FMD003	TRANSFER TANK WASTE RETRIEVAL PROCESS FLOW DIAGRAM SAMPLE VALVE ENCLOSURE	2
13FMD004	TRANSFER TANK WASTE RETRIEVAL PROCESS FLOW DIAGRAM FUTURE REMEDIATION FACILITY	2
14FMD002	DECANT SUMP RETRIEVAL SYSTEM PROCESS FLOW DIAGRAM DECANT SUMP RETRIEVAL	3
20FMD003	RADON CONTROL SYSTEM PROCESS FLOW DIAGRAM SILO 2	2
20FMD004	RADON CONTROL SYSTEM PROCESS FLOW DIAGRAM SILO 1	2
20FMD005	RADON CONTROL SYSTEM PROCESS FLOW DIAGRAM FILTER & FILTRATE STORAGE TANKS	2
20FMD006	RADON CONTROL SYSTEM PROCESS FLOW DIAGRAM TTA STORAGE TANKS	2
20FMD007	RADON CONTROL SYSTEM PROCESS FLOW DIAGRAM CARBON BEDS	2

Process Flow Diagrams for All Systems

DOCUMENT NO. 624-P622-05 3387

DRAWING NUMBER	DRAWING TITLE	REVISION
20FMD008	RADON CONTROL SYSTEM PROCESS FLOW DIAGRAM AIR HANDLING & CONDENSATE	2
20FMD009	RADON CONTROL SYSTEM PROCESS FLOW DIAGRAM SAMPLE TANKS	2
20FMD010	RADON CONTROL SYSTEM PROCESS FLOW DIAGRAM EXHAUST & RECIRC FAN	2
20FMD011	RADON CONTROL SYSTEM PROCESS FLOW DIAGRAM DECANT WASTE RETRIEVAL	2
77FMD001	MISC FACILITIES HVAC SYSTEM HVAC FLOW DIAGRAM LOCATION AND CONTROL	0
77FMD003	MISC FACILITIES HVAC SYSTEM HVAC FLOW DIAGRAM RCS BLDG VENTILATION 1ST FLOOR	0
77FMD005	MISC FACILITIES HVAC SYSTEM HVAC FLOW DIAGRAM RCS BLDG VENTILATION 2ND FLOOR	0
77FMD006	MISC FACILITIES HVAC SYSTEM HVAC CONTROL DIAGRAM RCS BLDG VENTILATION 1ST FLOOR	0

Process Flow Diagrams for All Systems

DOCUMENT NO. 624-P622-05 3387

DRAWING NUMBER	DRAWING TITLE	REVISION
77FMD008	MISC FACILITIES HVAC SYSTEM HVAC CONTROL DIAGRAM RCS BLDG VENTILATION 2ND FLOOR	0

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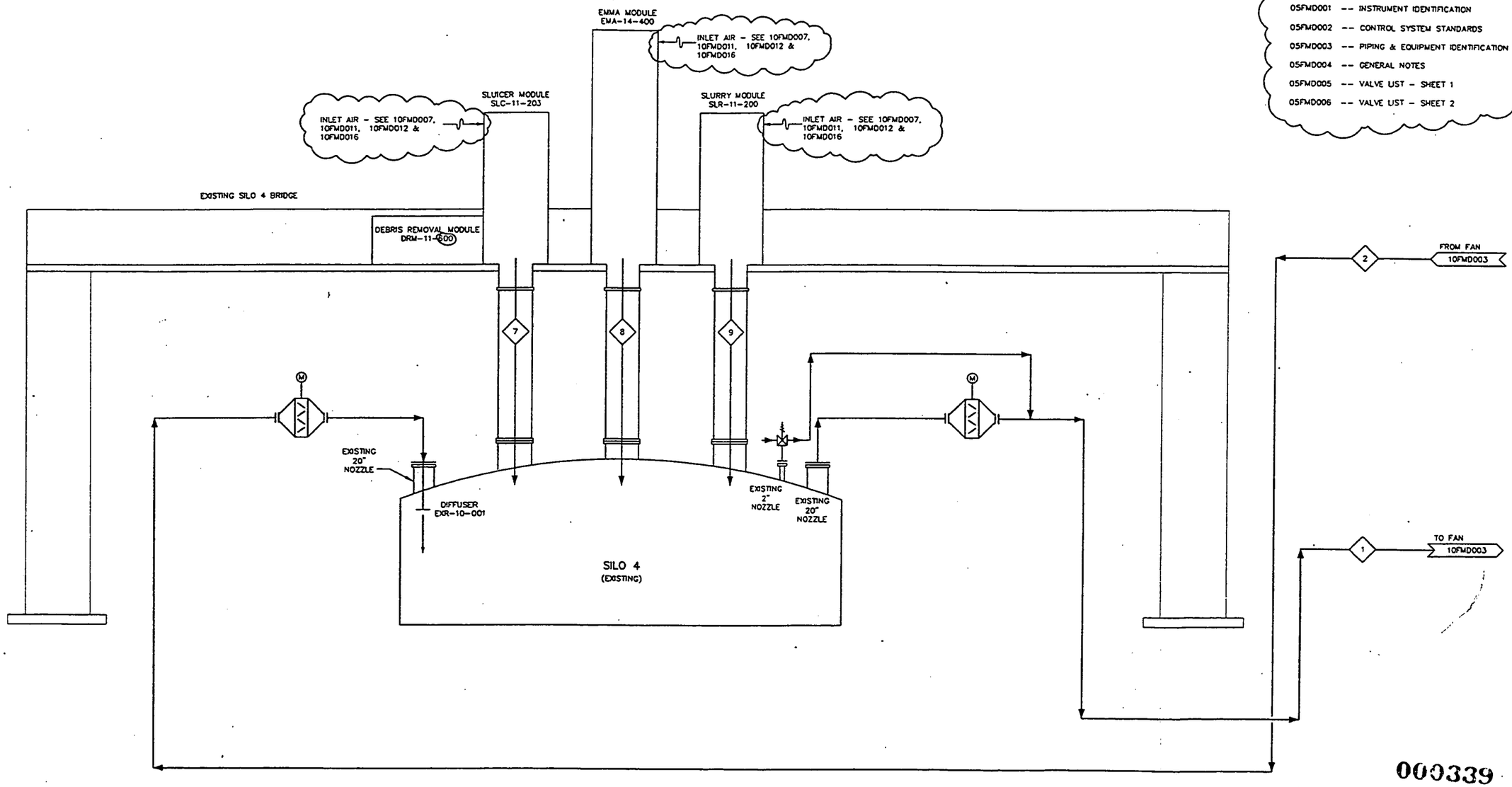
INFORMATION ONLY

NOTES:

1. FOR GENERAL NOTES SEE DRAWING 05FMD004.
2. FOR MASS BALANCE TABLES SEE DRAWING 10FMD001.

REFERENCE DRAWINGS:

05FMD001 -- INSTRUMENT IDENTIFICATION
05FMD002 -- CONTROL SYSTEM STANDARDS
05FMD003 -- PIPING & EQUIPMENT IDENTIFICATION
05FMD004 -- GENERAL NOTES
05FMD005 -- VALVE LIST - SHEET 1
05FMD006 -- VALVE LIST - SHEET 2



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THE ORIGINAL DRAWING AND SUBSEQUENT REVISIONS THEREOF, WITH APPROVAL NAMES, INITIALS, AND THE PE SEAL, IF APPLICABLE, ARE MAINTAINED IN THE FILES OF FWENC.

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2					REVISED PER CHANGE PROPOSAL CP-00-001
1	01/07/00	BJD	SWH	KDR	CERTIFIED FOR CONSTRUCTION
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DRAWN BY	B J DAVIS	DATE 01/07/00
DESIGNED BY	B J DAVIS	DATE 01/07/00
CHECKED BY	S W HUNGATE	DATE 01/07/00
APPROVED BY	KENNETH RICKETT	DATE 01/07/00
APPROVED BY	JOHN LAWSON	DATE 01/07/00

DEPARTMENT OF ENERGY
FERNALD ENVIRONMENTAL MANAGEMENT PROJECT
SILOS 1 AND 2 ACCELERATED WASTE RETRIEVAL PROJECT
FERNALD, OHIO
FDF CONTRACT NO. FSC 624

FOSTER WHEELER
FOSTER WHEELER ENVIRONMENTAL CORPORATION

TITLE
FULL-SCALE MOCKUP SYSTEM
PROCESS FLOW DIAGRAM
RADON CONTROL SYSTEM

SIZE D | SCALE: NONE | DWG. NO. 10FMD002 | REV 2

FILENAME: 10FMD002.DWG

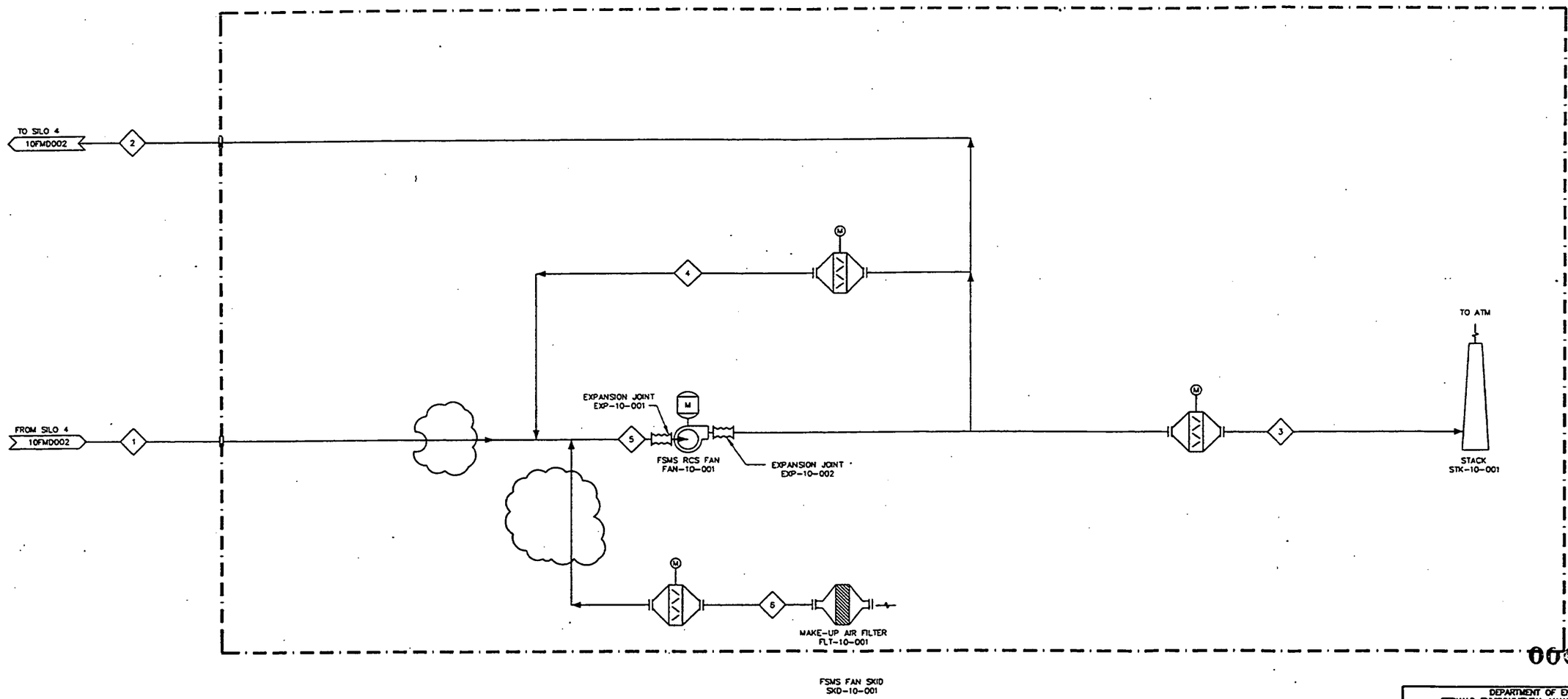
INFORMATION ONLY

NOTES: 3387

1. FOR GENERAL NOTES SEE DRAWING 05FMD004.
2. FOR MASS BALANCE TABLES SEE DRAWING 10FMD001.

REFERENCE DRAWINGS:

05FMD001 -- INSTRUMENT IDENTIFICATION
05FMD002 -- CONTROL SYSTEM STANDARDS
05FMD003 -- PIPING & EQUIPMENT IDENTIFICATION
05FMD004 -- GENERAL NOTES
05FMD005 -- VALVE LIST - SHEET 1
05FMD006 -- VALVE LIST - SHEET 2



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THE ORIGINAL DRAWING AND SUBSEQUENT REVISIONS THEREOF, WITH APPROVAL NAMES, INITIALS, AND THE PE SEAL, IF APPLICABLE, ARE MAINTAINED IN THE FILES OF FWENC.

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APPROVED BY JOHN LAWSON	DATE 01/07/00	

DEPARTMENT OF ENERGY
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SILOS 1 AND 2 ACCELERATED WASTE RETRIEVAL PROJECT
FERNALD, OHIO
FDF CONTRACT NO. FSC 624

FOSTER WHEELER
FOSTER WHEELER ENVIRONMENTAL CORPORATION

TITLE
FULL-SCALE MOCKUP SYSTEM
PROCESS FLOW DIAGRAM
RADON CONTROL SYSTEM

SIZE	SCALE	DWG. NO.	REV
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FILENAME: 10FMD003.DWG

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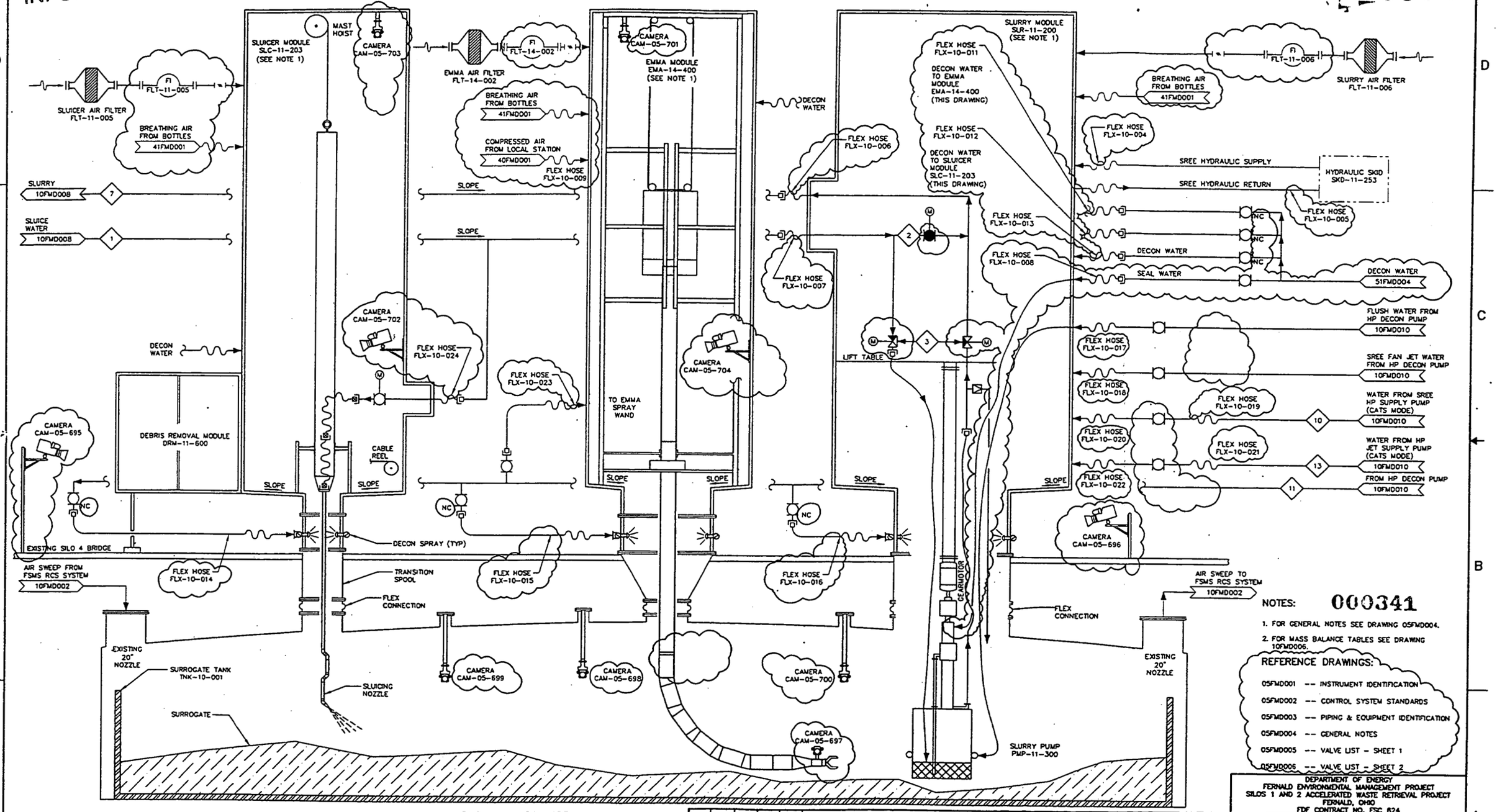

SILO 4 – SWRS MODE

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NOTES:

1. FOR GENERAL NOTES SEE DRAWING 05FMD004.
2. FOR MASS BALANCE TABLES SEE DRAWING 10FMD006.

REFERENCE DRAWINGS:

- 05FMD001 -- INSTRUMENT IDENTIFICATION
- 05FMD002 -- CONTROL SYSTEM STANDARDS
- 05FMD003 -- PIPING & EQUIPMENT IDENTIFICATION
- 05FMD004 -- GENERAL NOTES
- 05FMD005 -- VALVE LIST – SHEET 1
- 05FMD006 -- VALVE LIST – SHEET 2

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APPROVED BY J LAWSON	DATE 01/07/00	

DEPARTMENT OF ENERGY
FERNALD ENVIRONMENTAL MANAGEMENT PROJECT
SILOS 1 AND 2 ACCELERATED WASTE RETRIEVAL PROJECT
FERNALD, OHIO
FDF CONTRACT NO. FSC 824

FOSTER WHEELER
FOSTER WHEELER ENVIRONMENTAL CORPORATION

TITLE
FULL-SCALE MOCKUP SYSTEM
PROCESS FLOW DIAGRAM
SILO 4 – SWRS MODE

SIZE D | SCALE: NONE | DWG. NO. 10FMD007 | REV 2

FILENAME: 10FMD007.DWG

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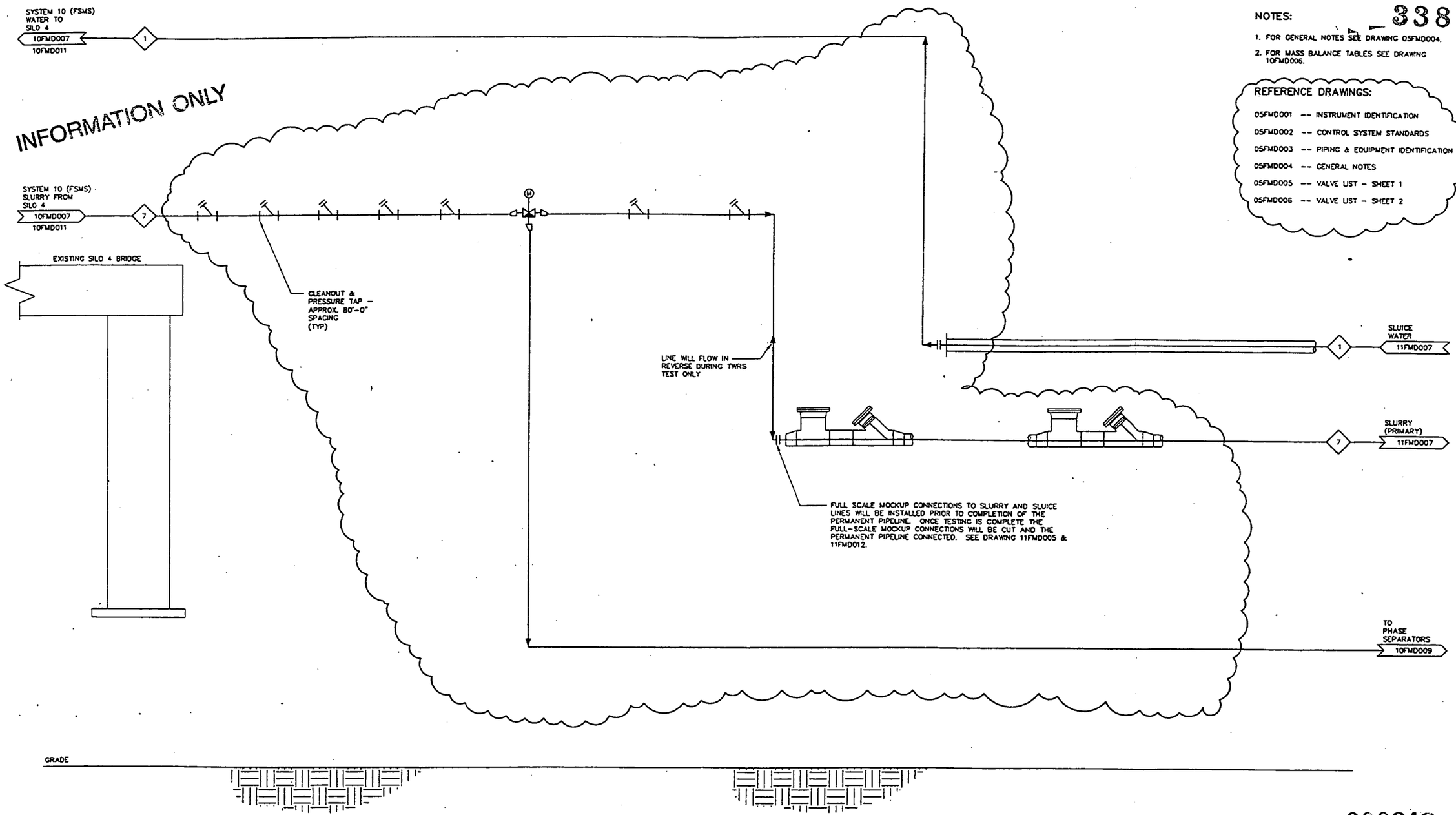

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NOTES:

1. FOR GENERAL NOTES SEE DRAWING 05FMD004.
2. FOR MASS BALANCE TABLES SEE DRAWING 10FMD006.

REFERENCE DRAWINGS:

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05FMD002 -- CONTROL SYSTEM STANDARDS
05FMD003 -- PIPING & EQUIPMENT IDENTIFICATION
05FMD004 -- GENERAL NOTES
05FMD005 -- VALVE LIST – SHEET 1
05FMD006 -- VALVE LIST – SHEET 2

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THE ORIGINAL DRAWING AND SUBSEQUENT REVISIONS THEREOF, WITH APPROVAL NAMES, INITIALS, AND THE PE SEAL, IF APPLICABLE, ARE MAINTAINED IN THE FILES OF FWENC.

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DEPARTMENT OF ENERGY
FERNALD ENVIRONMENTAL MANAGEMENT PROJECT
SILOS 1 AND 2 ACCELERATED WASTE RETRIEVAL PROJECT
FERNALD, OHIO
FDF CONTRACT NO. FSC 624

FOSTER WHEELER
FOSTER WHEELER ENVIRONMENTAL CORPORATION

TITLE
FULL-SCALE MOCKUP SYSTEM PROCESS FLOW DIAGRAM SLURRY & WATER PIPING TIE-IN

SIZE	SCALE	DWG. NO.	REV
D	NONE	10FMD008	2

FILENAME: 10FMD008.DWG

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INFORMATION ONLY

NOTES:

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1. FOR GENERAL NOTES SEE DRAWING 05FMD004.
2. FOR MASS BALANCE TABLES SEE DRAWING 10FMD006.

REFERENCE DRAWINGS:

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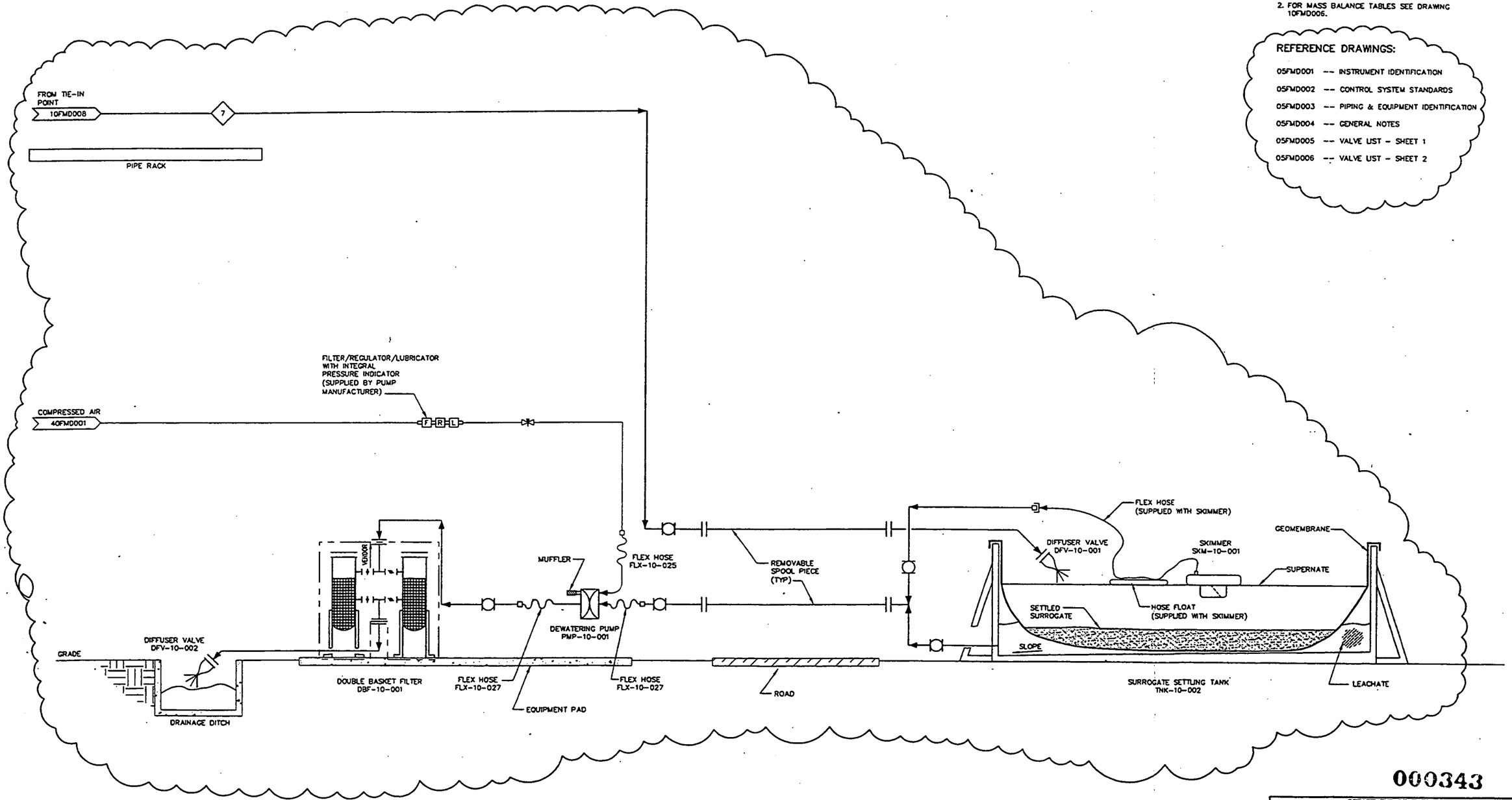
05FMD002 -- CONTROL SYSTEM STANDARDS
05FMD003 -- PIPING & EQUIPMENT IDENTIFICATION
05FMD004 -- GENERAL NOTES
05FMD005 -- VALVE LIST - SHEET 1
05FMD006 -- VALVE LIST - SHEET 2



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DEPARTMENT OF ENERGY
FERNALD ENVIRONMENTAL MANAGEMENT PROJECT
SILOS 1 AND 2 ACCELERATED WASTE RETRIEVAL PROJECT
FERNALD, OHIO
FDF CONTRACT NO. FSC 624

FOSTER WHEELER
FOSTER WHEELER ENVIRONMENTAL CORPORATION

TITLE
FULL-SCALE MOCKUP SYSTEM
PROCESS FLOW DIAGRAM
SURROGATE DEWATERING

SIZE	SCALE	DWG. NO.	REV
D	NONE	10FMD009	2

FILENAME: 10FMD009.DWG

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INFORMATION ONLY

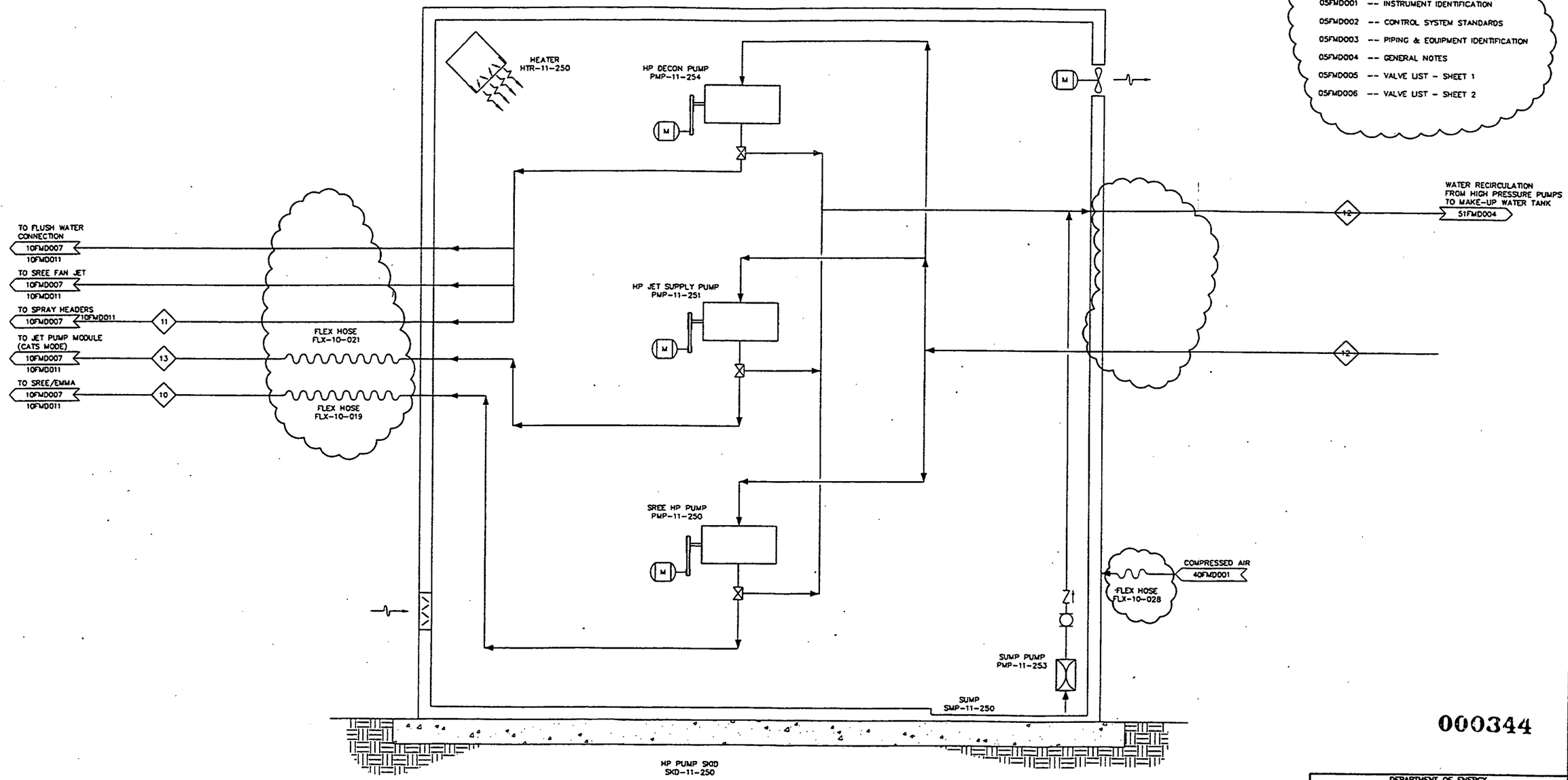
NOTES:

3387

1. FOR GENERAL NOTES SEE DRAWING 05FMD004.
2. FOR MASS BALANCE TABLES SEE DRAWING 10FMD006.

REFERENCE DRAWINGS:

05FMD001 -- INSTRUMENT IDENTIFICATION
05FMD002 -- CONTROL SYSTEM STANDARDS
05FMD003 -- PIPING & EQUIPMENT IDENTIFICATION
05FMD004 -- GENERAL NOTES
05FMD005 -- VALVE LIST - SHEET 1
05FMD006 -- VALVE LIST - SHEET 2



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THE ORIGINAL DRAWING AND SUBSEQUENT REVISIONS THEREOF, WITH APPROVAL NAMES, INITIALS, AND THE PE SEAL, IF APPLICABLE, ARE MAINTAINED IN THE FILES OF FWENC.

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APPROVED BY	JOHN LAWSON	01/07/00

DEPARTMENT OF ENERGY
FERNALD ENVIRONMENTAL MANAGEMENT PROJECT
SILOS 1 AND 2 ACCELERATED WASTE RETRIEVAL PROJECT
FERNALD, OHIO
FDF CONTRACT NO. FSC 624

FOSTER WHEELER
FOSTER WHEELER ENVIRONMENTAL CORPORATION

TITLE
FULL-SCALE MOCKUP SYSTEM
PROCESS FLOW DIAGRAM
HP PUMP SKID SKD-11-250

SIZE	SCALE	DWG. NO.	REV
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FILENAME: 10FMD010.DWG

INFORMATION ONLY

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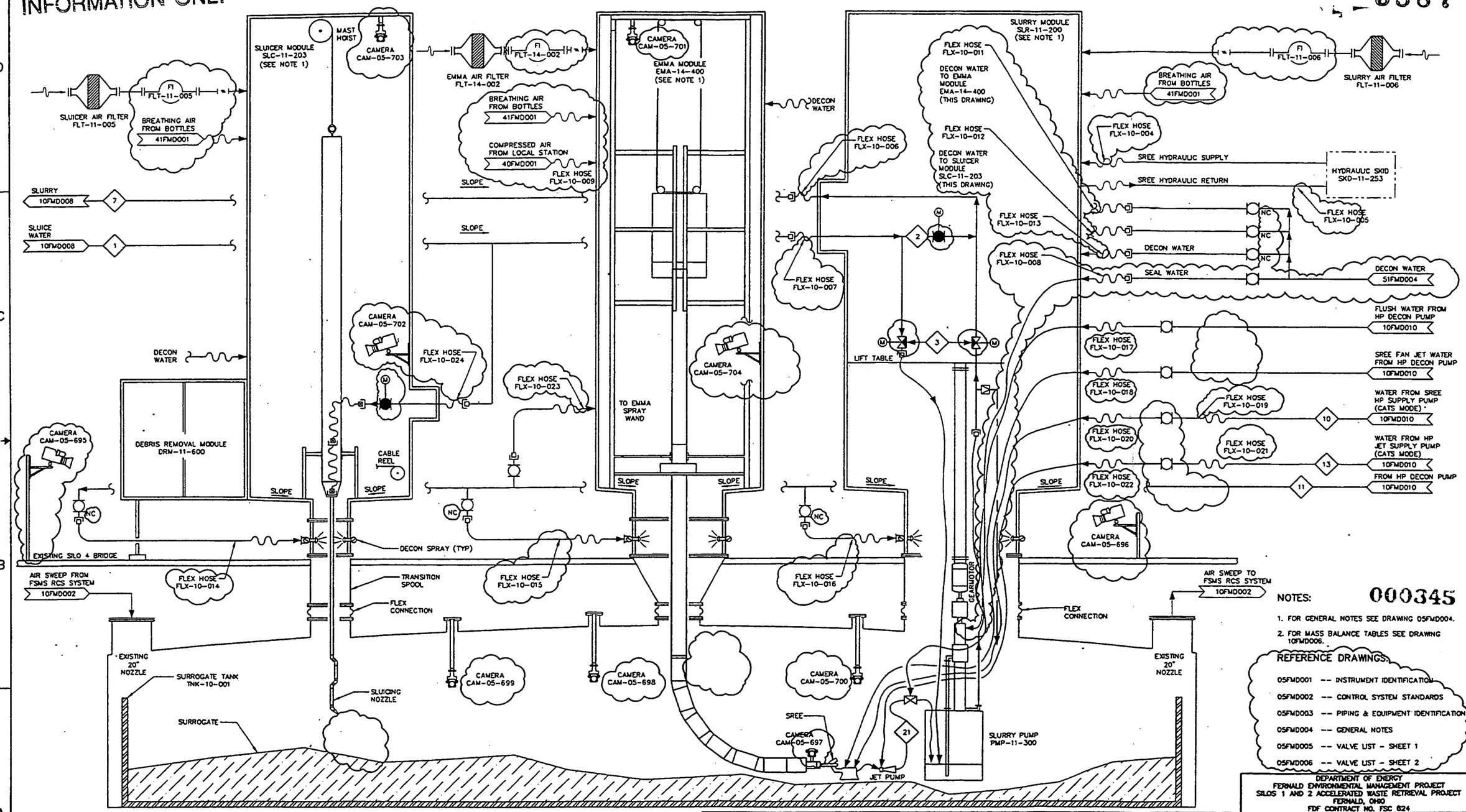

SILO 4 – CATS MODE

NOTES:

1. FOR GENERAL NOTES SEE DRAWING 05FMD004.
2. FOR MASS BALANCE TABLES SEE DRAWING 10FMD006.

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REFERENCE DRAWINGS:

05FMD001 -- INSTRUMENT IDENTIFICATION
05FMD002 -- CONTROL SYSTEM STANDARDS
05FMD003 -- PIPING & EQUIPMENT IDENTIFICATION
05FMD004 -- GENERAL NOTES
05FMD005 -- VALVE LIST - SHEET 1
05FMD006 -- VALVE LIST - SHEET 2

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THE ORIGINAL DRAWING AND SUBSEQUENT REVISIONS THEREOF, WITH APPROVAL NAMES, INITIALS, AND THE PE SEAL, IF APPLICABLE, ARE MAINTAINED IN THE FILES OF FWENC.

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		DATE
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CHECKED BY	S W HUNGATE	01/07/00
APPROVED BY	KENNETH RICKETT	01/07/00
APPROVED BY	JOHN LAWSON	01/07/00

DEPARTMENT OF ENERGY
FERNALD ENVIRONMENTAL MANAGEMENT PROJECT
SILOS 1 AND 2 ACCELERATED WASTE RETRIEVAL PROJECT
FERNALD, OHIO
FDF CONTRACT NO. FSC 624

FOSTER WHEELER
FOSTER WHEELER ENVIRONMENTAL CORPORATION

TITLE
FULL-SCALE MOCKUP SYSTEM
PROCESS FLOW DIAGRAM
SILO 4 – CATS MODE

SIZE D | SCALE: NONE | DWG. NO. 10FMD011 | REV 2

FILENAME: 10FMD011.DWG

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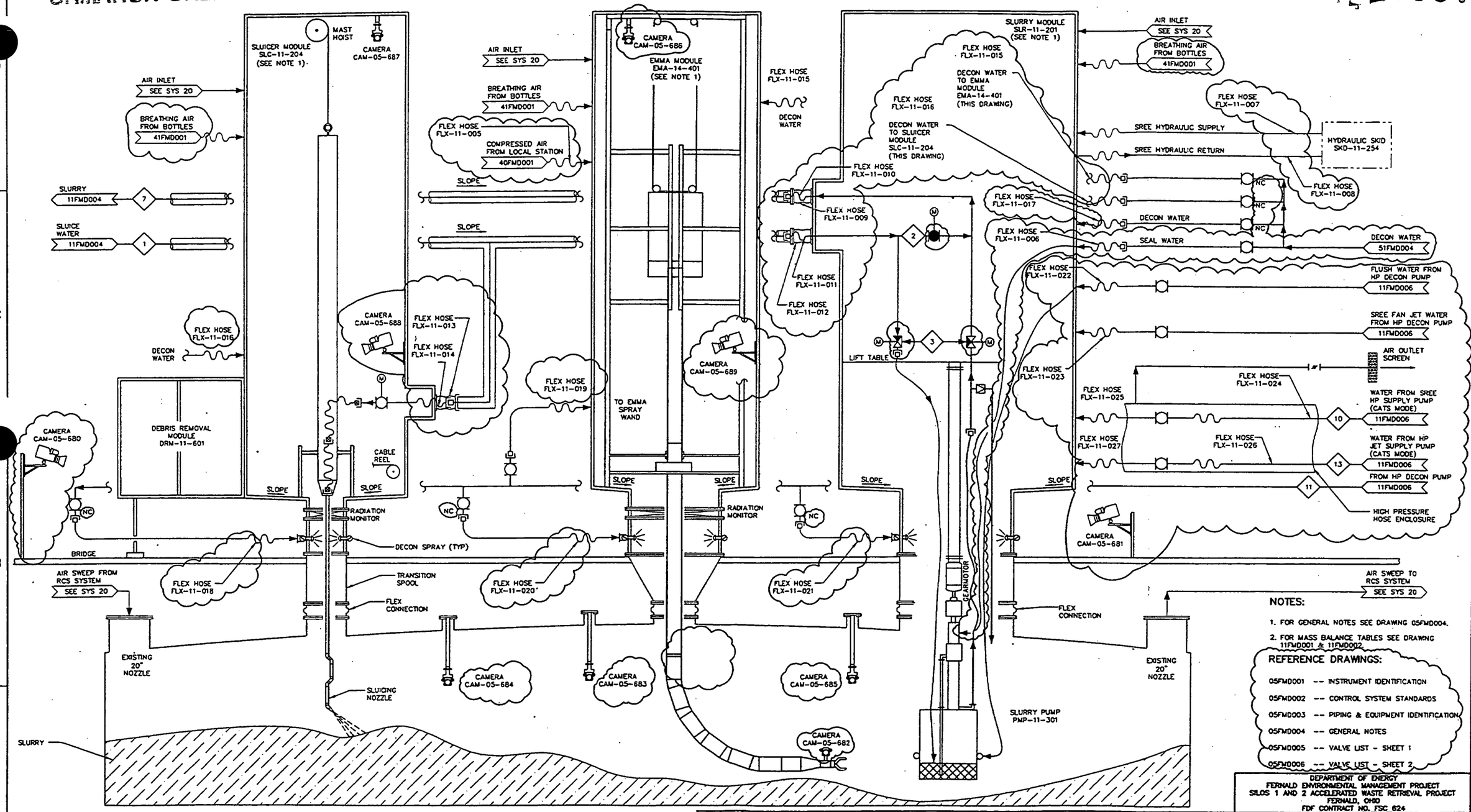


SILO 2 – SWRS MODE

NOTES:

1. FOR GENERAL NOTES SEE DRAWING 05FMD004.
2. FOR MASS BALANCE TABLES SEE DRAWING 11FMD001 & 11FMD002.

REFERENCE DRAWINGS:

05FMD001 -- INSTRUMENT IDENTIFICATION
05FMD002 -- CONTROL SYSTEM STANDARDS
05FMD003 -- PIPING & EQUIPMENT IDENTIFICATION
05FMD004 -- GENERAL NOTES
05FMD005 -- VALVE LIST - SHEET 1
05FMD006 -- VALVE LIST - SHEET 2

REV	DATE	BY	CHK'D	APR'VD	DESCRIPTION/ISSUE
2					REVISED PER CHANGE PROPOSAL CP-00-001
1	01/07/00	BJD	SWH	KDR	CERTIFIED FOR CONSTRUCTION
0	11/01/99	BJD	SWH		PRELIMINARY DESIGN SUBMITTAL

THE ORIGINAL DRAWING AND SUBSEQUENT REVISIONS THEREOF, WITH APPROVAL NAMES, INITIALS, AND THE PE SEAL, IF APPLICABLE, ARE MAINTAINED IN THE FILES OF FWENC.

DRAWN BY B J DAVIS	DATE 01/07/00	
DESIGNED BY B J DAVIS	DATE 01/07/00	
CHECKED BY S W HUNGATE	DATE 01/07/00	
APPROVED BY KENNETH RICKETT	DATE 01/07/00	
APPROVED BY JOHN LAWSON	DATE 01/07/00	

DEPARTMENT OF ENERGY
FERNALD ENVIRONMENTAL MANAGEMENT PROJECT
SILOS 1 AND 2 ACCELERATED WASTE RETRIEVAL PROJECT
FERNALD, OHIO
FDF CONTRACT NO. FSC 624

FOSTER WHEELER
FOSTER WHEELER ENVIRONMENTAL CORPORATION

TITLE
SILO WASTE RETRIEVAL SYSTEM
PROCESS FLOW DIAGRAM
SILO 2 – SWRS MODE

SIZE D | SCALE: NONE | DWG. NO. 11FMD003 | REV 2

000332

000346

FILENAME: 11FMD003.DWG

INFORMATION ONLY

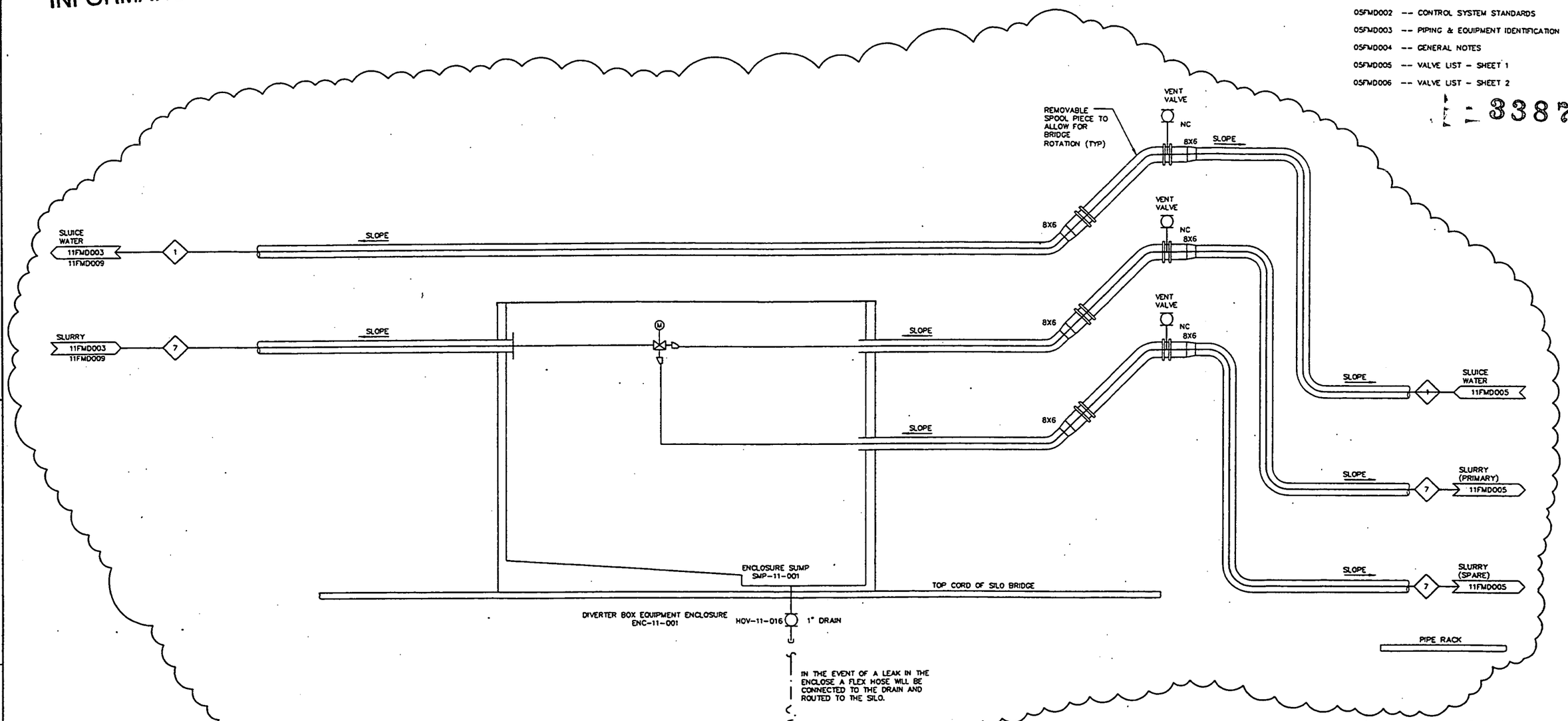
NOTES:

1. FOR GENERAL NOTES SEE DRAWING 05FMD004.
2. FOR MASS BALANCE TABLES SEE DRAWING 11FMD001 & 11FMD002.

REFERENCE DRAWINGS:

05FMD001 -- INSTRUMENT IDENTIFICATION
05FMD002 -- CONTROL SYSTEM STANDARDS
05FMD003 -- PIPING & EQUIPMENT IDENTIFICATION
05FMD004 -- GENERAL NOTES
05FMD005 -- VALVE LIST - SHEET 1
05FMD006 -- VALVE LIST - SHEET 2

- 3387



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THE ORIGINAL DRAWING AND SUBSEQUENT REVISIONS THEREOF, WITH APPROVAL NAMES, INITIALS, AND THE PE SEAL, IF APPLICABLE, ARE MAINTAINED IN THE FILES OF FWENC.

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PE#

		DATE
DRAWN BY	B J DAVIS	01/07/00
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CHECKED BY	S W HUNGATE	01/07/00
APPROVED BY	KENNETH RICKETT	01/07/00
APPROVED BY	JOHN LAWSON	01/07/00

DEPARTMENT OF ENERGY
FERNALD ENVIRONMENTAL MANAGEMENT PROJECT
SILOS 1 AND 2 ACCELERATED WASTE RETRIEVAL PROJECT
FERNALD, OHIO
FDF CONTRACT NO. FSC 624

FOSTER WHEELER
FOSTER WHEELER ENVIRONMENTAL CORPORATION

TITLE
SILO WASTE RETRIEVAL SYSTEM
PROCESS FLOW DIAGRAM
DIVERTER BOX ENC-11-001

SIZE	SCALE	DWG. NO.	REV
D	NONE	11FMD004	2

FILENAME: 11FMD004.DWG

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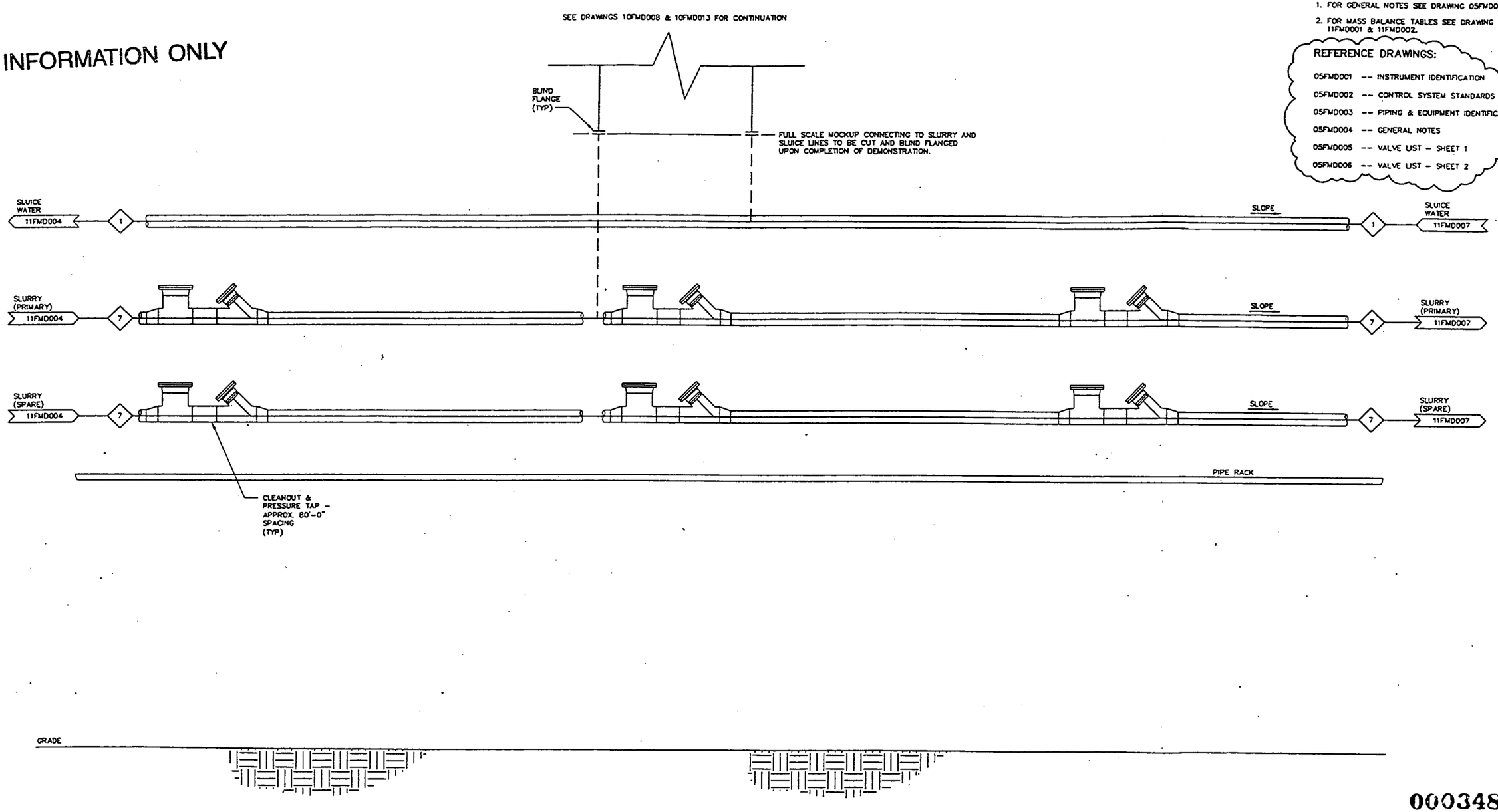
INFORMATION ONLY

NOTES: 3387

1. FOR GENERAL NOTES SEE DRAWING 05FMD004.
2. FOR MASS BALANCE TABLES SEE DRAWING 11FMD001 & 11FMD002.

REFERENCE DRAWINGS:

05FMD001 -- INSTRUMENT IDENTIFICATION
05FMD002 -- CONTROL SYSTEM STANDARDS
05FMD003 -- PIPING & EQUIPMENT IDENTIFICATION
05FMD004 -- GENERAL NOTES
05FMD005 -- VALVE LIST - SHEET 1
05FMD006 -- VALVE LIST - SHEET 2



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THE ORIGINAL DRAWING AND SUBSEQUENT REVISIONS THEREOF, WITH APPROVAL NAMES, INITIALS, AND THE PE SEAL, IF APPLICABLE, ARE MAINTAINED IN THE FILES OF FWENC.

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DEPARTMENT OF ENERGY
FERNALD ENVIRONMENTAL MANAGEMENT PROJECT
SILOS 1 AND 2 ACCELERATED WASTE RETRIEVAL PROJECT
FERNALD, OHIO
FDF CONTRACT NO. FSC 624

FOSTER WHEELER
FOSTER WHEELER ENVIRONMENTAL CORPORATION

TITLE
SILO WASTE RETRIEVAL SYSTEM
PROCESS FLOW DIAGRAM
SLURRY LINE CLEANOUTS

SIZE	SCALE:	DWG. NO.	REV
D	NONE	11FMD005	2

FILENAME: 11FMD005.DWG

INFORMATION ONLY

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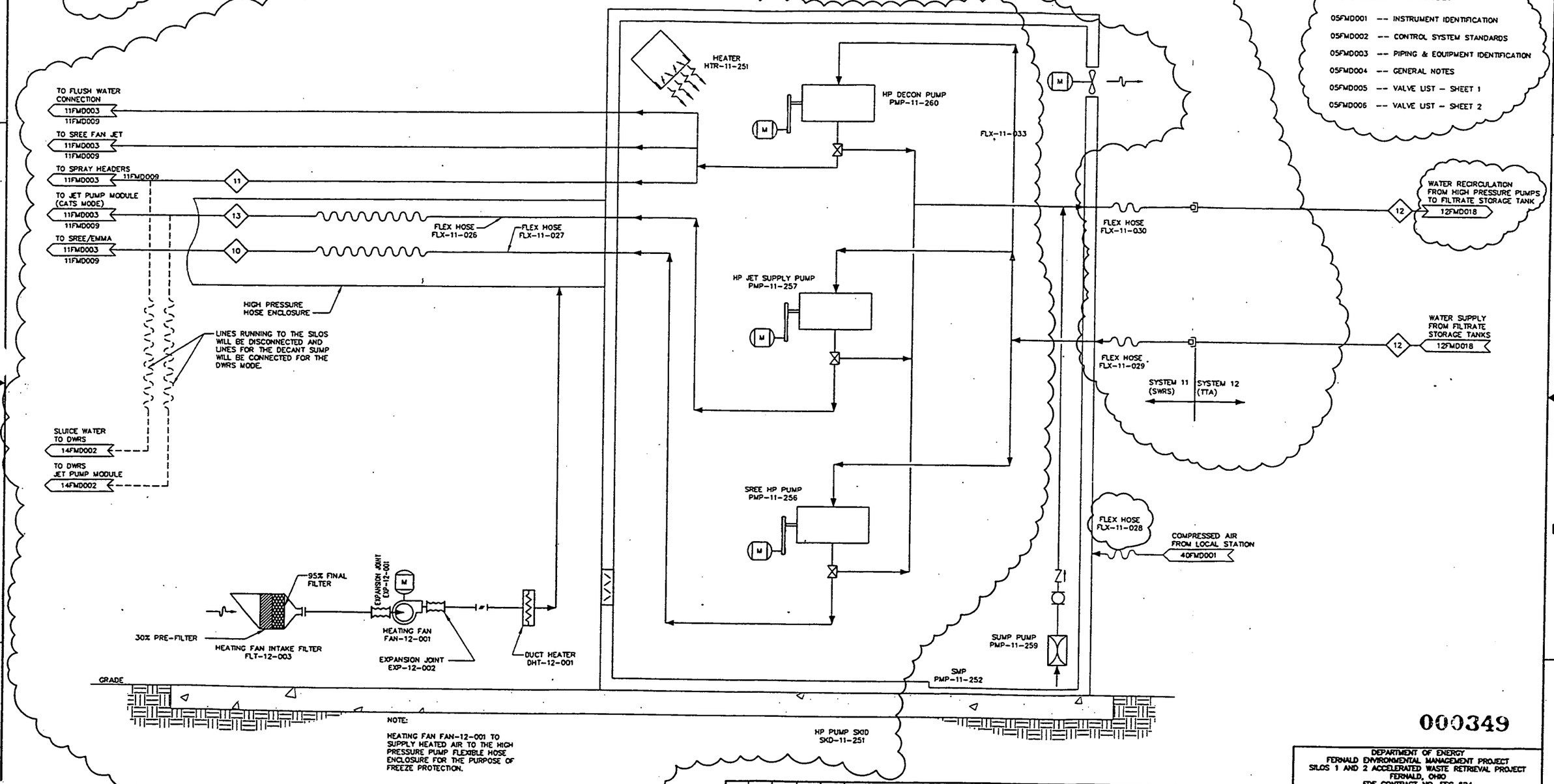
NOTES:

1. FOR GENERAL NOTES SEE DRAWING 05FMD004.
2. FOR MASS BALANCE TABLES SEE DRAWING 11FMD001 & 11FMD002.

REFERENCE DRAWINGS:

05FMD001 -- INSTRUMENT IDENTIFICATION
05FMD002 -- CONTROL SYSTEM STANDARDS
05FMD003 -- PIPING & EQUIPMENT IDENTIFICATION
05FMD004 -- GENERAL NOTES
05FMD005 -- VALVE LIST - SHEET 1
05FMD006 -- VALVE LIST - SHEET 2



NOTE:

HEATING FAN FAN-12-001 TO SUPPLY HEATED AIR TO THE HIGH PRESSURE PUMP FLEXIBLE HOSE ENCLOSURE FOR THE PURPOSE OF FREEZE PROTECTION.

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THE ORIGINAL DRAWING AND SUBSEQUENT REVISIONS THEREOF, WITH APPROVAL NAMES, INITIALS, AND THE PE SEAL, IF APPLICABLE, ARE MAINTAINED IN THE FILES OF FWENC.

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RPE

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APPROVED BY	JOHN LAWSON	01/07/00

DEPARTMENT OF ENERGY
FERNALD ENVIRONMENTAL MANAGEMENT PROJECT
SILOS 1 AND 2 ACCELERATED WASTE RETRIEVAL PROJECT
FERNALD, OHIO
FDF CONTRACT NO. FSC 624

FOSTER WHEELER
FOSTER WHEELER ENVIRONMENTAL CORPORATION

TITLE
SILO WASTE RETRIEVAL SYSTEM
PROCESS FLOW DIAGRAM
HP PUMP SKID SKD-11-251

SIZE D | SCALE: NONE | DWG. NO. 11FMD006 | REV 2

FILENAME: 11FMD006.DWG

INFORMATION ONLY

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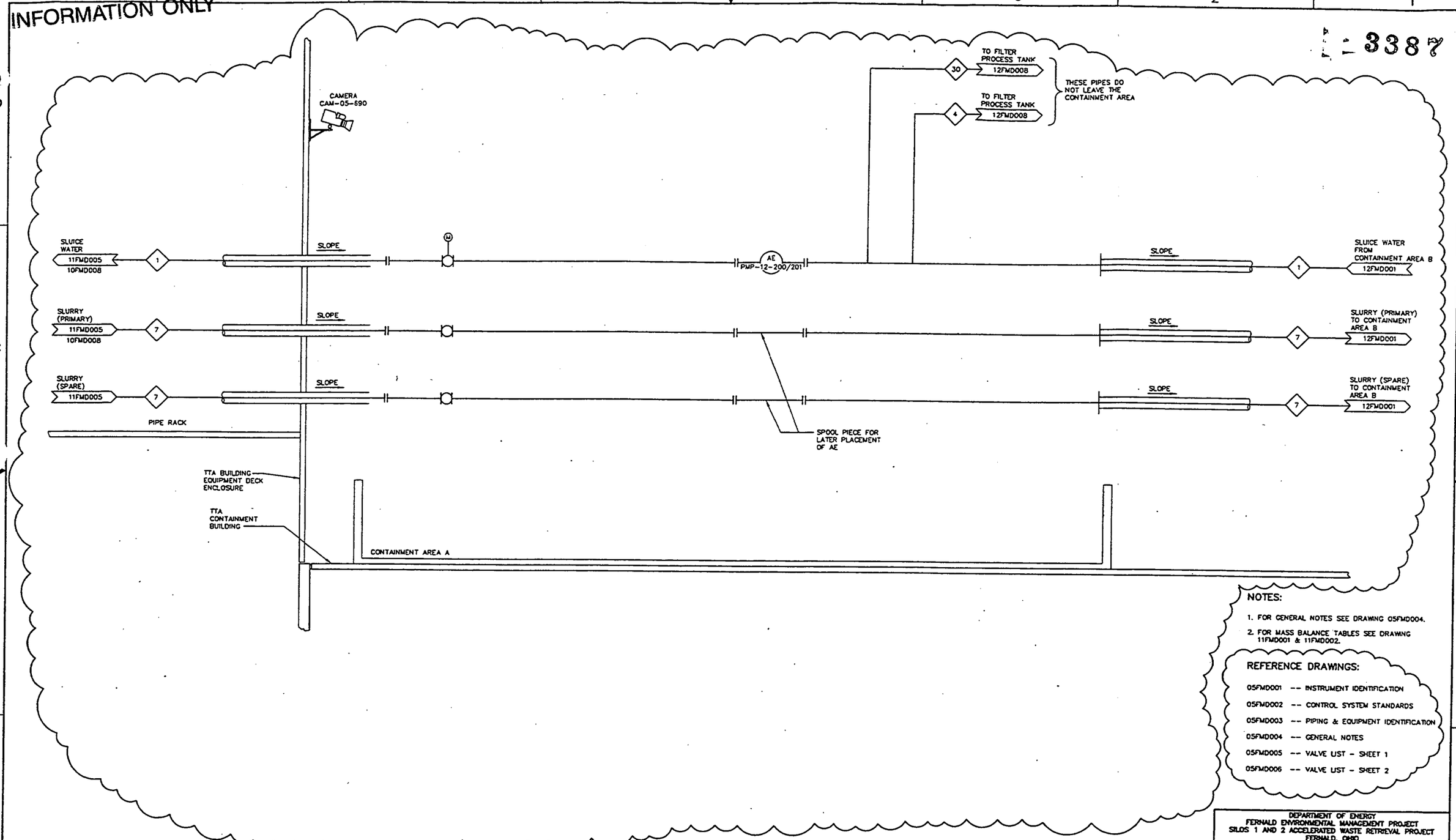

NOTES:

1. FOR GENERAL NOTES SEE DRAWING 05FMD004.
2. FOR MASS BALANCE TABLES SEE DRAWING 11FMD001 & 11FMD002.

REFERENCE DRAWINGS:

05FMD001 -- INSTRUMENT IDENTIFICATION
05FMD002 -- CONTROL SYSTEM STANDARDS
05FMD003 -- PIPING & EQUIPMENT IDENTIFICATION
05FMD004 -- GENERAL NOTES
05FMD005 -- VALVE LIST - SHEET 1
05FMD006 -- VALVE LIST - SHEET 2

THE ORIGINAL DRAWING AND SUBSEQUENT REVISIONS THEREOF, WITH APPROVAL NAMES, INITIALS, AND THE PE SEAL, IF APPLICABLE, ARE MAINTAINED IN THE FILES OF FWENC.

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DEPARTMENT OF ENERGY
FERNALD ENVIRONMENTAL MANAGEMENT PROJECT
SILOS 1 AND 2 ACCELERATED WASTE RETRIEVAL PROJECT
FERNALD, OHIO
FDF CONTRACT NO. FSC 624

FOSTER WHEELER
FOSTER WHEELER ENVIRONMENTAL CORPORATION

TITLE
SILO WASTE RETRIEVAL SYSTEM
PROCESS FLOW DIAGRAM
(PROCESS ANALYZER)

SIZE D | SCALE: NONE | DWG. NO. 11FMD007 | REV 2

FILENAME: 11FMD007.DWG

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INFORMATION ONLY

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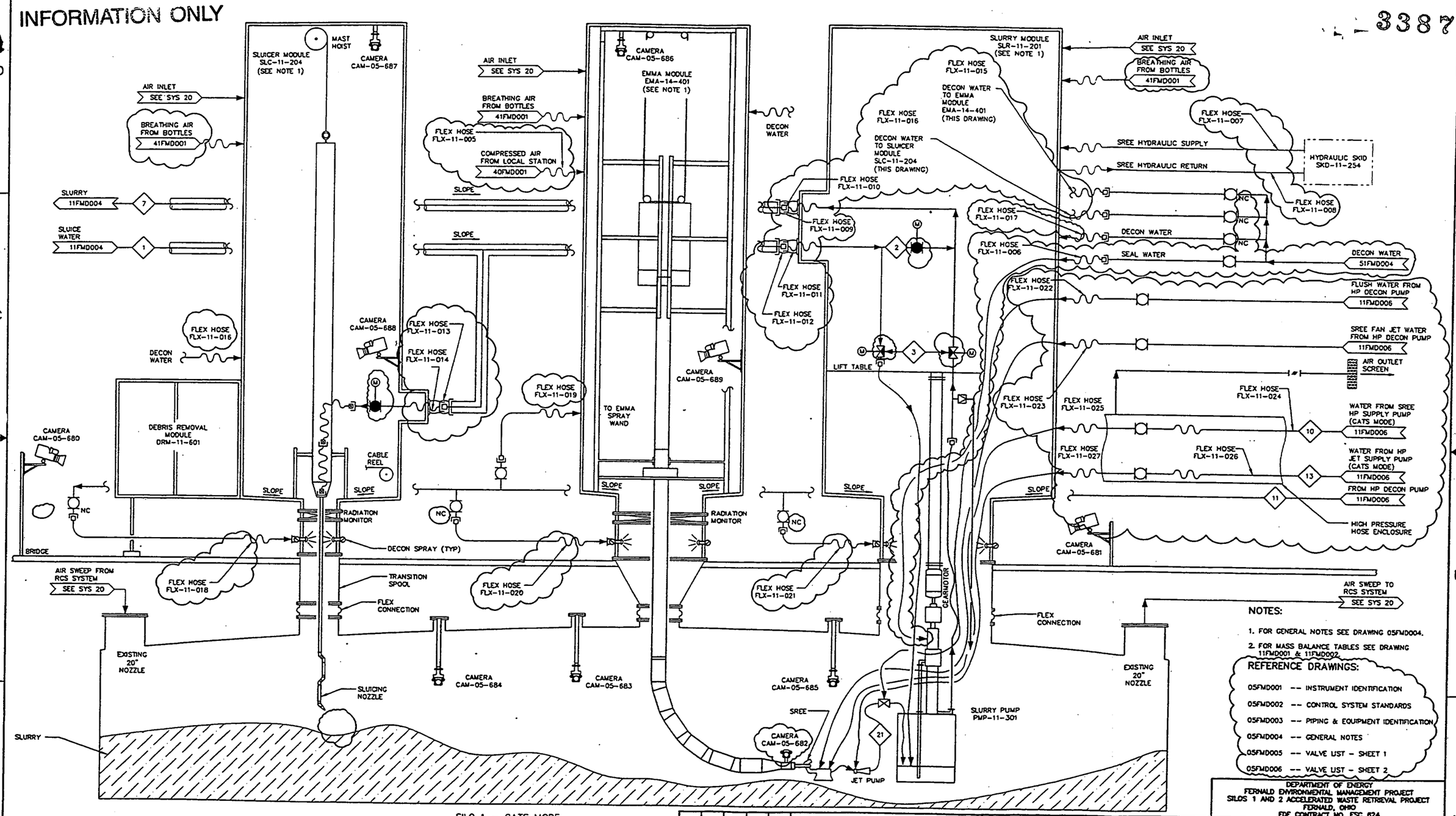

SILO 1 – CATS MODE

NOTES:

1. FOR GENERAL NOTES SEE DRAWING 05FMD004.
2. FOR MASS BALANCE TABLES SEE DRAWING 11FMD001 & 11FMD002.

REFERENCE DRAWINGS:

05FMD001 -- INSTRUMENT IDENTIFICATION
05FMD002 -- CONTROL SYSTEM STANDARDS
05FMD003 -- PIPING & EQUIPMENT IDENTIFICATION
05FMD004 -- GENERAL NOTES
05FMD005 -- VALVE LIST – SHEET 1
05FMD006 -- VALVE LIST – SHEET 2

REV	DATE	BY	CHK'D	APR'VD	DESCRIPTION/ISSUE
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THE ORIGINAL DRAWING AND SUBSEQUENT REVISIONS THEREOF, WITH APPROVAL NAMES, INITIALS, AND THE PE SEAL, IF APPLICABLE, ARE MAINTAINED IN THE FILES OF FWENC.

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DESIGNED BY B J DAVIS	DATE 01/07/00	
CHECKED BY S W HUNGATE	DATE 01/07/00	
APPROVED BY KENNETH RICKETT	DATE 01/07/00	
APPROVED BY JOHN LAWSON	DATE 01/07/00	

DEPARTMENT OF ENERGY
FERNALD ENVIRONMENTAL MANAGEMENT PROJECT
SILOS 1 AND 2 ACCELERATED WASTE RETRIEVAL PROJECT
FERNALD, OHIO
FDF CONTRACT NO. FSC 624

FOSTER WHEELER
FOSTER WHEELER ENVIRONMENTAL CORPORATION

TITLE
SILO WASTE RETRIEVAL SYSTEM
PROCESS FLOW DIAGRAM
SILO 1 – CATS MODE

SIZE D | SCALE: NONE | DWG. NO. 11FMD009 | REV 2

000351

FILENAME: 11FMD009.DWG

000337

NOTES:

1. FOR GENERAL NOTES SEE DRAWING 05FMD004.
2. FOR MASS BALANCE TABLES SEE DRAWING 11FMD001 & 11FMD002.

REFERENCE DRAWINGS:

05FMD001 -- INSTRUMENT IDENTIFICATION
05FMD002 -- CONTROL SYSTEM STANDARDS
05FMD003 -- PIPING & EQUIPMENT IDENTIFICATION
05FMD004 -- GENERAL NOTES
05FMD005 -- VALVE LIST - SHEET 1
05FMD006 -- VALVE LIST - SHEET 2

SYSTEM 11 (SWRS) | SYSTEM 12 (TTA)

SLUICE WATER TO CONTAINMENT AREA A — 11FMD007 / 13FMD003 — 1
SLURRY (PRIMARY) FROM CONTAINMENT AREA A — 11FMD007 / 13FMD003 — 7
SLURRY (SPARE) FROM CONTAINMENT AREA A — 11FMD007 / 13FMD003 — 7

FILTER CONCENTRATE FROM FILTRATION SYSTEM — 12FMD007 — 8

SLURRY FROM/TO TANK TNK-12-001B — 12FMD003 — 7

SLURRY FROM/TO TANK TNK-12-001A — 12FMD002 — 7

SLURRY FROM/TO TANK TNK-12-002A — 12FMD004 / 13FMD002 — 7

SLURRY FROM/TO TANK TNK-12-002B — 12FMD005 — 7

MAKE-UP WATER — 51FMD004 — 18

FILTRATE — 12FMD018

SLUICE WATER FROM/TO TANK TNK-12-001A — 12FMD002 — 37

SLUICE WATER FROM/TO TANK TNK-12-002A — 12FMD004 / 13FMD002 — 37

SLUICE WATER FROM/TO TANK TNK-12-001B — 12FMD003 — 37

SLUICE WATER FROM/TO TANK TNK-12-002B — 12FMD005 — 37

FROM BUILDING SUMP — 12FMD006 — 27

SUMP PUMP PMP-12-004

TTA EQUIPMENT DECK

CONTAINMENT AREA B

CONTAINMENT AREA B SUMP SMP-12-004

SLOPE

INFORMATION ONLY

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THE ORIGINAL DRAWING AND SUBSEQUENT REVISIONS THEREOF, WITH APPROVAL NAMES, INITIALS, AND THE PE SEAL, IF APPLICABLE, ARE MAINTAINED IN THE FILES OF FWENC.

REV	DATE	BY	CHK'D	APR'VD	DESCRIPTION/ISSUE
2					REVISED PER CHANGE PROPOSAL CP-00-001
1	12/07/00	BJD	SWH	KDR	CERTIFIED FOR CONSTRUCTION
0	11/03/99	BJD	SWH		PRELIMINARY DESIGN SUBMITTAL

PE

		DATE
DRAWN BY	B J DAVIS	01/07/00
DESIGNED BY	B J DAVIS	01/07/00
CHECKED BY	S W HUNGATE	01/07/00
APPROVED BY	KENNETH RICKETT	01/07/00
APPROVED BY	JOHN LAWSON	01/07/00

DEPARTMENT OF ENERGY
FERNALD ENVIRONMENTAL MANAGEMENT PROJECT
SILOS 1 AND 2 ACCELERATED WASTE RETRIEVAL PROJECT
FERNALD, OHIO
FDF CONTRACT NO. FSC 624

FOSTER WHEELER
FOSTER WHEELER ENVIRONMENTAL CORPORATION

TITLE
TRANSFER TANK SYSTEM
PROCESS FLOW DIAGRAM
CONTAINMENT AREA B

SIZE D | SCALE: NONE | DWG. NO. 12FMD001 | REV 2

FILENAME: 12FMD001.DWG

INFORMATION ONLY

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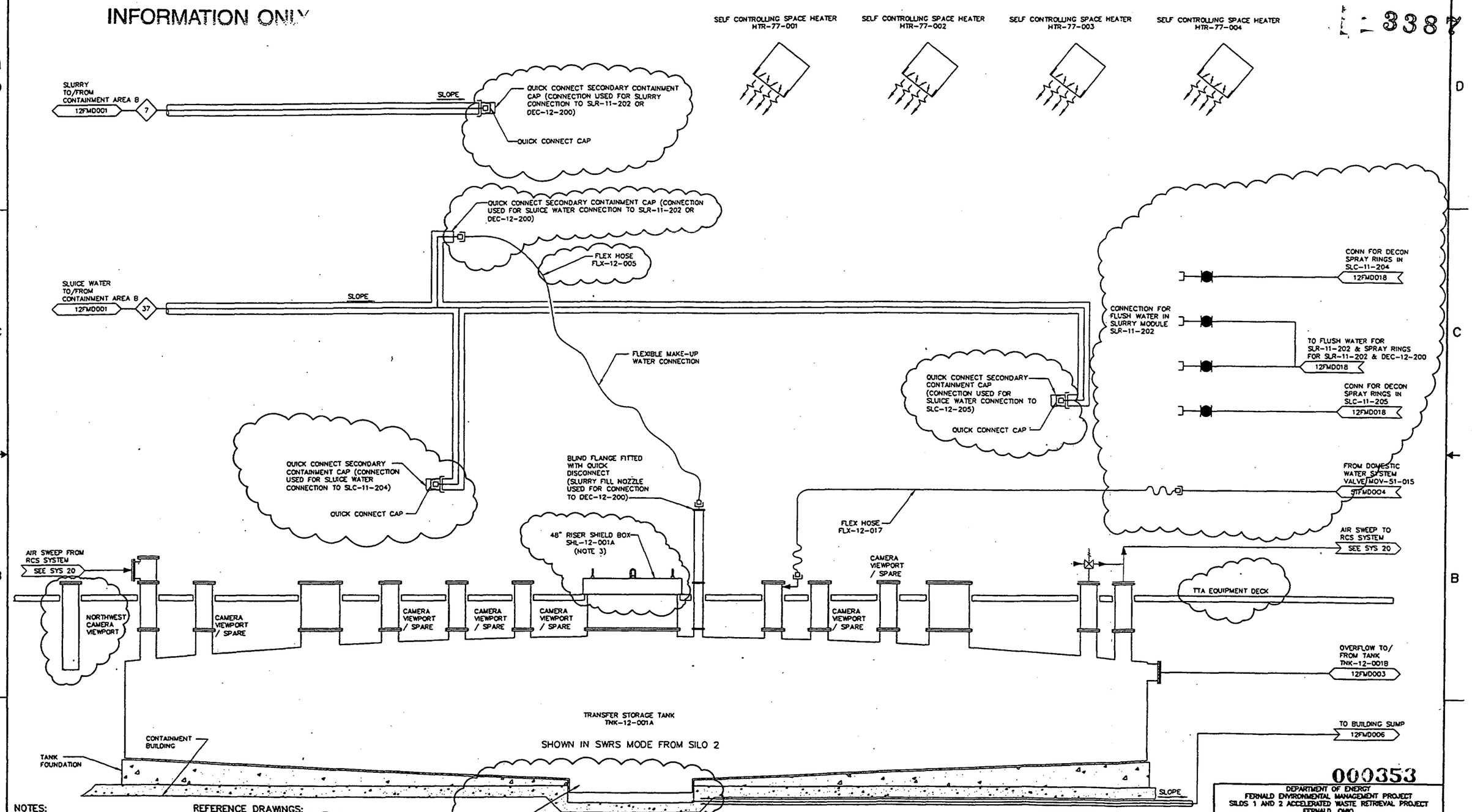

000353

NOTES:

1. FOR GENERAL NOTES SEE DRAWING 05FMD004.
2. FOR MASS BALANCE TABLES SEE DRAWING 11FMD001 & 11FMD002.
3. SHIELD BOX TO BE PLACED OVER E2-48" RISER WHEN NOT IN USE.

REFERENCE DRAWINGS:

05FMD001 -- INSTRUMENT IDENTIFICATION
05FMD002 -- CONTROL SYSTEM STANDARDS
05FMD003 -- PIPING & EQUIPMENT IDENTIFICATION
05FMD004 -- GENERAL NOTES
05FMD005 -- VALVE LIST - SHEET 1
05FMD006 -- VALVE LIST - SHEET 2

000329

THE ORIGINAL DRAWING AND SUBSEQUENT REVISIONS THEREOF, WITH APPROVAL NAMES, INITIALS, AND THE PE SEAL, IF APPLICABLE, ARE MAINTAINED IN THE FILES OF FWENC.

REV	DATE	BY	CHK'D	APR'VD	DESCRIPTION/ISSUE
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APPROVED BY	JOHN LAWSON	DATE 01/07/00

DEPARTMENT OF ENERGY
FERNALD ENVIRONMENTAL MANAGEMENT PROJECT
SILOS 1 AND 2 ACCELERATED WASTE RETRIEVAL PROJECT
FERNALD, OHIO
FDF CONTRACT NO. FSC 624

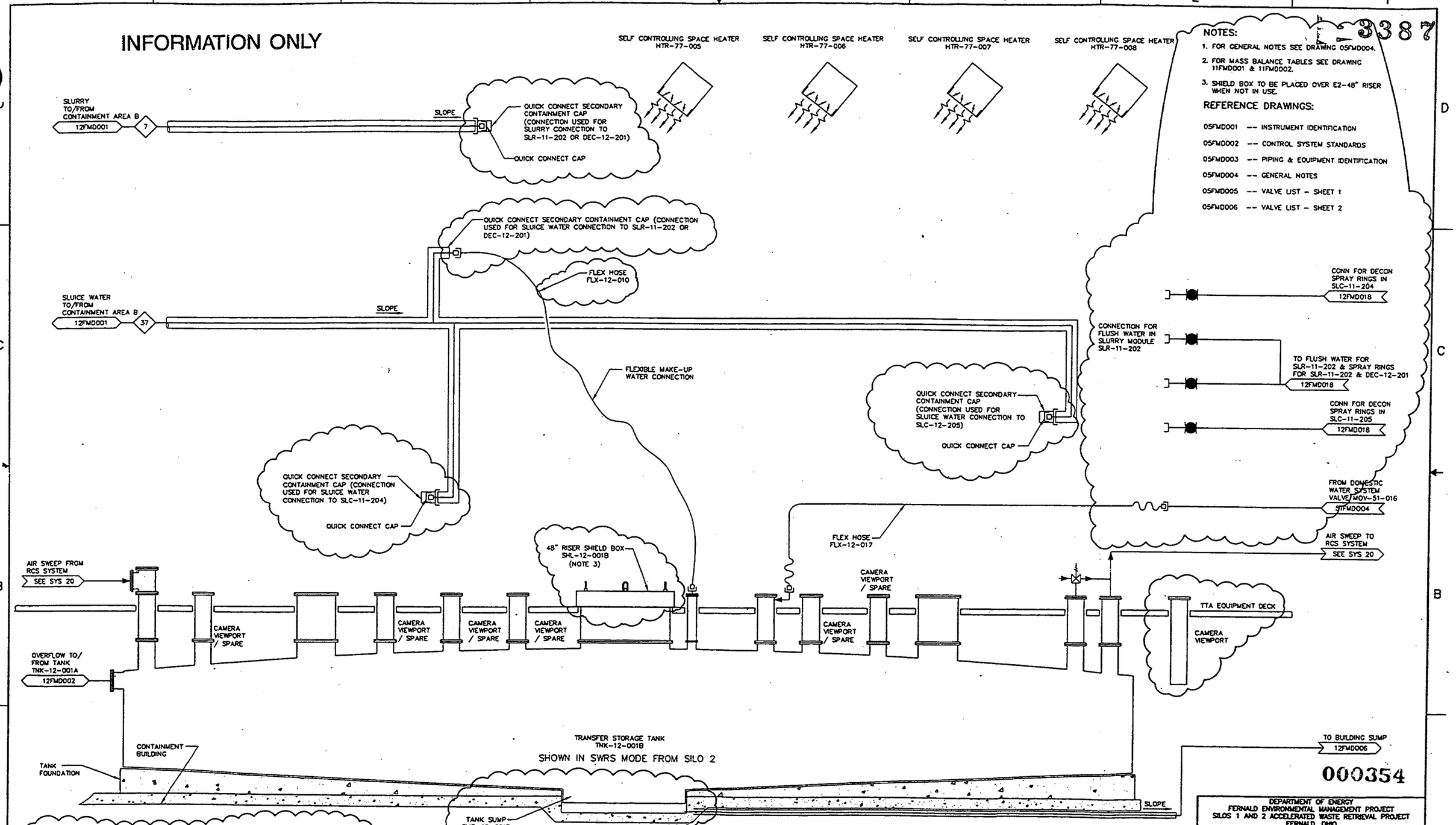
POSTER WHEELER
FOSTER WHEELER ENVIRONMENTAL CORPORATION

TITLE
TRANSFER TANK SYSTEM
PROCESS FLOW DIAGRAM
STORAGE TANK TNK-12-001A

SIZE	SCALE	DWG. NO.	REV
D	NONE	12FMD002	2

FILENAME: 12FMD002.DWG

INFORMATION ONLY



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THE ORIGINAL DRAWING AND SUBSEQUENT REVISIONS THEREOF, WITH APPROVAL NAMES, INITIALS, AND THE PE SEAL, IF APPLICABLE, ARE MAINTAINED IN THE FILES OF FWENC.

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DEPARTMENT OF ENERGY
FERNALD ENVIRONMENTAL MANAGEMENT PROJECT
SILOS 1 AND 2 ACCELERATED WASTE RETRIEVAL PROJECT
FERNALD, OHIO
FDF CONTRACT NO. FSC 624

FOSTER WHEELER
FOSTER WHEELER ENVIRONMENTAL CORPORATION

TITLE
TRANSFER TANK SYSTEM
PROCESS FLOW DIAGRAM
STORAGE TANK TNK-12-001B

SIZE D | SCALE NONE | DWG. NO. 12FMD003 | REV 2

FILENAME: 12FMD003.DWG

INFORMATION ONLY

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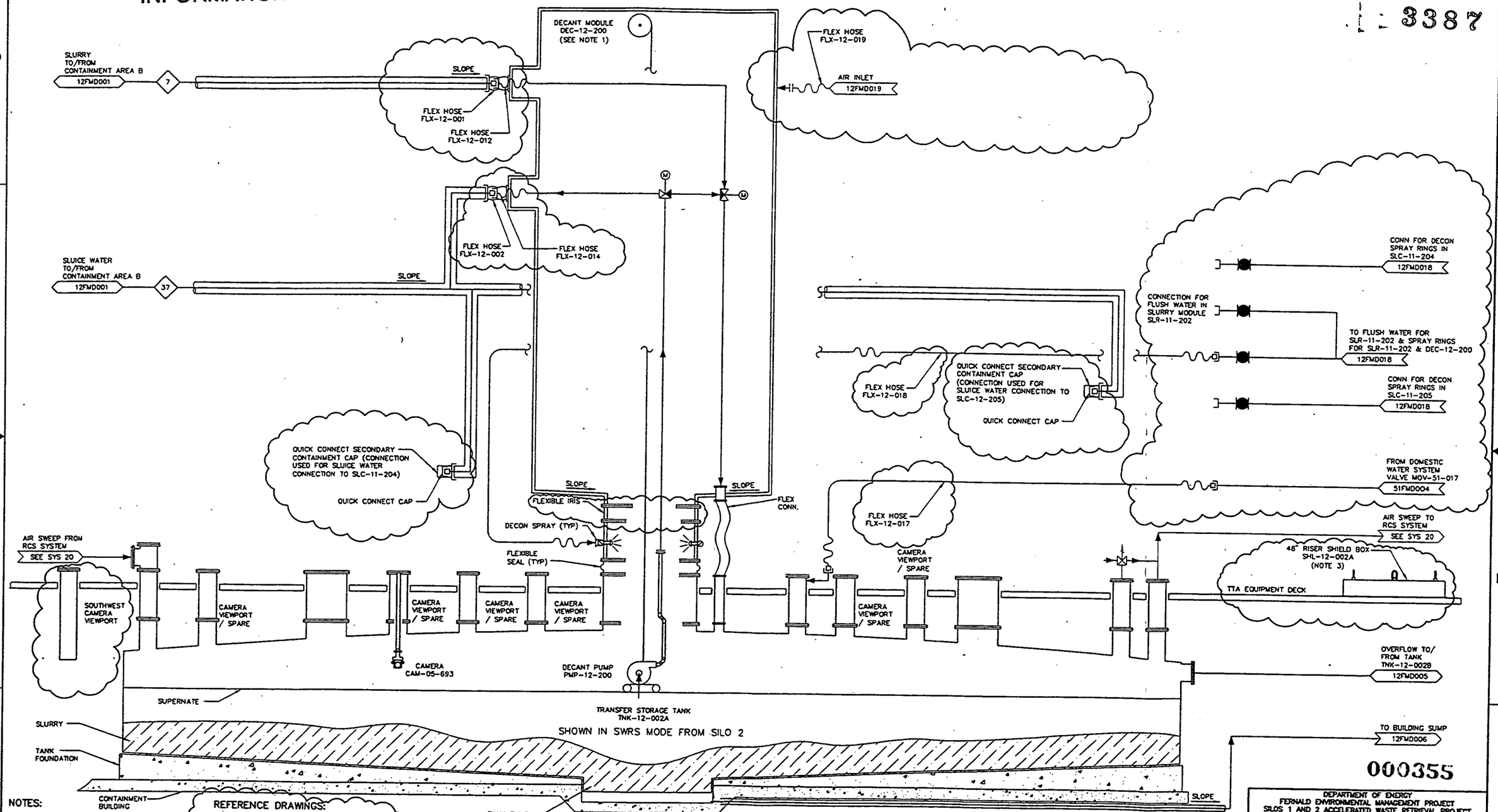

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NOTES:

1. FOR GENERAL NOTES SEE DRAWING 05FMD004.
2. FOR MASS BALANCE TABLES SEE DRAWING 11FMD001 & 11FMD002.
3. SHIELD BOX TO BE PLACED OVER E2-48" RISER WHEN NOT IN USE.

REFERENCE DRAWINGS:

05FMD001 -- INSTRUMENT IDENTIFICATION
05FMD002 -- CONTROL SYSTEM STANDARDS
05FMD003 -- PIPING & EQUIPMENT IDENTIFICATION
05FMD004 -- GENERAL NOTES
05FMD005 -- VALVE LIST - SHEET 1
05FMD006 -- VALVE LIST - SHEET 2

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THE ORIGINAL DRAWING AND SUBSEQUENT REVISIONS THEREOF, WITH APPROVAL NAMES, INITIALS, AND THE PE SEAL, IF APPLICABLE, ARE MAINTAINED IN THE FILES OF FWENC.

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DEPARTMENT OF ENERGY
FERNALD ENVIRONMENTAL MANAGEMENT PROJECT
SILOS 1 AND 2 ACCELERATED WASTE RETRIEVAL PROJECT
FERNALD, OHIO
FDF CONTRACT NO. FSC 624

FOSTER WHEELER
FOSTER WHEELER ENVIRONMENTAL CORPORATION

TITLE
TRANSFER TANK SYSTEM
PROCESS FLOW DIAGRAM
STORAGE TANK TNK-12-002A

SIZE D | SCALE: NONE | DWG. NO. 12FMD004 | REV 2

FILENAME: 12FMD004.DWG

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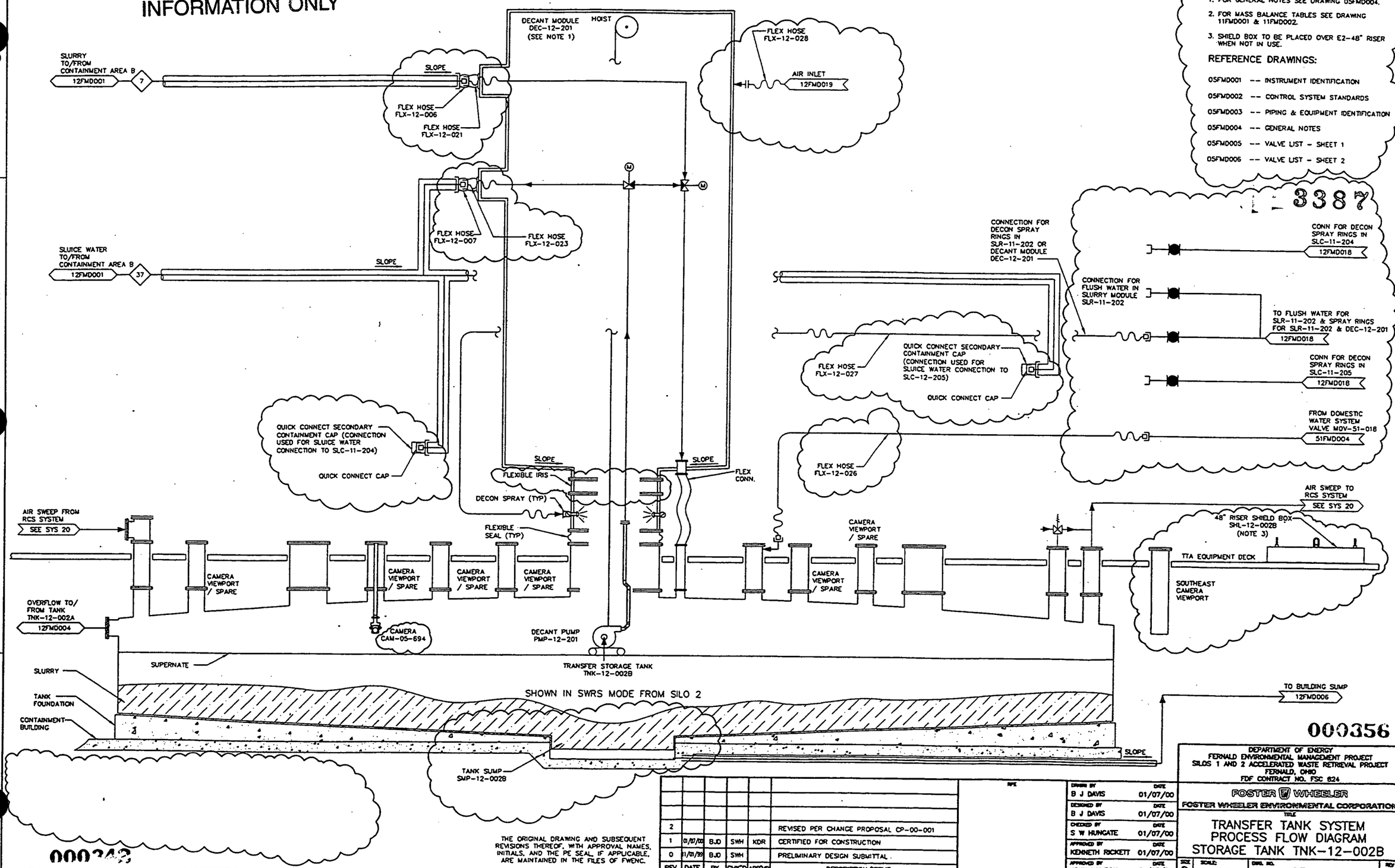
INFORMATION ONLY



NOTES:

1. FOR GENERAL NOTES SEE DRAWING 05FMD004.
2. FOR MASS BALANCE TABLES SEE DRAWING 11FMD001 & 11FMD002.
3. SHIELD BOX TO BE PLACED OVER E2-48" RISER WHEN NOT IN USE.

REFERENCE DRAWINGS:

05FMD001 -- INSTRUMENT IDENTIFICATION
05FMD002 -- CONTROL SYSTEM STANDARDS
05FMD003 -- PIPING & EQUIPMENT IDENTIFICATION
05FMD004 -- GENERAL NOTES
05FMD005 -- VALVE LIST - SHEET 1
05FMD006 -- VALVE LIST - SHEET 2

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THE ORIGINAL DRAWING AND SUBSEQUENT REVISIONS THEREOF, WITH APPROVAL NAMES, INITIALS, AND THE PE SEAL, IF APPLICABLE, ARE MAINTAINED IN THE FILES OF FWENC.

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APPROVED BY	KENNETH RICKETT	01/07/00
APPROVED BY	JOHN LAWSON	01/07/00

DEPARTMENT OF ENERGY
FERNALD ENVIRONMENTAL MANAGEMENT PROJECT
SILOS 1 AND 2 ACCELERATED WASTE RETRIEVAL PROJECT
FERNALD, OHIO
FDF CONTRACT NO. FSC 624

FOSTER WHEELER
FOSTER WHEELER ENVIRONMENTAL CORPORATION

TITLE
TRANSFER TANK SYSTEM
PROCESS FLOW DIAGRAM
STORAGE TANK TNK-12-002B

SIZE D | SCALE: NONE | DWG. NO. 12FMD005 | REV 2

FILENAME: 12FMD005.DWG

INFORMATION ONLY

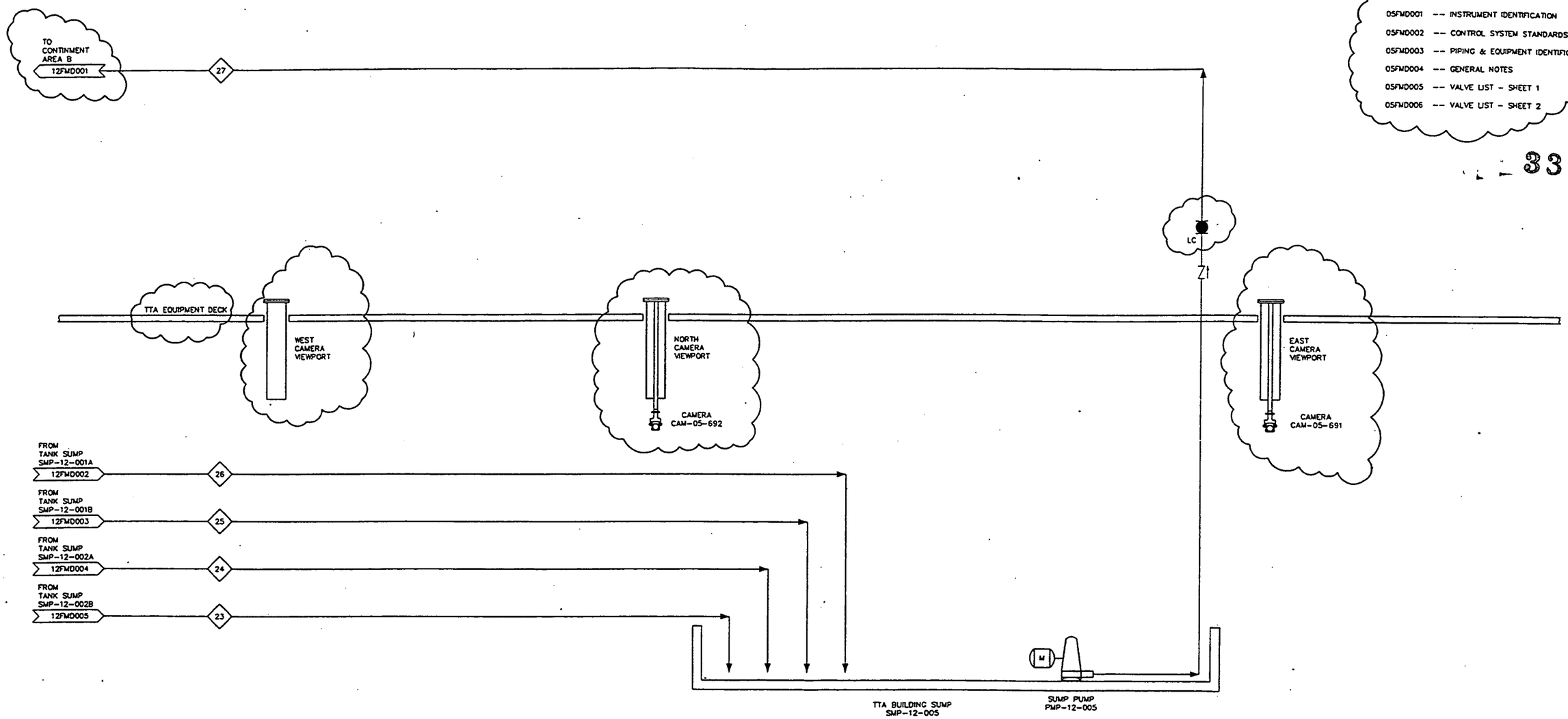
NOTES:

1. FOR GENERAL NOTES SEE DRAWING 05FMD004.
2. FOR MASS BALANCE TABLES SEE DRAWING 11FMD001 & 11FMD002.

REFERENCE DRAWINGS:

05FMD001 -- INSTRUMENT IDENTIFICATION
05FMD002 -- CONTROL SYSTEM STANDARDS
05FMD003 -- PIPING & EQUIPMENT IDENTIFICATION
05FMD004 -- GENERAL NOTES
05FMD005 -- VALVE LIST - SHEET 1
05FMD006 -- VALVE LIST - SHEET 2

338



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THE ORIGINAL DRAWING AND SUBSEQUENT REVISIONS THEREOF, WITH APPROVAL NAMES, INITIALS, AND THE PE SEAL, IF APPLICABLE, ARE MAINTAINED IN THE FILES OF FWENC.

REV	DATE	BY	CHK'D	APR'VD	DESCRIPTION/ISSUE
2					REVISED PER CHANGE PROPOSAL CP-00-001
1	01/07/00	BJD	SWH	KDR	CERTIFIED FOR CONSTRUCTION
0	01/01/99	BJD	SWH		PRELIMINARY DESIGN SUBMITTAL

PE

DRAWN BY B J DAVIS	DATE 01/07/00	
DESIGNED BY B J DAVIS	DATE 01/07/00	
CHECKED BY S W HUNGATE	DATE 01/07/00	
APPROVED BY KENNETH RICKETT	DATE 01/07/00	
APPROVED BY JOHN LAWSON	DATE 01/07/00	

DEPARTMENT OF ENERGY
FERNALD ENVIRONMENTAL MANAGEMENT PROJECT
SILOS 1 AND 2 ACCELERATED WASTE RETRIEVAL PROJECT
FERNALD, OHIO
FDF CONTRACT NO. FSC 624

FOSTER WHEELER
FOSTER WHEELER ENVIRONMENTAL CORPORATION

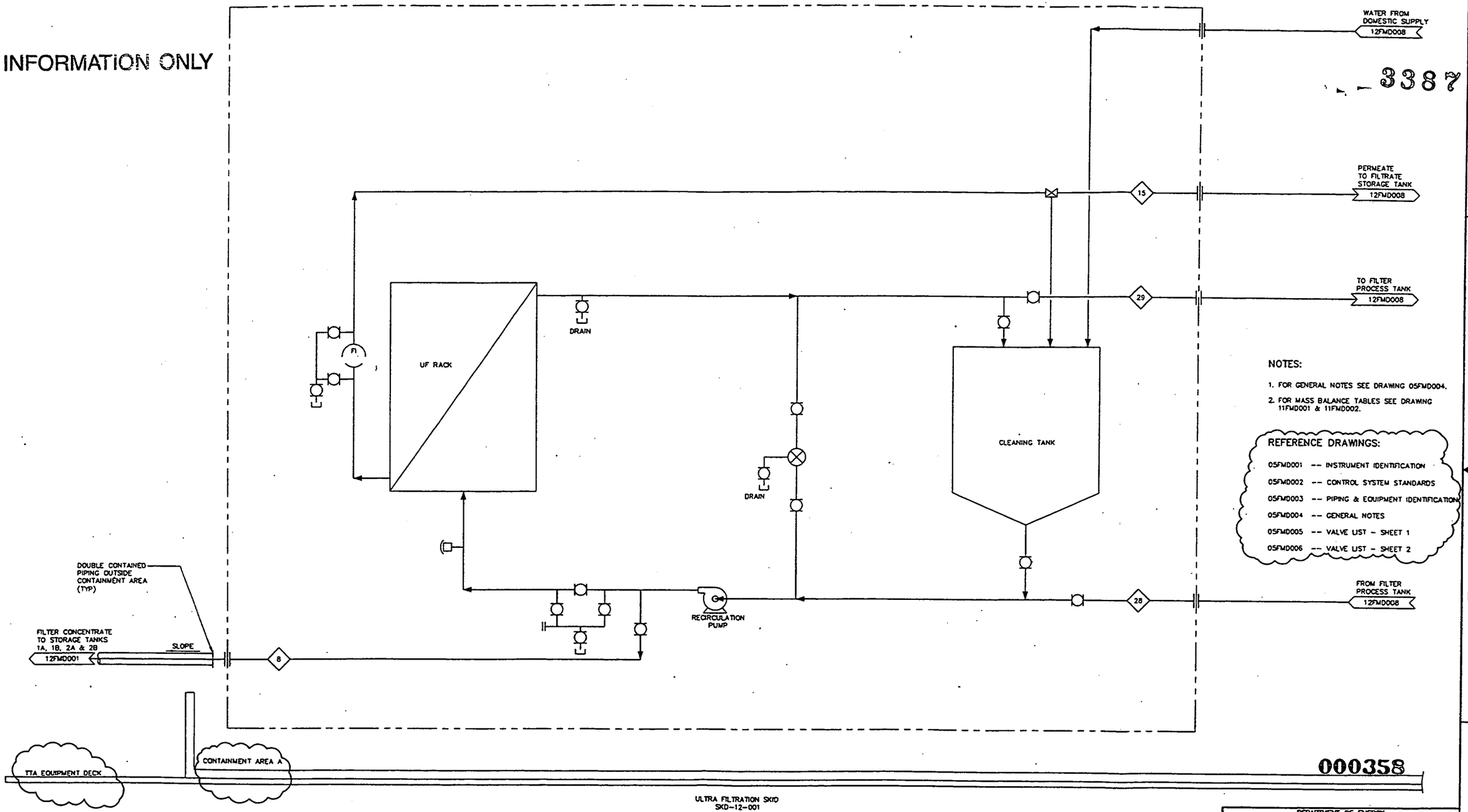
TITLE
TRANSFER TANK SYSTEM
PROCESS FLOW DIAGRAM
BUILDING SUMP SMP-12-005

SIZE	SCALE:	DWG. NO.	REV
D	NONE	12FMD006	2

FILENAME: 12FMD006.DWG

INFORMATION ONLY

3387



NOTES:

1. FOR GENERAL NOTES SEE DRAWING 05FMD004.
2. FOR MASS BALANCE TABLES SEE DRAWING 11FMD001 & 11FMD002.

REFERENCE DRAWINGS:

05FMD001 -- INSTRUMENT IDENTIFICATION
05FMD002 -- CONTROL SYSTEM STANDARDS
05FMD003 -- PIPING & EQUIPMENT IDENTIFICATION
05FMD004 -- GENERAL NOTES
05FMD005 -- VALVE LIST - SHEET 1
05FMD006 -- VALVE LIST - SHEET 2

000358

000344

THE ORIGINAL DRAWING AND SUBSEQUENT REVISIONS THEREOF, WITH APPROVAL NAMES, INITIALS, AND THE PE SEAL, IF APPLICABLE, ARE MAINTAINED IN THE FILES OF FWENC.

REV	DATE	BY	CHK'D	APR'VD	DESCRIPTION/ISSUE
2					REVISED PER CHANGE PROPOSAL CP-00-001
1	01/07/00	BJD	SWH	KDR	CERTIFIED FOR CONSTRUCTION
0	11/01/99	BJD	SWH		PRELIMINARY DESIGN SUBMITTAL

RPC

		DATE
DRAWN BY	B J DAVIS	01/07/00
DESIGNED BY	B J DAVIS	01/07/00
CHECKED BY	S W HUNGATE	01/07/00
APPROVED BY	KENNETH RICKETT	01/07/00
APPROVED BY	JOHN LAWSON	01/07/00

DEPARTMENT OF ENERGY
FERNALD ENVIRONMENTAL MANAGEMENT PROJECT
SILOS 1 AND 2 ACCELERATED WASTE RETRIEVAL PROJECT
FERNALD, OHIO
FDF CONTRACT NO. FSC 624

FOSTER WHEELER
FOSTER WHEELER ENVIRONMENTAL CORPORATION

TITLE
TRANSFER TANK SYSTEM
PROCESS FLOW DIAGRAM
ULTRA FILTRATION SKD-12-001

SIZE: D | SCALE: NONE | DWG. NO. 12FMD007 | REV 2

FILENAME: 12FMD007.DWG

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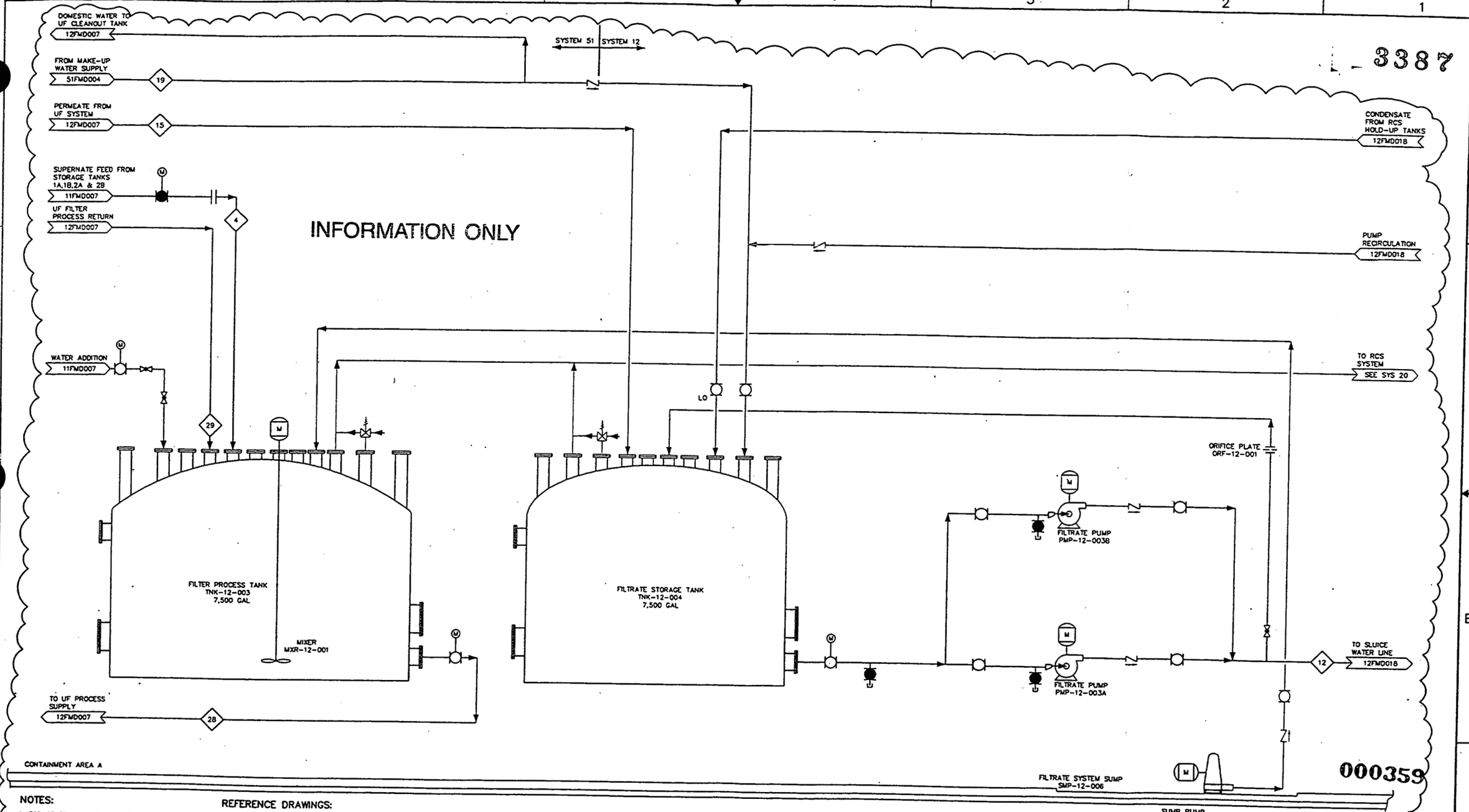

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000359

NOTES:

1. FOR GENERAL NOTES SEE DRAWING 05FMD004.
2. FOR MASS BALANCE TABLES SEE DRAWING 11FMD001 & 11FMD002.
3. SEE DRAWING 11PMD403 FOR DETAILS OF HIGH PRESSURE PUMP SKID SKD-11-252.

REFERENCE DRAWINGS:

05FMD001 -- INSTRUMENT IDENTIFICATION
05FMD002 -- CONTROL SYSTEM STANDARDS
05FMD003 -- PIPING & EQUIPMENT IDENTIFICATION
05FMD004 -- GENERAL NOTES
05FMD005 -- VALVE LIST - SHEET 1
05FMD006 -- VALVE LIST - SHEET 2

000245

THE ORIGINAL DRAWING AND SUBSEQUENT REVISIONS THEREOF, WITH APPROVAL NAMES, INITIALS, AND THE PE SEAL, IF APPLICABLE, ARE MAINTAINED IN THE FILES OF FWENC.

REV	DATE	BY	CHK'D	APR'VD	DESCRIPTION/ISSUE
2					REVISED PER CHANGE PROPOSAL CP-00-001
1	01/07/00	BJD	SWH	KDR	CERTIFIED FOR CONSTRUCTION
0	11/01/99	BJD	SWH		PRELIMINARY DESIGN SUBMITTAL

RPE

		DATE
DRAWN BY	B J DAVIS	01/07/00
DESIGNED BY	B J DAVIS	01/07/00
CHECKED BY	S W HUNGATE	01/07/00
APPROVED BY	KENNETH RICKETT	01/07/00
APPROVED BY	JOHN LAWSON	01/07/00

DEPARTMENT OF ENERGY
FERNALD ENVIRONMENTAL MANAGEMENT PROJECT
SILOS 1 AND 2 ACCELERATED WASTE RETRIEVAL PROJECT
FERNALD, OHIO
FDF CONTRACT NO. FSC 624

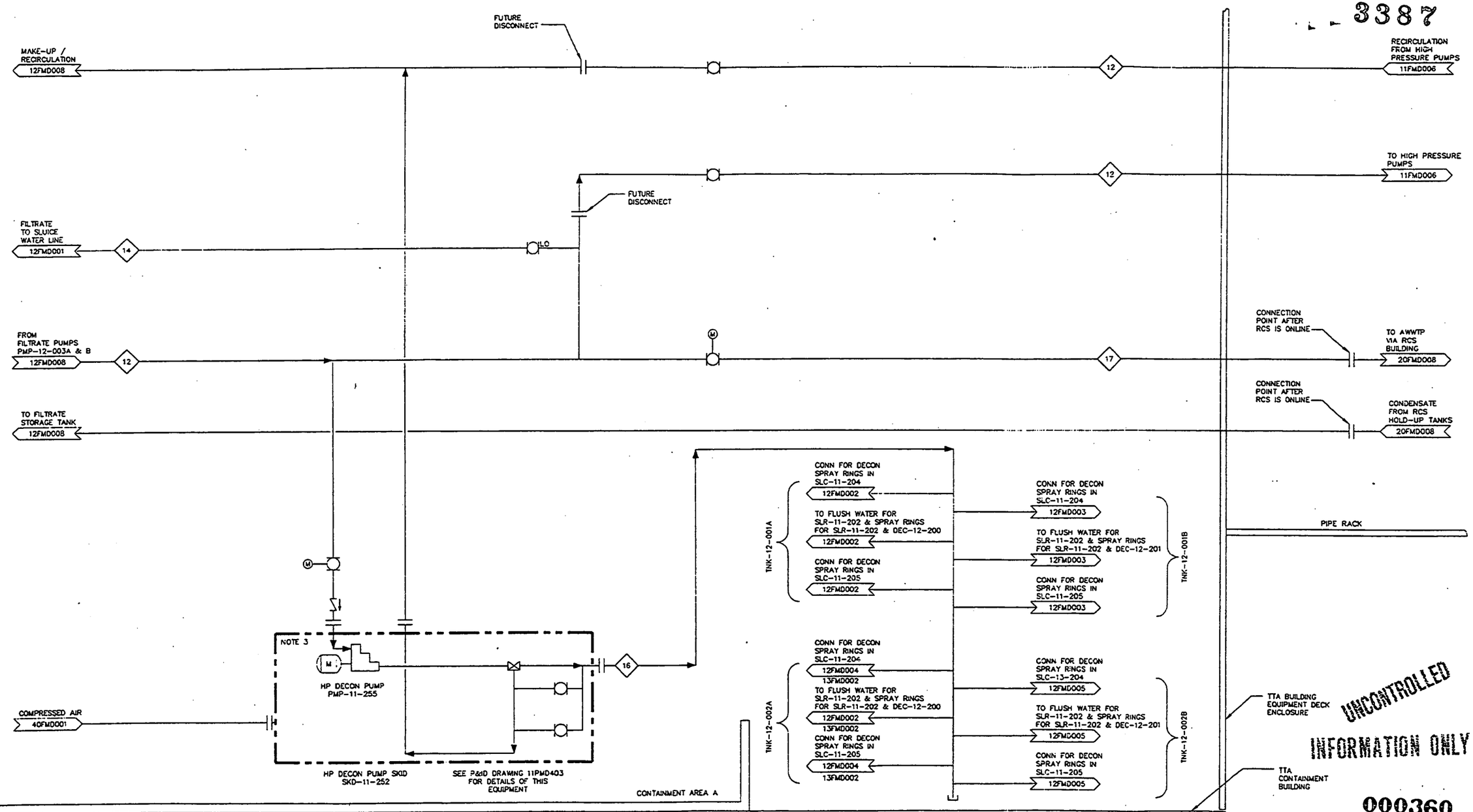
FOSTER WHEELER
FOSTER WHEELER ENVIRONMENTAL CORPORATION

TITLE
TRANSFER TANK SYSTEM
PROCESS FLOW DIAGRAM
FILTRATE SYSTEM (TANKS)

SIZE	SCALE	DWG. NO.	REV
D	NONE	12FMD008	2

FILENAME: 12FMD008.DWG

3387



UNCONTROLLED

INFORMATION ONLY

000360

NOTES:

1. FOR GENERAL NOTES SEE DRAWING 05FMD004.
2. FOR MASS BALANCE TABLES SEE DRAWING 11FMD001 & 11FMD002.

REFERENCE DRAWINGS:

05FMD001 -- INSTRUMENT IDENTIFICATION
05FMD002 -- CONTROL SYSTEM STANDARDS
05FMD003 -- PIPING & EQUIPMENT IDENTIFICATION
05FMD004 -- GENERAL NOTES
05FMD005 -- VALVE LIST - SHEET 1
05FMD006 -- VALVE LIST - SHEET 2

PRELIMINARY
NOT FOR CONSTRUCTION

000246

REV	DATE	BY	CHK'D	APR'VD	DESCRIPTION/ISSUE
A					ISSUED FOR 90% REVIEW

RPK

DRAWN BY DATE
DESIGNED BY DATE
CHECKED BY DATE
APPROVED BY DATE
APPROVED BY DATE

DEPARTMENT OF ENERGY
FERNALD ENVIRONMENTAL MANAGEMENT PROJECT
SILOS 1 AND 2 ACCELERATED WASTE RETRIEVAL PROJECT
FERNALD, OHIO
FDF CONTRACT NO. FSC 624

FOSTER WHEELER
FOSTER WHEELER ENVIRONMENTAL CORPORATION

TITLE
TRANSFER TANK SYSTEM
PROCESS FLOW DIAGRAM
FILTRATE RECIRC & TRANSFER

SIZE	SCALE:	DWG. NO.	REV
D	NONE	12FMD018	A

FILENAME. 12FMD018.DWG

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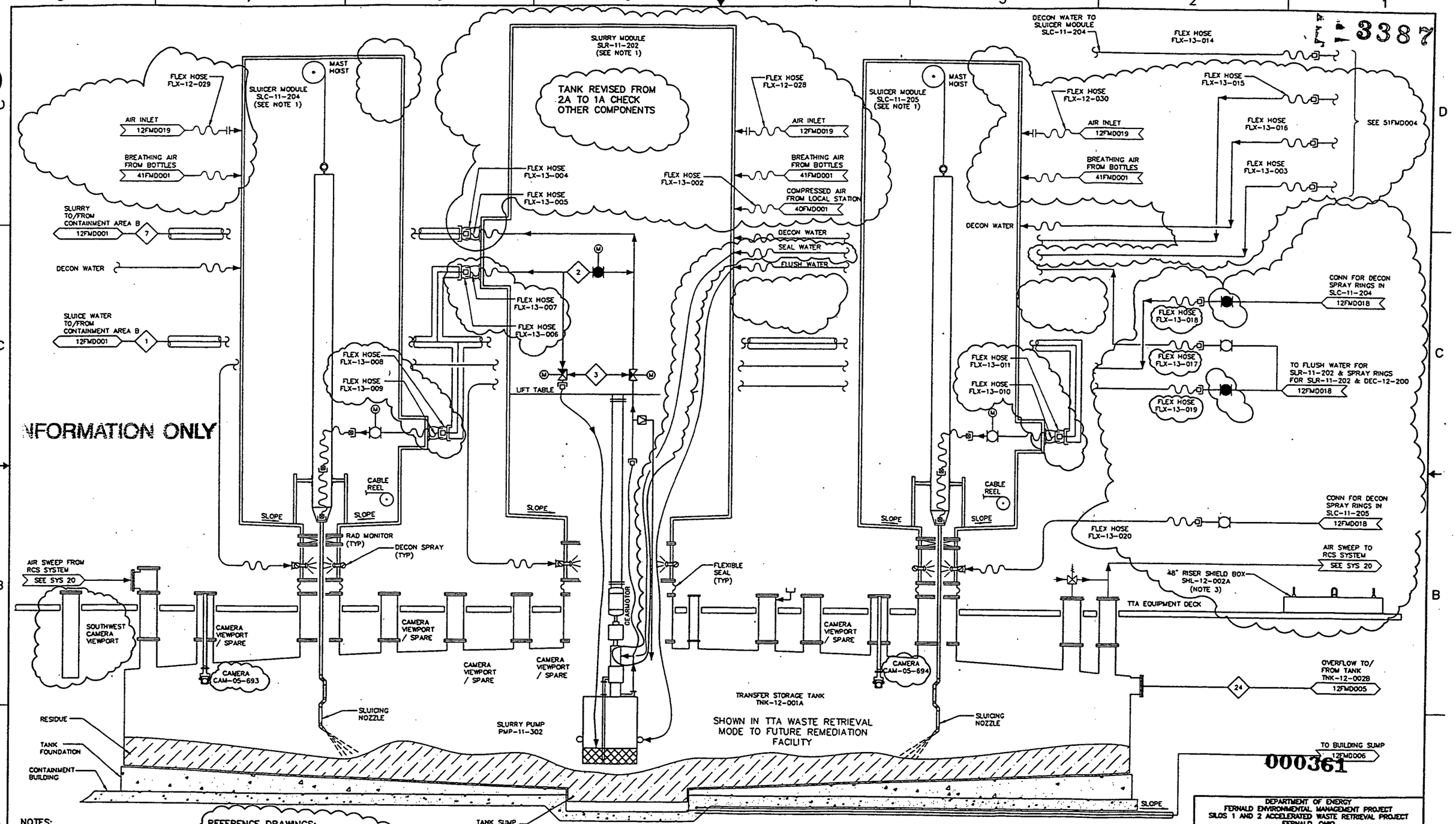

NOTES:

1. FOR GENERAL NOTES SEE DRAWING 05FMD004.
2. FOR MASS BALANCE TABLES SEE DRAWING 13FMD001.
3. SHIELD BOX TO BE PLACED OVER E2-48" RISER WHEN NOT IN USE.

REFERENCE DRAWINGS:

05FMD001 -- INSTRUMENT IDENTIFICATION
05FMD002 -- CONTROL SYSTEM STANDARDS
05FMD003 -- PIPING & EQUIPMENT IDENTIFICATION
05FMD004 -- GENERAL NOTES
05FMD005 -- VALVE LIST - SHEET 1
05FMD006 -- VALVE LIST - SHEET 2

THE ORIGINAL DRAWING AND SUBSEQUENT REVISIONS THEREOF, WITH APPROVAL NAMES, INITIALS, AND THE PE SEAL, IF APPLICABLE, ARE MAINTAINED IN THE FILES OF FWENC.

REV	DATE	BY	CHK'D	APR'VD	DESCRIPTION/ISSUE
2					REVISED PER CHANGE PROPOSAL CP-00-001
1	01/07/00	BJD	SWH	KDR	CERTIFIED FOR CONSTRUCTION
0	11/01/99	BJD	SWH		PRELIMINARY DESIGN SUBMITTAL

RPE

DRAWN BY B J DAVIS	DATE 01/07/00	
DESIGNED BY B J DAVIS	DATE 01/07/00	
CHECKED BY S W HUNGATE	DATE 01/07/00	
APPROVED BY KENNETH RICKETT	DATE 01/07/00	
APPROVED BY JOHN LAWSON	DATE 01/07/00	

DEPARTMENT OF ENERGY
FERNALD ENVIRONMENTAL MANAGEMENT PROJECT
SILOS 1 AND 2 ACCELERATED WASTE RETRIEVAL PROJECT
FERNALD, OHIO
FDF CONTRACT NO. FSC 624

FOSTER WHEELER

FOSTER WHEELER ENVIRONMENTAL CORPORATION

TITLE
TRANSFER TANK WASTE RETRIEVAL PROCESS FLOW DIAGRAM STORAGE TANK TNK-12-001A

SIZE	SCALE	DWG. NO.	REV
D	NONE	13FMD002	2

FILENAME: 13FMD002.DWG

000343

INFORMATION ONLY

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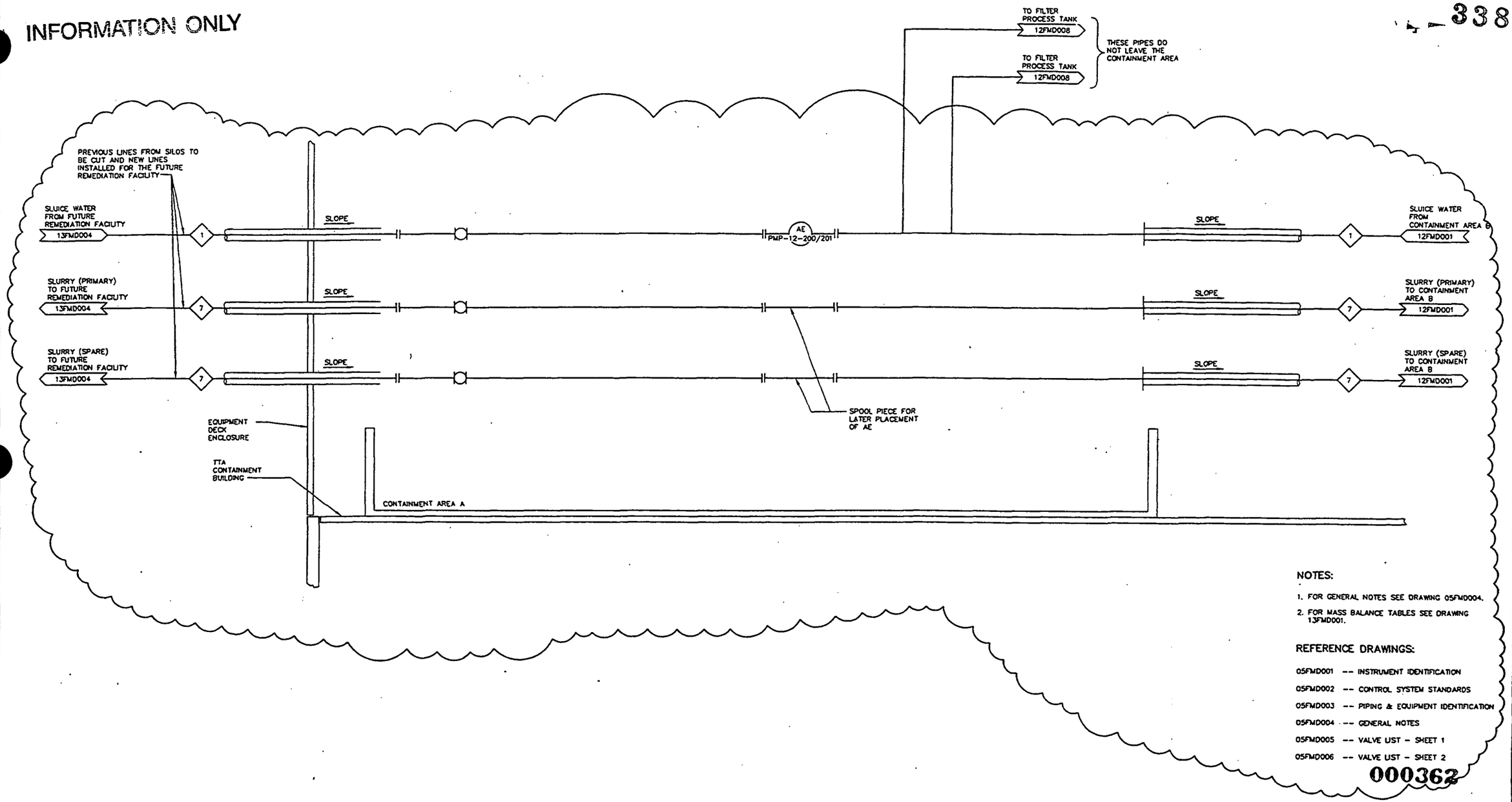


NOTES:

1. FOR GENERAL NOTES SEE DRAWING 05FMD004.
2. FOR MASS BALANCE TABLES SEE DRAWING 13FMD001.

REFERENCE DRAWINGS:

05FMD001 -- INSTRUMENT IDENTIFICATION
05FMD002 -- CONTROL SYSTEM STANDARDS
05FMD003 -- PIPING & EQUIPMENT IDENTIFICATION
05FMD004 -- GENERAL NOTES
05FMD005 -- VALVE LIST - SHEET 1
05FMD006 -- VALVE LIST - SHEET 2

000362

000348

THE ORIGINAL DRAWING AND SUBSEQUENT REVISIONS THEREOF, WITH APPROVAL NAMES, INITIALS, AND THE PE SEAL, IF APPLICABLE, ARE MAINTAINED IN THE FILES OF FWENC.

REV	DATE	BY	CHK'D	APR'VD	DESCRIPTION/ISSUE
2					REVISED PER CHANGE PROPOSAL CP-00-001
1	01/07/00	BJD	SWH	KDR	CERTIFIED FOR CONSTRUCTION
0	11/01/99	BJD	SWH		PRELIMINARY DESIGN SUBMITTAL

PE

		DATE
DRAWN BY	B J DAVIS	01/07/00
DESIGNED BY	B J DAVIS	01/07/00
CHECKED BY	S W HUNGATE	01/07/00
APPROVED BY	KENNETH RICKETT	01/07/00
APPROVED BY	JOHN LAWSON	01/07/00

DEPARTMENT OF ENERGY
FERNALD ENVIRONMENTAL MANAGEMENT PROJECT
SILOS 1 AND 2 ACCELERATED WASTE RETRIEVAL PROJECT
FERNALD, OHIO
FDF CONTRACT NO. FSC 624

FOSTER WHEELER
FOSTER WHEELER ENVIRONMENTAL CORPORATION

TITLE
TRANSFER TANK WASTE RETRIEVAL
PROCESS FLOW DIAGRAM
PROCESS ANALYZER

SIZE	SCALE:	DWG. NO.	REV
D	NONE	13FMD003	2

FILENAME: 13FMD003.DWG

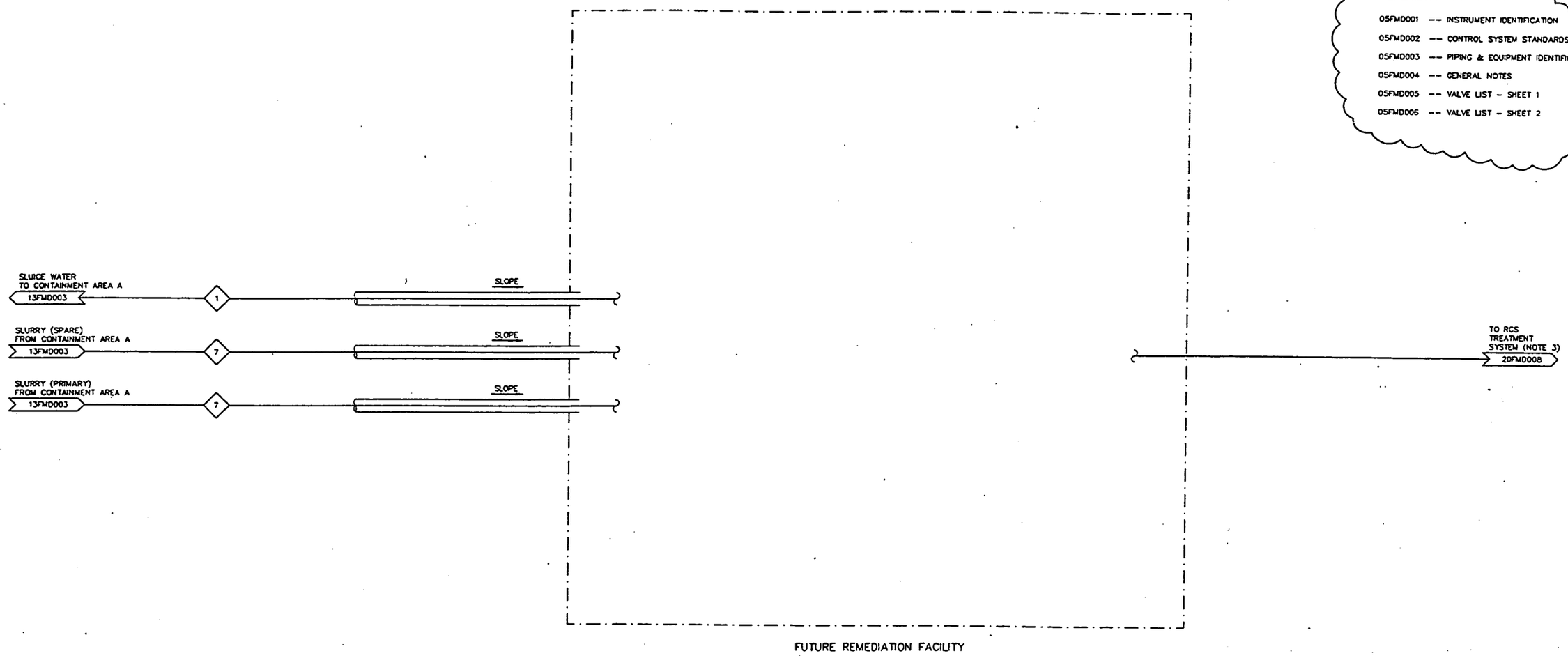
INFORMATION ONLY

NOTES: 3387

1. FOR GENERAL NOTES SEE DRAWING 05FMD004.
2. FOR MASS BALANCE TABLES SEE DRAWING 13FMD001.
3. CORRESPONDS TO STREAM 11 OF RCS – SYSTEM 20.

REFERENCE DRAWINGS:

05FMD001 -- INSTRUMENT IDENTIFICATION
05FMD002 -- CONTROL SYSTEM STANDARDS
05FMD003 -- PIPING & EQUIPMENT IDENTIFICATION
05FMD004 -- GENERAL NOTES
05FMD005 -- VALVE LIST – SHEET 1
05FMD006 -- VALVE LIST – SHEET 2



000363

000349

THE ORIGINAL DRAWING AND SUBSEQUENT REVISIONS THEREOF, WITH APPROVAL NAMES, INITIALS, AND THE PE SEAL, IF APPLICABLE, ARE MAINTAINED IN THE FILES OF FWENC.

REV	DATE	BY	CHK'D	APR'VD	DESCRIPTION/ISSUE
2					REVISED PER CHANGE PROPOSAL CP-00-001
1	01/07/00	BJD	SWH	KDR	CERTIFIED FOR CONSTRUCTION
0	01/01/99	BJD	SWH		PRELIMINARY DESIGN SUBMITTAL

RPC

DRAWN BY B J DAVIS	DATE 01/07/00
DESIGNED BY B J DAVIS	DATE 01/07/00
CHECKED BY S W HUNGATE	DATE 01/07/00
APPROVED BY KENNETH RICKETT	DATE 01/07/00
APPROVED BY JOHN LAWSON	DATE 01/07/00

DEPARTMENT OF ENERGY
FERNALD ENVIRONMENTAL MANAGEMENT PROJECT
SILOS 1 AND 2 ACCELERATED WASTE RETRIEVAL PROJECT
FERNALD, OHIO
FDF CONTRACT NO. FSC 824

FOSTER WHEELER
FOSTER WHEELER ENVIRONMENTAL CORPORATION

TITLE
TRANSFER TANK WASTE RETRIEVAL
PROCESS FLOW DIAGRAM
FUTURE REMEDIATION FACILITY

SIZE	SCALE:	DWG. NO.	REV
D	NONE	13FMD004	2

FILENAME: 13FMD004.DWG

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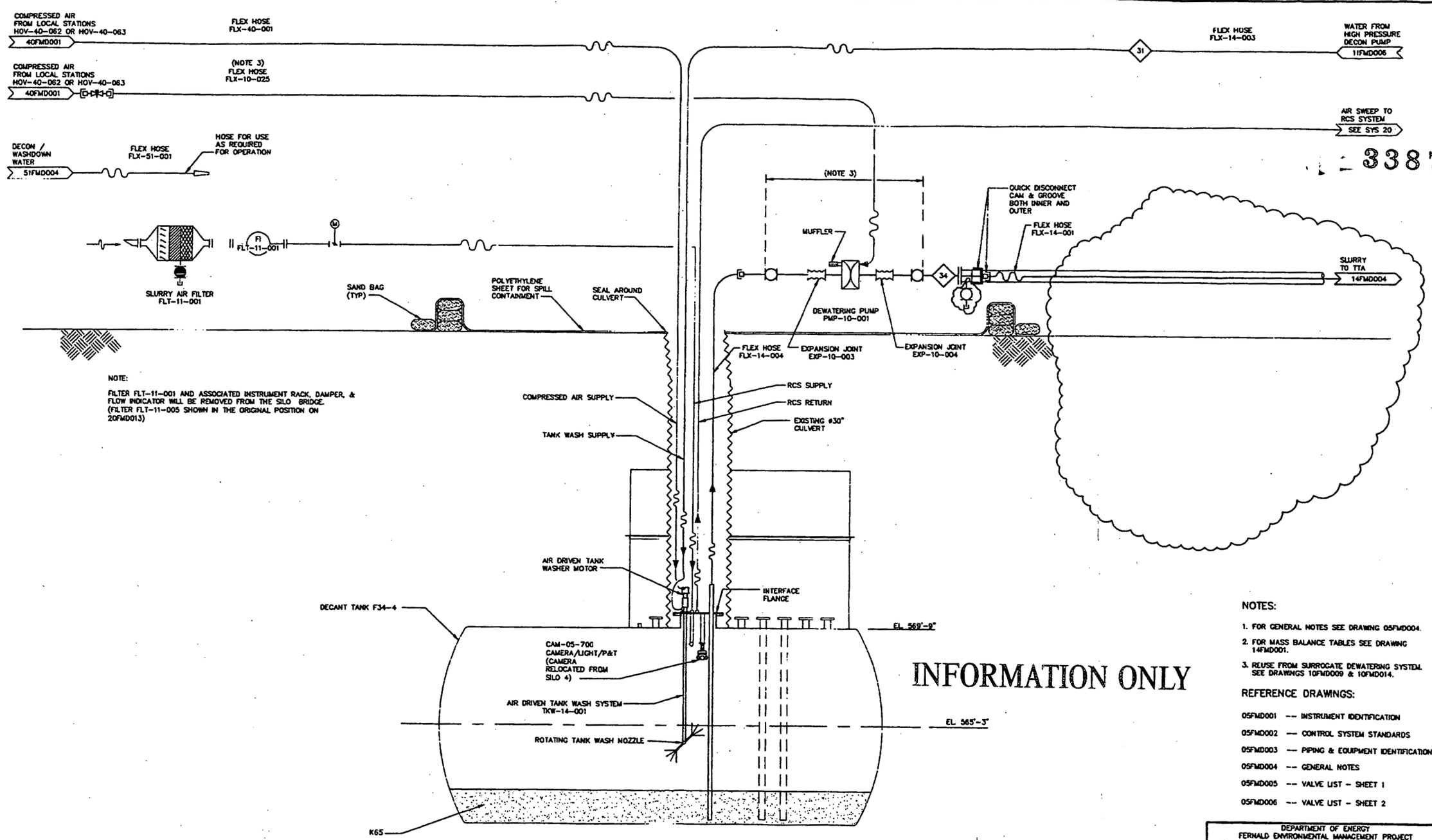


3387

INFORMATION ONLY

NOTES:

1. FOR GENERAL NOTES SEE DRAWING 05FMD004.
2. FOR MASS BALANCE TABLES SEE DRAWING 14FMD001.
3. REUSE FROM SURROGATE DEWATERING SYSTEM. SEE DRAWINGS 10FMD009 & 10FMD014.

REFERENCE DRAWINGS:

05FMD001 -- INSTRUMENT IDENTIFICATION
05FMD002 -- CONTROL SYSTEM STANDARDS
05FMD003 -- PIPING & EQUIPMENT IDENTIFICATION
05FMD004 -- GENERAL NOTES
05FMD005 -- VALVE LIST - SHEET 1
05FMD006 -- VALVE LIST - SHEET 2

000350

THE ORIGINAL DRAWING AND SUBSEQUENT REVISIONS THEREOF, WITH APPROVAL NAMES, INITIALS, AND THE PE SEAL, IF APPLICABLE, ARE MAINTAINED IN THE FILES OF FWENC.

REV	DATE	BY	CHK'D	APRVD	DESCRIPTION/ISSUE
3	11/6/00	MJD	BAL	KDR	REVISED PER AWR-DCN-M-0005
2	08/31/00	BJD	BAL	KDR	REVISED PER CHANGE PROPOSAL CP-00-001
1	01/07/00	BJD	SWH	KDR	CERTIFIED FOR CONSTRUCTION
0	01/01/99	BJD	SWH		PRELIMINARY DESIGN SUBMITTAL

RPE
STATE OF OHIO
KENNETH D. RICKETT
E-64418
REGISTERED PROFESSIONAL ENGINEER
11/07/00

DRAWN BY	B J DAVIS	DATE 01/07/00
DESIGNED BY	B J DAVIS	DATE 01/07/00
CHECKED BY	S W HUNGATE	DATE 01/07/00
APPROVED BY	KENNETH RICKETT	DATE 01/07/00
APPROVED BY	JOHN LAWSON	DATE 01/07/00

DEPARTMENT OF ENERGY
FERNALD ENVIRONMENTAL MANAGEMENT PROJECT
SILOS 1 AND 2 ACCELERATED WASTE RETRIEVAL PROJECT
FERNALD, OHIO
FDF CONTRACT NO. FSC 624

FOSTER WHEELER
FOSTER WHEELER ENVIRONMENTAL CORPORATION

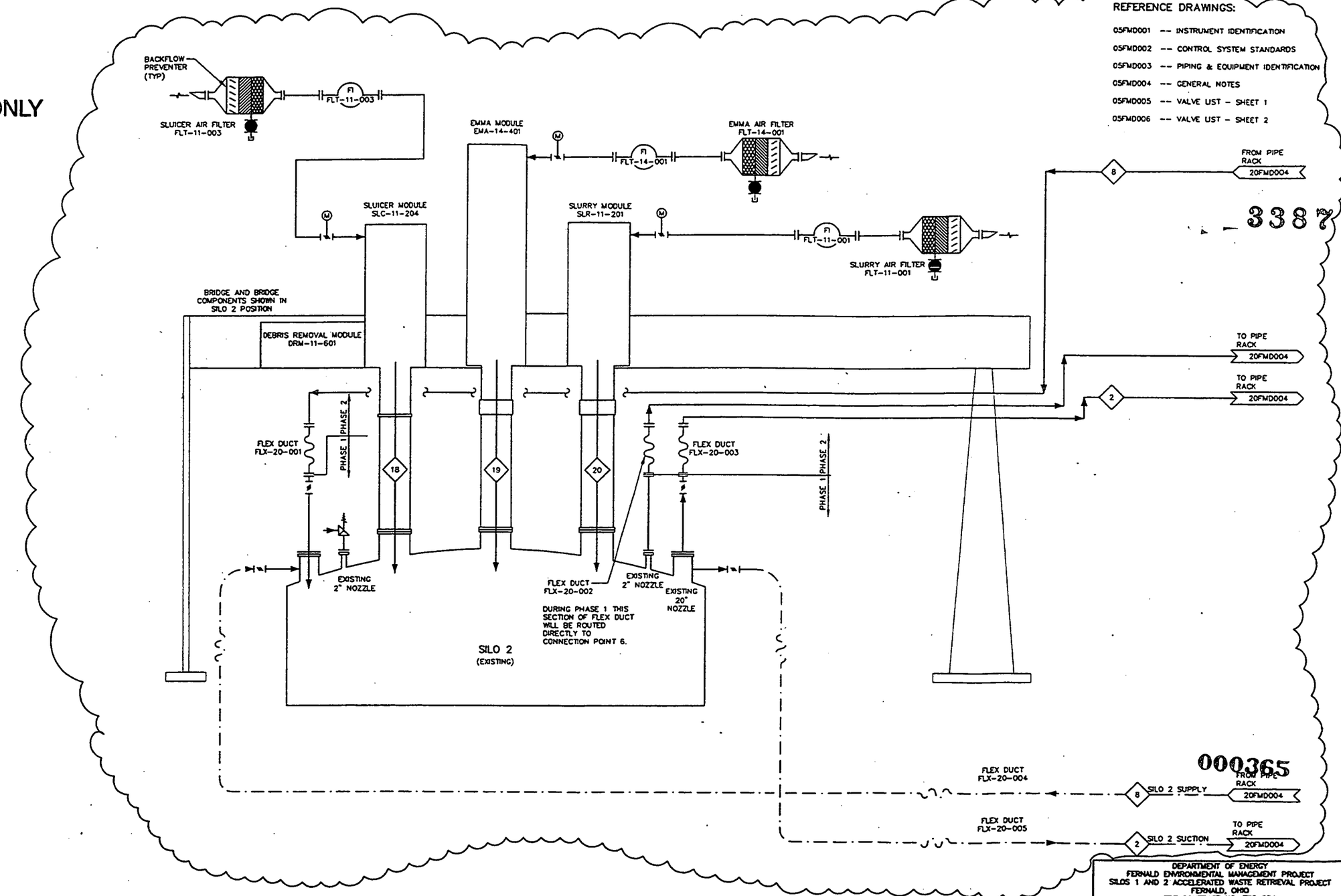
TITLE
DECANT SUMP RETRIEVAL SYSTEM
PROCESS FLOW DIAGRAM
DECANT SUMP RETRIEVAL

SIZE D | SCALE: NONE | DWG. NO. 14FMD002 | REV 3

000364

FILENAME: 14FMD002.DWG

INFORMATION ONLY



REFERENCE DRAWINGS:

05FMD001 -- INSTRUMENT IDENTIFICATION
05FMD002 -- CONTROL SYSTEM STANDARDS
05FMD003 -- PIPING & EQUIPMENT IDENTIFICATION
05FMD004 -- GENERAL NOTES
05FMD005 -- VALVE UST - SHEET 1
05FMD006 -- VALVE UST - SHEET 2

3387

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THE ORIGINAL DRAWING AND SUBSEQUENT REVISIONS THEREOF, WITH APPROVAL NAMES, INITIALS, AND THE PE SEAL, IF APPLICABLE, ARE MAINTAINED IN THE FILES OF FWENC.

REV	DATE	BY	CHK'D	APR'VD	DESCRIPTION/ISSUE
2	5/15/00	BJD	GCH	KDR	REVISED PER CHANGE PROPOSAL CP-00-001
1	01/07/00	BJD	SWH	KDR	CERTIFIED FOR CONSTRUCTION
0	11/01/99	BJD	KR		PRELIMINARY DESIGN SUBMITTAL

PE: KENNETH D. RICKETT
P.E. NO. E-64418
5/15/00
REVISION 2

DRAWN BY B J DAVIS	DATE 01/07/00	
DESIGNED BY B J DAVIS	DATE 01/07/00	
CHECKED BY S W HUNGATE	DATE 01/07/00	
APPROVED BY KENNETH RICKETT	DATE 01/07/00	
APPROVED BY JOHN LAWSON	DATE 01/07/00	

DEPARTMENT OF ENERGY
FERNALD ENVIRONMENTAL MANAGEMENT PROJECT
SILOS 1 AND 2 ACCELERATED WASTE RETRIEVAL PROJECT
FERNALD, OHIO
FDF CONTRACT NO. FSC 624

FOSTER WHEELER
FOSTER WHEELER ENVIRONMENTAL CORPORATION

TITLE
RADON CONTROL SYSTEM
PROCESS FLOW DIAGRAM
SILO 2

SIZE	SCALE	DWG. NO.	REV
D	NONE	20FMD003	2

FILENAME: 20FMD003.DWG

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BACKFLOW PREVENTER (TYP)
SLUICER AIR FILTER FLT-11-003
FI FLT-11-003
SLUICER MODULE SLC-11-204
EMMA MODULE EMA-14-401
FI FLT-14-001
EMMA AIR FILTER FLT-14-001
SLURRY MODULE SLR-11-201
FI FLT-11-001
SLURRY AIR FILTER FLT-11-001
BRIDGE AND BRIDGE COMPONENTS SHOWN IN SILO 1 POSITION
DEBRIS REMOVAL MODULE DRM-11-601
FLEX DUCT FLX-20-001
PHASE 1 PHASE 2
EXISTING 20" NOZZLE
EXISTING 2" NOZZLE
FLEX DUCT FLX-20-002
DURING PHASE 1 THIS SECTION OF FLEX DUCT WILL BE ROUTED DIRECTLY TO CONNECTION POINT 7.
SILO 1 (EXISTING)
FLEX DUCT FLX-20-003
EXISTING 20" NOZZLE
FLEX DUCT FLX-20-007
FLEX DUCT FLX-20-006
FLEX DUCT FLX-20-004
FLEX DUCT FLX-20-005
TO SILO 2 20FMD003
FROM SILO 2 20FMD003
SILO 1 SUCTION
SILO 1 SUPPLY
SILO 2 SUPPLY
SILO 2 SUCTION
AIR FLOW
BLIND FLANGE WHEN NOT IN USE
CONDENSATE TRAP
DETAIL 1 SCALE: NONE
DETAIL 2 SCALE: NONE
20FMD004 20FMD013
SPOOL PIECE 4 REMOVABLE TO ALLOW BRIDGE ROTATION (TYP)
SPOOL PIECE 1
PHASE 2 PHASE 1
SPOOL PIECE 2
SPOOL PIECE 5 REMOVABLE TO ALLOW BRIDGE ROTATION (TYP)
SPOOL PIECE 6 REMOVABLE TO ALLOW BRIDGE ROTATION (TYP)
SPOOL PIECE 3
FROM RECIRCULATION FANS 20FMD010
TO TREATMENT SYSTEM 20FMD009
PIPE RACK
RCS PHASE 2 PIPE RACK CONSTRUCTION
RCS PHASE 1 PIPE RACK CONSTRUCTION

NOTES:
1. FOR NOTES SEE DRAWINGS 20FMD003, & 20FMD012

LEGEND:
(1) = INDICATES CONNECTION POINTS FOR PIPING.
= INDICATES PIPING FOR PHASE 1 THAT WILL BE REMOVED FROM SERVICE DURING THE REMAINING PHASES OF OPERATION
= INDICATES FLEX PIPING FOR PHASE 1

REFERENCE DRAWINGS:
05FMD001 -- INSTRUMENT IDENTIFICATION
05FMD002 -- CONTROL SYSTEM STANDARDS
05FMD003 -- PIPING & EQUIPMENT IDENTIFICATION
05FMD004 -- GENERAL NOTES
05FMD005 -- VALVE LIST - SHEET 1
05FMD006 -- VALVE LIST - SHEET 2

SECTION & DETAIL KEY
LETTER OR NUMBER OF SECTION OR DETAIL
DRAWING ON WHICH SECTION OR DETAIL IS TAKEN
DRAWING ON WHICH SECTION OR DETAIL IS SHOWN
THE ORIGINAL DRAWING AND SUBSEQUENT REVISIONS THEREOF, WITH APPROVAL NAMES, INITIALS, AND THE PE SEAL, IF APPLICABLE, ARE MAINTAINED IN THE FILES OF FWENC.

REV	DATE	BY	CHK'D	APR'VD	DESCRIPTION/ISSUE
2	[illegible]	BJD	KDR	KDR	REVISED PER CHANGE PROPOSAL CP-00-001
1	01/01/00	BJD	SWH	KDR	CERTIFIED FOR CONSTRUCTION
0	01/01/99	BJD	KR		PRELIMINARY DESIGN SUBMITTAL

KENNETH D. RICKETT E-64416 REGISTERED PROFESSIONAL ENGINEER

DRAWN BY B J DAVIS	DATE 01/07/00	
DESIGNED BY B J DAVIS	DATE 01/07/00	
CHECKED BY S W HUNGATE	DATE 01/07/00	
APPROVED BY KENNETH RICKETT	DATE 01/07/00	
APPROVED BY JOHN LAWSON	DATE 01/07/00	

DEPARTMENT OF ENERGY
FERNALD ENVIRONMENTAL MANAGEMENT PROJECT
SILOS 1 AND 2 ACCELERATED WASTE RETRIEVAL PROJECT
FERNALD, OHIO
FDF CONTRACT NO. FSC 624

FOSTER WHEELER
FOSTER WHEELER ENVIRONMENTAL CORPORATION

TITLE
RADON CONTROL SYSTEM PROCESS FLOW DIAGRAM SILO 1

SIZE D | SCALE: NONE | DWG. NO. 20FMD004 | REV 2

FILENAME: 20FMD004.DWG

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INFORMATION ONLY

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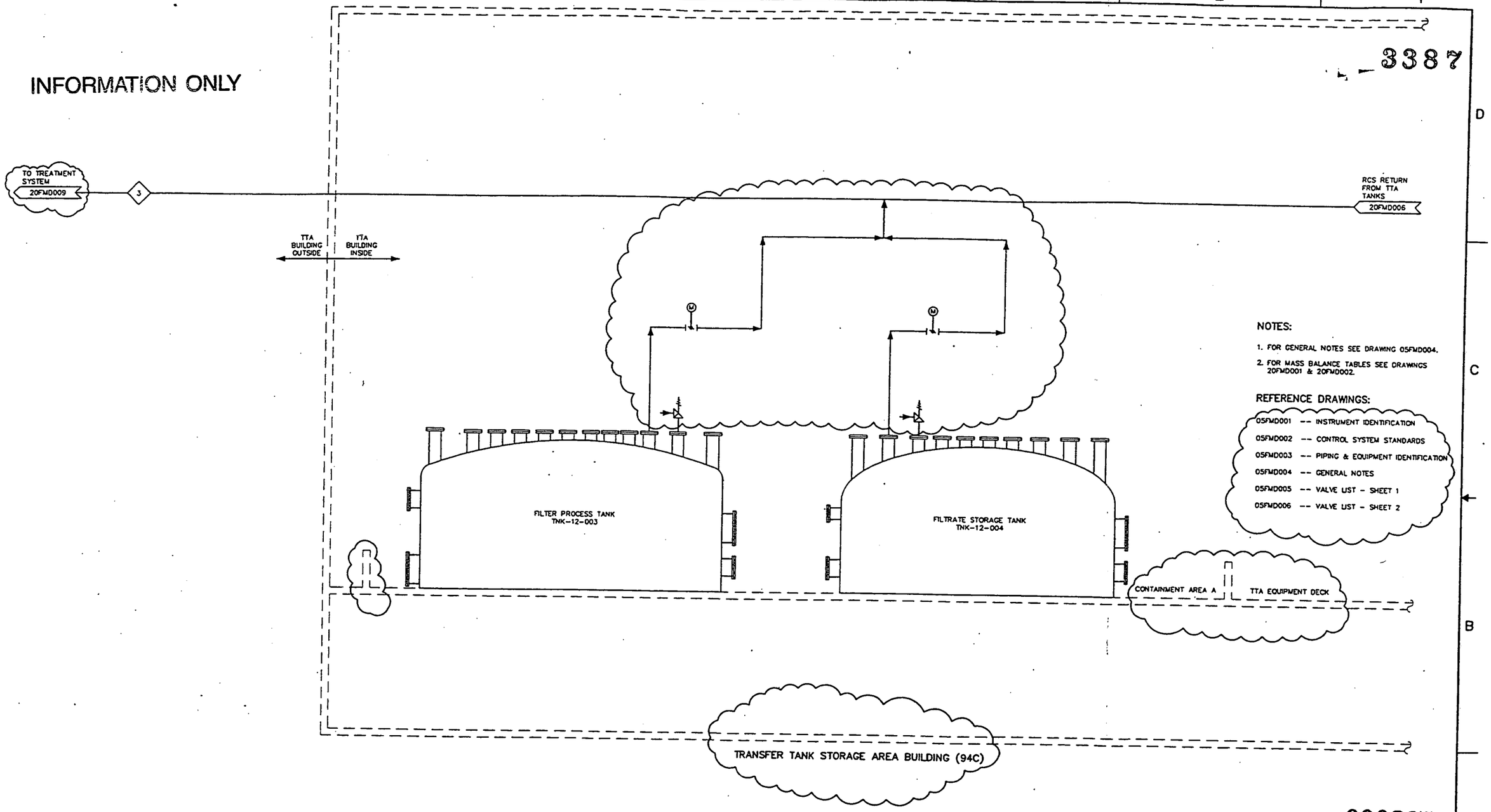

NOTES:

1. FOR GENERAL NOTES SEE DRAWING 05FMD004.
2. FOR MASS BALANCE TABLES SEE DRAWINGS 20FMD001 & 20FMD002.

REFERENCE DRAWINGS:

05FMD001 -- INSTRUMENT IDENTIFICATION
05FMD002 -- CONTROL SYSTEM STANDARDS
05FMD003 -- PIPING & EQUIPMENT IDENTIFICATION
05FMD004 -- GENERAL NOTES
05FMD005 -- VALVE LIST - SHEET 1
05FMD006 -- VALVE LIST - SHEET 2

000367

000353

THE ORIGINAL DRAWING AND SUBSEQUENT REVISIONS THEREOF, WITH APPROVAL NAMES, INITIALS, AND THE PE SEAL, IF APPLICABLE, ARE MAINTAINED IN THE FILES OF FWENC.

REV	DATE	BY	CHK'D	APR'VD	DESCRIPTION/ISSUE
2					REVISED PER CHANGE PROPOSAL CP-00-001
1	01/07/00	BJD	SWH	KDR	CERTIFIED FOR CONSTRUCTION
0	11/01/99	BJD	KR		PRELIMINARY DESIGN SUBMITTAL

PE

		DATE
DRAWN BY	B J DAVIS	01/07/00
DESIGNED BY	B J DAVIS	01/07/00
CHECKED BY	S W HUNGATE	01/07/00
APPROVED BY	KENNETH RICKETT	01/07/00
APPROVED BY	JOHN LAWSON	01/07/00

DEPARTMENT OF ENERGY
FERNALD ENVIRONMENTAL MANAGEMENT PROJECT
SILOS 1 AND 2 ACCELERATED WASTE RETREVAL PROJECT
FERNALD, OHIO
FDF CONTRACT NO. FSC 824

FOSTER WHEELER
FOSTER WHEELER ENVIRONMENTAL CORPORATION

TITLE
RADON CONTROL SYSTEM
PROCESS FLOW DIAGRAM
FILTER & FILTRATE STORAGE TNKS

SIZE	SCALE:	DWG. NO.	REV
D	NONE	20FMD005	2

FILENAME: 20FMD005.DWG

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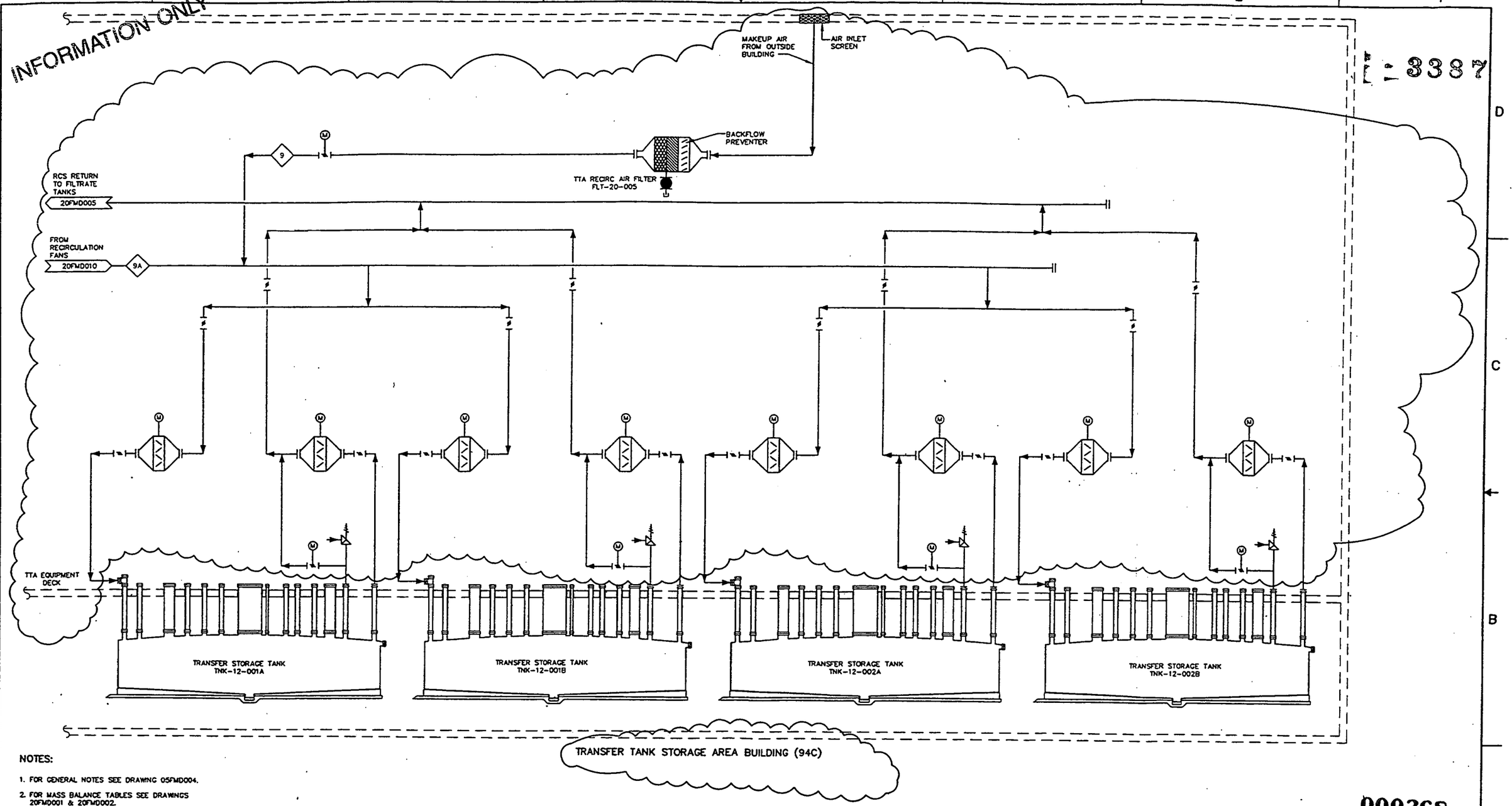
INFORMATION ONLY

L-3387



NOTES:

1. FOR GENERAL NOTES SEE DRAWING 05FMD004.
2. FOR MASS BALANCE TABLES SEE DRAWINGS 20FMD001 & 20FMD002.

REFERENCE DRAWINGS:

05FMD001 -- INSTRUMENT IDENTIFICATION
05FMD002 -- CONTROL SYSTEM STANDARDS
05FMD003 -- PIPING & EQUIPMENT IDENTIFICATION
05FMD004 -- GENERAL NOTES
05FMD005 -- VALVE LIST - SHEET 1
05FMD006 -- VALVE LIST - SHEET 2

000368

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THE ORIGINAL DRAWING AND SUBSEQUENT REVISIONS THEREOF, WITH APPROVAL NAMES, INITIALS, AND THE PE SEAL, IF APPLICABLE, ARE MAINTAINED IN THE FILES OF FWENC.

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0	11/01/99	BJD	KR		PRELIMINARY DESIGN SUBMITTAL

UNDER TEMPORARY AUTHORIZATION (BASED ON APPLICATION TO REGISTER BY COMITY IN THE STATE OF OHIO, DATED DECEMBER 6, 1999) WHICH WILL EXPIRE ON MARCH 31, 2000.

DRAWN BY	B J DAVIS	01/07/00
DESIGNED BY	B J DAVIS	01/07/00
CHECKED BY	S W HUNGATE	01/07/00
APPROVED BY	KENNETH RICKETT	01/07/00
APPROVED BY	JOHN LAWSON	01/07/00

DEPARTMENT OF ENERGY
FERNALD ENVIRONMENTAL MANAGEMENT PROJECT
SILOS 1 AND 2 ACCELERATED WASTE RETRIEVAL PROJECT
FERNALD, OHIO
FDF CONTRACT NO. FSC 624

FOSTER WHEELER
FOSTER WHEELER ENVIRONMENTAL CORPORATION

TITLE
RADON CONTROL SYSTEM
PROCESS FLOW DIAGRAM
TTA STORAGE TANKS

SIZE D | SCALE: NONE | DWG. NO. 20FMD006 | REV 2

FILENAME: 20FMD006.DWG

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INFORMATION ONLY

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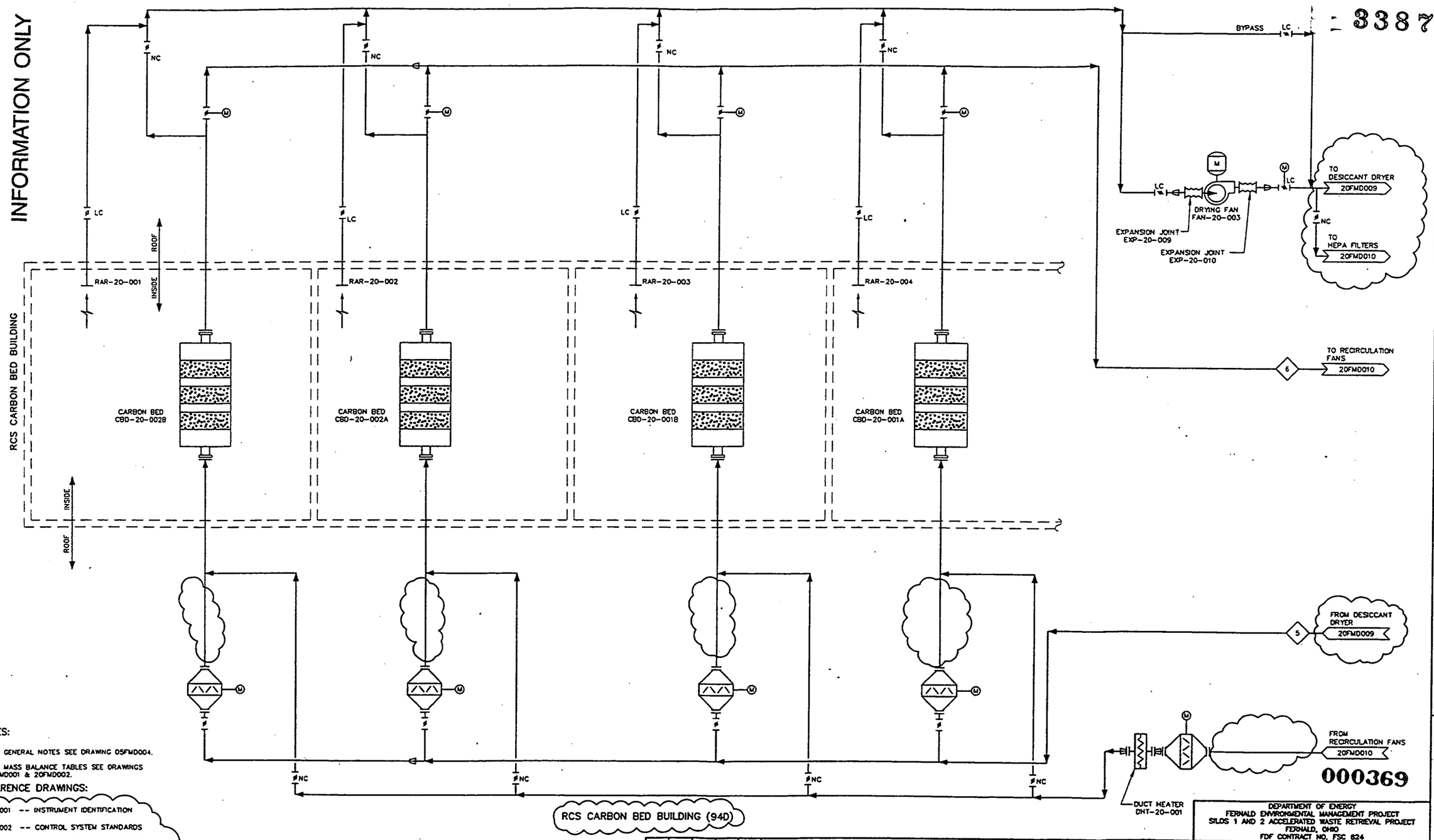


000369

NOTES:

1. FOR GENERAL NOTES SEE DRAWING 05FMD004.
2. FOR MASS BALANCE TABLES SEE DRAWINGS 20FMD001 & 20FMD002.

REFERENCE DRAWINGS:

05FMD001 -- INSTRUMENT IDENTIFICATION
05FMD002 -- CONTROL SYSTEM STANDARDS
05FMD003 -- PIPING & EQUIPMENT IDENTIFICATION
05FMD004 -- GENERAL NOTES
05FMD005 -- VALVE LIST - SHEET 1
05FMD006 -- VALVE LIST - SHEET 2

000255

THE ORIGINAL DRAWING AND SUBSEQUENT REVISIONS THEREOF, WITH APPROVAL NAMES, INITIALS, AND THE PE SEAL, IF APPLICABLE, ARE MAINTAINED IN THE FILES OF FWENC.

REV	DATE	BY	CHK'D	APR'VD	DESCRIPTION/ISSUE
2	05/15/00	BJD	GCH	KDR	REVISED PER CHANGE PROPOSAL CP-00-001
1	03/07/00	BJD	SWH	KDR	CERTIFIED FOR CONSTRUCTION
0	01/01/99	BJD	KR		PRELIMINARY DESIGN SUBMITTAL

PE: KENNETH D. RICKETT
P.E. NO. E-64418
5/15/00
REVISION 2

		DATE
DRAWN BY	B J DAVIS	01/07/00
DESIGNED BY	B J DAVIS	01/07/00
CHECKED BY	S W HUNGATE	01/07/00
APPROVED BY	KENNETH RICKETT	01/07/00
APPROVED BY	JOHN LAWSON	01/07/00

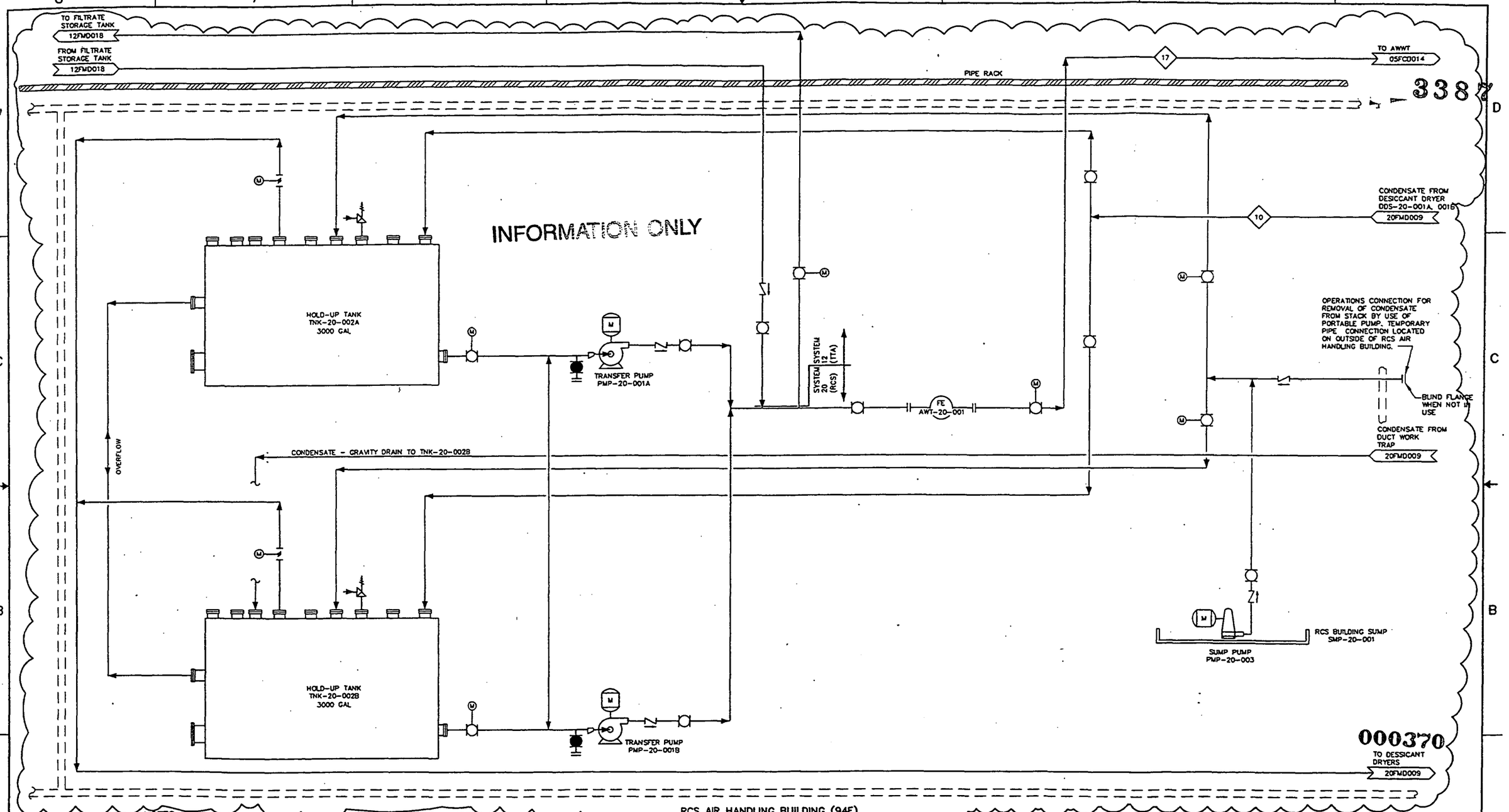
DEPARTMENT OF ENERGY
FERNALD ENVIRONMENTAL MANAGEMENT PROJECT
SILOS 1 AND 2 ACCELERATED WASTE RETRIEVAL PROJECT
FERNALD, OHIO
FDF CONTRACT NO. FSC 624

FOSTER WHEELER
FOSTER WHEELER ENVIRONMENTAL CORPORATION

TITLE
RADON CONTROL SYSTEM
PROCESS FLOW DIAGRAM
CARBON BEDS

SIZE	SCALE	DWG. NO.	REV
D	NONE	20FMD007	2

FILENAME: 20FMD007.DWG



NOTES:

1. FOR GENERAL NOTES SEE DRAWING 05FMD004.
2. FOR MASS BALANCE TABLES SEE DRAWINGS 20FMD001 & 20FMD002.
3. DESICCANT DRYING SYSTEM INCLUDES PRECOOLING COIL, DESICCANT WHEEL, POST-COOLING COIL, CLOSED LOOP REACTIVATION SYSTEM, CONDENSATE COLLECTION TRANSFER SYSTEM, AND INSTRUMENTATION.

REFERENCE DRAWINGS:

05FMD001 -- INSTRUMENT IDENTIFICATION
05FMD001 -- CONTROL SYSTEM STANDARDS
05FMD001 -- PIPING & EQUIPMENT IDENTIFICATION
05FMD001 -- GENERAL NOTES
05FMD001 -- VALVE LIST - SHEET 1
05FMD001 -- VALVE LIST - SHEET 2

000256

THE ORIGINAL DRAWING AND SUBSEQUENT REVISIONS THEREOF, WITH APPROVAL NAMES, INITIALS, AND THE PE SEAL, IF APPLICABLE, ARE MAINTAINED IN THE FILES OF FWENC.

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0	11/17/99	BJD	KR		PRELIMINARY DESIGN SUBMITTAL

RPE
KENNETH D. RICKETT
P.E. NO. E-64418
5/15/00
REVISION 2

		DATE
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DESIGNED BY	B J DAVIS	01/07/00
CHECKED BY	S W HUNGATE	01/07/00
APPROVED BY	KENNETH RICKETT	01/07/00
APPROVED BY	JOHN LAWSON	01/07/00

DEPARTMENT OF ENERGY
FERNALD ENVIRONMENTAL MANAGEMENT PROJECT
SILOS 1 AND 2 ACCELERATED WASTE RETRIEVAL PROJECT
FERNALD, OHIO
FDF CONTRACT NO. FSC 624

FOSTER WHEELER
FOSTER WHEELER ENVIRONMENTAL CORPORATION

TITLE
RADON CONTROL SYSTEM
PROCESS FLOW DIAGRAM
HOLD-UP TANKS & CONDENSATE

SIZE: D | SCALE: NONE | DWG. NO. 20FMD008 | REV 2

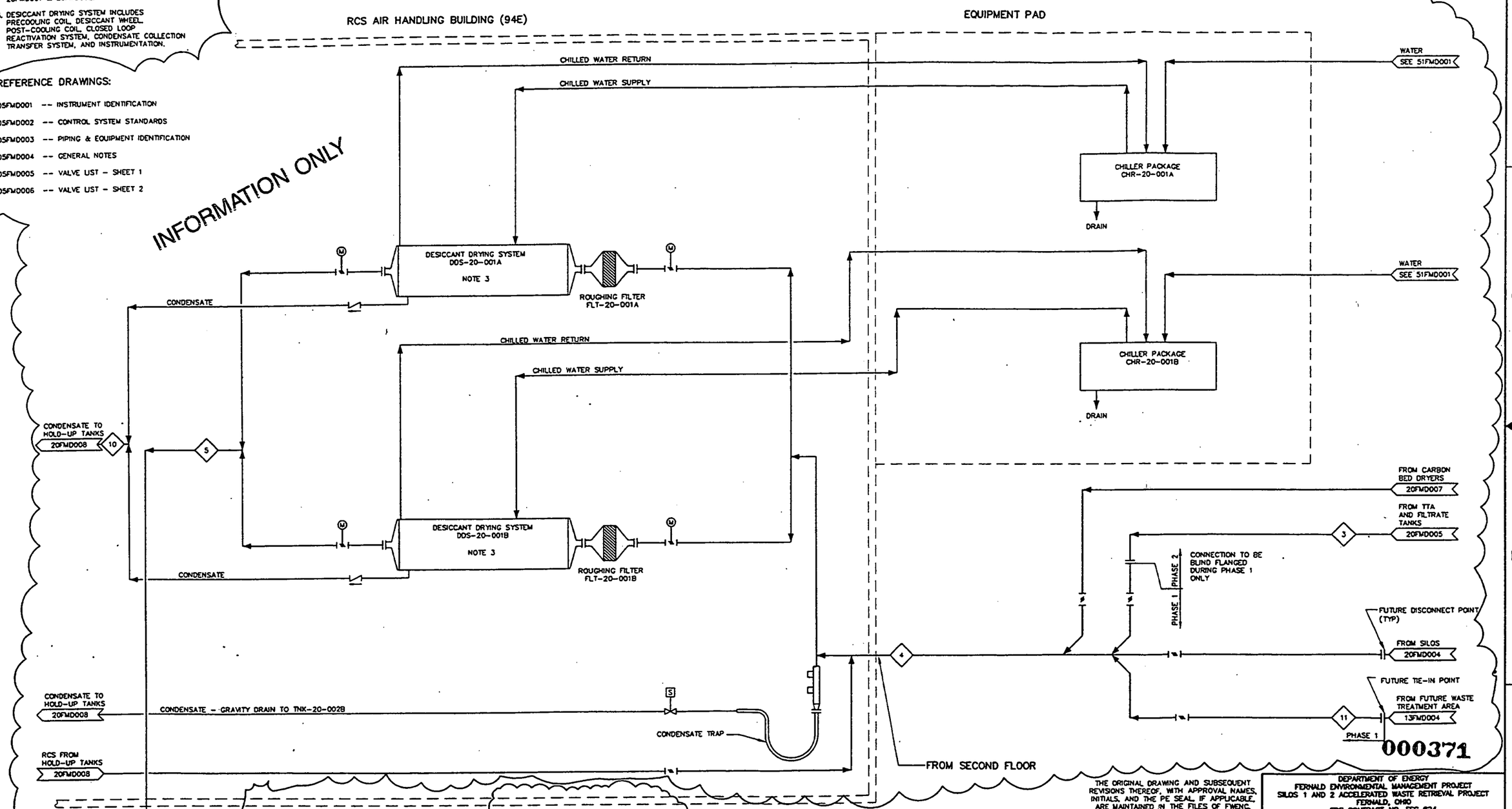
FILENAME: 20FMD008.DWG

3387

NOTES:
1. FOR GENERAL NOTES SEE DRAWING 05FMD004.
2. FOR MASS BALANCE TABLES SEE DRAWINGS 20FMD001 & 20FMD002.
3. DESICCANT DRYING SYSTEM INCLUDES PRECOOLING COIL, DESICCANT WHEEL, POST-COOLING COIL, CLOSED LOOP REACTIVATION SYSTEM, CONDENSATE COLLECTION TRANSFER SYSTEM, AND INSTRUMENTATION.

REFERENCE DRAWINGS:
05FMD001 -- INSTRUMENT IDENTIFICATION
05FMD002 -- CONTROL SYSTEM STANDARDS
05FMD003 -- PIPING & EQUIPMENT IDENTIFICATION
05FMD004 -- GENERAL NOTES
05FMD005 -- VALVE LIST - SHEET 1
05FMD006 -- VALVE LIST - SHEET 2

INFORMATION ONLY



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THE ORIGINAL DRAWING AND SUBSEQUENT REVISIONS THEREOF, WITH APPROVAL NAMES, INITIALS, AND THE PE SEAL, IF APPLICABLE, ARE MAINTAINED IN THE FILES OF FWENC.

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RPE: KENNETH D. RICKETT
P.E. NO. E-64418
5/15/00
REVISION 2

DRAWN BY	B J DAVIS	01/07/00
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APPROVED BY	KENNETH RICKETT	01/07/00
APPROVED BY	JOHN LAWSON	01/07/00

DEPARTMENT OF ENERGY
FERNALD ENVIRONMENTAL MANAGEMENT PROJECT
SILOS 1 AND 2 ACCELERATED WASTE RETRIEVAL PROJECT
FERNALD, OHIO
FDF CONTRACT NO. FSC 624

FOSTER WHEELER
FOSTER WHEELER ENVIRONMENTAL CORPORATION

TITLE
RADON CONTROL SYSTEM
PROCESS FLOW DIAGRAM
DRYERS & AIR HANDLING

SIZE D | SCALE: NONE | DWG. NO. 20FMD009 | REV 2

FILENAME: 20FMD009.DWG

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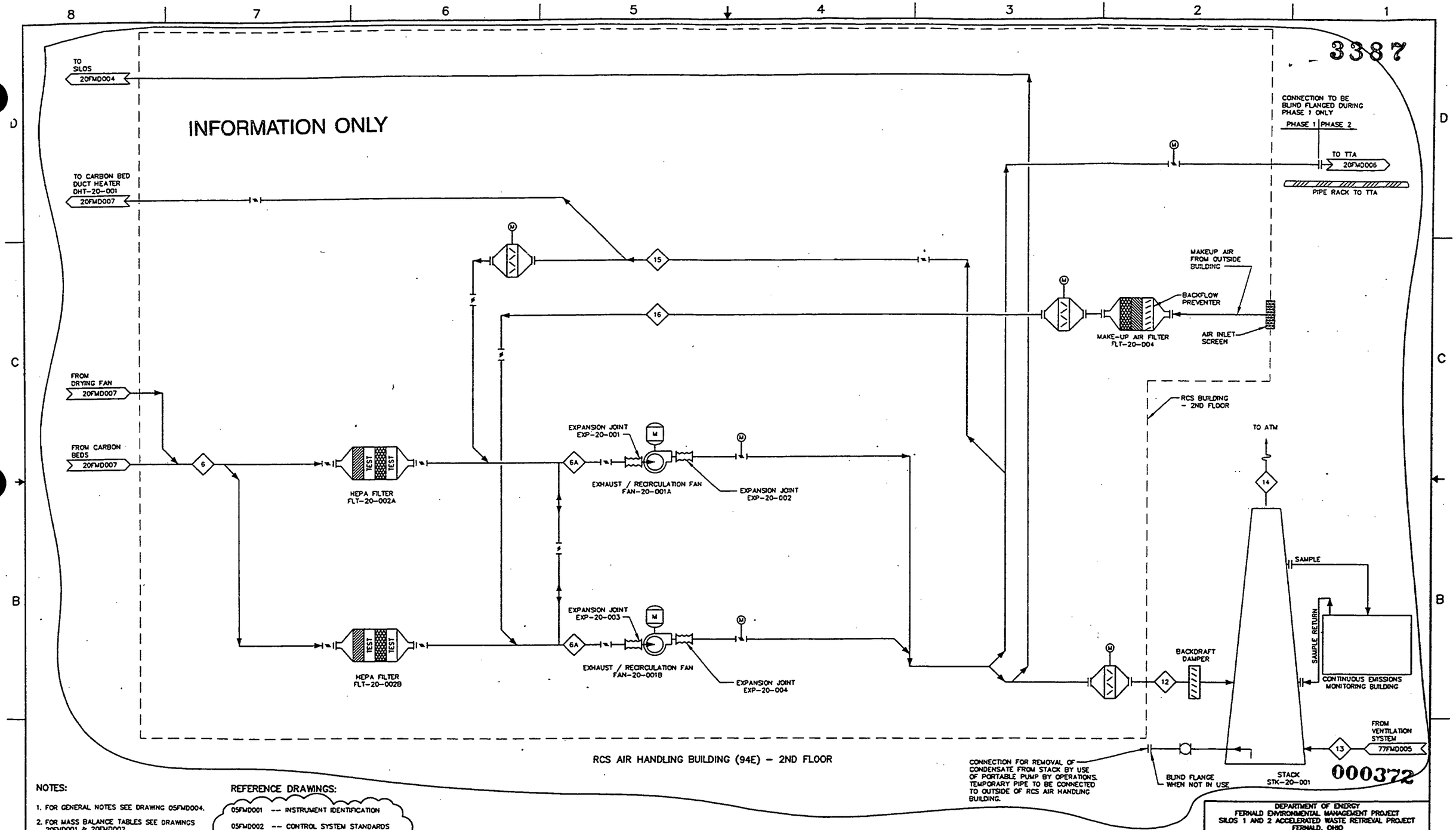

NOTES:

1. FOR GENERAL NOTES SEE DRAWING 05FMD004.
2. FOR MASS BALANCE TABLES SEE DRAWINGS 20FMD001 & 20FMD002.

REFERENCE DRAWINGS:

05FMD001 -- INSTRUMENT IDENTIFICATION
05FMD002 -- CONTROL SYSTEM STANDARDS
05FMD003 -- PIPING & EQUIPMENT IDENTIFICATION
05FMD004 -- GENERAL NOTES
05FMD005 -- VALVE LIST - SHEET 1
05FMD006 -- VALVE LIST - SHEET 2

000358

THE ORIGINAL DRAWING AND SUBSEQUENT REVISIONS THEREOF, WITH APPROVAL NAMES, INITIALS, AND THE PE SEAL, IF APPLICABLE, ARE MAINTAINED IN THE FILES OF FWENC.

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1	01/07/00	BJD	SWH	KDR	CERTIFIED FOR CONSTRUCTION
0	11/01/99	BJD	KR		PRELIMINARY DESIGN SUBMITTAL

PIPE
KENNETH D. RICKETT
P.E. NO. E-64418
5/15/00
REVISION 2

DRAWN BY	B J DAVIS	DATE 01/07/00
DESIGNED BY	B J DAVIS	DATE 01/07/00
CHECKED BY	S W HUNGATE	DATE 01/07/00
APPROVED BY	KENNETH RICKETT	DATE 01/07/00
APPROVED BY	JOHN LAWSON	DATE 01/07/00

DEPARTMENT OF ENERGY
FERNALD ENVIRONMENTAL MANAGEMENT PROJECT
SILOS 1 AND 2 ACCELERATED WASTE RETRIEVAL PROJECT
FERNALD, OHIO
FDF CONTRACT NO. FSC 624

FOSTER WHEELER
FOSTER WHEELER ENVIRONMENTAL CORPORATION

TITLE
RADON CONTROL SYSTEM
PROCESS FLOW DIAGRAM
EXHAUST & RECIRC FANS

SIZE D | SCALE: NONE | DWG. NO. 20FMD010 | REV 2

FILENAME: 20FMD010.DWG

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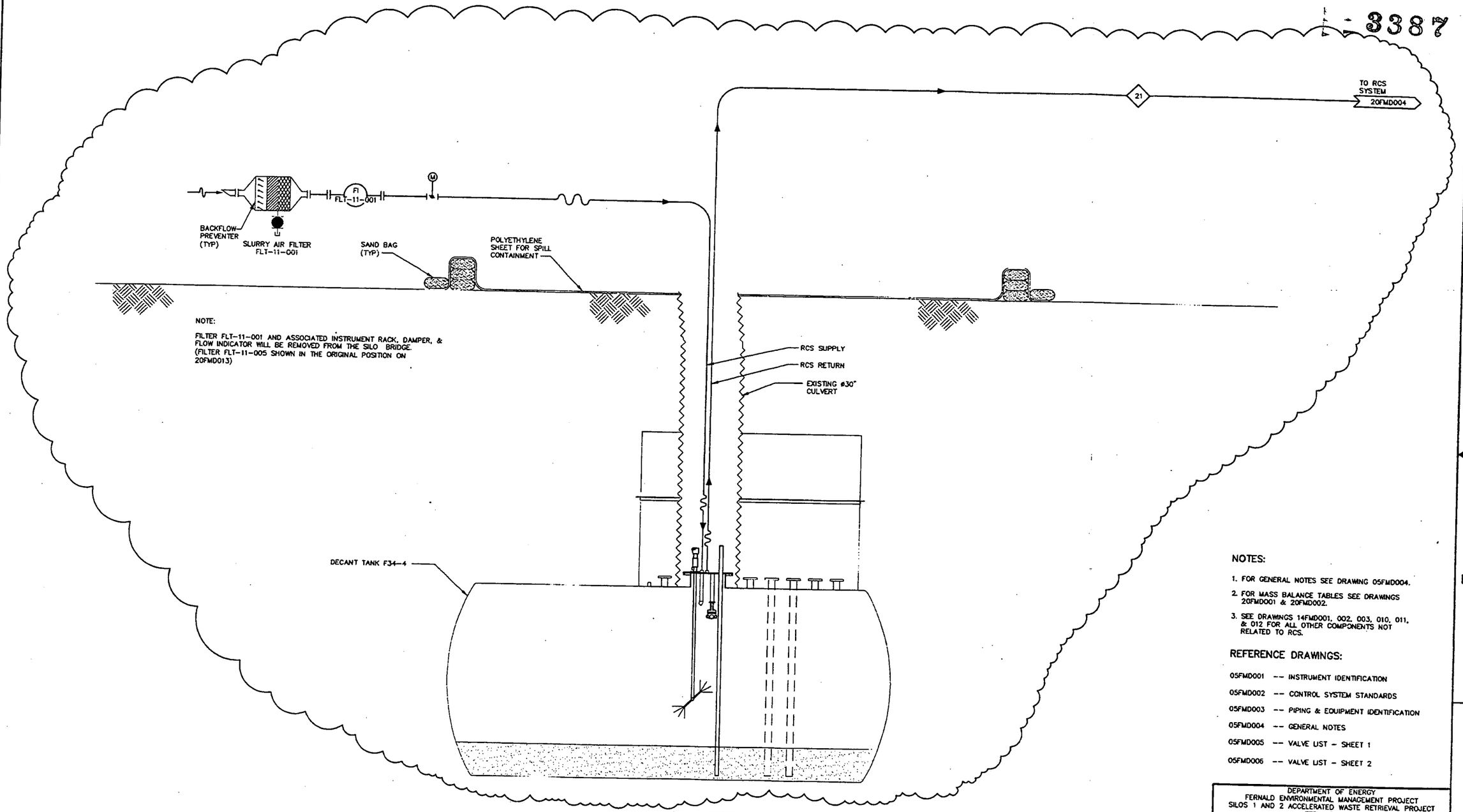


NOTE:

FILTER FLT-11-001 AND ASSOCIATED INSTRUMENT RACK, DAMPER, & FLOW INDICATOR WILL BE REMOVED FROM THE SILO BRIDGE. (FILTER FLT-11-005 SHOWN IN THE ORIGINAL POSITION ON 20FMD013)

NOTES:

1. FOR GENERAL NOTES SEE DRAWING 05FMD004.
2. FOR MASS BALANCE TABLES SEE DRAWINGS 20FMD001 & 20FMD002.
3. SEE DRAWINGS 14FMD001, 002, 003, 010, 011, & 012 FOR ALL OTHER COMPONENTS NOT RELATED TO RCS.

REFERENCE DRAWINGS:

05FMD001 -- INSTRUMENT IDENTIFICATION
05FMD002 -- CONTROL SYSTEM STANDARDS
05FMD003 -- PIPING & EQUIPMENT IDENTIFICATION
05FMD004 -- GENERAL NOTES
05FMD005 -- VALVE LIST - SHEET 1
05FMD006 -- VALVE LIST - SHEET 2

000359

THE ORIGINAL DRAWING AND SUBSEQUENT REVISIONS THEREOF, WITH APPROVAL NAMES, INITIALS, AND THE PE SEAL, IF APPLICABLE, ARE MAINTAINED IN THE FILES OF FWENC.

REV	DATE	BY	CHK'D	APR'VD	DESCRIPTION/ISSUE
2	08/00	BJD	SWH	KDR	REVISED PER CHANGE PROPOSAL CP-00-001
1	01/07/00	BJD	SWH	KDR	CERTIFIED FOR CONSTRUCTION
0	11/01/99	BJD	KR		PRELIMINARY DESIGN SUBMITTAL

RPE: STATE OF OHIO, KENNETH D. RICKETT, E-64418, REGISTERED PROFESSIONAL ENGINEER

DRAWN BY	B J DAVIS	DATE 01/07/00
DESIGNED BY	B J DAVIS	DATE 01/07/00
CHECKED BY	S W HUNGATE	DATE 01/07/00
APPROVED BY	KENNETH RICKETT	DATE 01/07/00
APPROVED BY	JOHN LAWSON	DATE 01/07/00

DEPARTMENT OF ENERGY
FERNALD ENVIRONMENTAL MANAGEMENT PROJECT
SILOS 1 AND 2 ACCELERATED WASTE RETRIEVAL PROJECT
FERNALD, OHIO
FDF CONTRACT NO. FSC 624

FOSTER WHEELER
FOSTER WHEELER ENVIRONMENTAL CORPORATION

TITLE
RADON CONTROL SYSTEM
PROCESS FLOW DIAGRAM
DECANT WASTE RETRIEVAL

SIZE: D | SCALE: NONE | DWG. NO. 20FMD011 | REV 2

000373

FILENAME: 20FMD011.DWG

3387

STORAGE TRAILER (T-411)

STORAGE TRAILER (T-412)

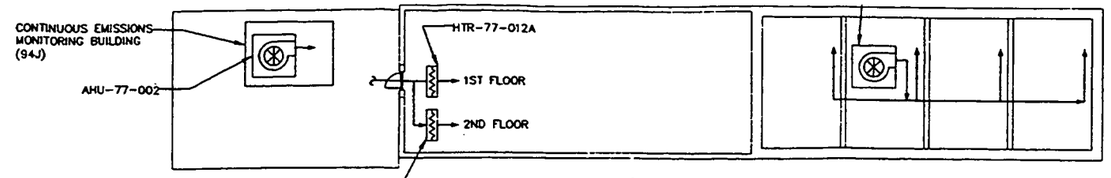
CONTROL TRAILER (T-409)

ELECTRICAL EQUIPMENT BUILDING (94G)

SUPPORT TRAILERS

STORAGE TRAILERS WILL NOT BE HEATED OR COOLED.

CONTROL TRAILER SUPPLIED WITH INDEPENDENT HEATING AND COOLING UNITS.

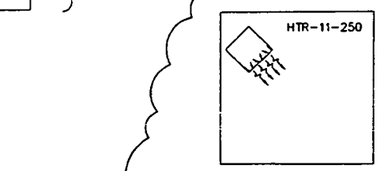


EQUIPMENT PAD

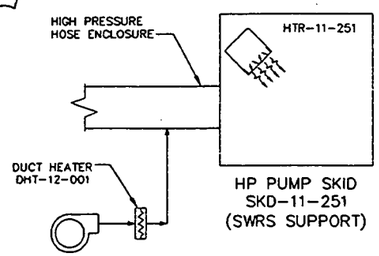
AIR HANDLING BUILDING / RCS (94E)

1. AIR HANDLING BUILDING & CARBON BED BUILDING HEATED BY AN ELECTRIC DUCT HEATER.
2. VENTILATION PROVIDED BY A VENTILATION SYSTEM. SEE DRAWINGS 77FMD003, 77FMD005, 77FMD006, & 77FMD008 FOR DETAILS.

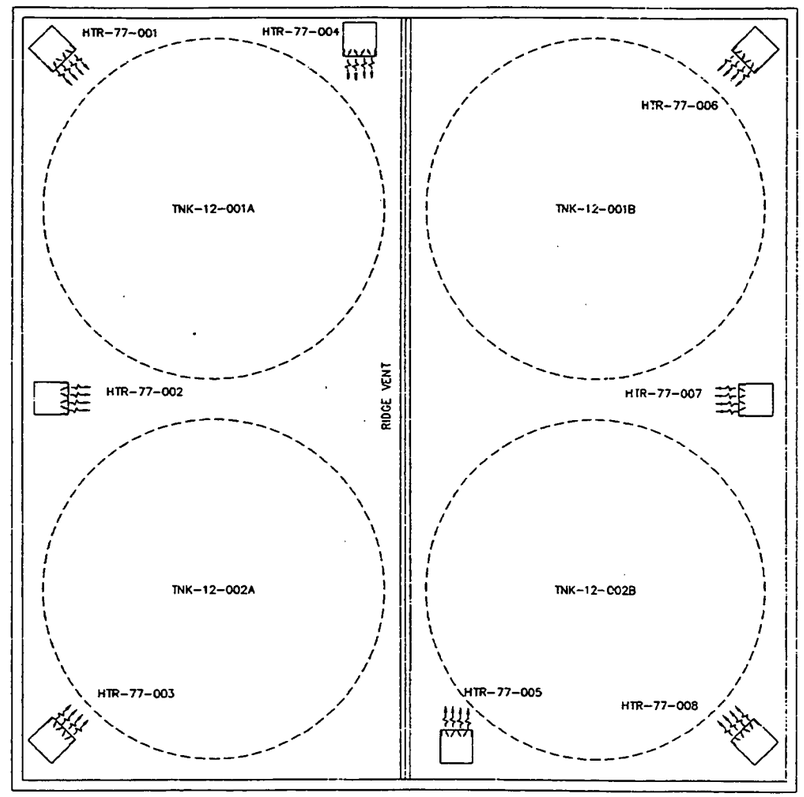
CARBON BED BUILDING / RCS (94D)



HP PUMP SKID
SKD-11-250
(FSM SUPPORT)



HP PUMP SKID
SKD-11-251
(SWRS SUPPORT)



TANK TRANSFER AREA BUILDING
(94C)

1. VENTILATION PROVIDED BY LOUVERS AND A RIDGE VENT.

HOLD

SUPPORT TRAILERS

1. ALL TRAILERS SUPPLIED WITH INDEPENDENT HEATING AND COOLING UNITS

H&S TRAILER (T-408)

H&S TRAILER (T-407)

BREAK TRAILER (T-406)

BREAK TRAILER (T-405)

OFFICE TRAILER (T-404)

OFFICE TRAILER (T-403)

EQUIPMENT MODULES

1. AIR LOCKS ARE PROVIDED WITH EACH ENCLOSURE.
2. RADIANT HEATERS ARE PROVIDED WITH EACH ENCLOSURE FOR FREEZE PROTECTION.
3. VENTILATION OF MODULES ARE PROVIDED BY THE RADON CONTROL SYSTEM. SEE SYSTEM 20 DRAWING FOR DETAILS.
4. SEE DRAWING 05FMD005 FOR MODULE LOCATIONS.

DECANT MODULE DEC-12-200	SLUICER MODULE SLC-11-204
DECANT MODULE DEC-12-201	SLUICER MODULE SLC-11-205
SLURRY MODULE SLR-11-200	EMMA MODULE EMA-14-400
SLURRY MODULE SLR-11-201	EMMA MODULE EMA-14-401
SLURRY MODULE SLR-11-202	DEBRIS REMOVAL MODULE DRM-11-600
SLUICER MODULE SLC-11-203	DEBRIS REMOVAL MODULE DRM-11-601

THE ORIGINAL DRAWING AND SUBSEQUENT REVISIONS THEREOF, WITH APPROVAL NAMES, INITIALS, AND THE PE SEAL, IF APPLICABLE, ARE MAINTAINED IN THE FILES OF FWENC.

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REV	DATE	BY	CHK'D	APR'VD	DESCRIPTION/ISSUE
0	08/16/00	BJD	KDR	KDR	CERTIFIED FOR CONSTRUCTION

RPE: STATE OF OHIO, KENNETH D. RICKETT, E-64418, REGISTERED PROFESSIONAL ENGINEER

Rev 0

DRAWN BY: B.J. Davis DATE: 08/16/00
DESIGNED BY: B.J. Davis DATE: 08/16/00
CHECKED BY: Kenneth D. Rickett DATE: 08/10/00
APPROVED BY: Kenneth D. Rickett DATE: 08/10/00
APPROVED BY: John Sanson DATE: 8/10/00

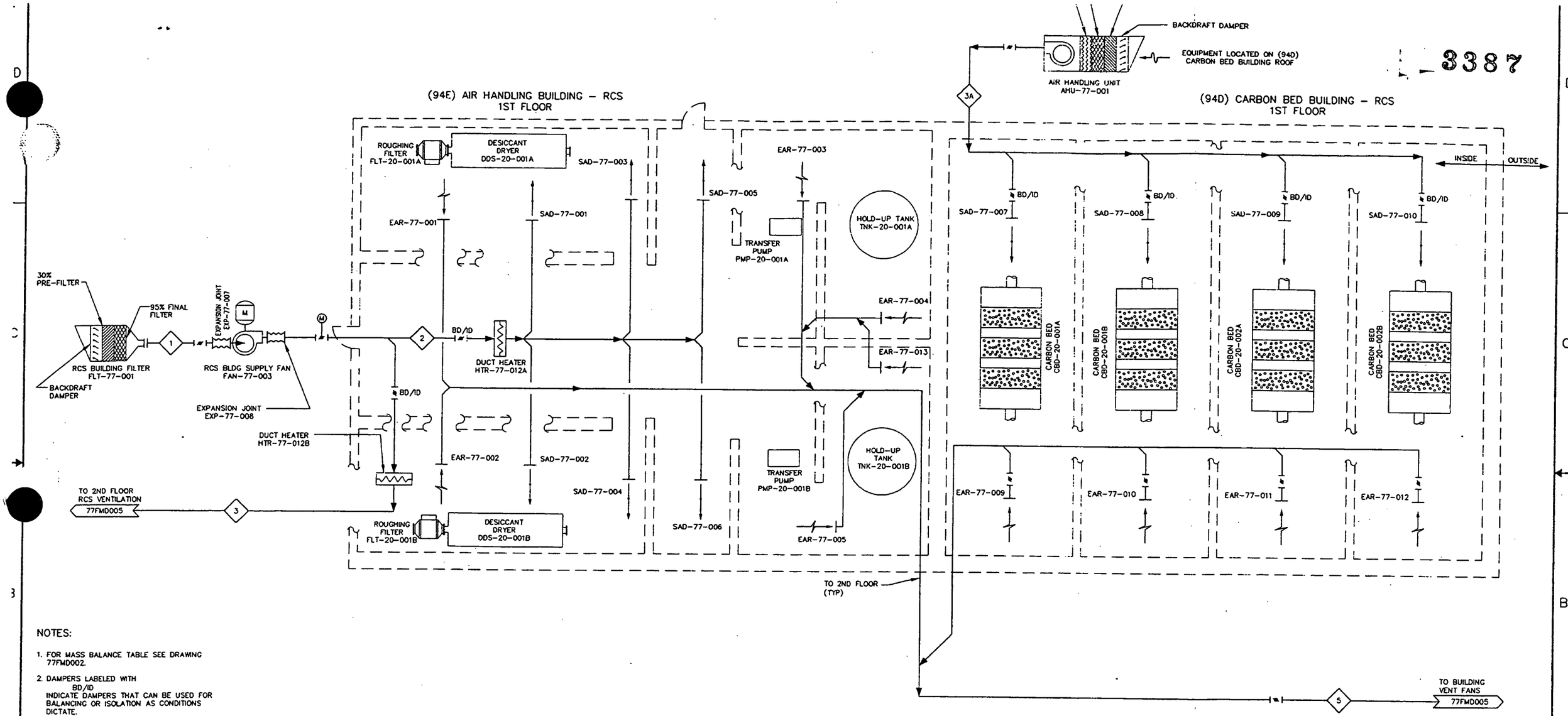
DEPARTMENT OF ENERGY
FERNALD ENVIRONMENTAL MANAGEMENT PROJECT
SILOS 1 AND 2 ACCELERATED WASTE RETRIEVAL PROJECT
FERNALD, OHIO
FDF CONTRACT NO. FSC 624

FOSTER WHEELER
FOSTER WHEELER ENVIRONMENTAL CORPORATION

TITLE: MISC FACILITIES HVAC SYSTEM HVAC FLOW DIAGRAM LOCATION AND CONTROL

SIZE: D | SCALE: NONE | DWG. NO. 77FMD001 | REV 0

3387



NOTES:

1. FOR MASS BALANCE TABLE SEE DRAWING 77FMD002.
2. DAMPERS LABELED WITH BD/ID INDICATE DAMPERS THAT CAN BE USED FOR BALANCING OR ISOLATION AS CONDITIONS DICTATE.
3. DAMPERS LABELED WITH LC BD/ID INDICATE DAMPERS THAT ARE TO BE LOCKED CLOSED DURING PHASE 1 OPERATION AND USED FOR BALANCING OR ISOLATION AS CONDITIONS DICTATE DURING ALL OTHER PHASES.

REFERENCE DRAWINGS:

05FMD001 -- INSTRUMENT IDENTIFICATION
05FMD002 -- CONTROL SYSTEM STANDARDS
05FMD003 -- PIPING & EQUIPMENT IDENTIFICATION
05FMD004 -- GENERAL NOTES
77FMD005 -- VALVE LIST – SHEET 1
77FMD006 -- VALVE LIST – SHEET 2

000361

000375

THE ORIGINAL DRAWING AND SUBSEQUENT REVISIONS THEREOF, WITH APPROVAL NAMES, INITIALS, AND THE PE SEAL, IF APPLICABLE, ARE MAINTAINED IN THE FILES OF FWENC.

REV	DATE	BY	CHK'D	APR'VD	DESCRIPTION/ISSUE
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PE: STATE OF OHIO, KENNETH D. RICKETT, E-64418, REGISTERED PROFESSIONAL ENGINEER

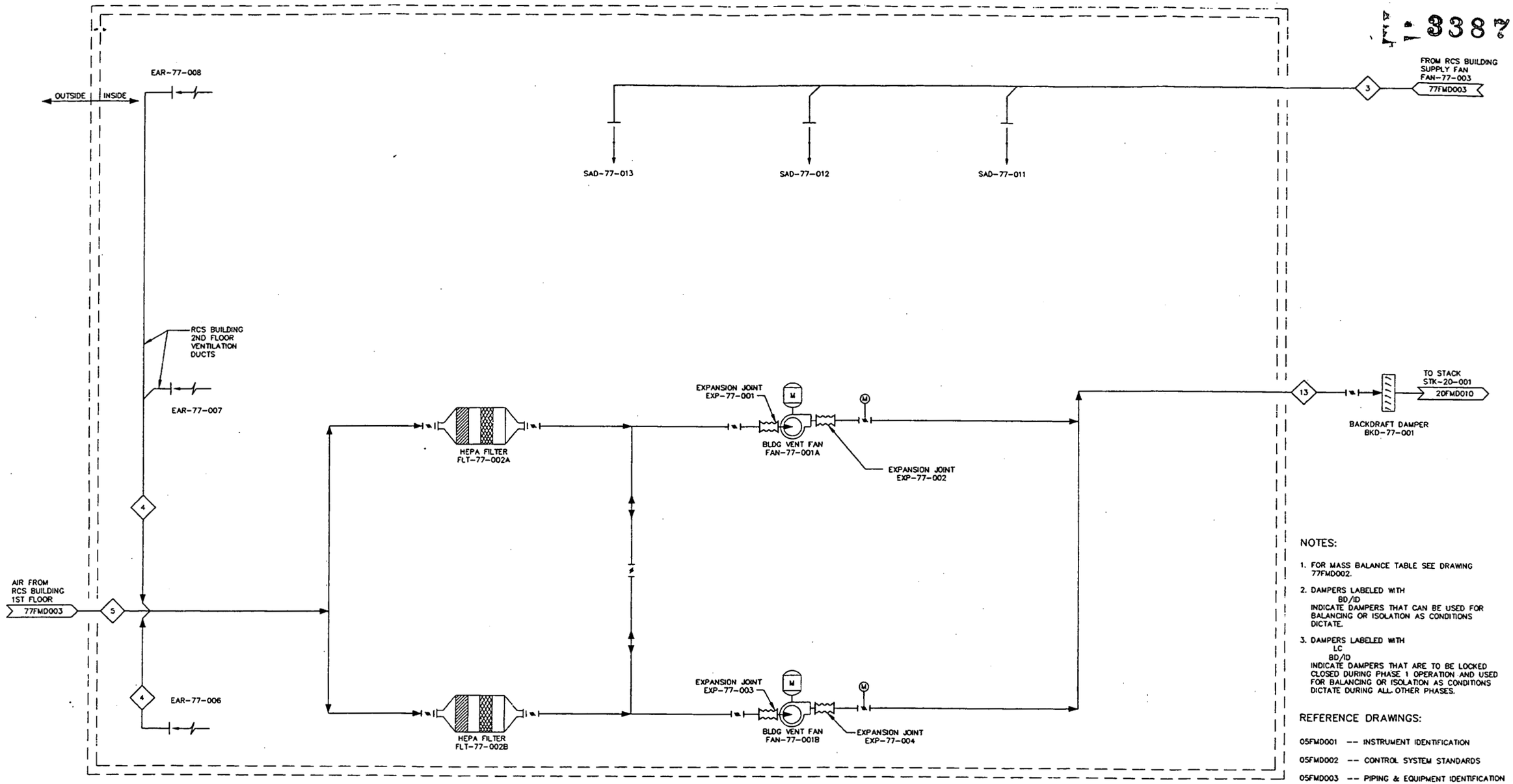
DRAWN BY	BJ Davis	DATE 08/10/00
DESIGNED BY	BJ Davis	DATE 08/10/00
CHECKED BY	Kenneth D. Rickett	DATE 08/10/00
APPROVED BY	Kenneth D. Rickett	DATE 08/10/00
APPROVED BY	Gil Lawson	DATE 8/10/00

DEPARTMENT OF ENERGY
FERNALD ENVIRONMENTAL MANAGEMENT PROJECT
SILOS 1 AND 2 ACCELERATED WASTE RETRIEVAL PROJECT
FERNALD, OHIO
FDF CONTRACT NO. FSC 624

FOSTER WHEELER
FOSTER WHEELER ENVIRONMENTAL CORPORATION

TITLE
MISC FACILITIES HVAC SYSTEM
HVAC FLOW DIAGRAM
RCS BLDG VENTILATION–1ST FL

SIZE	SCALE:	DWG. NO.	REV
D	NONE	77FMD003	0



(94E) AIR HANDLING BUILDING – RCS
2ND FLOOR

NOTES:

1. FOR MASS BALANCE TABLE SEE DRAWING 77FMD002.
2. DAMPERS LABELED WITH BD/ID INDICATE DAMPERS THAT CAN BE USED FOR BALANCING OR ISOLATION AS CONDITIONS DICTATE.
3. DAMPERS LABELED WITH LC BD/ID INDICATE DAMPERS THAT ARE TO BE LOCKED CLOSED DURING PHASE 1 OPERATION AND USED FOR BALANCING OR ISOLATION AS CONDITIONS DICTATE DURING ALL OTHER PHASES.

REFERENCE DRAWINGS:

05FMD001 -- INSTRUMENT IDENTIFICATION
05FMD002 -- CONTROL SYSTEM STANDARDS
05FMD003 -- PIPING & EQUIPMENT IDENTIFICATION
05FMD004 -- GENERAL NOTES
05FMD005 -- VALVE LIST – SHEET 1
05FMD006 -- VALVE LIST – SHEET 2

THE ORIGINAL DRAWING AND SUBSEQUENT REVISIONS THEREOF, WITH APPROVAL NAMES, INITIALS, AND THE PE SEAL, IF APPLICABLE, ARE MAINTAINED IN THE FILES OF FWENC.

DEPARTMENT OF ENERGY
FERNALD ENVIRONMENTAL MANAGEMENT PROJECT
SILOS 1 AND 2 ACCELERATED WASTE RETRIEVAL PROJECT
FERNALD, OHIO
FDF CONTRACT NO. FSC 624

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RPE
STATE OF OHIO
KENNETH D. RICKETT
E-64418
REGISTERED PROFESSIONAL ENGINEER

		DATE
DRAWN BY	BJ Davis	08/10/00
DESIGNED BY	BJ Davis	08/10/00
CHECKED BY	Kenneth D. Rickett	08/10/00
APPROVED BY	Kenneth D. Rickett	08/10/00
APPROVED BY	John Lawson	8/10/00

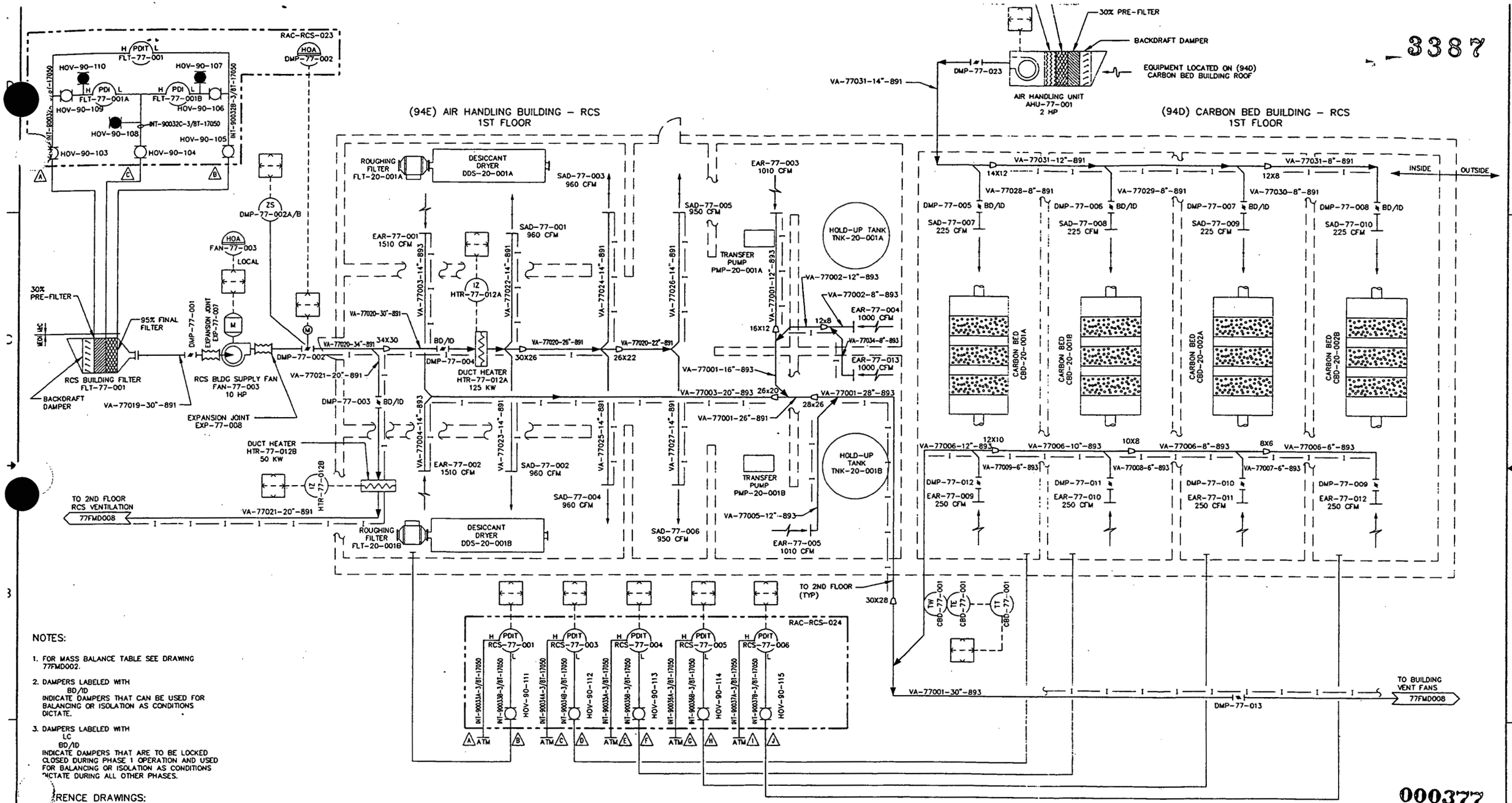
FOSTER WHEELER
FOSTER WHEELER ENVIRONMENTAL CORPORATION

TITLE
MISC FACILITIES HVAC SYSTEM
HVAC FLOW DIAGRAM
RCS BLDG VENTILATION–2ND FL

SIZE	SCALE:	DWG. NO.	REV
D	NONE	77FMD005	0

000376

3387



NOTES:

1. FOR MASS BALANCE TABLE SEE DRAWING 77FMD002.
2. DAMPERS LABELED WITH BD/ID INDICATE DAMPERS THAT CAN BE USED FOR BALANCING OR ISOLATION AS CONDITIONS DICTATE.
3. DAMPERS LABELED WITH LC BD/ID INDICATE DAMPERS THAT ARE TO BE LOCKED CLOSED DURING PHASE 1 OPERATION AND USED FOR BALANCING OR ISOLATION AS CONDITIONS DICTATE DURING ALL OTHER PHASES.

REFERENCE DRAWINGS:

05FMD001 -- INSTRUMENT IDENTIFICATION
05FMD002 -- CONTROL SYSTEM STANDARDS
05FMD003 -- PIPING & EQUIPMENT IDENTIFICATION
05FMD004 -- GENERAL NOTES
05FMD005 -- VALVE LIST – SHEET 1
05FMD006 -- VALVE LIST – SHEET 2

000377

000363

THE ORIGINAL DRAWING AND SUBSEQUENT REVISIONS THEREOF, WITH APPROVAL NAMES, INITIALS, AND THE PE SEAL, IF APPLICABLE, ARE MAINTAINED IN THE FILES OF FWENC.

REV	DATE	BY	CHK'D	APR'VD	DESCRIPTION/ISSUE
0	08/10/00	MD	KDR	KDR	CERTIFIED FOR CONSTRUCTION

PE: STATE OF OHIO, KENNETH D RICKETT, E-64418, REGISTERED PROFESSIONAL ENGINEER

		DATE
DRAWN BY	B J Davis	08/10/00
DESIGNED BY	B J Davis	08/10/00
CHECKED BY	Kenneth D Rickett	08/10/00
APPROVED BY	Kenneth D Rickett	08/10/00
APPROVED BY	John Lawson	8/10/00

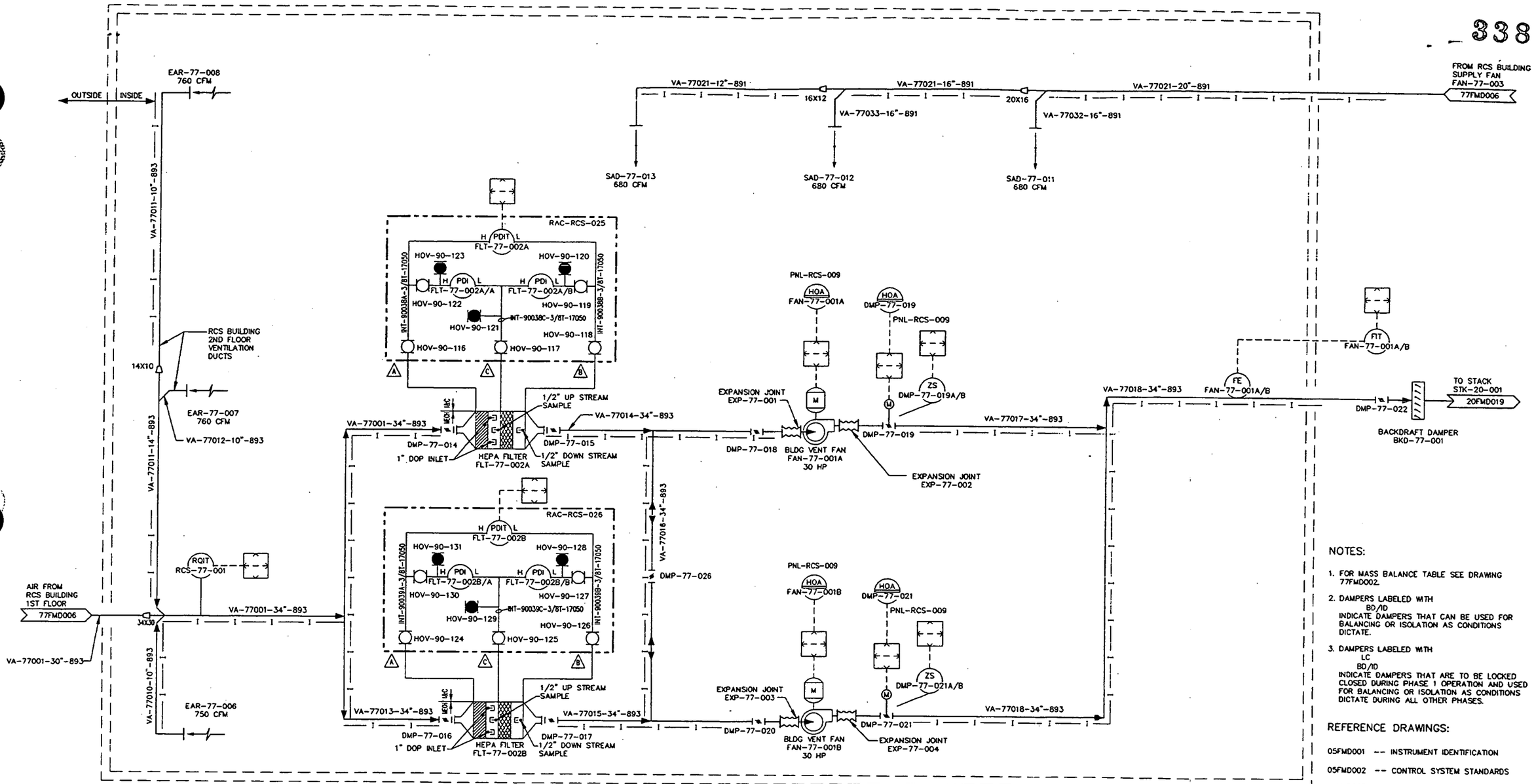
DEPARTMENT OF ENERGY
FERNALD ENVIRONMENTAL MANAGEMENT PROJECT
SILOS 1 AND 2 ACCELERATED WASTE RETRIEVAL PROJECT
FERNALD, OHIO
FDF CONTRACT NO. FSC 624

FOSTER WHEELER
FOSTER WHEELER ENVIRONMENTAL CORPORATION

TITLE
MISC FACILITIES HVAC SYSTEM
HVAC CONTROL DIAGRAM
RCS BLDG VENTILATION–1ST FL

SIZE	SCALE	DWG. NO.	REV
D	NONE	77FMD006	0

3387



(94E) AIR HANDLING BUILDING – RCS
2ND FLOOR

NOTES:

1. FOR MASS BALANCE TABLE SEE DRAWING 77FMD002.
2. DAMPERS LABELED WITH BD/ID INDICATE DAMPERS THAT CAN BE USED FOR BALANCING OR ISOLATION AS CONDITIONS DICTATE.
3. DAMPERS LABELED WITH LC BD/ID INDICATE DAMPERS THAT ARE TO BE LOCKED CLOSED DURING PHASE 1 OPERATION AND USED FOR BALANCING OR ISOLATION AS CONDITIONS DICTATE DURING ALL OTHER PHASES.

REFERENCE DRAWINGS:

05FMD001 -- INSTRUMENT IDENTIFICATION
05FMD002 -- CONTROL SYSTEM STANDARDS
05FMD003 -- PIPING & EQUIPMENT IDENTIFICATION
05FMD004 -- GENERAL NOTES
05FMD005 -- VALVE LIST – SHEET 1
05FMD006 -- VALVE LIST – SHEET 2

000378

THE ORIGINAL DRAWING AND SUBSEQUENT REVISIONS THEREOF, WITH APPROVAL NAMES, INITIALS, AND THE PE SEAL, IF APPLICABLE, ARE MAINTAINED IN THE FILES OF FWENC.

REV	DATE	BY	CHK'D	APR'VD	DESCRIPTION/ISSUE
0	08/10/00	BJD	KDR	KDR	CERTIFIED FOR CONSTRUCTION

PE STATE OF OHIO KENNETH D. RICKETT E-64418 REGISTERED PROFESSIONAL ENGINEER 8-10-00

DRAWN BY B.J. Davis DATE 08/10/00
DESIGNED BY B.J. Davis DATE 08/10/00
CHECKED BY Kenneth D. Rickett DATE 08/10/00
APPROVED BY Kenneth D. Rickett DATE 08/10/00
APPROVED BY John Lawson DATE 8/11/00

DEPARTMENT OF ENERGY
FERNALD ENVIRONMENTAL MANAGEMENT PROJECT
SILOS 1 AND 2 ACCELERATED WASTE RETRIEVAL PROJECT
FERNALD, OHIO
FDF CONTRACT NO. FSC 624

FOSTER WHEELER
FOSTER WHEELER ENVIRONMENTAL CORPORATION

TITLE
MISC FACILITIES HVAC SYSTEM
HVAC CONTROL DIAGRAM
RCS BLDG VENTILATION–2ND FL

SIZE D | SCALE: NONE | DWG. NO. 77FMD008 | REV 0

000364

E-3387

Appendix B

GENERAL ARRANGEMENT DRAWINGS

For information regarding General Arrangement Drawings, please see the following drawings:

DRAWING NUMBER	DRAWING TITLE	REVISION
05FMD010	MISC. FACILITIES GENERAL ARRANGEMENT KEY PLAN	3
10FMD017	FULL-SCALE MOCKUP SYSTEM GENERAL ARRANGEMENT SHEET 1 OF 2	3
10FMD018	FULL-SCALE MOCKUP SYSTEM SECTION SHEET 2 OF 2	2
11FCD003	SILO WASTE RETRIEVAL SYSTEM EXCAVATION PLAN PHASE 1	C
11FMD019	SILO WASTE RETRIEVAL SYSTEM GENERAL ARRANGEMENT SILO 1 & 2 BRIDGE	2
11FMD020	SILO WASTE RETRIEVAL SYSTEM GENERAL ARRANGEMENT SILO 1 & 2 BRIDGE	2

GENERAL ARRANGEMENT DRAWINGS

DOCUMENT NO. 624-P622-12

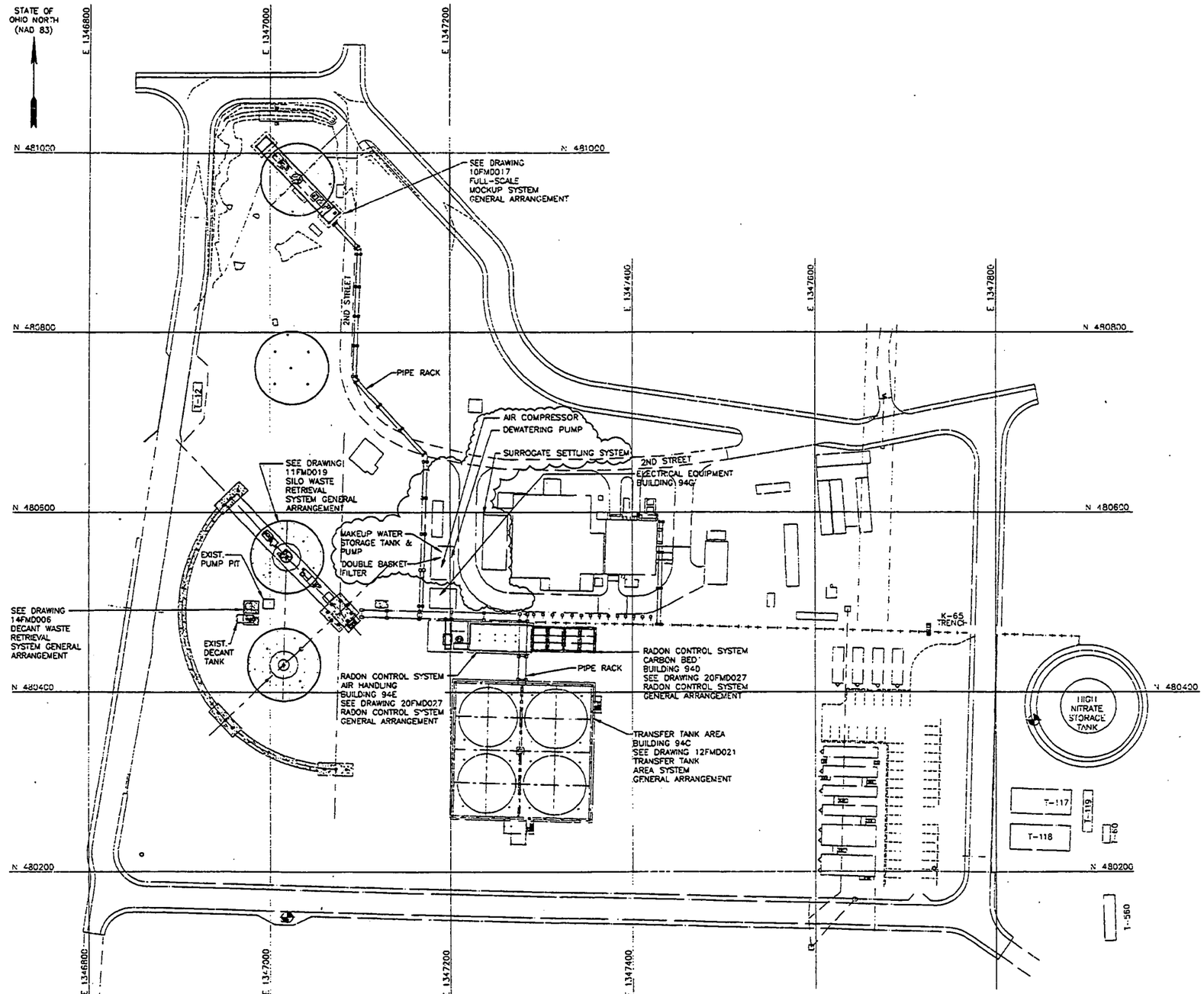
DRAWING NUMBER	DRAWING TITLE	REVISION
12FMD021	TRANSFER TANK SYSTEM GENERAL ARRANGEMENT SHEET 1 OF 6	2
12FMD022	TRANSFER TANK SYSTEM GENERAL ARRANGEMENT SHEET 2 OF 6	2
12FMD023	TRANSFER TANK SYSTEM GENERAL ARRANGEMENT SHEET 3 OF 6	1
12FMD024	TRANSFER TANK SYSTEM GENERAL ARRANGEMENT SHEET 4 OF 6	1
12FMD025	TRANSFER TANK SYSTEM GENERAL ARRANGEMENT SHEET 5 OF 6	1
12FMD026	TRANSFER TANK SYSTEM GENERAL ARRANGEMENT SHEET 6 OF 6	2
14FMD006	DECANT WASTE RETRIEVAL SYSTEM GENERAL ARRANGEMENT SHEET 1 0F 2	3
14FMD007	DECANT WASTE RETRIEVAL SYSTEM GENERAL ARRANGEMENT SHEET 2 0F 2	3

GENERAL ARRANGEMENT DRAWINGS

DOCUMENT NO. 624-P622-12

DRAWING NUMBER	DRAWING TITLE	REVISION
20FMD027	RADON CONTROL SYSTEM GENERAL ARRANGEMENT 1st FLOOR	3
20FMD028	RADON CONTROL SYSTEM GENERAL ARRANGEMENT 2ND FLOOR	3
20FMD148	RADON CONTROL SYSTEM GENERAL ARRANGEMENT RCS EXHAUST STACK	0

3387



INFORMATION ONLY

UNCONTROLLED

000382

000368

THE ORIGINAL DRAWING AND SUBSEQUENT REVISIONS THEREOF, WITH APPROVAL NAMES, INITIALS, AND THE PE SEAL, IF APPLICABLE, ARE MAINTAINED IN THE FILES OF FWENC.

REV	DATE	BY	CHK'D	APR'VD	DESCRIPTION/ISSUE
3					RELOCATED EQUIPMENT, DELETED EQUIPMENT AND ADDED EQUIPMENT
2	01/07/00	WCB	SWH	KDR	CERTIFIED FOR CONSTRUCTION
1	12/01/99	WCB	SWH		REVISED FOR NOZZLE LOCATIONS
0	11/99	WCB	SWH		PRELIMINARY DESIGN SUBMITTAL

RPE

DRAWN BY W C BLUME	DATE 01/07/00	
DESIGNED BY W C BLUME	DATE 01/07/00	
CHECKED BY S W HUNGATE	DATE 01/07/00	
APPROVED BY KENNETH RICKETT	DATE 01/07/00	
APPROVED BY JOHN LAWSON	DATE 01/07/00	

DEPARTMENT OF ENERGY
FERNALD ENVIRONMENTAL MANAGEMENT PROJECT
SILOS 1 AND 2 ACCELERATED WASTE RETRIEVAL PROJECT
FERNALD, OHIO
FDF CONTRACT NO. FSC 624

FOSTER WHEELER
FOSTER WHEELER ENVIRONMENTAL CORPORATION

MISC FACILITIES
GENERAL ARRANGEMENT
KEY PLAN

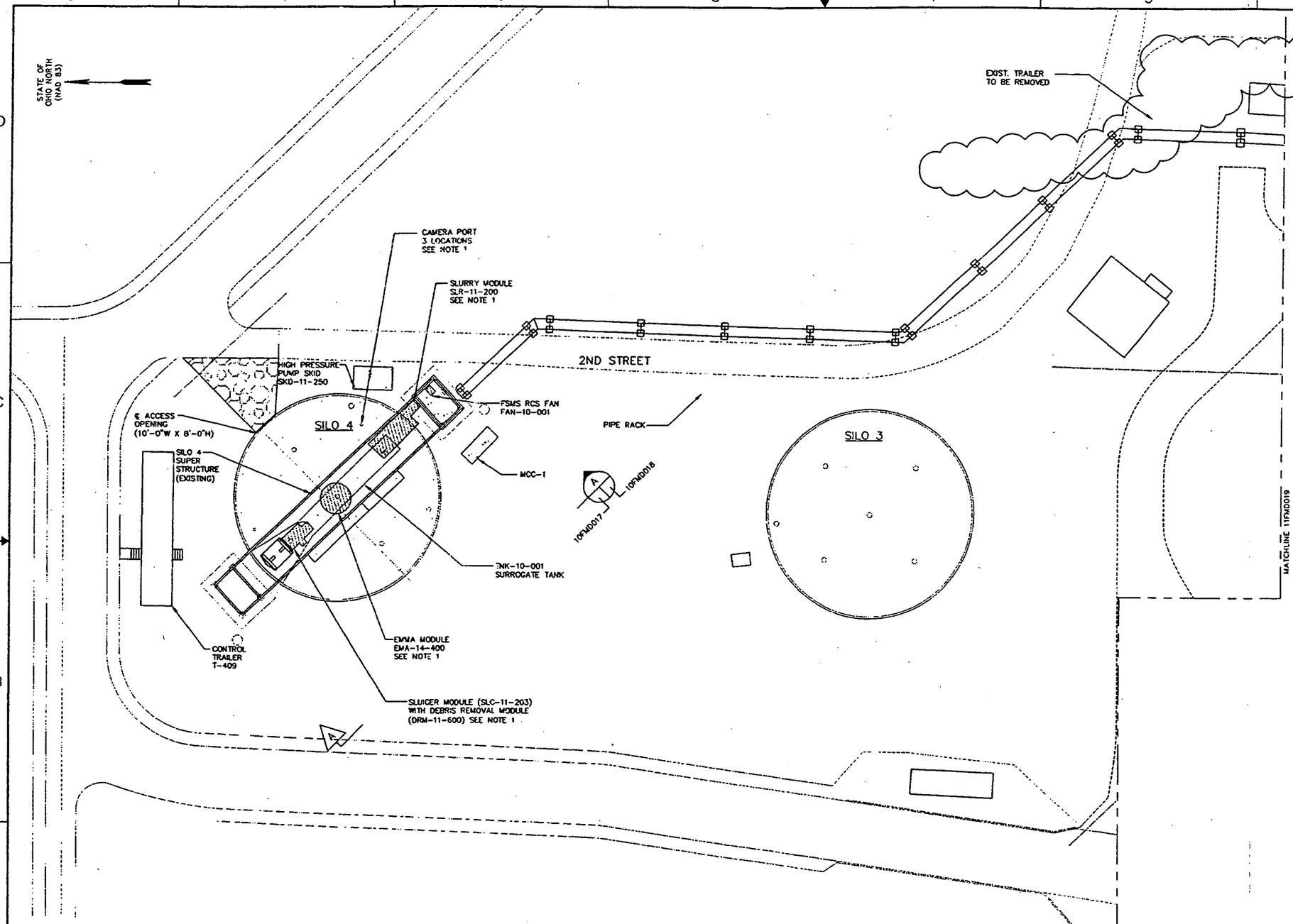
SIZE	SCALE:	DWG. NO.	REV
D	1"=60'-0"	05FMD010	3

FILENAME: 05FMD010.DWG

G:\EMIRGE\FOFSILOS\WEC\05FMD010.dwg Thu Jan 22 14:11:16 2000

DWG REF DRAWINGS

3387



NOTES:

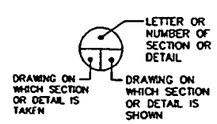
1. FOR RISER DETAILS, SEE SILO PENETRATION AND RISER INSTALLATION PLAN, DOCUMENT NO. 624-P622-63

REFERENCE DRAWINGS:

05FMD010 GENERAL ARRANGEMENT KEY PLAN

000383

000369



SECTION & DETAIL KEY

UNDER TEMPORARY AUTHORIZATION (BASED ON APPLICATION TO REGISTER BY COMITY IN THE STATE OF OHIO, DATED DECEMBER 6, 1999) WHICH WILL EXPIRE ON MARCH 31, 2000.

REV	DATE	BY	CHK'D	APR'VD	DESCRIPTION/ISSUE
3	8/8/00	[illegible]	[illegible]	[illegible]	REVISED PER CHANGE PROPOSAL CP-00-004
2	01/07/00	WCB	SWH	KDR	CERTIFIED FOR CONSTRUCTION
1	12/01/99	WCB	SWH		REVISED FOR NOZZLE LOCATIONS
0	11/99	WCB	RAR		PRELIMINARY DESIGN SUBMITTAL

RPE

STATE OF OHIO KENNETH D. RICKETT E-64418 REGISTERED PROFESSIONAL ENGINEER

DRAWN BY	W C BLUME	DATE 01/07/00
DESIGNED BY	W C BLUME	DATE 01/07/00
CHECKED BY	S W HUNGATE	DATE 01/07/00
APPROVED BY	KENNETH RICKETT	DATE 01/07/00
APPROVED BY	JOHN LAWSON	DATE 01/07/00

DEPARTMENT OF ENERGY
FERNALD ENVIRONMENTAL MANAGEMENT PROJECT
SILOS 1 AND 2 ACCELERATED WASTE RETRIEVAL PROJECT
FERNALD, OHIO
FDF CONTRACT NO. FSC 624

FOSTER WHEELER
FOSTER WHEELER ENVIRONMENTAL CORPORATION

TITLE
FULL-SCALE MOCKUP SYSTEM
GENERAL ARRANGEMENT
SHEET 1 OF 2

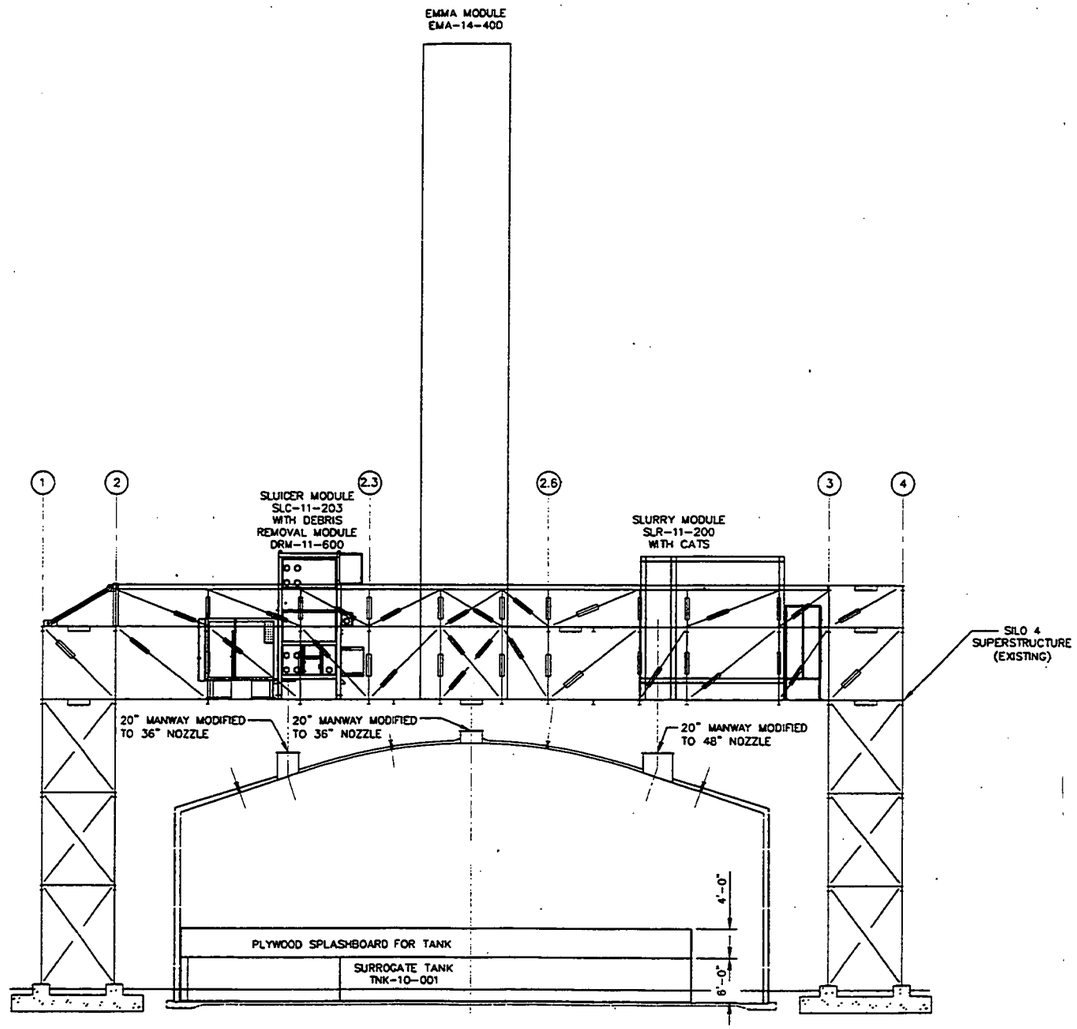
SIZE	SCALE:	DWG. NO.	REV
D	1"=20'-0"	10FMD017	3

FILENAME: 10FMD017.DWG

G:\CHARGE\FDFSILOS\MEC\[illegible]017.dwg Thu Aug 31 12:17:52 2000

3387

INFORMATION ONLY



A SECTION
SCALE: 1"=10'-0"
10FMD017 10FMD018

000384

UNDER TEMPORARY AUTHORIZATION (BASED ON APPLICATION TO REGISTER BY COMITY IN THE STATE OF OHIO, DATED DECEMBER 6, 1999) WHICH WILL EXPIRE ON MARCH 31, 2000.

DEPARTMENT OF ENERGY
FERNALD ENVIRONMENTAL MANAGEMENT PROJECT
SILOS 1 AND 2 ACCELERATED WASTE RETRIEVAL PROJECT
FERNALD, OHIO
FDF CONTRACT NO. FSC 624

FOSTER WHEELER
FOSTER WHEELER ENVIRONMENTAL CORPORATION

TITLE
FULL-SCALE MOCKUP SYSTEM
SECTION
SHEET 2 OF 2

RPE	KENNETH D. RICKETT P.E. NO. 103742 01/07/00 REVISION 2
DRAWN BY	W C BLUME 01/07/00
DESIGNED BY	W C BLUME 01/07/00
CHECKED BY	S W HUNGATE 01/07/00
APPROVED BY	KENNETH RICKETT 01/07/00
APPROVED BY	JOHN LAWSON 01/07/00
SIZE	D
SCALE:	1"=10'-0"
DWG. NO.	10FMD018
REV	2

REV	DATE	BY	CHK'D	APR'VD	DESCRIPTION/ISSUE
2	01/07/00	WCB	SWH	KDR	CERTIFIED FOR CONSTRUCTION
1	12/01/99	WCB	SWH		REVISED FOR NOZZLE LOCATIONS
0	11/99	WCB	RAR		PRELIMINARY DESIGN SUBMITTAL

LETTER OR NUMBER OF SECTION OR DETAIL
DRAWING ON WHICH SECTION OR DETAIL IS TAKEN
DRAWING ON WHICH SECTION OR DETAIL IS SHOWN
SECTION & DETAIL KEY

000370

FILENAME: 10FMD018

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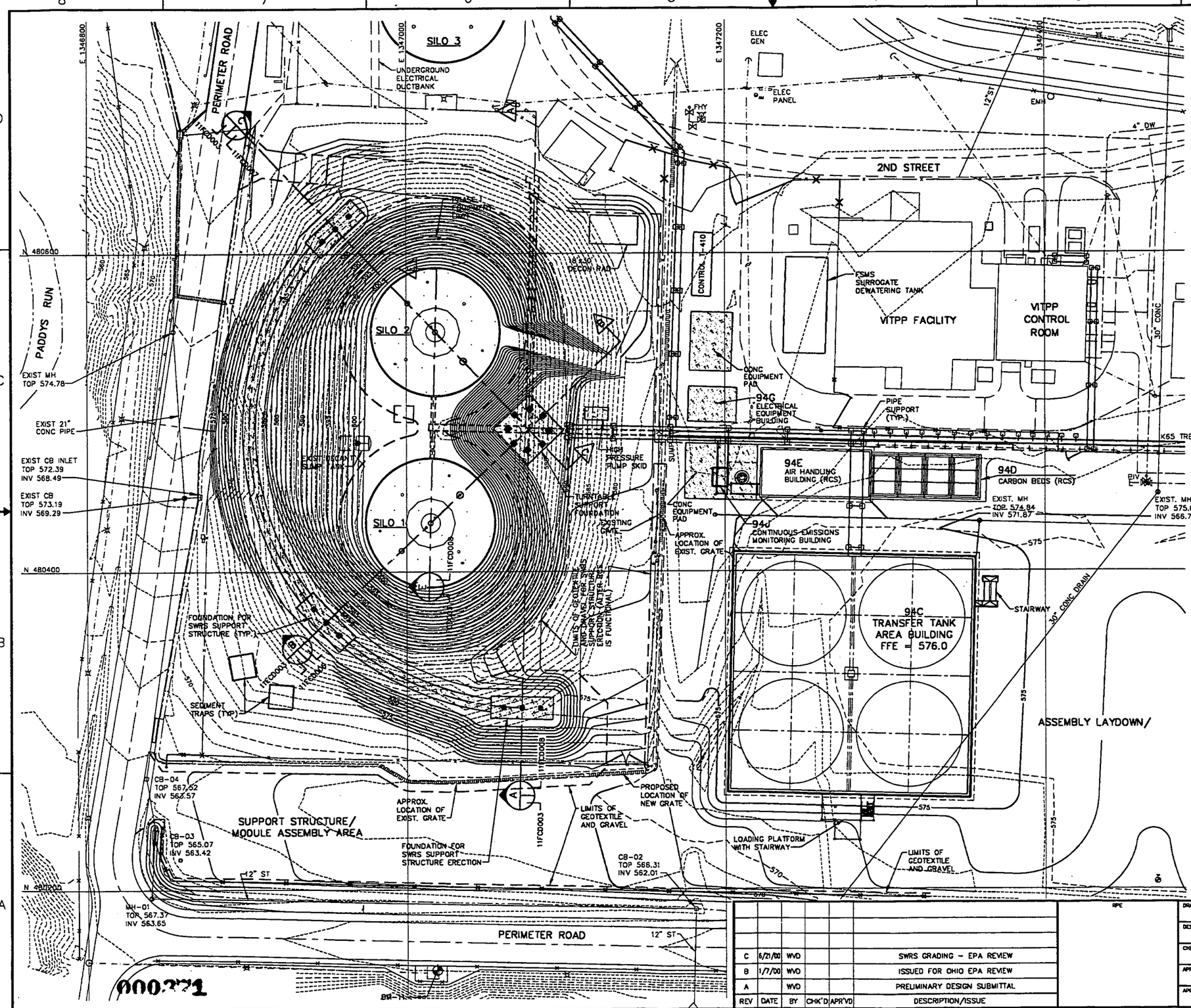
3387



NOTES:

HOLD

1. SEE DRAWING 05FCD011 FOR GENERAL NOTES AND LEGEND.
2. SEE DRAWING 66FCD002 FOR STORM WATER SYSTEM DRAINAGE PLAN.
4. SEE DRAWING 66FCD007 FOR STORM WATER SYSTEM PROFILES.
5. CONTRACTOR WILL BE RESPONSIBLE FOR LOCATING EXISTING UTILITIES BEFORE BEGINNING EXCAVATION.
6. ALL EROSION CONTROL MEASURES WILL BE INSTALLED AT THE BEGINNING OF EXCAVATION AND MAINTAINED FOR THE DURATION OF THE PROJECT.
7. AREAS DISTURBED BY EXCAVATION ACTIVITIES ARE TO BE SEEDED AND MULCHED AS SOON AS PRACTICAL. REFER TO SPECIFICATION SECTION 02924.
8. REFER TO SPECIFICATION SECTION 02300 FOR EARTHWORK.
9. BM-11 LOCATION: N 480,149.10, E 1,347,018.61, ELEV. 569.14
10. SEPARATION FABRIC SHALL BE MIRAFI 180 N OR EQUIVALENT.
11. REFER TO SPECIFICATION SECTION 02722 FOR AGGREGATE AND/OR GRADED, CRUSHED AGGREGATE BASE COURSE.
12. REFER TO SPECIFICATION SECTION 02630 FOR STORM DRAINAGE.
13. CONTRACTOR RESPONSIBLE FOR LOCATING EXISTING FEATURES WITH SURVEY TIE-INS.
14. EXISTING STANDPIPE AT DECANT SUMP TANK TO BE PROTECTED DURING ALL PHASES OF EXCAVATION WITH A 2' HAND EXCAVATION AREA AROUND PIPE.

STATE OF OHIO NORTH (NAD 83)

LETTER OR NUMBER OF SECTION OR DETAIL

DRAWING ON WHICH SECTION OR DETAIL IS TAKEN

DRAWING ON WHICH SECTION OR DETAIL IS SHOWN

SECTION & DETAIL KEY

000385

30 0 30 60

SCALE IN FEET

REV	DATE	BY	CHK'D	APR'VD	DESCRIPTION/ISSUE
C	6/21/00	WVD			SWRS GRADING - EPA REVIEW
B	1/7/00	WVD			ISSUED FOR OHIO EPA REVIEW
A		WVD			PRELIMINARY DESIGN SUBMITTAL

RPE

DRAWN BY DATE
DESIGNED BY DATE
CHECKED BY DATE
APPROVED BY DATE
APPROVED BY DATE

DEPARTMENT OF ENERGY
FERNALD ENVIRONMENTAL MANAGEMENT PROJECT
SILOS 1 AND 2 ACCELERATED WASTE RETRIEVAL PROJECT
FERNALD, OHIO
FDF CONTRACT NO. FSC 624

FOSTER WHEELER
FOSTER WHEELER ENVIRONMENTAL CORPORATION

TITLE
SILO WASTE RETRIEVAL SYSTEM
EXCAVATION PLAN
PHASE 1

SIZE D | SCALE: 1"=30' | DWG. NO. 11FCD003 | REV C

FILENAME: 11FCD003.DWG

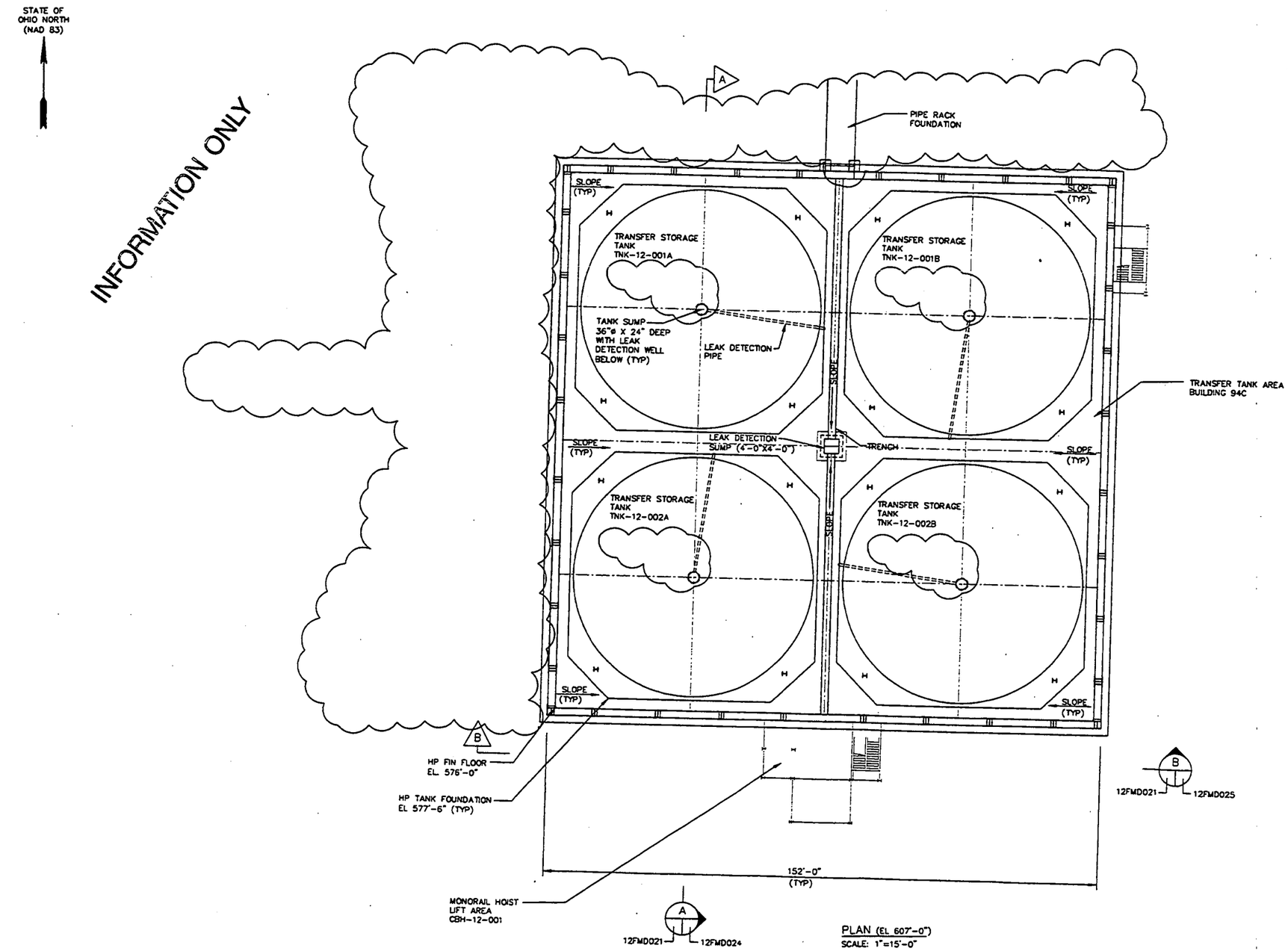
XREF DRAWINGS: 30-

000371

NOTES:

1. RATE OF FLOOR SLOPE IS 1"/8'-0" UNLESS NOTED OTHERWISE.

3387



PLAN (EL 607'-0")
SCALE: 1"=15'-0"

REFERENCE DRAWINGS:
05FMD010 GENERAL ARRANGEMENT KEYPLAN

000386

UNDER TEMPORARY AUTHORIZATION (BASED ON APPLICATION TO REGISTER BY COMITY IN THE STATE OF OHIO, DATED DECEMBER 6, 1999) WHICH WILL EXPIRE ON MARCH 31, 2000.

LETTER OR NUMBER OF SECTION OR DETAIL
DRAWING ON WHICH SECTION OR DETAIL IS TAKEN
DRAWING ON WHICH SECTION OR DETAIL IS SHOWN
SECTION & DETAIL KEY

000372

REV	DATE	BY	CHK'D	APR'VD	DESCRIPTION/ISSUE
2					REVISED PER CHANGE PROPOSAL CP-00-001
1	01/07/00	WCB	SWH	KDR	CERTIFIED FOR CONSTRUCTION
0	11/01/99	WCB	SWH		PRELIMINARY DESIGN SUBMITTAL

RPE

		DATE
DRAWN BY	W C BLUME	01/07/00
DESIGNED BY	W C BLUME	01/07/00
CHECKED BY	S W HUNGATE	01/07/00
APPROVED BY	KENNETH RICKETT	01/07/00
APPROVED BY	JOHN LAWSON	01/07/00

DEPARTMENT OF ENERGY
FERNALD ENVIRONMENTAL MANAGEMENT PROJECT
SILOS 1 AND 2 ACCELERATED WASTE RETRIEVAL PROJECT
FERNALD, OHIO
FDF CONTRACT NO. FSC 624

FOSTER WHEELER
FOSTER WHEELER ENVIRONMENTAL CORPORATION

TITLE
TRANSFER TANK SYSTEM
GENERAL ARRANGEMENT
SHEET 1 OF 6

SIZE: D | SCALE: 1"=15'-0" | DWG. NO. 12FMD021 | REV 2

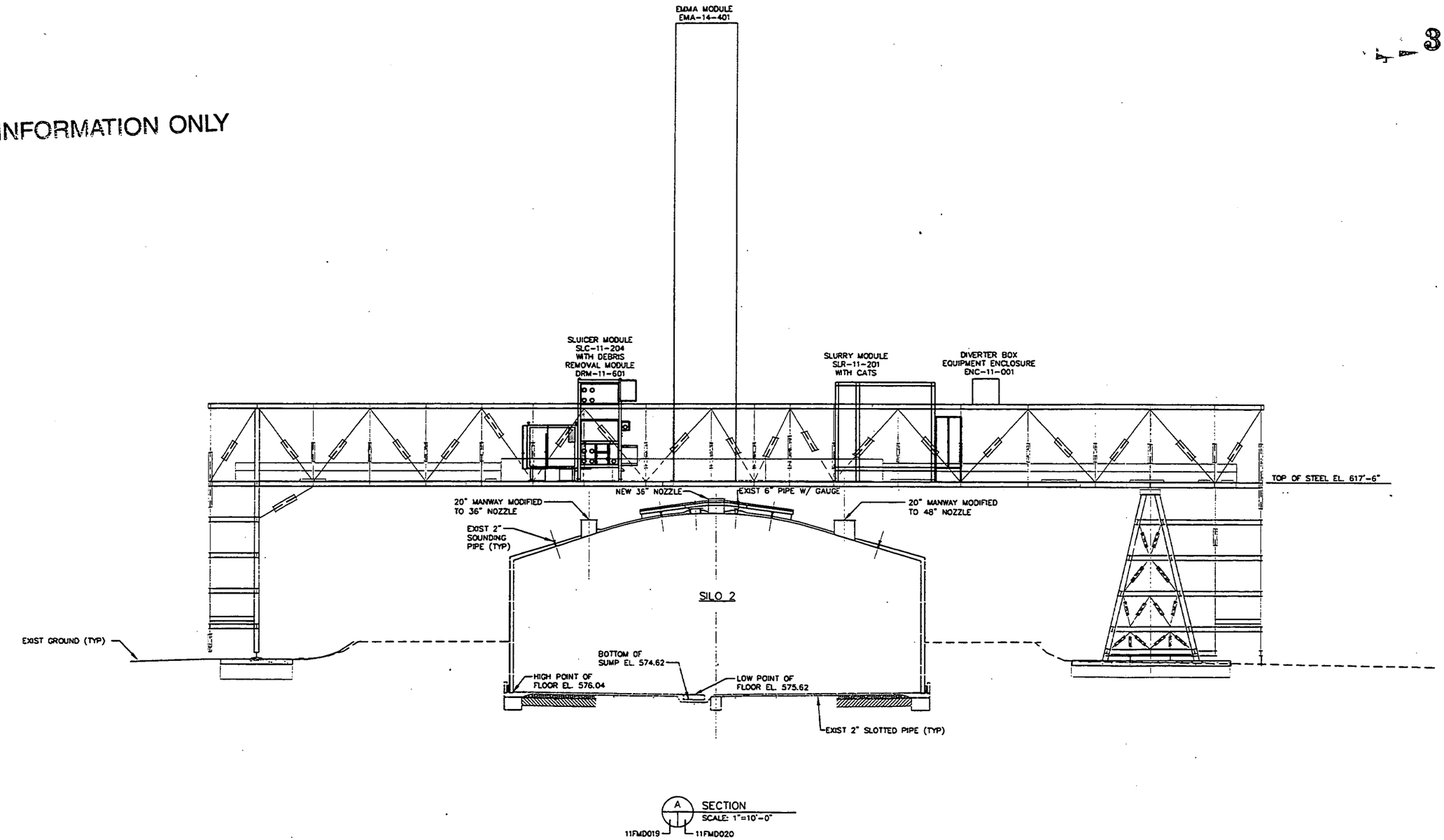
FILENAME: 12FMD021

XREF DRAWINGS: 10FMD010.DWG

G:\CHARGE\F[illegible]S\MEC\SYS12\12fmd021.dwg Thu Jun 01 15:56:55 2000

3387

INFORMATION ONLY



000387

UNDER TEMPORARY AUTHORIZATION (BASED ON APPLICATION TO REGISTER BY COMITY IN THE STATE OF OHIO, DATED DECEMBER 6, 1999) WHICH WILL EXPIRE ON MARCH 31, 2000.

DEPARTMENT OF ENERGY
FERNALD ENVIRONMENTAL MANAGEMENT PROJECT
SILOS 1 AND 2 ACCELERATED WASTE RETRIEVAL PROJECT
FERNALD, OHIO
FDF CONTRACT NO. FSC 624

LETTER OR NUMBER OF SECTION OR DETAIL
DRAWING ON WHICH SECTION OR DETAIL IS TAKEN
DRAWING ON WHICH SECTION OR DETAIL IS SHOWN
SECTION & DETAIL KEY

REV	DATE	BY	CHK'D	APR'VD	DESCRIPTION/ISSUE
2	01/07/00	WCB	SWH	KDR	CERTIFIED FOR CONSTRUCTION
1	12/01/99	WCB	SWH		REVISED FOR NOZZLE LOCATIONS
0	11/99	WCB	SWH		PRELIMINARY DESIGN SUBMITTAL

RPE
KENNETH D. RICKETT
P.E. NO. 103742
01/07/00
REVISION 2

		DATE
DRAWN BY	W C BLUME	01/07/00
DESIGNED BY	W C BLUME	01/07/00
CHECKED BY	S W HUNGATE	01/07/00
APPROVED BY	KENNETH RICKETT	01/07/00
APPROVED BY	JOHN LAWSON	01/07/00

FOSTER WHEELER
FOSTER WHEELER ENVIRONMENTAL CORPORATION

TITLE
SILO WASTE RETRIEVAL SYSTEM
GENERAL ARRANGEMENT
SILO 1 & 2 BRIDGE

SIZE D | SCALE: 1"=10'-0" | DWG. NO. 11FMD020 | REV 2

000373

FILENAME: 11FMD020.

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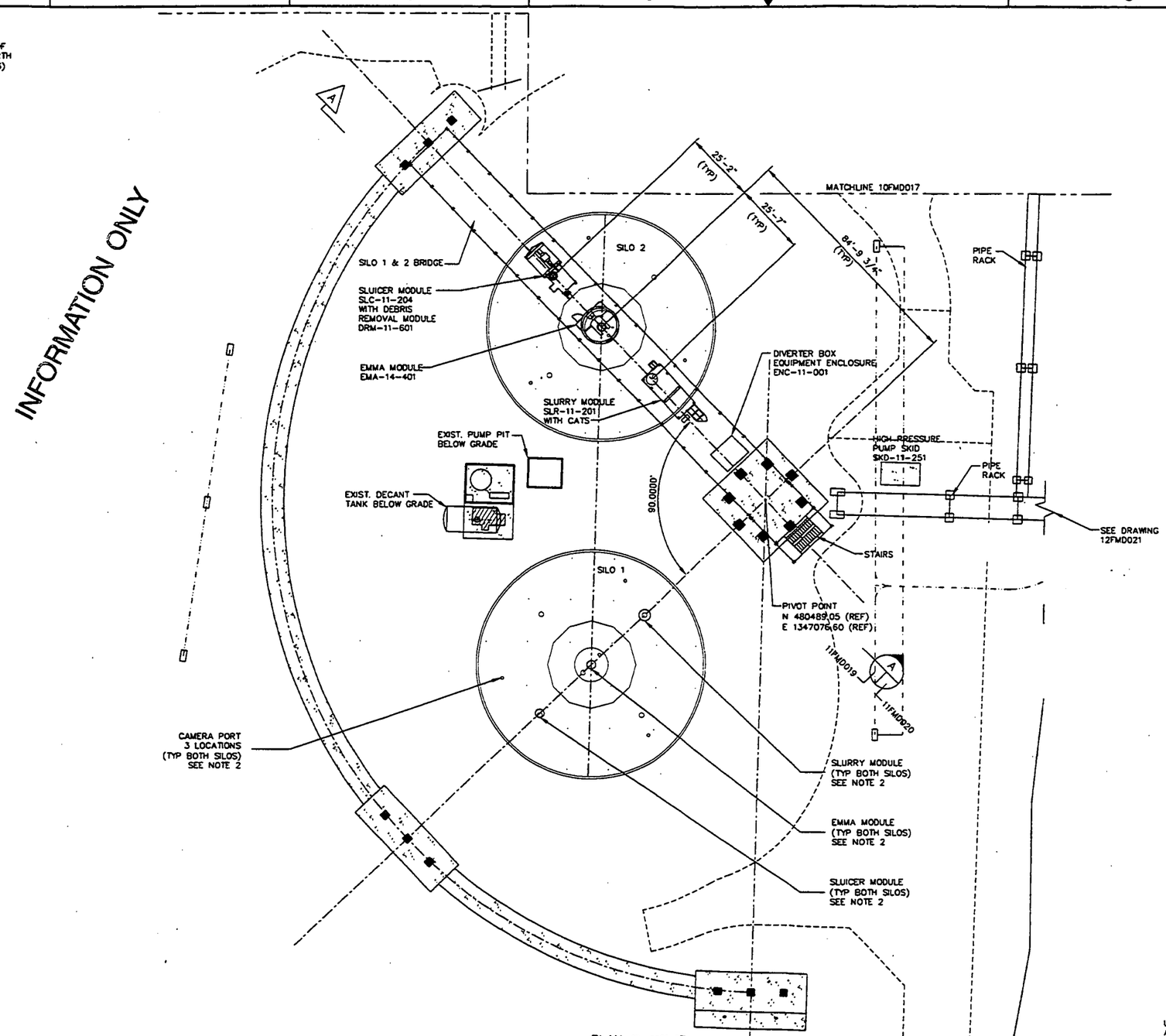

PLAN (EL 607'-0")
SCALE: 1"=20'-0"

NOTES:

1. BRIDGE CRANE SHOWN IN SILO 2 OPERATION POSITION. SILO 1 IS SIMILAR.
2. FOR RISER DETAILS, SEE SILO PENETRATION AND RISER INSTALLATION PLAN, DOCUMENT NO. 624-P622-63

3387

REFERENCE DRAWINGS:

05FMD010 GENERAL ARRANGEMENT KEY PLAN

000388

LETTER OR NUMBER OF SECTION OR DETAIL
DRAWING ON WHICH SECTION OR DETAIL IS TAKEN
DRAWING ON WHICH SECTION OR DETAIL IS SHOWN
SECTION & DETAIL KEY

000374

REV	DATE	BY	CHK'D	APR'VD	DESCRIPTION/ISSUE
2	01/07/00	WCB	SWH	KDR	CERTIFIED FOR CONSTRUCTION
1	12/01/99	WCB	SWH		REVISED FOR NOZZLE LOCATIONS
0	11/99	WCB	SWH		PRELIMINARY DESIGN SUBMITTAL

RPE: KENNETH D. RICKETT, P.E. NO. 103742, 01/07/00, REVISION 2

UNDER TEMPORARY AUTHORIZATION (BASED ON APPLICATION TO REGISTER BY COMITY IN THE STATE OF OHIO, DATED DECEMBER 6, 1999) WHICH WILL EXPIRE ON MARCH 31, 2000.

DRAWN BY	W C BLUME	DATE 01/07/00
DESIGNED BY	W C BLUME	DATE 01/07/00
CHECKED BY	S W HUNGATE	DATE 01/07/00
APPROVED BY	KENNETH RICKETT	DATE 01/07/00
APPROVED BY	JOHN LAWSON	DATE 01/07/00

DEPARTMENT OF ENERGY
FERNALD ENVIRONMENTAL MANAGEMENT PROJECT
SILOS 1 AND 2 ACCELERATED WASTE RETRIEVAL PROJECT
FERNALD, OHIO
FDF CONTRACT NO. FSC 624

FOSTER WHEELER
FOSTER WHEELER ENVIRONMENTAL CORPORATION

TITLE: SILO WASTE RETRIEVAL SYSTEM GENERAL ARRANGEMENT SILO 1 & 2 BRIDGE

SIZE: D | SCALE: 1"=20'-0" | DWG. NO. 11FMD019 | REV 2

FILENAME: 11FMD019.

XREF DRAWINGS: 10FMD010.DWG, 69-PROP.DWG, 69-EXIST.DWG

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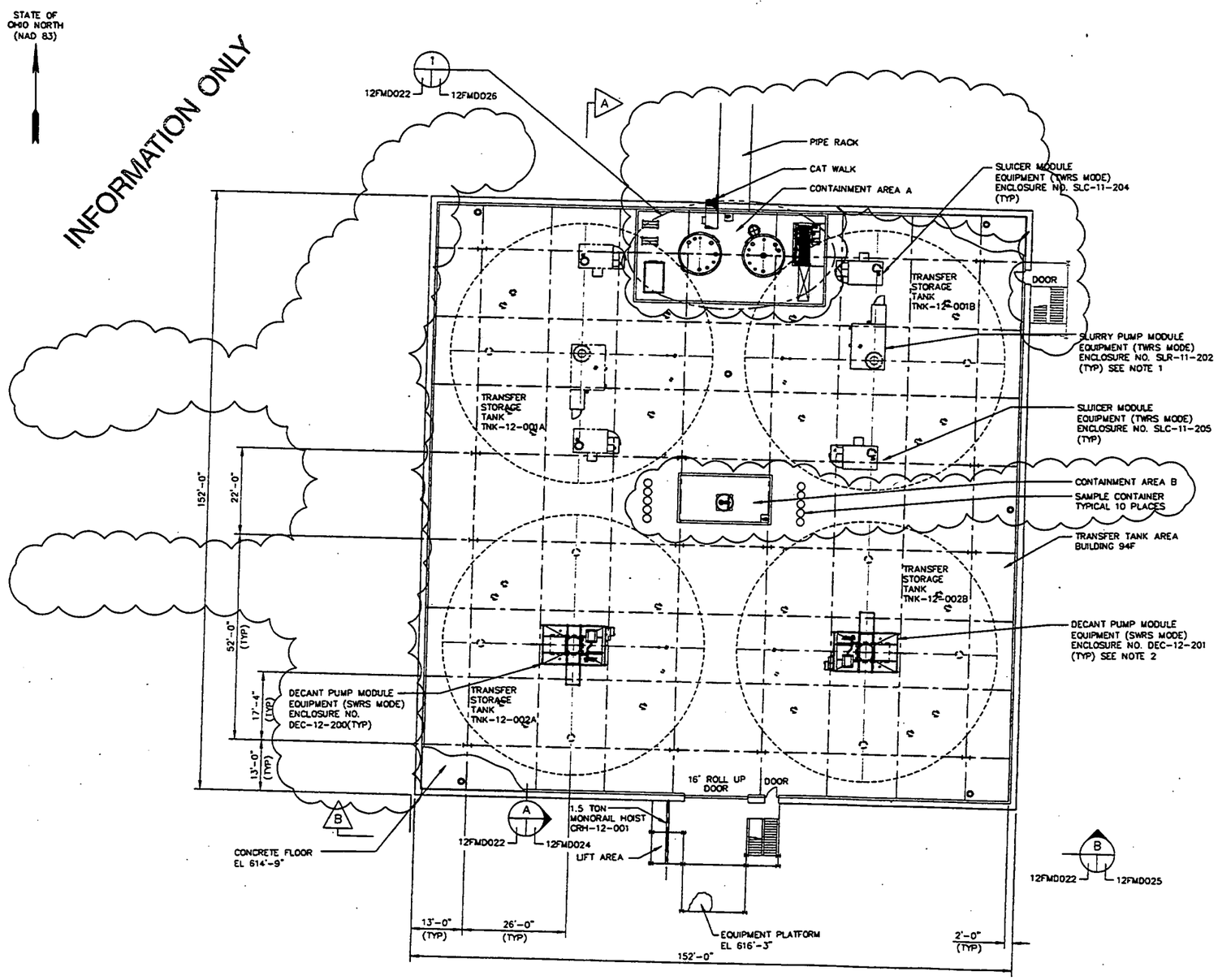


NOTES:

1. TANK TNK-12-001B IS SHOWN WITH TWRS MODE EQUIPMENT IN PLACE. THIS SAME EQUIPMENT WILL MOVE FROM TANK TO TANK. THE EQUIPMENT SHOWN ON TANK TNK-12-001A IS FOR ORIENTATION PURPOSES ONLY.
2. TANK TNK-12-002A & 002B REFLECTS EQUIPMENT REQUIRED FOR SWRS MODE. THE DECANT MODULES WILL BE MOVED AS REQUIRED.

3387

PLAN (EL 638'-0")
SCALE: 1"=15'-0"

000389

000375

LETTER OR NUMBER OF SECTION OR DETAIL
DRAWING ON WHICH SECTION OR DETAIL IS TAKEN
DRAWING ON WHICH SECTION OR DETAIL IS SHOWN
SECTION & DETAIL KEY

REV	DATE	BY	CHK'D	APR'VD	DESCRIPTION/ISSUE
2					REVISED PER CHANGE PROPOSAL CP-00-001
1	01/07/00	WCB	SWH	KDR	CERTIFIED FOR CONSTRUCTION
0	11/01/99	WCB	SWH		PRELIMINARY DESIGN SUBMITTAL

UNDER TEMPORARY AUTHORIZATION (BASED ON APPLICATION TO REGISTER BY COMITY IN THE STATE OF OHIO, DATED DECEMBER 6, 1999) WHICH WILL EXPIRE ON MARCH 31, 2000.

RPE

		DATE
DRAWN BY	W C BLUME	01/07/00
DESIGNED BY	W C BLUME	01/07/00
CHECKED BY	S W HUNGATE	01/07/00
APPROVED BY	KENNETH RICKETT	01/07/00
APPROVED BY	JOHN LAWSON	01/07/00

DEPARTMENT OF ENERGY
FERNALD ENVIRONMENTAL MANAGEMENT PROJECT
SILOS 1 AND 2 ACCELERATED WASTE RETRIEVAL PROJECT
FERNALD, OHIO
FDF CONTRACT NO. FSC 624

FOSTER WHEELER
FOSTER WHEELER ENVIRONMENTAL CORPORATION

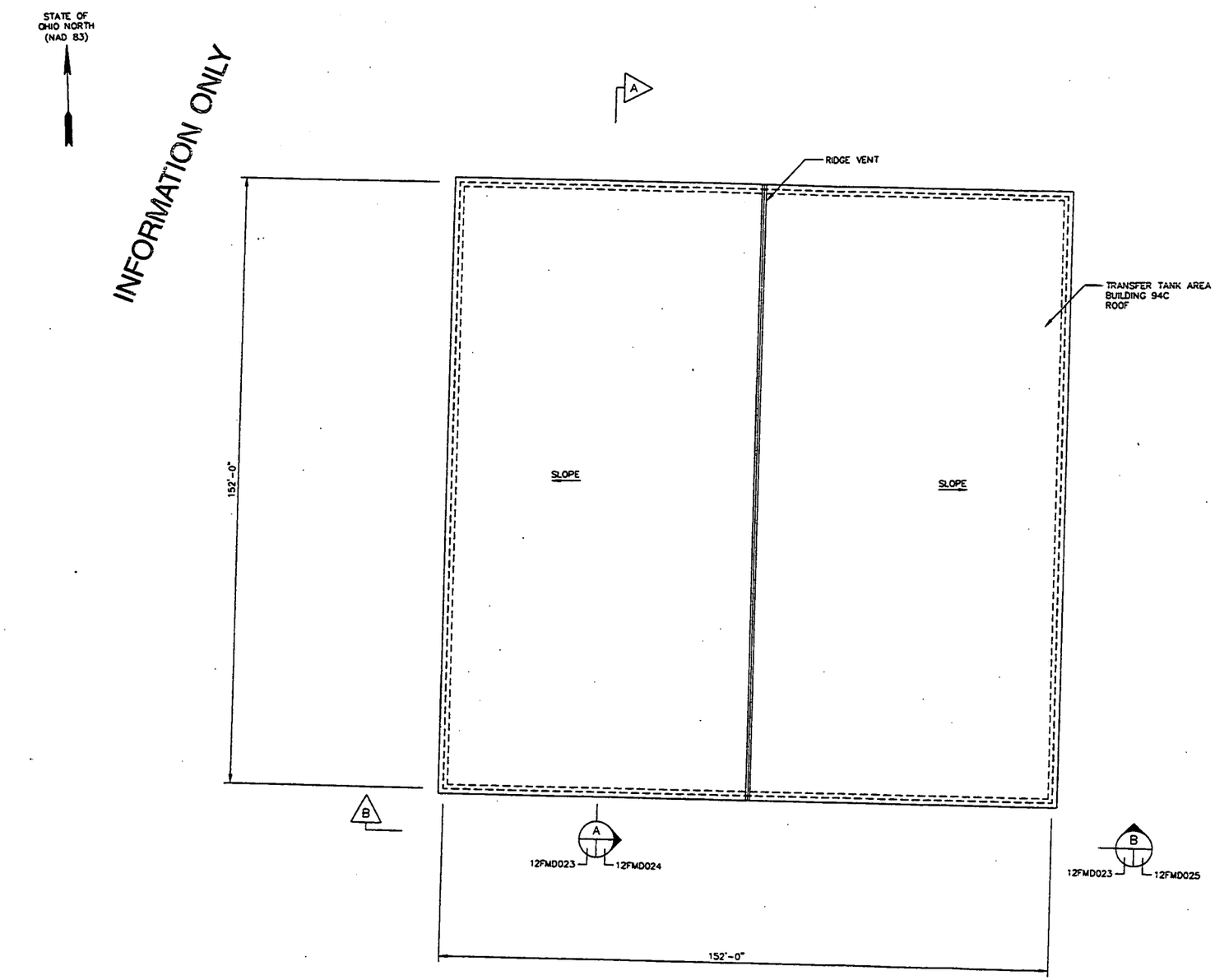
TITLE
TRANSFER TANK SYSTEM
GENERAL ARRANGEMENT
SHEET 2 OF 6

SIZE: D | SCALE: 1"=15'-0" | DWG. NO. 12FMD022 | REV 2

FILENAME: 12FMD022.

G:\CHARGE\F...OS\MEC\SYS12\12fmd022.dwg Thu Jun 01 15:57:19 2000

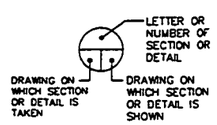
3387



PLAN (EL 650'-0")
SCALE: 1"=15'-0"

000390

000376



SECTION & DETAIL KEY

REV	DATE	BY	CHK'D	APR'VD	DESCRIPTION/ISSUE
1	01/07/00	WCB	SWH	KDR	CERTIFIED FOR CONSTRUCTION
0	11/01/99	WCB	SWH		PRELIMINARY DESIGN SUBMITTAL

UNDER TEMPORARY AUTHORIZATION (BASED ON APPLICATION TO REGISTER BY COMITY IN THE STATE OF OHIO, DATED DECEMBER 6, 1999) WHICH WILL EXPIRE ON MARCH 31, 2000.

RPE
KENNETH D. RICKETT
P.E. NO. 103742
01/07/00
REVISION 1

DRAWN BY	W C BLUME	DATE 01/07/00
DESIGNED BY	W C BLUME	DATE 01/07/00
CHECKED BY	S W HUNGATE	DATE 01/07/00
APPROVED BY	KENNETH RICKETT	DATE 01/07/00
APPROVED BY	JOHN LAWSON	DATE 01/07/00

DEPARTMENT OF ENERGY
FERNALD ENVIRONMENTAL MANAGEMENT PROJECT
SILOS 1 AND 2 ACCELERATED WASTE RETRIEVAL PROJECT
FERNALD, OHIO
FDF CONTRACT NO. FSC 624

FOSTER WHEELER
FOSTER WHEELER ENVIRONMENTAL CORPORATION

TITLE
TRANSFER TANK SYSTEM
GENERAL ARRANGEMENT
SHEET 3 OF 6

SIZE	SCALE:	DWG. NO.	REV
D	1"=15'-0"	12FMD023	1

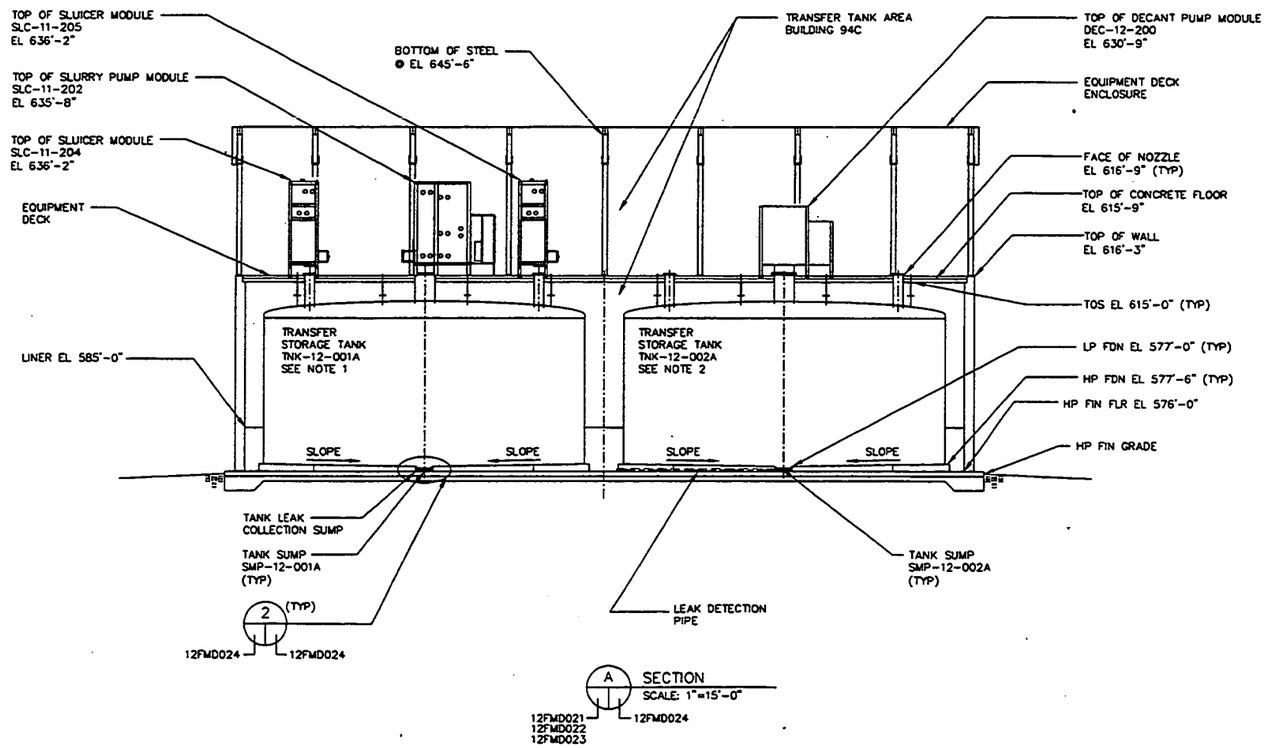
FILENAME: 12FMD023.

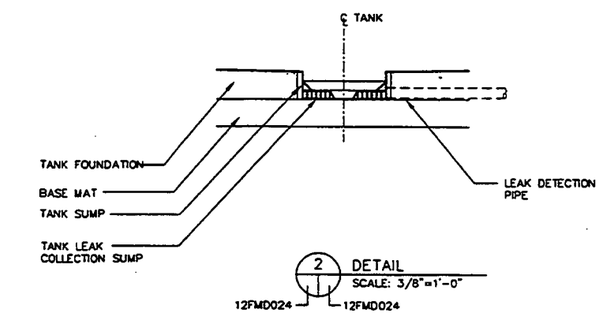
G:\CHARGE\FA...OS\MEC\SYS12\12fmd023.dwg Thu Jun 01 15:57:39 2000

INFORMATION ONLY

NOTES:
1. TNK-12-001A IS SHOWN IN TWRS MODE.
2. TNK-12-002A IS SHOWN IN SWRS MODE.

3387





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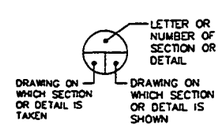

SECTION & DETAIL KEY

000377

REV	DATE	BY	CHK'D	APR'VD	DESCRIPTION/ISSUE
1	01/07/00	WCB	SWH	KDR	CERTIFIED FOR CONSTRUCTION
0	11/01/99	WCB	SWH		PRELIMINARY DESIGN SUBMITTAL

UNDER TEMPORARY AUTHORIZATION (BASED ON APPLICATION TO REGISTER BY COMITY IN THE STATE OF OHIO, DATED DECEMBER 6, 1999) WHICH WILL EXPIRE ON MARCH 31, 2000.

RPE
KENNETH D. RICKETT
P.E. NO. 103742
01/07/00
REVISION 1

DRAWN BY	W C BLUME	DATE 01/07/00
DESIGNED BY	W C BLUME	DATE 01/07/00
CHECKED BY	S W HUNGATE	DATE 01/07/00
APPROVED BY	KENNETH RICKETT	DATE 01/07/00
APPROVED BY	JOHN LAWSON	DATE 01/07/00

DEPARTMENT OF ENERGY
FERNALD ENVIRONMENTAL MANAGEMENT PROJECT
SILOS 1 AND 2 ACCELERATED WASTE RETRIEVAL PROJECT
FERNALD, OHIO
FDF CONTRACT NO. FSC 624

FOSTER WHEELER
FOSTER WHEELER ENVIRONMENTAL CORPORATION

TITLE
TRANSFER TANK SYSTEM
GENERAL ARRANGEMENT
SHEET 4 OF 6

SIZE D | SCALE: 1"=15'-0" | DWG. NO. 12FMD024 | REV 1

FILENAME: 12FMD024.

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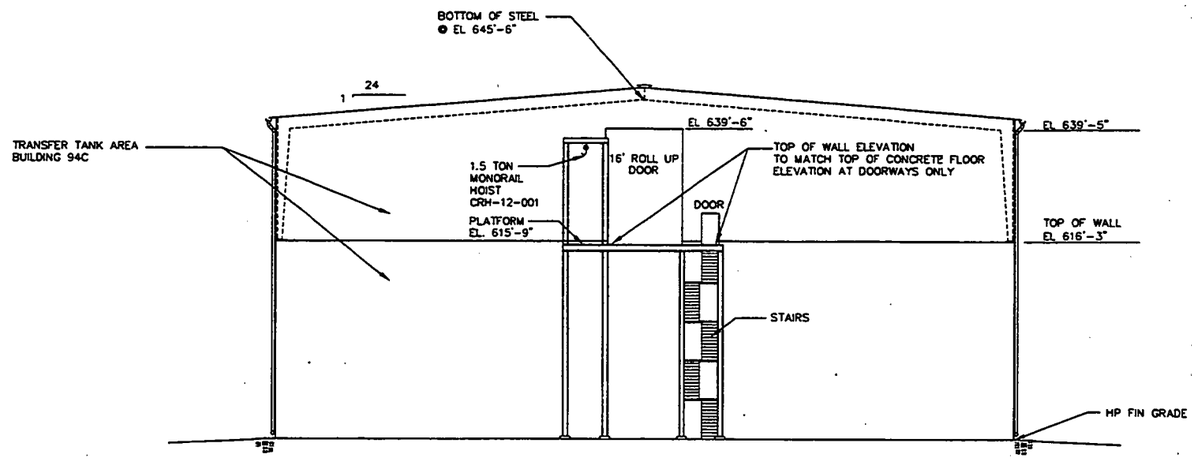
INFORMATION ONLY



B SECTION
SCALE: 1"=15'-0"
12FMD021
12FMD022
12FMD023
12FMD025

000392

000378

LETTER OR NUMBER OF SECTION OR DETAIL
DRAWING ON WHICH SECTION OR DETAIL IS TAKEN
DRAWING ON WHICH SECTION OR DETAIL IS SHOWN
SECTION & DETAIL KEY

REV	DATE	BY	CHK'D	APR'VD	DESCRIPTION/ISSUE
1	01/07/00	WCB	SWH	KDR	CERTIFIED FOR CONSTRUCTION
0	11/01/99	WCB	SWH		PRELIMINARY DESIGN SUBMITTAL

UNDER TEMPORARY AUTHORIZATION (BASED ON APPLICATION TO REGISTER BY COMITY IN THE STATE OF OHIO, DATED DECEMBER 6, 1999) WHICH WILL EXPIRE ON MARCH 31, 2000.

RPE
KENNETH D. RICKETT
P.E. NO. 103742
01/07/00
REVISION 1

DRAWN BY	W C BLUME	DATE 01/07/00
DESIGNED BY	W C BLUME	DATE 01/07/00
CHECKED BY	S W HUNGATE	DATE 01/07/00
APPROVED BY	KENNETH RICKETT	DATE 01/07/00
APPROVED BY	JOHN LAWSON	DATE 01/07/00

DEPARTMENT OF ENERGY
FERNALD ENVIRONMENTAL MANAGEMENT PROJECT
SILOS 1 AND 2 ACCELERATED WASTE RETRIEVAL PROJECT
FERNALD, OHIO
FDF CONTRACT NO. FSC 624

FOSTER WHEELER
FOSTER WHEELER ENVIRONMENTAL CORPORATION

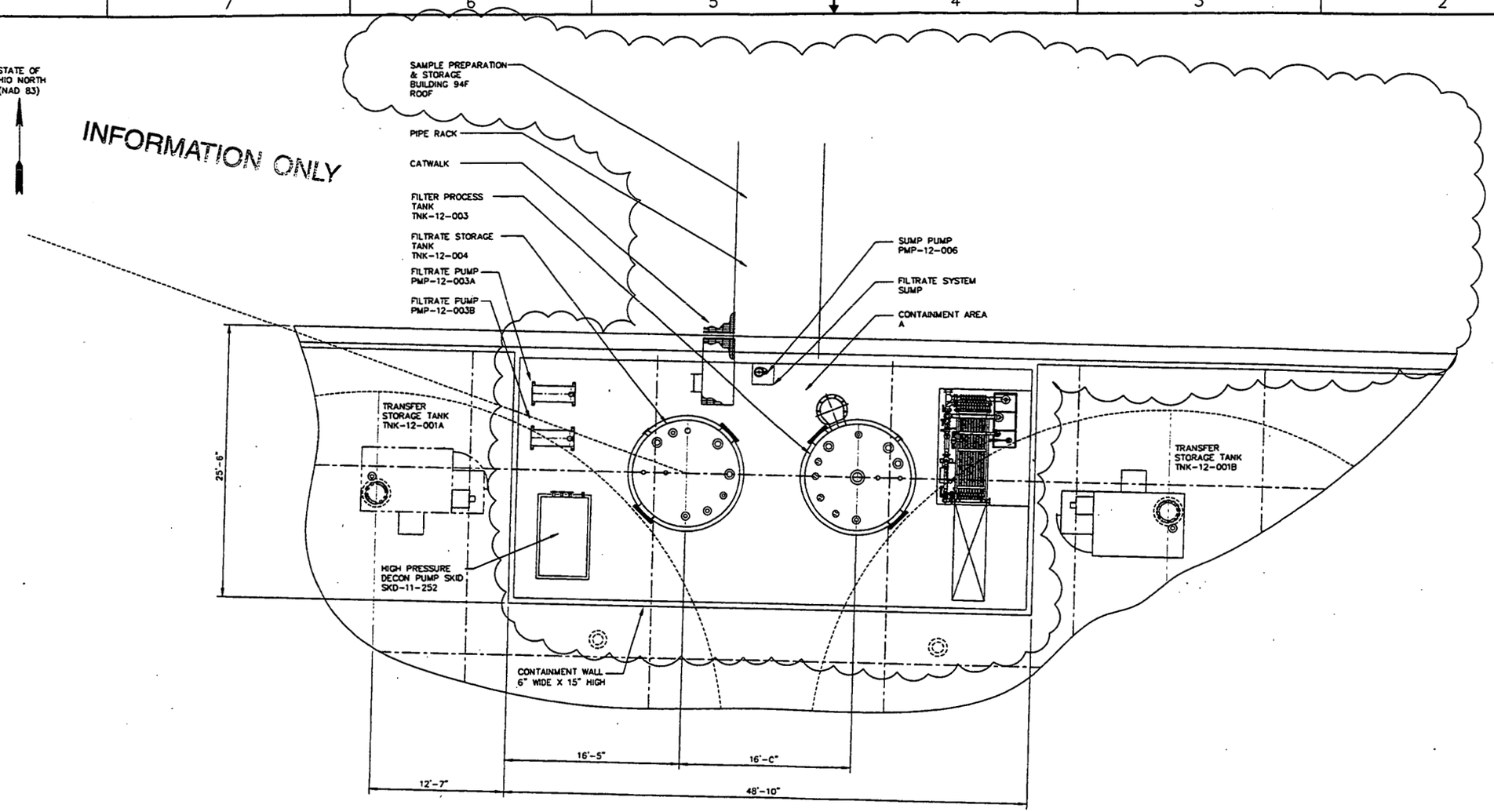
TITLE
TRANSFER TANK SYSTEM
GENERAL ARRANGEMENT
SHEET 5 OF 6

SIZE	SCALE:	DWG. NO.	REV
D	1"=15'-0"	12FMD025	1

FILENAME: 12FMD025

G:\CHARGE\F[redacted]OS\MEC\SYS12\12fmd025.dwg Thu Jun 01 15:58:17 2000

3387



PARTIAL PLAN VIEW–EQUIPMENT DECK

ULTRA FILTRATION SYSTEM AND FILTRATE STORAGE AREA

1 DETAIL
SCALE: 3/16"=1'-0"
12FMD022 — 12FMD026

000393

UNDER TEMPORARY AUTHORIZATION (BASED ON APPLICATION TO REGISTER BY COMITY IN THE STATE OF OHIO, DATED DECEMBER 6, 1999) WHICH WILL EXPIRE ON MARCH 31, 2000.

LETTER OR NUMBER OF SECTION OR DETAIL
DRAWING ON WHICH SECTION OR DETAIL IS TAKEN
DRAWING ON WHICH SECTION OR DETAIL IS SHOWN

SECTION & DETAIL KEY

000379

REV	DATE	BY	CHK'D	APR'VD	DESCRIPTION/ISSUE
2					REVISED PER CHANGE PROPOSAL CP-00-001
1	01/07/00	WCB	SWH	KDR	CERTIFIED FOR CONSTRUCTION
0	01/01/99	WCB	SWH		PRELIMINARY DESIGN SUBMITTAL

RPE

DRAWN BY	W C BLUME	DATE 01/07/00
DESIGNED BY	W C BLUME	DATE 01/07/00
CHECKED BY	S W HUNGATE	DATE 01/07/00
APPROVED BY	KENNETH RICKETT	DATE 01/07/00
APPROVED BY	JOHN LAWSON	DATE 01/07/00

DEPARTMENT OF ENERGY
FERNALD ENVIRONMENTAL MANAGEMENT PROJECT
SILOS 1 AND 2 ACCELERATED WASTE RETRIEVAL PROJECT
FERNALD, OHIO
FDF CONTRACT NO. FSC 624

FOSTER WHEELER
FOSTER WHEELER ENVIRONMENTAL CORPORATION

TITLE
TRANSFER TANK SYSTEM
GENERAL ARRANGEMENT
SHEET 6 OF 6

SIZE	SCALE:	DWG. NO.	REV
D	3/16" = 1'-0"	12FMD026	2

FILENAME: 12FMD026.D

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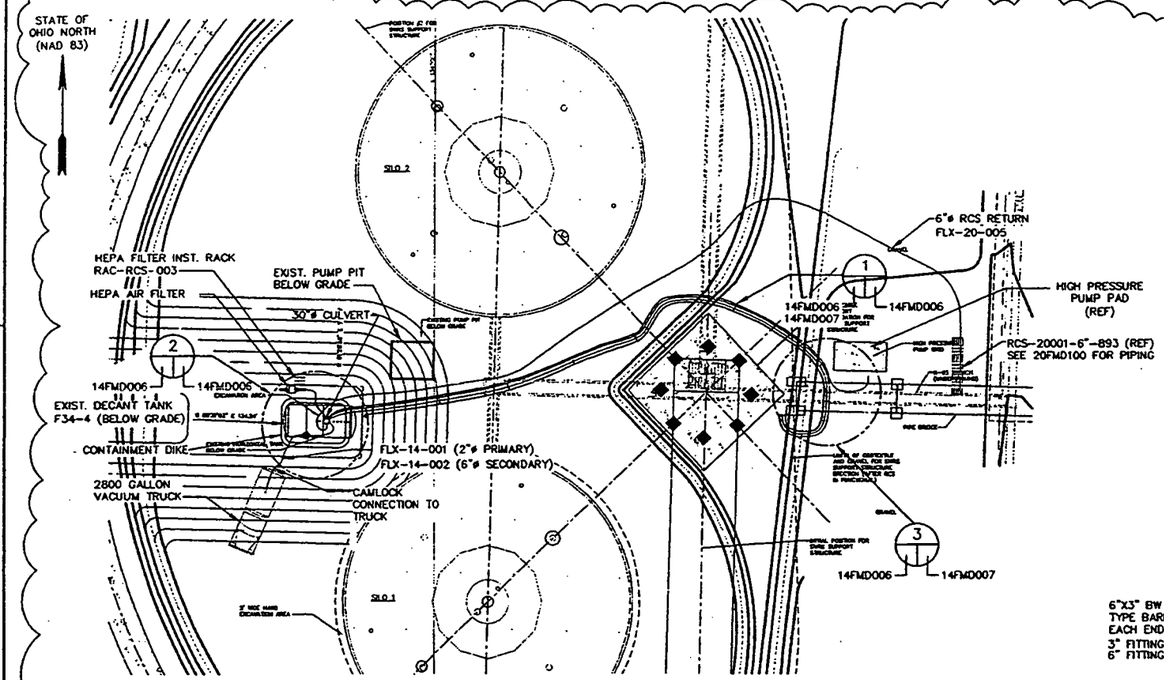
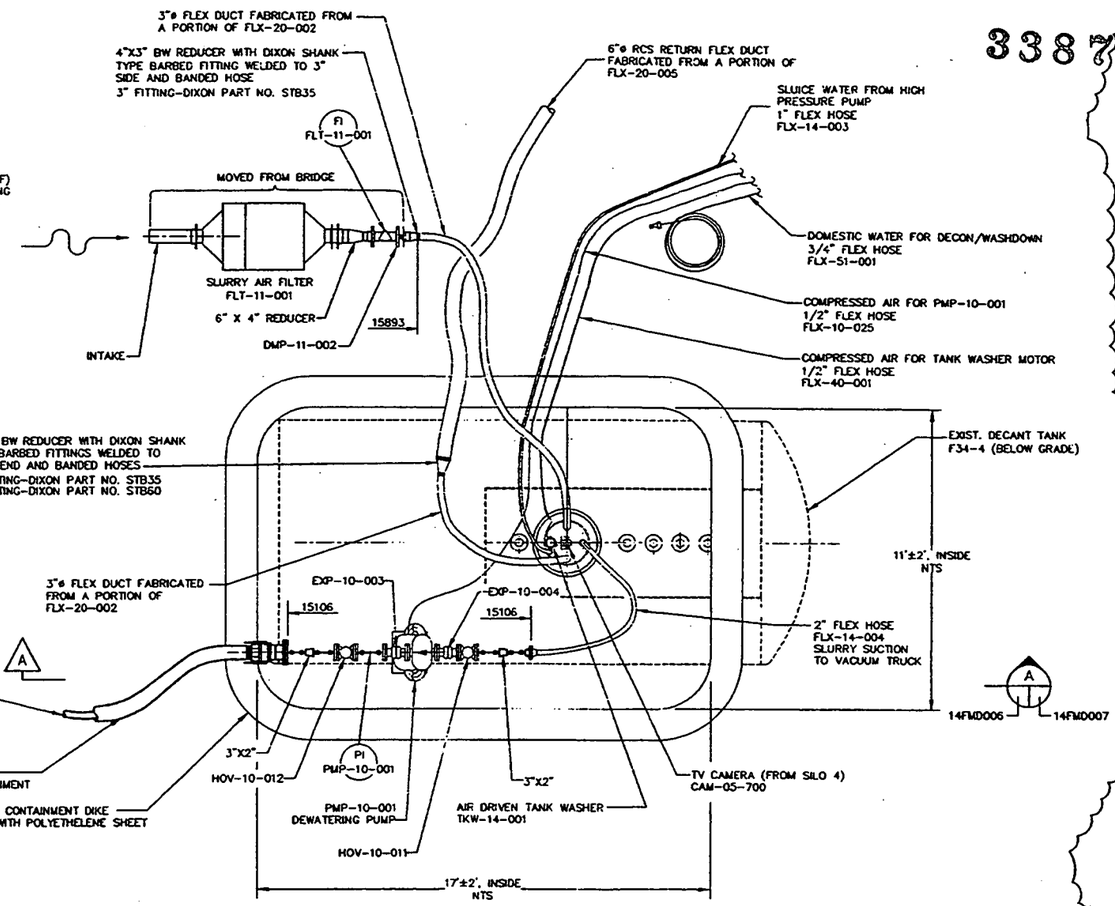
NOTES:

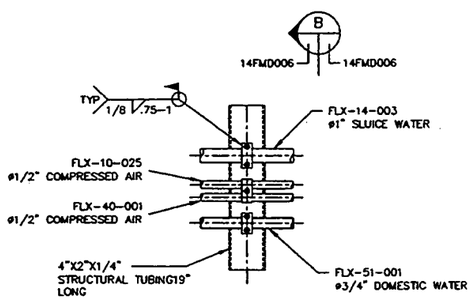
1. HEPA FILTER AND ASSOCIATED INSTRUMENT RACK TO BE SALVAGED FROM BRIDGE.
2. FIELD TO PROVIDE TEMPORARY SUPPORTS FOR PUMPS, HOSES, FILTERS & INSTRUMENT RACKS.
3. DIAPHRAGM PUMP TO BE SALVAGED FROM THE FULL SCALE MOCKUP SURROGATE DEWATERING TANK.
4. SEE CONSTRUCTION SPECIFICATION DIVISION 15120 FOR HOSE MATERIALS, INSTALLATION, TESTING AND MAINTENANCE.

3387

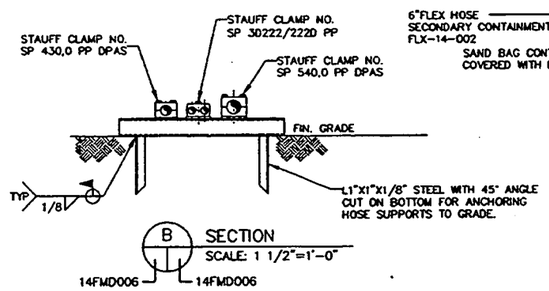


PLAN (EL 607'-0")
SCALE: 1"=20'-0"





NOTE:
SUPPORTS REQUIRED AT 20'-0" INTERVALS FROM THE PIPE RACK/HP PUMP SKID AREA TO THE F34-4 DECANT TANK.



B SECTION
SCALE: 1 1/2"=1'-0"

2 DETAIL
SCALE: 3/8"=1'-0"
14FMD006 — 14FMD006

1 DETAIL
SCALE: 1 1/2"=1'-0"
14FMD006 — 14FMD006

000394

REFERENCE DRAWINGS:

05FMD010 GENERAL ARRANGEMENT KEY PLAN
14FMD020 DECANT TANK F34-4 INTERFACE FLANGE

LETTER OR NUMBER OF SECTION OR DETAIL
DRAWING ON WHICH SECTION OR DETAIL IS TAKEN
DRAWING ON WHICH SECTION OR DETAIL IS SHOWN
SECTION & DETAIL KEY

REV	DATE	BY	CHK'D	APR'VD	DESCRIPTION/ISSUE
3	3/31/00	BCL	RLR	KDR	REVISED PER CP-00-004
2	1/7/00	WCB	SWH	KDR	CERTIFIED FOR CONSTRUCTION
1	12/01/99	WCB	SWH		REVISED FOR NOZZLE LOCATIONS
0	11/99	WCB	SWH		PRELIMINARY DESIGN SUBMITTAL

THE ORIGINAL DRAWING AND SUBSEQUENT REVISIONS THEREOF, WITH APPROVAL NAMES, INITIALS, AND THE PE SEAL, IF APPLICABLE, ARE MAINTAINED IN THE FILES OF FWENC.

PE: STATE OF OHIO KENNETH D. RICKETT E-64418 REGISTERED PROFESSIONAL ENGINEER

DRAWN BY	W C BLUME	01/07/00
DESIGNED BY	W C BLUME	01/07/00
CHECKED BY	S W HUNGATE	01/07/00
APPROVED BY	KENNETH RICKETT	01/07/00
APPROVED BY	JOHN LAWSON	SWH

DEPARTMENT OF ENERGY
FERNALD ENVIRONMENTAL MANAGEMENT PROJECT
SILOS 1 AND 2 ACCELERATED WASTE RETRIEVAL PROJECT
FERNALD, OHIO
FDF CONTRACT NO. FSC 624

FOSTER WHEELER
FOSTER WHEELER ENVIRONMENTAL CORPORATION

TITLE
DECANT WASTE RETRIEVAL SYSTEM
GENERAL ARRANGEMENT & PIPING
SHEET 1 OF 2

SIZE	SCALE:	DWG. NO.	REV
D	1"=20'-0"	14FMD006	3

FILENAME: 14FMD006.DWG

000430

XREF DRAWINGS: 14FD0001.DWG

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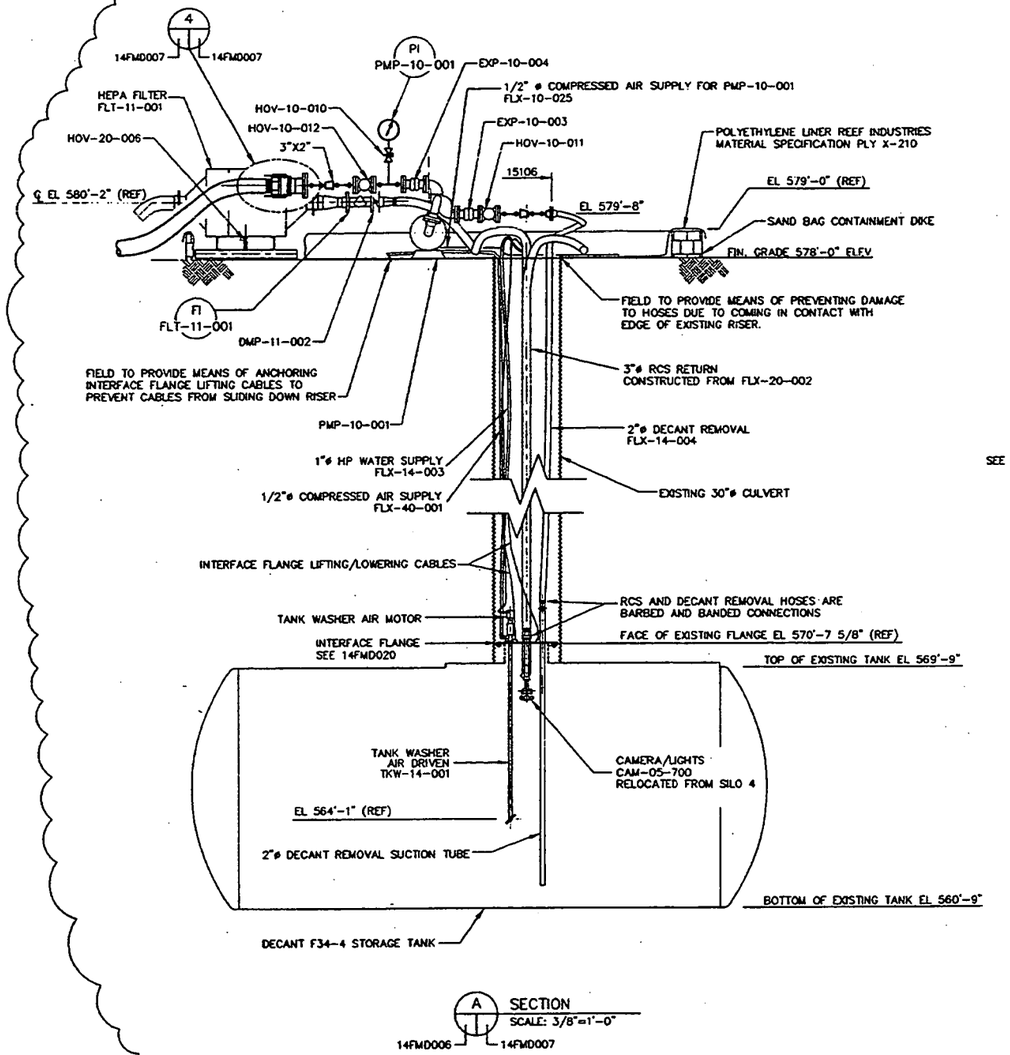
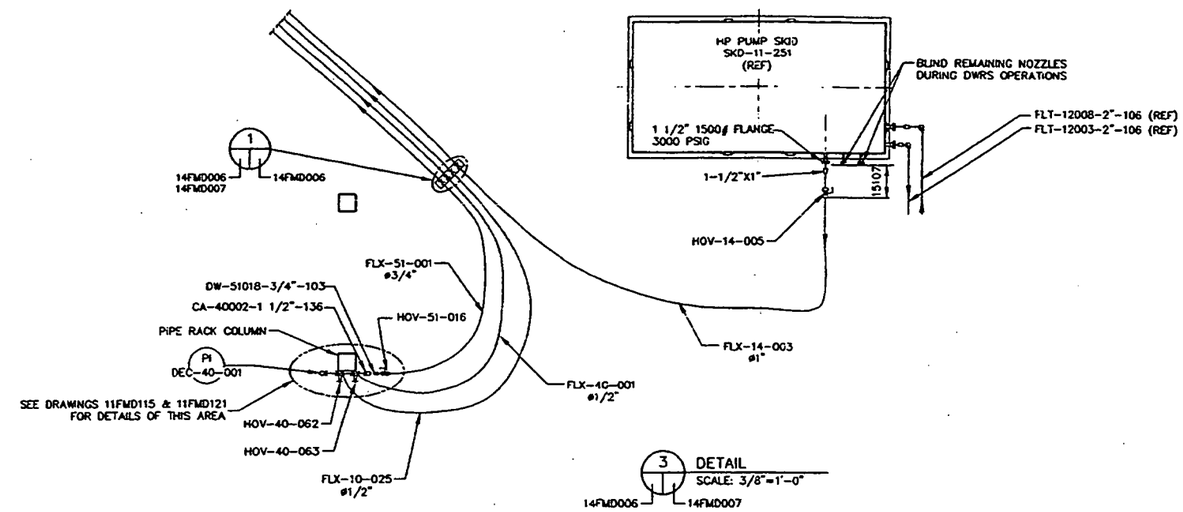
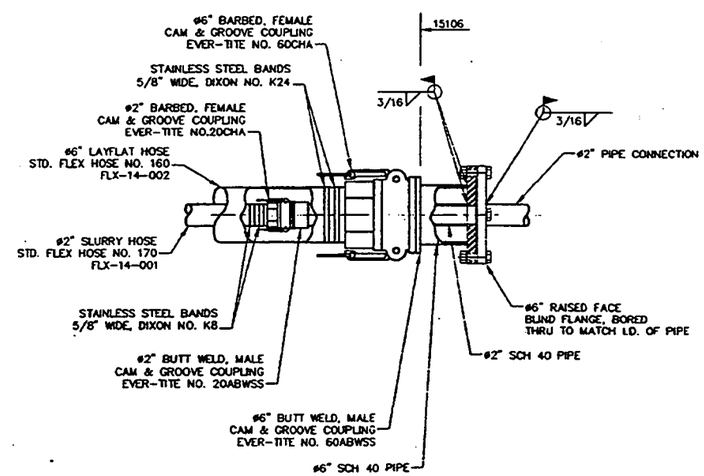


A SECTION
SCALE: 3/8"=1'-0"
14FMD006 — 14FMD007



3 DETAIL
SCALE: 3/8"=1'-0"
14FMD006 — 14FMD007



4 DETAIL
SCALE: 1-1/2"=1'-0"
14FMD007 — 14FMD007

NOTES:

1. FOR GENERAL NOTES, SEE DRAWING 14FMD015.

000395

THE ORIGINAL DRAWING AND SUBSEQUENT REVISIONS THEREOF, WITH APPROVAL NAMES, INITIALS, AND THE PE SEAL, IF APPLICABLE, ARE MAINTAINED IN THE FILES OF FWENC.

LETTER OR NUMBER OF SECTION OR DETAIL
DRAWING ON WHICH SECTION OR DETAIL IS TAKEN
DRAWING ON WHICH SECTION OR DETAIL IS SHOWN
SECTION & DETAIL KEY

000381

REV	DATE	BY	CHK'D	APR'VD	DESCRIPTION/ISSUE
3	6/5/00	DLR	RWR	KDR	REVISED PER CP-00-004
2	01/07/00	WCB	SWH	KDR	CERTIFIED FOR CONSTRUCTION
1	12/01/99	WCB	SWH		REVISED FOR NOZZLE LOCATIONS
0	11/99	WCB	SWH		PRELIMINARY DESIGN SUBMITTAL

RPE
STATE OF OHIO
KENNETH D. RICKETT
E-64418
REGISTERED PROFESSIONAL ENGINEER

		DATE
DRAWN BY	W C BLUME	01/07/00
DESIGNED BY	W C BLUME	01/07/00
CHECKED BY	S W HUNGATE	01/07/00
APPROVED BY	KENNETH RICKETT	01/07/00
APPROVED BY	JOHN LAWSON	01/07/00

DEPARTMENT OF ENERGY
FERNALD ENVIRONMENTAL MANAGEMENT PROJECT
SILOS 1 AND 2 ACCELERATED WASTE RETRIEVAL PROJECT
FERNALD, OHIO
FDF CONTRACT NO. FSC 624

FOSTER WHEELER
FOSTER WHEELER ENVIRONMENTAL CORPORATION

TITLE
DECANT WASTE RETRIEVAL SYSTEM
GENERAL ARRANGEMENT & PIPING
SHEET 2 OF 2

SIZE	SCALE:	DWG. NO.	REV
D	3/8"=1'-0"	14FMD007	3

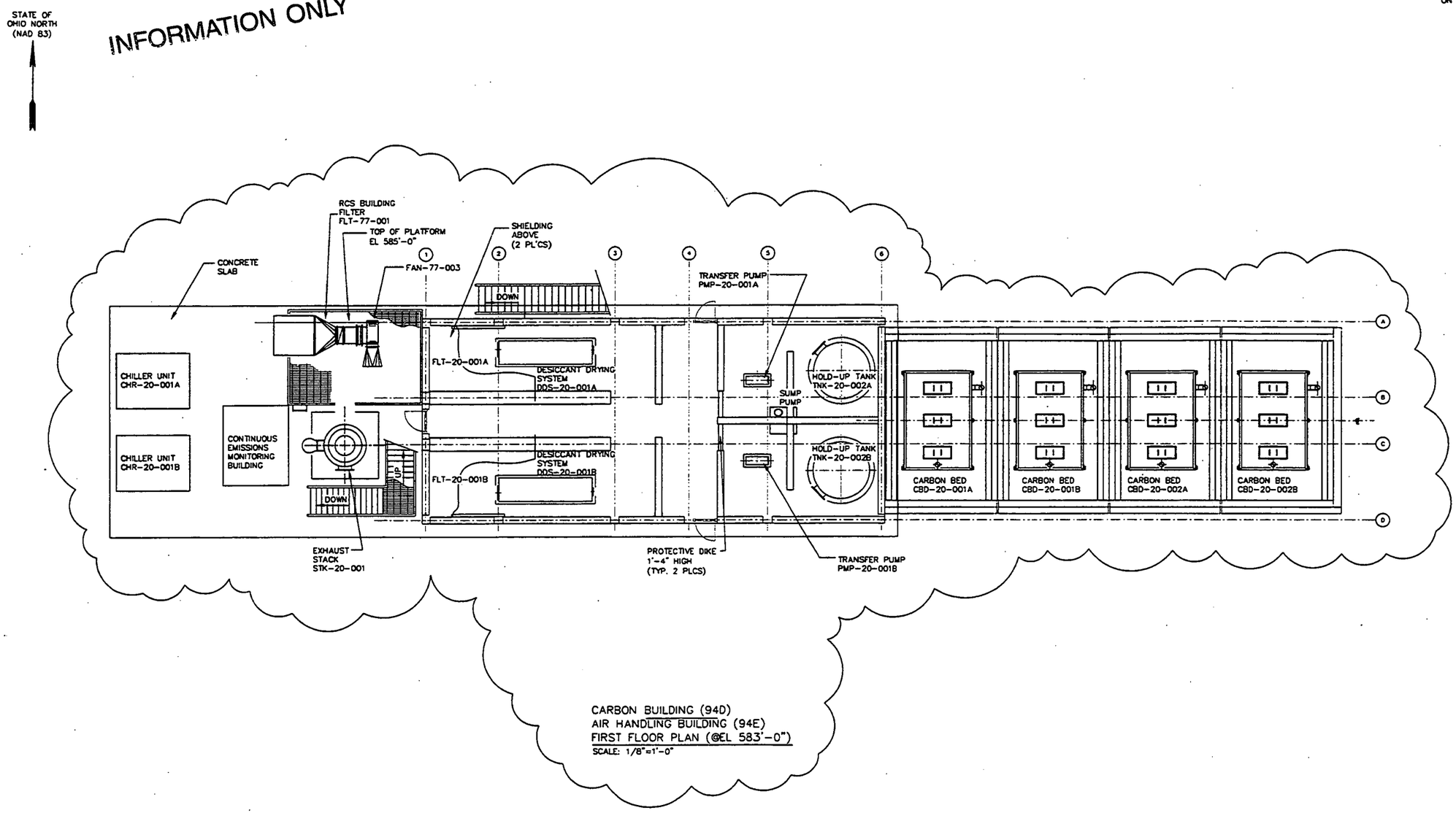
FILENAME: 14FMD007.DWG

G:\CHARGEYDFSILOS\14fmd007.zwg Thu Aug 31 12:46:31 2000

NOTES:
1. FOR CLARITY SYSTEM 20 RCS AND SYSTEM 77 MISCELLANEOUS HVAC FACILITIES HVAC SYSTEM ARE PRESENTED ON SYSTEM 20 DRAWINGS.

INFORMATION ONLY

E-3387



000396

THE ORIGINAL DRAWING AND SUBSEQUENT REVISIONS THEREOF, WITH APPROVAL NAMES, INITIALS, AND THE PE SEAL, IF APPLICABLE, ARE MAINTAINED IN THE FILES OF FWENC.

DEPARTMENT OF ENERGY
FERNALD ENVIRONMENTAL MANAGEMENT PROJECT
SILOS 1 AND 2 ACCELERATED WASTE RETRIEVAL PROJECT
FERNALD, OHIO
FDF CONTRACT NO. FSC 624

FOSTER WHEELER
FOSTER WHEELER ENVIRONMENTAL CORPORATION

TITLE
RADON CONTROL SYSTEM
GENERAL ARRANGEMENT
1ST FLOOR

REV	DATE	BY	CHK'D	APR'VD	DESCRIPTION/ISSUE
2	05/15/00	JG	GCH	KDR	REVISED PER CHANGE PROPOSAL CP-00-004
1	01/07/00	WCB	SWH	KDR	CERTIFIED FOR CONSTRUCTION
0	11/01/99	WCB	MBF		PRELIMINARY DESIGN SUBMITTAL

RPE
KENNETH D. RICKETT
P.E. NO. E-64418
5/15/00
REVISION 2

DRAWN BY	W C BLUME	DATE 01/07/00
DESIGNED BY	W C BLUME	DATE 01/07/00
CHECKED BY	S W HUNGATE	DATE 01/07/00
APPROVED BY	KENNETH RICKETT	DATE 01/07/00
APPROVED BY	JOHN LAWSON	DATE 01/07/00

SIZE D | SCALE: 1/8"=1'-0" | DWG. NO. 20FMD027 | REV 2

LETTER OR NUMBER OF SECTION OR DETAIL
DRAWING ON WHICH SECTION OR DETAIL IS TAKEN
DRAWING ON WHICH SECTION OR DETAIL IS SHOWN
SECTION & DETAIL KEY

000382

FILENAME: 20FMD027.

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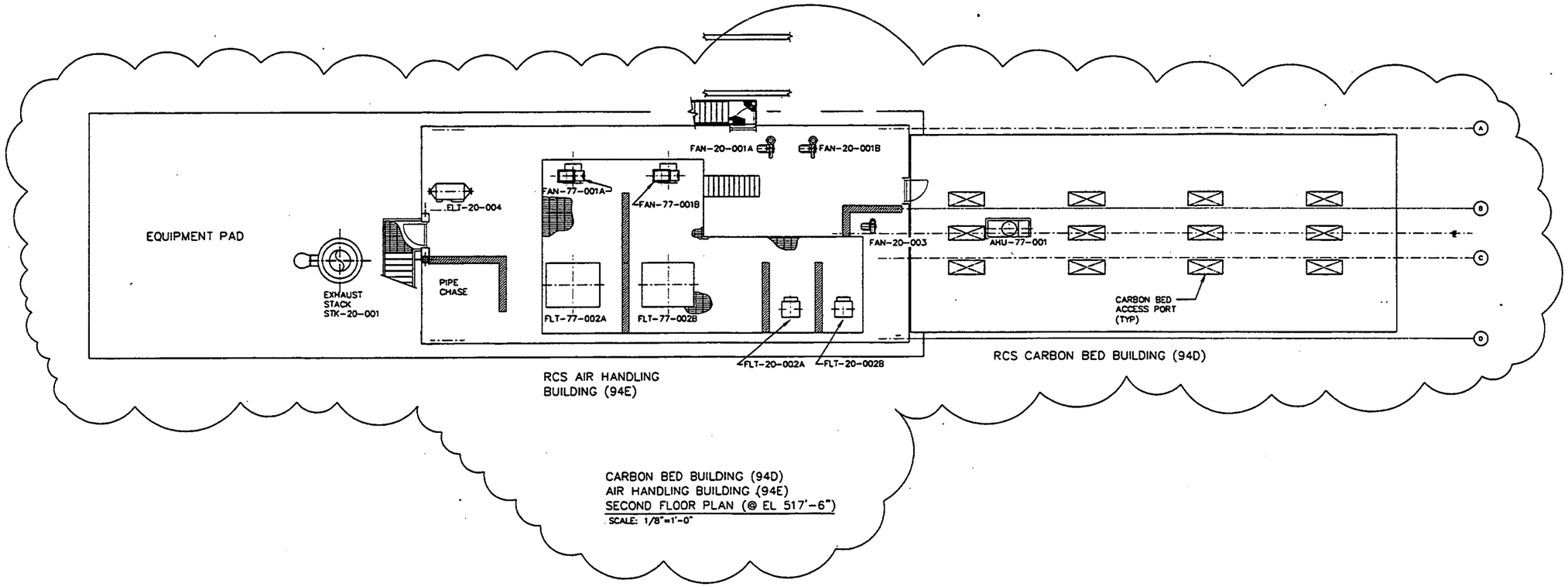
NOTES:
1. FOR CLARITY SYSTEM 20 RCS AND SYSTEM 77 MISCELLANEOUS HVAC FACILITIES HVAC SYSTEM ARE PRESENTED ON SYSTEM 20 DRAWINGS.

STATE OF OHIO NORTH (NAD 83)

INFORMATION ONLY

3387



CARBON BED BUILDING (94D)
AIR HANDLING BUILDING (94E)
SECOND FLOOR PLAN (@ EL 517'-6")
SCALE: 1/8"=1'-0"

000397

THE ORIGINAL DRAWING AND SUBSEQUENT REVISIONS THEREOF, WITH APPROVAL NAMES, INITIALS, AND THE PE SEAL, IF APPLICABLE, ARE MAINTAINED IN THE FILES OF FWENC.

DEPARTMENT OF ENERGY
FERNALD ENVIRONMENTAL MANAGEMENT PROJECT
SILOS 1 AND 2 ACCELERATED WASTE RETRIEVAL PROJECT
FERNALD, OHIO
FDF CONTRACT NO. FSC 624

FOSTER WHEELER
FOSTER WHEELER ENVIRONMENTAL CORPORATION

TITLE
RADON CONTROL SYSTEM
GENERAL ARRANGEMENT
2ND FLOOR

DRAWN BY W C BLUME	DATE 01/07/00
DESIGNED BY W C BLUME	DATE 01/07/00
CHECKED BY S W HUNGATE	DATE 01/07/00
APPROVED BY KENNETH RICKETT	DATE 01/07/00
APPROVED BY JOHN LAWSON	DATE 01/07/00

SIZE D | SCALE: 1/8"=1'-0" | DWG. NO. 20FMD028 | REV 2

RPE
KENNETH D. RICKETT
P.E. NO. E-64418
5/15/00
REVISION 2

REV	DATE	BY	CHK'D	APR'VD	DESCRIPTION/ISSUE
2	05/15/00	JC	GCH	KDR	REVISED PER CHANGE PROPOSAL CP-00-004
1	01/07/00	WCB	SWH	KDR	CERTIFIED FOR CONSTRUCTION
0	11/01/99	WCB	MBF		PRELIMINARY DESIGN SUBMITTAL

LETTER OR NUMBER OF SECTION OR DETAIL
DRAWING ON WHICH SECTION OR DETAIL IS TAKEN
DRAWING ON WHICH SECTION OR DETAIL IS SHOWN
SECTION & DETAIL KEY

00283

FILENAME: 20FMD028.

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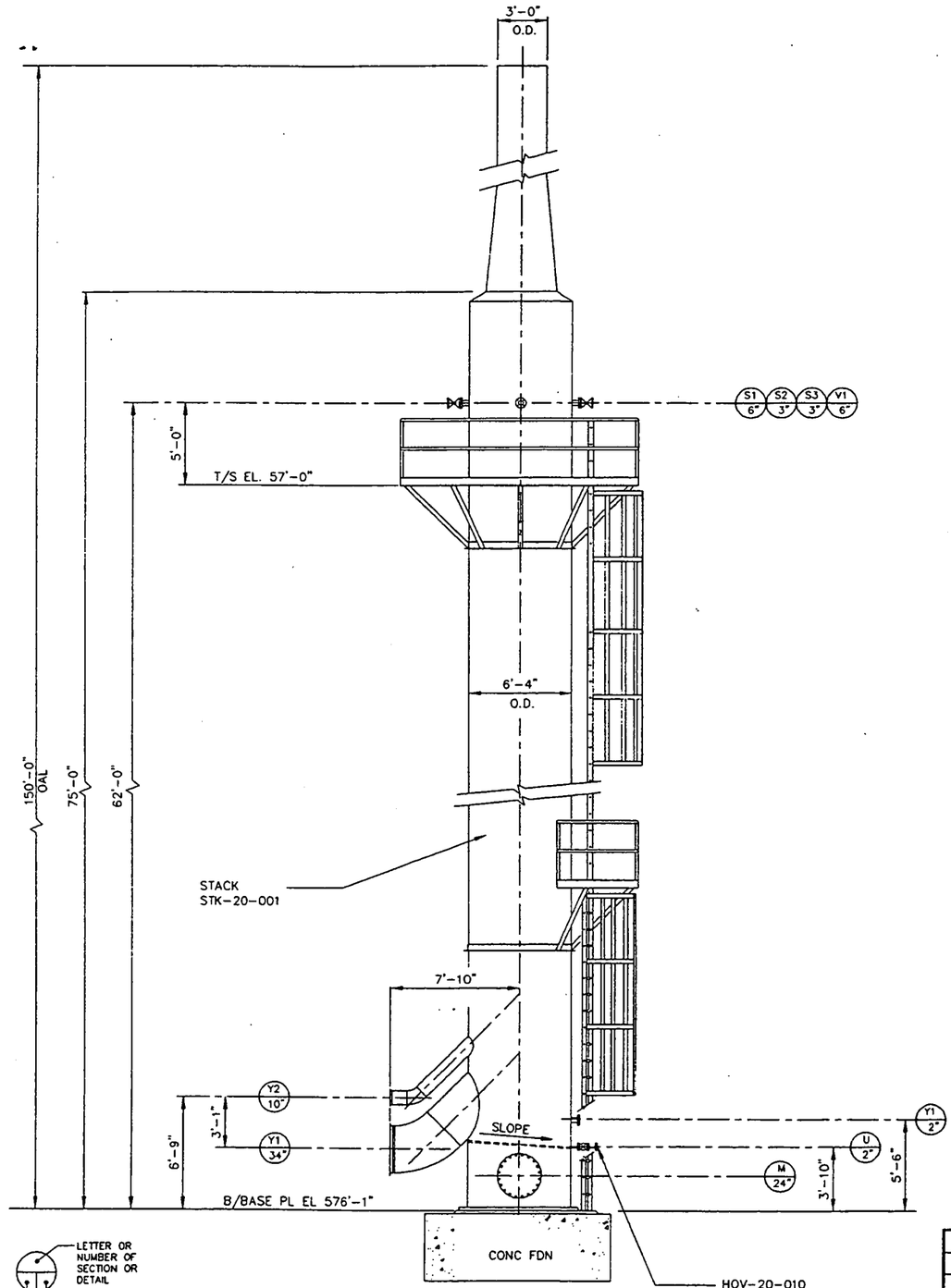
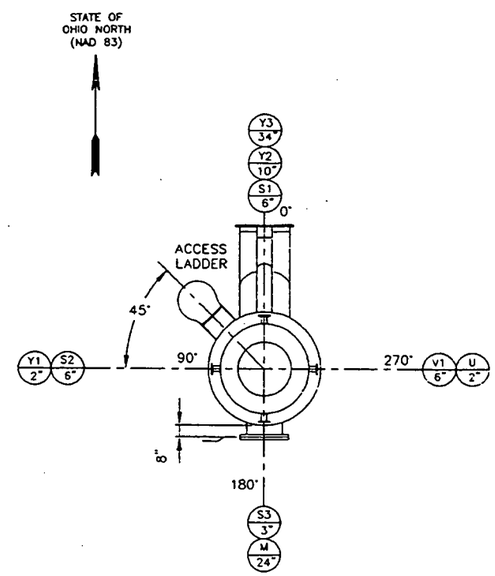


ELEVATION VIEW

SOME NOZZLES SHOWN HAVE BEEN ROTATED FOR CLARITY. SEE PLAN VIEW THIS DRAWING FOR CORRECT ORIENTATION.



PLAN VIEW

NOZZLE SCHEDULE

SYMBOL	SIZE	TYPE	SERVICE
M	24"	150# FF FLG	MANWAY W/BLIND
S1	6"	150# FF FLG	ACCESS SAMPLING PORT W/BLIND
S2	3"	150# FF FLG	ACCESS SAMPLING PORT W/BLIND
S3	3"	150# FF FLG	ACCESS/SAMPLE PORT W/BLIND
U	2"	150# FF FLG	DRAIN
V1	6"	150# FF FLG	ISOKINETIC SAMPLER PORT W/BLIND
Y1	2"	150# FF FLG	ISOKINETIC SAMPLER RETURN W/BLIND
Y2	10"	ANGLE RING	RCS INLET EXHAUST AIR
Y3	34"	ANGLE RING	HVAC INLET EXHAUST AIR

3387

NOTES:
1. ALL NOZZLE PROJECTIONS ARE 6" PROJECTION U.N.O.
2. ANGLE RING FLANGE FOR NOZZLE (Y3/34") TO MATCH 125# BOLTING REQUIREMENTS PER ANSI B16.1.
3. ANGLE RING FLANGE FOR NOZZLE (Y2/10") TO MATCH 150# BOLTING REQUIREMENTS PER ANSI B16.5.

LETTER OR NUMBER OF SECTION OR DETAIL
DRAWING ON WHICH SECTION OR DETAIL IS TAKEN
DRAWING ON WHICH SECTION OR DETAIL IS SHOWN
SECTION & DETAIL KEY

3294

000398

THE ORIGINAL DRAWING AND SUBSEQUENT REVISIONS THEREOF, WITH APPROVAL NAMES, INITIALS, AND THE PE SEAL, IF APPLICABLE, ARE MAINTAINED IN THE FILES OF FWENC.

REV	DATE	BY	CHK'D	APR'VD	DESCRIPTION/ISSUE
0	8-11-00				CERTIFIED FOR CONSTRUCTION

PE: STATE OF OHIO, ROBERT D. RICKETT, E-64418, REGISTERED PROFESSIONAL ENGINEER

		DATE
DRAWN BY		8-1-00
DESIGNED BY		8-1-00
CHECKED BY		8/11/00
APPROVED BY		8/11/00
APPROVED BY		8/11/00

DEPARTMENT OF ENERGY
FERNALD ENVIRONMENTAL MANAGEMENT PROJECT
SILOS 1 AND 2 ACCELERATED WASTE RETRIEVAL PROJECT
FERNALD, OHIO
FDF CONTRACT NO. FSC 624

FOSTER WHEELER
FOSTER WHEELER ENVIRONMENTAL CORPORATION

TITLE
RADON CONTROL SYSTEM
GENERAL ARRANGEMENT
RCS EXHAUST STACK

SIZE	SCALE:	DWG. NO.	REV
D	1/4"=1'-0"	20FMD148	0

FILENAME: 20FMD148.DWG

Appendix C

Heat and Material Balances for All Materials

DOCUMENT NO. 624-P622-06

DRAWING NUMBER	DRAWING TITLE	REVISION
10FMD001	FULL-SCALE MOCKUP SYSTEM PROCESS FLOW DIAGRAM MASS BALANCE – RADON CONTROL	2
10FMD006	FULL-SCALE MOCKUP SYSTEM PROCESS FLOW DIAGRAM MASS BALANCE TABLE	2
11FMD001	SILO WASTE RETRIEVAL SYSTEM PROCESS FLOW DIAGRAM MASS BALANCE TABLE - SHT 1	2
11FMD002	SILO WASTE RETRIEVAL SYSTEM PROCESS FLOW DIAGRAM MASS BALANCE TABLE - SHT 2	2
13FMD001	TRANSFER TANK WASTE RETRIEVAL PROCESS FLOW DIAGRAM MASS BALANCE TABLE	2
14FMD001	DECANT SUMP RETRIEVAL SYSTEM PROCESS FLOW DIAGRAM MASS BALANCE TABLE	2
20FMD001	RADON CONTROL SYSTEM PROCESS FLOW DIAGRAM MASS BALANCE TABLES – SHT 1	2
20FMD002	RADON CONTROL SYSTEM PROCESS FLOW DIAGRAM MASS BALANCE TABLES – SHT 2	2
77FMD002	MISC FACILITIES HVAC SYSTEM HVAC FLOW DIAGRAM MASS BALANCE TABLE	0

INFORMATION ONLY

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PHASE 1 (SEE NOTE 2)

STREAM NUMBER	1	2	3	4	5	6	7	8	9
COMPONENT	AIR FROM SILO 4	AIR TO SILO 4	AIR TO STACK	FAN RECYCLE FLOW	AIR TO FAN	MAKE-UP AIR	EQUIPMENT ENCLOSURE AIR INFLOW	EQUIPMENT ENCLOUSRE AIR INFLOW	EQUIPMENT ENCLOSURE AIR INLFLOW
AIR (LBS/HR)	2,166	2,166	216.6	1,949.4	4,332	--	--	--	--
WATER (LBS/HR)	40.6	40.6	4.1	36.5	81.2	--	--	--	--
TOTAL (LBS/HR)	2,206.6	2,206.6	220.7	1,985.9	4,413.2	--	--	--	--
FLOW (CFM)	500	500	50	450	1,000	50	--	--	--
FLOW (GPM)	--	--	--	--	--	--	--	--	--
RADON (PICOCURIES/L)	--	--	--	--	--	--	--	--	--
RADON (CURIES/HR)	--	--	--	--	--	--	--	--	--
TEMPERATURE (DEG F)	75	75	75	75	75	--	--	--	--
PRESSURE (INCHES WC)	--	--	--	--	--	--	--	--	--
NOTES									

PHASE 2 (SEE NOTE 3)

STREAM NUMBER	1	2	3	4	5	6	7	8	9
COMPONENT	AIR FROM SILO 4	AIR TO SILO 4	AIR TO STACK	FAN RECYCLE FLOW	AIR TO FAN	MAKE-UP AIR	EQUIPMENT ENCLOSURE AIR INFLOW	EQUIPMENT ENCLOSURE AIR INFLOW	EQUIPMENT ENCLOSURE AIR INFLOW
AIR (LBS/HR)	1,083	--	3,249	1,083	4,332	2,166	361	361	361
WATER (LBS/HR)	20.3	--	60.9	20.3	81.2	40.6	6.8	6.8	6.8
TOTAL (LBS/HR)	1,103.3	--	3,309.9	1,103.3	4,413.2	2,206.6	367.8	367.8	367.8
FLOW (CFM)	250	--	750	250	1,000	500	83	83	83
FLOW (GPM)	--	--	--	--	--	--	--	--	--
RADON (PICOCURIES/L)	--	--	--	--	--	--	--	--	--
RADON (CURIES/HR)	--	--	--	--	--	--	--	--	--
TEMPERATURE (DEG F)	75	--	75	75	75	75	75	75	75
PRESSURE (INCHES WC)	--	--	--	--	--	--	--	--	--
NOTES									

NOTES:

1. MASS BALANCE TABLES TO BE USED IN CONJUNCTION WITH 10FMD002, & 10FMD003.
2. PHASE 1 MASS BALANCE REPRESENTS RCS RECYCLE WITH 100% OF AIR PULLED FROM SILO 4 RECYCLED BACK TO SILO 4.
3. PHASE 2 MASS BALANCE REPRESENTS RCS OPERATION DURING RETRIEVAL MODE FROM SILOS AND AIRFLOW THROUGH EQUIPMENT MODULES.

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THE ORIGINAL DRAWING AND SUBSEQUENT REVISIONS THEREOF, WITH APPROVAL NAMES, INITIALS, AND THE PE SEAL, IF APPLICABLE, ARE MAINTAINED IN THE FILES OF FWENC.

REV	DATE	BY	CHK'D	APR'VD	DESCRIPTION/ISSUE
2					REVISED PER CHANGE PROPOSAL CP-00-001
1	01/07/00	BJD	SWH	KDR	CERTIFIED FOR CONSTRUCTION
0	01/07/99	BJD	RAR		PRELIMINARY DESIGN SUBMITTAL

PE

		DATE
DRAWN BY	B J DAVIS	01/07/00
DESIGNED BY	B J DAVIS	01/07/00
CHECKED BY	S W HUNGATE	01/07/00
APPROVED BY	KENNETH RICKETT	01/07/00
APPROVED BY	JOHN LAWSON	01/07/00

DEPARTMENT OF ENERGY
FERNALD ENVIRONMENTAL MANAGEMENT PROJECT
SILOS 1 AND 2 ACCELERATED WASTE RETRIEVAL PROJECT
FERNALD, OHIO
FDF CONTRACT NO. FSC 624

FOSTER WHEELER
FOSTER WHEELER ENVIRONMENTAL CORPORATION

TITLE
FULL-SCALE MOCKUP SYSTEM
PROCESS FLOW DIAGRAM
MASS BALANCE-RADON CONTROL

SIZE	SCALE	DWG. NO.	REV
D	NONE	10FMD001	2

FILENAME: 10FMD001.DWG

10FMD001.dwg, 05/26/2000 02:32:41 PM

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FULL-SCALE MOCKUP MASS BALANCE TABLE

FSMS INVENTORY		STREAM NUMBER	37	1	1	2	3	4	30	--	--	7	7	7	21	--	8	28	29	--
		STREAM DESCRIPTION	DECANT FROM TTA TO UF MAKE-UP CONNECTION	DECANT FROM UF MAKE-UP CONNECTION (BULK RETRIEVAL)	DECANT FROM UF MAKE-UP CONNECTION (CATS)	DECANT DILUTION WATER	DECANT FLUSH WATER	DECANT WATER TO BE FILTERED	DECANT MAKE-UP TO FILTER PROCESS TANK			SLURRY DISCHARGE (BULK RETRIEVAL)	SLURRY DISCHARGE RETRIEVED WASTE (BULK RETRIEVAL)	SLURRY DISCHARGE (CATS WITH DILUTION WATER)	SLURRY DISCHARGE (FROM SREE TO SLURRY PUMP)		SLURRY LINE FROM UF SYSTEM	UF SUPPLY FROM PROCESS TANK	UF RETURN TO PROCESS TANK	
TOTAL SOLIDS (LB)	184,751		NOTE 2					NOTE 2	NOTE 2	--	--					--	NOTE 2	NOTE 2	NOTE 2	--
BENTOGROUT (LB)	3,791	FLOW (GPM)	300	250	250	50	250	300	50	--	--	296	296	275	25	--	300	300	100	--
FIU SIMULANT (LB)	180,960	% SOLIDS (WT)	0	0	0	0	0	0	0	--	--	15.0	15.0	3.6	32	--	0	0	0	--
VOLUME BENTOGROUT (GAL) IN-SITU	1,575	SOLIDS PER GAL (LB)	0	0	0	0	0	0	0	--	--	1.334	1.334	0.293	3.183	--	0	0	0	--
VOLUME FIU (GAL) IN-SITU	20,886	SOLIDS PER DAY (LB)	0	0	0	0	0	0	0	--	--	189,520	189,520	38,795	38,811	--	0	0	0	--
WATER (LB)	94,886	MINUTES PER DAY OPERATION (MIN)	480	480	480	60	60	25	375	--	--	480	480	480	480	--	25	375	375	--
TOTAL MASS (LB)	279,637	TOTAL VOLUME PER DAY (GALLONS)	144,000	120,000	120,000	3,000	15,000	7,500	18,750	--	--	142,072	142,072	132,192	12,192	--	7,500	112,500	37,500	--
VOLUME WATER (GALLONS)	11,861	DAYS OF OPERATION	1.01	0.76	0.25	0	0	1.01	1.01	--	--	0.76	0.76	0.25	0.25	--	1.01	1.01	1.01	--
TOTAL VOLUME (GALLONS)	22,461	TOTAL VOLUME (GALLONS)	145,440	91,200	30,000	0	0	7,575	18,938	--	--	107,975	107,975	33,048	3,048	--	7,575	113,625	37,875	--
		TOTAL MASS SOLIDS (LB)	0	0	0	0	0	0	0	--	--	144,035	144,035	9,699	9,703	--	0	0	0	--
		SOLIDS PER HOUR (LB/HR)	0	0	0	0	0	0	0	--	--	23,690	23,690	4,849	4,851	--	0	0	0	--

NOTES:

1. MASS BALANCE TABLES TO BE USED IN CONJUNCTION WITH 10FMD007, 10FMD008, 10FMD010 & 10FMD011.
2. DURING ICAT & SOT OPERATION OF THE FULL-SCALE MOCKUP (FSM), COMPONENTS AND FLOW STREAMS OF THE PERMANENT FACILITY WILL BE USED. CERTAIN FLOW STREAM IDENTIFIERS HAVE BEEN DUPLICATED ON THIS MASS BALANCE WHEN COMPARED TO OTHER SYSTEM MASS BALANCES. THE STREAMS ARE DUPLICATED BECAUSE THE MASS BALANCE VALUES ARE DIFFERENT DURING FSM OPERATION AS OPPOSED TO NORMAL SYSTEM OPERATION. ALL OF THE DUPLICATE STREAM NUMBERS DO NOT APPEAR ON THE FULL-SCALE MOCKUP SYSTEM (FSMS) PROCESS FLOW DIAGRAMS. THE LIST BELOW SHOWS THE LOCATION OF THE DUPLICATE STREAMS NOT SHOWN ON THE FSMS PROCESS FLOW DIAGRAMS. THE VALUES PRESENTED ON THIS DRAWING SHOULD ONLY BE USED FOR FSM OPERATION. STREAM NUMBERS ARE PRESENTED IN THE ORDER THEY APPEAR ON THE MASS BALANCE.
3. ROUND OFF OF QUANTITIES MAY RESULT IN MINOR DIFFERENCES WITHIN THE MASS BALANCE.

STREAM NUMBER	DRAWING
37	11FMD005 11FMD007 12FMD001 12FMD003
4	11FMD007 12FMD008
30	11FMD007
8	12FMD001 12FMD007
28	12FMD007 12FMD008
29	12FMD007 12FMD008
14	12FMD001 12FMD018
15	12FMD007 12FMD008
18	12FMD001
19	12FMD008

FULL-SCALE MOCKUP MASS BALANCE TABLE - CONT.

FSMS INVENTORY		STREAM NUMBER	10	11	12	13	14	15	18	19
		STREAM DESCRIPTION	SREE SPRAYERS (FILTERED WATER)	EMMA SPRAY WAND, AND DECON SPRAY RINGS (FILTERED WATER)	FILTRATE RECIRCULATION LOOP (FILTERED WATER)	HP JET PUMP SUPPLY (FILTERED WATER)	RINSE WATER (FILTERED WATER)	FROM UF TO FW TANK (FILTERED WATER)	MAKE-UP WATER	MAKE-UP WATER TO FILTRATE TANK
TOTAL SOLIDS (LB)	184,751						NOTE 2	NOTE 2	NOTE 2	NOTE 2
BENTOGROUT (LB)	3,791	FLOW (GPM)	6	40	60	10	150	20	200	200
FIU SIMULANT (LB)	180,960	% SOLIDS (WT)	0	0	0	0	0	0	0	0
VOLUME BENTOGROUT (GAL) IN-SITU	1,575	SOLIDS PER GAL (LB)	0	0	0	0	0	0	0	0
VOLUME FIU (GAL) IN-SITU	20,886	SOLIDS PER DAY (LB)	0	0	0	0	0	0	0	0
WATER (LB)	94,886	MINUTES PER DAY OPERATION (MIN)	240	60	30	480	2	375	90	30
TOTAL MASS (LB)	279,637	TOTAL VOLUME PER DAY (GALLONS)	1,440	2,400	1,800	4,800	300	7,500	18,000	6,000
VOLUME WATER (GALLONS)	11,861	DAYS OF OPERATION	0.25	5	0.25	0.25	1.01	1.01	11.00	1.00
TOTAL VOLUME (GALLONS)	22,461	TOTAL VOLUME (GALLONS)	360	12,000	450	1,200	303	7,575	198,000	6,000
		TOTAL MASS SOLIDS (LB)	0	0	0	0	0	0	0	0
		SOLIDS PER HOUR (LB/HR)	0	0	0	0	0	0	0	0

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2	08/31/00	BJD	BAL	KDR	REVISED PER CHANGE PROPOSAL CP-00-001
1	01/07/00	BJD	SWH	KDR	CERTIFIED FOR CONSTRUCTION
0	11/01/99	BJD	SWH		PRELIMINARY DESIGN SUBMITTAL

RPE
KENNETH D. RICKETT
P.E. NO. E-64418
08/31/00
REVISION 2

		DATE
DRAWN BY	B J DAVIS	01/07/00
DESIGNED BY	B J DAVIS	01/07/00
CHECKED BY	S W HUNGATE	01/07/00
APPROVED BY	KENNETH RICKETT	01/07/00
APPROVED BY	JOHN LAWSON	01/07/00

DEPARTMENT OF ENERGY
FERNALD ENVIRONMENTAL MANAGEMENT PROJECT
SILOS 1 AND 2 ACCELERATED WASTE RETRIEVAL PROJECT
FERNALD, OHIO
FDF CONTRACT NO. FSC 624

FOSTER WHEELER
FOSTER WHEELER ENVIRONMENTAL CORPORATION

TITLE
FULL-SCALE MOCKUP SYSTEM
PROCESS FLOW DIAGRAM
MASS BALANCE TABLE

SIZE	SCALE:	DWG. NO.	REV
D	NONE	10FMD006	2

FILENAME: 10FMD006.DWG

3387

SILO 2 – AWRS MASS BALANCE TABLE

INVENTORY		STREAM NUMBER	37	1	1	2	3	4	30	--	--	7	7	7	21	--	8	28	29
		STREAM DESCRIPTION	DECANT FROM TTA TO UF MAKE-UP CONNECTION	DECANT FROM UF MAKE-UP CONNECTION (BULK RETRIEVAL)	DECANT FROM UF MAKE-UP CONNECTION (CATS)	DECANT DILUTION WATER	DECANT FLUSH WATER	DECANT WATER TO BE FILTERED	DECANT MAKE-UP TO FILTER PROCESS TANK			SLURRY DISCHARGE (BULK RETRIEVAL)	SLURRY DISCHARGE RETRIEVED WASTE (BULK RETRIEVAL)	SLURRY DISCHARGE (CATS WITH DILUTION WATER)	SLURRY DISCHARGE (FROM SREE TO SLURRY PUMP)		SLURRY LINE FROM UF SYSTEM	UF SUPPLY FROM PROCESS TANK	UF RETURN TO PROCESS TANK
													NOTE 2						
TOTAL SOLIDS (LB)	9,130,965	FLOW (GPM)	300	250	250	50	250	300	50	--	--	275.7	275.7	271	21	--	300	300	280
BENTOGROUT (LB)	187,369	% SOLIDS (WT)	2.0	2.0	2.0	2.0	2.0	2.0	2.0	--	--	15.0	13.38	4.6	31.0	--	4.0	2.0	2.14
K-65 (LB)	8,943,596	SOLIDS PER GAL (LB)	0.167	0.167	0.167	0.167	0.167	0.167	0.167	--	--	1.315	1.164	0.387	2.983	--	0.336	0.167	0.179
VOLUME BENTOGROUT (GALLONS) IN-SITU	83,011	SOLIDS PER DAY (LB)	24,050	20,042	20,042	501	2,505	1,253	1,253	--	--	173,968	153,959	50,344	30,071	--	2,519	18,789	18,770
VOLUME K-65 (GALLONS) IN-SITU	751,141	MINUTES PER DAY OPERATION (MIN)	480	480	480	60	60	25	150	--	--	480	480	480	480	--	25	375	375
WATER (LB)	4,210,225	TOTAL VOLUME PER DAY (GALLONS)	144,000	120,000	120,000	3,000	15,000	7,500	7,500	--	--	132,314	132,314	130,080	10,080	--	7,500	112,500	105,000
TOTAL MASS (LB)	13,341,190	DAYS OF OPERATION	71.52	56.34	15.18	0.00	0.00	74.02	74.02	--	--	56.34	56.34	15.18	15.18	--	74.02	74.02	74.02
VOLUME WATER (GALLONS)	504,509	TOTAL VOLUME (GALLONS)	10,299,519	6,761,069	1,821,863	0	0	555,183	555,183	--	--	7,454,874	7,454,874	1,974,900	153,037	--	555,183	8,327,749	7,772,566
TOTAL VOLUME (GALLONS)	834,152	TOTAL MASS SOLIDS (LB)	1,720,188	1,129,209	304,281	0	0	92,725	92,725	--	--	9,801,761	8,674,417	764,325	456,548	--	186,500	1,390,870	1,389,403
CURIES	9,682	SOLIDS PER HOUR (LB/HR)	3,006	2,505	2,505	501	2,505	3,006	501	--	--	21,746	19,245	6,293	3,759	--	6,047	3,006	3,003
		CURIES	1,824	1,197	323	0	0	98	98	--	--	10,393	9,198	810	484	--	198	1,475	1,473

SILO 2 – AWRS MASS BALANCE TABLE – CONT.

INVENTORY		STREAM NUMBER		10	11	12	13	14	15	16	17	18	19	20	23	24	25	26	27
		STREAM DESCRIPTION	--	SREE SPRAYERS (FILTERED WATER)	EMMA, SPRAY WAND, AND DECON SPRAY RINGS (FILTERED WATER)	FILTRATE RECIRCULATION LOOP (FILTERED WATER)	HP JET PUMP SUPPLY (FILTERED WATER)	RINSE WATER (FILTERED WATER)	FROM UF TO FW TANK (FILTERED WATER)	TTA HP DECON (FILTERED WATER)	AWWTP SUPPLY	MAKE-UP WATER TO TTA	MAKE-UP WATER TO FILTRATE TANK	RCS CONDENSATE RETURN	STORAGE TANK 2B SUMP DRAIN	STORAGE TANK 1B SUMP DRAIN	STORAGE TANK 2A SUMP DRAIN	STORAGE TANK 1A SUMP DRAIN	FROM TTA SUMP PUMP LINE
															NOTE 3	NOTE 3	NOTE 3	NOTE 3	NOTE 3
TOTAL SOLIDS (LB)	9,130,965	FLOW (GPM)	--	6	40	60	10	150	20	40	80	200	200	50	0	0	0	0	300
BENTOGROUT (LB)	187,369	% SOLIDS (WT)	--	0	0	0	0	0	0	0	0	0	0	0	20	20	20	20	20
K-65 (LB)	8,943,596	SOLIDS PER GAL (LB)	--	0	0	0	0	0	0	0	0	0	0	0	1.80	1.80	1.80	1.80	1.80
VOLUME BENTOGROUT (GALLONS) IN-SITU	83,011	SOLIDS PER DAY (LB)	--	0	0	0	0	0	0	0	0	0	0	0	--	--	--	--	--
VOLUME K-65 (GALLONS) IN-SITU	751,141	MINUTES PER DAY OPERATION (MIN)	--	480	60	480	480	2	375	20	0	90	30	60	--	--	--	--	--
WATER (LB)	4,210,225	TOTAL VOLUME PER DAY (GALLONS)	--	2,880	2,400	28,800	4,800	300	7,500	800	0	18,000	6,000	3,000	--	--	--	--	--
TOTAL MASS (LB)	13,341,190	DAYS OF OPERATION	--	15.18	5.00	15.18	15.18	71.52	74.02	0.00	0.00	21.00	21.00	4.00	--	--	--	--	--
VOLUME WATER (GALLONS)	504,509	TOTAL VOLUME (GALLONS)	--	43,725	12,000	437,247	72,875	21,457	555,183	0	0	378,000	126,000	12,000	--	--	--	--	--
TOTAL VOLUME (GALLONS)	834,152	TOTAL MASS SOLIDS (LB)	--	0	0	0	0	0	0	0	0	0	0	0	--	--	--	--	--
CURIES	9,682	SOLIDS PER HOUR (LB/HR)	--	0	0	0	0	0	0	0	0	0	0	0	--	--	--	--	--
		CURIES	--	0	0	0	0	0	0	0	0	0	0	0	--	--	--	--	--

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NOTES:

1. MASS BALANCE TABLES TO BE USED IN CONJUNCTION WITH DRAWINGS 11FMD003 THRU 11FMD009, & 12FMD001 THRU 12FMD008.
2. STREAM OF APPROXIMATE WASTE RETRIEVED (SLURRY SOILDS 15% – DECANT SOLIDS 2%).
3. NUMBERS PRESENTED HERE ARE FOR DESIGN BASIS FOR SIZING THE TTA SUMP PUMP.
4. ROUND OFF OF QUANTITIES MAY RESULT IN MINOR DIFFERENCES WITHIN THE MASS BALANCE.

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THE ORIGINAL DRAWING AND SUBSEQUENT REVISIONS THEREOF, WITH APPROVAL NAMES, INITIALS, AND THE PE SEAL, IF APPLICABLE, ARE MAINTAINED IN THE FILES OF FWENC.

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PE: KENNETH D. RICKETT
P.E. NO. E-64418
08/31/00
REVISION 2

		DATE
DRAWN BY	B J DAVIS	01/07/00
DESIGNED BY	B J DAVIS	01/07/00
CHECKED BY	S W HUNGATE	01/07/00
APPROVED BY	KENNETH RICKETT	01/07/00
APPROVED BY	JOHN LAWSON	01/07/00

DEPARTMENT OF ENERGY
FERNALD ENVIRONMENTAL MANAGEMENT PROJECT
SILOS 1 AND 2 ACCELERATED WASTE RETRIEVAL PROJECT
FERNALD, OHIO
FDF CONTRACT NO. FSC 624

FOSTER WHEELER
FOSTER WHEELER ENVIRONMENTAL CORPORATION

TITLE
SILO WASTE RETRIEVAL SYSTEM
PROCESS FLOW DIAGRAM
MASS BALANCE TABLE – SHT 1

SIZE: D | SCALE: NONE | DWG. NO. 11FMD001 | REV 2

FILENAME: 11FMD001.DWG

INFORMATION ONLY

3387

SILO 1 – AWRS MASS BALANCE TABLE

INVENTORY		STREAM NUMBER	37	1	1	2	3	4	30	5	6	7	7	7	21	22	8	28	29
		STREAM DESCRIPTION	DECANT FROM TTA TO UF MAKE-UP CONNECTION	DECANT FROM UF MAKE-UP CONNECTION (BULK RETRIEVAL)	DECANT FROM UF MAKE-UP CONNECTION (CATS)	DECANT DILUTION WATER	DECANT FLUSH WATER	DECANT WATER TO BE FILTERED	DECANT MAKE-UP TO FILTER PROCESS TANK			SLURRY DISCHARGE (BULK RETRIEVAL)	SLURRY DISCHARGE RETRIEVED WASTE (BULK RETRIEVAL)	SLURRY DISCHARGE (CATS WITH DILUTION WATER)	SLURRY DISCHARGE (FROM SREE TO SLURRY PUMP)		SLURRY LINE FROM UF SYSTEM	UF SUPPLY FROM PROCESS TANK	UF RETURN TO PROCESS TANK
													NOTE 2						
TOTAL SOLIDS (LB)	10,539,229	FLOW (GPM)	320	300	300	50	300	320	20			330.8	330.8	321	21		300	300	280
BENTOGROUT (LB)	214,613	% SOLIDS (WT)	2.0	2.0	2.0	2.0	2.0	2.0	2.0			15.0	13.38	4.18	31.0		4.0	2.0	2.14
K-65 (LB)	10,324,616	SOLIDS PER GAL (LB)	0.167	0.167	0.167	0.167	0.167	0.167	0.167			1.315	1.164	0.351	2.983		0.336	0.167	0.179
VOLUME BENTOGROUT (GALLONS) IN-SITU	95,130	SOLIDS PER DAY (LB)	25,654	24,050	24,050	501	3,006	1,256	1,253			208,762	184,751	54,118	30,071		2,519	18,789	18,770
VOLUME K-65 (GALLONS) IN-SITU	867,074	MINUTES PER DAY OPERATION (MIN)	480	480	480	60	60	24	375			480	480	480	480		25	375	375
WATER (LB)	4,510,370	TOTAL VOLUME PER DAY (GALLONS)	153,600	144,000	144,000	3,000	18,000	7,520	7,500			158,777	158,777	154,080	10,080		7,500	112,500	105,000
TOTAL MASS (LB)	15,049,599	DAYS OF OPERATION	69.78	54.57	15.21	0.00	0.00	72.28	72.28			54.57	54.57	15.21	15.21		72.28	72.28	72.28
VOLUME WATER (GALLONS)	540,475	TOTAL VOLUME (GALLONS)	10,718,260	7,858,042	2,190,327	0	0	543,548	542,103			8,664,415	8,664,415	2,343,650	153,323		542,103	8,131,538	7,589,435
TOTAL VOLUME (GALLONS)	962,204	TOTAL MASS SOLIDS (LB)	1,790,124	1,312,421	365,820	0	0	90,781	90,540			11,392,080	10,081,826	823,163	457,403		182,106	1,358,099	1,356,667
CURIES	17,363	SOLIDS PER HOUR (LB/HR)	3,207	3,006	3,006	501	3,006	3,207	200			26,095	23,094	6,765	3,759		6,047	3,006	3,003
		CURIES	2,949	2,162	603	0	0	150	149			18,768	16,609	1,356	754		300	2,237	2,235

SILO 1 – AWRS MASS BALANCE TABLE – CONT.

INVENTORY		STREAM NUMBER	9	10	11	12	13	14	15	16	17	18	19	20	23	24	25	26	27
		STREAM DESCRIPTION		SREE SPRAYERS (FILTERED WATER)	EMMA, SPRAY WAND, AND DECON SPRAY RINGS (FILTERED WATER)	FILTRATE RECIRCULATION LOOP (FILTERED WATER)	HP JET PUMP SUPPLY (FILTERED WATER)		FROM UF TO FW TANK (FILTERED WATER)	TTA HP DECON (FILTERED WATER)	AWWTP SUPPLY	MAKE-UP WATER TO TTA	MAKE-UP WATER TO FILTRATE TANK	RCS CONDENSATE RETURN	STORAGE TANK 2B SUMP DRAIN	STORAGE TANK 1B SUMP DRAIN	STORAGE TANK 2A SUMP DRAIN	STORAGE TANK 1A SUMP DRAIN	FROM TTA SUMP PUMP LINE
															NOTE 3	NOTE 3	NOTE 3	NOTE 3	NOTE 3
TOTAL SOLIDS (LB)	10,539,229	FLOW (GPM)		6	40	150	10		20	40	5	200	200	50	0	0	0	0	50
BENTOGROUT (LB)	214,613	% SOLIDS (WT)		0	0	0	0		0	0	0	0	0	0	20	20	20	20	20
K-65 (LB)	10,324,616	SOLIDS PER GAL (LB)		0	0	0	0		0	0	0	0	0	0	1.80	1.80	1.80	1.80	1.80
VOLUME BENTOGROUT (GALLONS) IN-SITU	95,130	SOLIDS PER DAY (LB)		0	0	0	0		0	0	0	0	0	0	0	0	0	0	0
VOLUME K-65 (GALLONS) IN-SITU	867,074	MINUTES PER DAY OPERATION (MIN)		480	60	480	480		375	20	480	90	30	60	0	0	0	0	0
WATER (LB)	4,510,370	TOTAL VOLUME PER DAY (GALLONS)		2,880	2,400	72,000	4,800		7,500	800	2,400	18,000	6,000	3,000	0	0	0	0	0
TOTAL MASS (LB)	15,049,599	DAYS OF OPERATION		15.21	5.00	15.21	15.21		72.28	0.00	0.00	22.10	20.70	5.00	0	0	0	0	0
VOLUME WATER (GALLONS)	540,475	TOTAL VOLUME (GALLONS)		43,807	12,000	1,095,163	73,011		542,103	0	0	397,800	124,200	15,000	0	0	0	0	0
TOTAL VOLUME (GALLONS)	962,204	TOTAL MASS SOLIDS (LB)		0	0	0	0		0	0	0	0	0	0	0	0	0	0	0
CURIES	17,363	SOLIDS PER HOUR (LB/HR)		0	0	0	0		0	0	0	0	0	0	0	0	0	0	0
		CURIES		0	0	0	0		0	0	0	0	0	0	0	0	0	0	0

NOTES:

1. MASS BALANCE TABLES TO BE USED IN CONJUNCTION WITH DRAWINGS 11FMD003 THRU 11FMD009, 12FMD001 THRU 12FMD008, & 51FMD001.
2. STREAM OF APPROXIMATE WASTE RETRIEVED (SLURRY SOILDS 15% – DECANT SOLIDS 2%).
3. TTA TANK FOUNDATION DRAIN.

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THE ORIGINAL DRAWING AND SUBSEQUENT REVISIONS THEREOF, WITH APPROVAL NAMES, INITIALS, AND THE PE SEAL, IF APPLICABLE, ARE MAINTAINED IN THE FILES OF FWENC.

REV	DATE	BY	CHK'D	APR'VD	DESCRIPTION/ISSUE
2					REVISED PER CHANGE PROPOSAL CP-00-001
1	01/07/00	BJD	SWH	KDR	CERTIFIED FOR CONSTRUCTION
0	11/03/99	BJD	SWH		PRELIMINARY DESIGN SUBMITTAL

PE

DRAWN BY B J DAVIS	DATE 01/07/00	
DESIGNED BY B J DAVIS	DATE 01/07/00	
CHECKED BY S W HUNGATE	DATE 01/07/00	
APPROVED BY KENNETH RICKETT	DATE 01/07/00	
APPROVED BY JOHN LAWSON	DATE 01/07/00	

DEPARTMENT OF ENERGY
FERNALD ENVIRONMENTAL MANAGEMENT PROJECT
SILOS 1 AND 2 ACCELERATED WASTE RETRIEVAL PROJECT
FERNALD, OHIO
FDF CONTRACT NO. FSC 624

FOSTER WHEELER
FOSTER WHEELER ENVIRONMENTAL CORPORATION

TITLE
SILO WASTE RETRIEVAL SYSTEM
PROCESS FLOW DIAGRAM
MASS BALANCE TABLE – SHT 2

SIZE	SCALE	DWG. NO.	REV
D	NONE	11FMD002	2

FILENAME: 11FMD002.DWG

05/26/2000 02:38:35 PM

NOTES:

1. MASS BALANCE TABLE TO BE USED IN CONJUNCTION WITH DRAWINGS 13FMD002, 13FMD003, & 13FMD004.
2. STREAM OF APPROXIMATE WASTE RETRIEVED (SLURRY SOILDS 15% – DECANT SOILDS 2%).
3. TTA TANK FOUNDATION DRAIN.

TYPICAL TTA TANK – MASS BALANCE

SILO 1 TTA TANK INVENTORY		STREAM NUMBER	1	2	3	7	7	16	23	24	25	26	27
		STREAM DESCRIPTION	SLUICING WATER	DILUTION WATER	FLUSH WATER	SLURRY DISCHARGE	RETRIEVED WASTE	TTA HP DECON (FILTERED WATER)	STORAGE TANK 2B SUMP DRAIN	STORAGE TANK 2A SUMP DRAIN	STORAGE TANK 1B SUMP DRAIN	STORAGE TANK 1A SUMP DRAIN	FROM TTA SUMP PUMP TO SLURRY LINE
TOTAL SOLIDS (LB)	5,270,000						NOTE 2		NOTE 3	NOTE 3	NOTE 3	NOTE 3	NOTE 3
BENTOGROUT (LB)	107,000	FLOW (GPM)	300	50	300	331	331	40	0	0	0	0	300
K-65 (LB)	5,160,000	% SOLIDS (WT)	2.0	2.0	2.0	15.0	13.38	0	20.0	20.0	20.0	20.0	20.0
WATER (LB)	4,660,000	SOLIDS PER GAL (LB)	0.167	0.167	0.167	1.315	1.164	0	1.798	1.798	1.798	1.798	1.798
TOTAL MASS (LB)	9,930,000	SOLIDS PER DAY (LB)	24,050	501	3,006	208,897	184,944	0	0	0	0	0	0
VOLUME WATER (GALLONS)	559,000	MINUTES PER DAY OPERATION (MIN)	480	60	60	480	480	20	0	0	0	0	0
TOTAL VOLUME (GALLONS)	750,000	TOTAL VOLUME PER DAY (GALLONS)	144,000	3,000	18,000	158,880	158,880	800	0	0	0	0	0
TOTAL SOLIDS (GALLONS)	190,000	DAYS OF OPERATION	28.49	0	0	28.49	28.49	5	0	0	0	0	0
CURIES	8,680	TOTAL VOLUME (GALLONS)	4,102,986	0	0	4,526,961	4,526,961	4,000	0	0	0	0	0
		TOTAL MASS SOLIDS (LB)	685,266	0	0	5,952,105	5,269,615	0	0	0	0	0	0
		SOLIDS PER HOUR (LB/HR)	3,006	501	3,006	25,112	23,118	0	0	0	0	0	0
		CURIES	1,129	0	0	9,806	8,681	0	0	0	0	0	0

TYPICAL TTA TANK – MASS BALANCE

SILO 2 TTA TANK INVENTORY		STREAM NUMBER	1	2	3	7	7	16	23	24	25	26	27
		STREAM DESCRIPTION	SLUICING WATER	DILUTION WATER	FLUSH WATER	SLURRY DISCHARGE	RETRIEVED WASTE	TTA HP DECON (FILTERED WATER)	STORAGE TANK 2B SUMP DRAIN	STORAGE TANK 2A SUMP DRAIN	STORAGE TANK 1B SUMP DRAIN	STORAGE TANK 1A SUMP DRAIN	FROM TTA SUMP PUMP TO SLURRY LINE
TOTAL SOLIDS (LB)	4,570,000						NOTE 2		NOTE 3	NOTE 3	NOTE 3	NOTE 3	NOTE 3
BENTOGROUT (LB)	93,700	FLOW (GPM)	300	50	300	331	331	40	0	0	0	0	300
K-65 (LB)	4,470,000	% SOLIDS (WT)	2.0	2.0	2.0	15.0	13.38	0	20.0	20.0	20.0	20.0	20.0
WATER (LB)	4,250,000	SOLIDS PER GAL (LB)	0.167	0.167	0.167	1.315	1.164	0	1.798	1.798	1.798	1.798	1.798
TOTAL MASS (LB)	8,820,000	SOLIDS PER DAY (LB)	24,050	501	3,006	208,897	184,944	0	0	0	0	0	0
VOLUME WATER (GALLONS)	510,000	MINUTES PER DAY OPERATION (MIN)	480	60	60	480	480	20	0	0	0	0	0
TOTAL VOLUME (GALLONS)	675,000	TOTAL VOLUME PER DAY (GALLONS)	144,000	3,000	18,000	158,880	158,880	800	0	0	0	0	0
TOTAL SOLIDS (GALLONS)	165,000	DAYS OF OPERATION	24.69	0	0	28.69	24.69	5	0	0	0	0	0
CURIES	4,840	TOTAL VOLUME (GALLONS)	3,554,740	0	0	3,922,063	3,922,063	4,000	0	0	0	0	0
		TOTAL MASS SOLIDS (LB)	593,700	0	0	5,156,778	4,565,483	0	0	0	0	0	0
		SOLIDS PER HOUR (LB/HR)	3,006	501	3,006	26,112	23,118	0	0	0	0	0	0
		CURIES	630	0	0	5,469	4,842	0	0	0	0	0	0

INFORMATION ONLY

UNCONTROLLED

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THE ORIGINAL DRAWING AND SUBSEQUENT REVISIONS THEREOF, WITH APPROVAL NAMES, INITIALS, AND THE PE SEAL, IF APPLICABLE, ARE MAINTAINED IN THE FILES OF FWENC.

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RPE

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APPROVED BY JOHN LAWSON	DATE 01/07/00

DEPARTMENT OF ENERGY
FERNALD ENVIRONMENTAL MANAGEMENT PROJECT
SILOS 1 AND 2 ACCELERATED WASTE RETRIEVAL PROJECT
FERNALD, OHIO
FDF CONTRACT NO. FSC 624

FOSTER WHEELER

FOSTER WHEELER ENVIRONMENTAL CORPORATION

TITLE

TRANSFER TANK WASTE RETRIEVAL PROCESS FLOW DIAGRAM MASS BALANCE TABLE

SIZE	SCALE:	DWG. NO.	REV
D	NONE	13FMD001	2

FILENAME: 13FMD001.DWG

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DECANT SUMP RETRIEVAL – AWRS MASS BALANCE TABLE

INVENTORY		STREAM NUMBER	31	34	40	41
		STREAM DESCRIPTION	SLUICE WATER FROM HP PUMP SKID	SLURRY FROM DECANT TANK TO VAC TRUCK	RINSE WATER TO VAC TRUCK	SLURRY FROM VAC TRUCK TO TTA TANK
TOTAL SLUDGE VOLUME (GAL)	1000	FLOW (GPM)	20.0	80.0	30.0	300.0
VOLUME K-65 (GAL) IN-SITU	477	% SOLIDS (WT)	0.0%	15.0%	0.0%	13.4%
VOLUME WATER (GAL) IN-SITU	523	SOLIDS PER GAL (LB/GAL)	0.000	1.310	0.000	1.170
K-65 (LB) IN-SITU	5686	SOLIDS PER HOUR (LB/HR)	0	6289	0	21058
WATER (LB) IN-SITU	4362	SOLIDS PER BATCH (LB/BATCH)	0	3275	0	3276
TOTAL MASS (LB) IN-SITU	10048	MINUTES PER BATCH OPERATION (MIN)	125	31	10	9
VOLUME OF SUPERNATE WATER IN-SITU (GAL)	2000	TOTAL VOLUME PER BATCH (GAL/BATCH)	2500	2500	300	2800
TOTAL VOLUME IN-SITU (GAL)	3000	NUMBER OF BATCHES	1.3	1.7	1.7	1.7
TOTAL TTA DISCHARGE (GAL)	4861	TOTAL VOLUME (GALLONS)	3340	4340	521	4861
		TOTAL MASS SOLIDS (LB)	0	5686	0	5686
CURIES	10	CURIES	0	10	0	10

NOTES: 3387

1. MASS BALANCE TABLE TO BE USED IN CONJUNCTION WITH DRAWINGS 14FMD002, 14FMD003, & 14FMD004.

INFORMATION ONLY

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THE ORIGINAL DRAWING AND SUBSEQUENT REVISIONS THEREOF, WITH APPROVAL NAMES, INITIALS, AND THE PE SEAL, IF APPLICABLE, ARE MAINTAINED IN THE FILES OF FWENC.

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		DATE
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DESIGNED BY	B J DAVIS	01/07/00
CHECKED BY	S W HUNGATE	01/07/00
APPROVED BY	KENNETH RICKETT	01/07/00
APPROVED BY	JOHN LAWSON	01/07/00

DEPARTMENT OF ENERGY
FERNALD ENVIRONMENTAL MANAGEMENT PROJECT
SILOS 1 AND 2 ACCELERATED WASTE RETRIEVAL PROJECT
FERNALD, OHIO
FDF CONTRACT NO. FSC 624

FOSTER WHEELER
FOSTER WHEELER ENVIRONMENTAL CORPORATION

TITLE
DECANT SUMP RETRIEVAL SYSTEM
PROCESS FLOW DIAGRAM
MASS BALANCE TABLE

SIZE	SCALE	DWG. NO.	REV
D	NONE	14FMD001	2

FILENAME: 14FMD001.DWG

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PHASE 1 – SILO 1 AND SILO 2 HEADSPACE REDUCTION

STREAM NUMBER	1	2	3	4	5	6	6A	7	8	9	9A	10	11	12	13	14	15	16	17	18	19	20
COMPONENT	AIR FLOW FROM SILO 1	AIR FLOW FROM SILO 2	AIR FLOW FROM TTA	AIR TO CHILLER	AIR TO CARBON BED	AIR FROM CARBON BED	FAN INLET (TREATED GAS + FAN RECYCLE + MAKEUP)	AIR TO SILO 1	AIR TO SILO 2	MAKEUP AIR TO TTA	RECYCLE AIR TO TTA	CONDENSATE TO HOLD-UP TANKS	AIR FROM FUTURE WASTE TREATMENT AREA	RCS TO STACK	BUILDING VENT TO STACK	AIR TO STACK	FAN RECYCLE FLOW	MAKE-UP AIR	CONDENSATE TO FILTRATE TANKS	EQUIPMENT ENCLOSURE AIR INFLOW	EQUIPMENT ENCLOSURE AIR INFLOW	EQUIPMENT ENCLOSURE AIR INFLOW
AIR (LBS/HR)	1081	1081	--	2161	2161	2161	2919	976	976	--	--	--	--	210	40219	40436	758	--	--	--	--	--
WATER (LBS/HR)	20	20	--	41	2	2	2	1	1	--	--	39	--	0	757	757	0	--	12519	--	--	--
TOTAL, (LBS/HR)	1101	1101	--	2202	2163	2163	2921	977	977	--	--	39	--	210	40976	41193	758	--	12519	--	--	--
FLOW (CFM)	250	250	--	500	454	454.00	649	225	225	--	--	--	--	50	9310	9360	175	--	--	--	--	--
FLOW (GPM)	--	--	--	--	--	--	--	--	--	--	--	0.08	--	--	--	--	--	--	25	--	--	--
RADON (PICOCURIES/L)	252197	249622	--	250910	276253	27	27	27	27	--	--	138043	--	27	0	0.144	27	--	2443	--	--	--
RADON (CURIES/HR)	1.07E-01	1.06E-01	--	2.13E-01	2.13E-01	2.08E-05	2.97E-05	1.03E-05	1.03E-05	--	--	2.44E-06	--	2.29E-06	0.00E+00	2.29E-06	8.0E-06	--	1.39E-05	--	--	--
TEMPERATURE (DEG F)	75	75	--	75	36	40	51	73	73	--	--	40	--	73	75	75	73	--	--	--	--	--
PRESSURE (INCHES WC)	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
NOTES	RELATIVE HUMIDITY= 100% RADON CONCENTRATION STEADY STATE	RELATIVE HUMIDITY= 100% RADON CONCENTRATION STEADY STATE	TTA NOT FUNCTIONAL IN PHASE 1	FLOW REPRESENTS SILOS 1 AND 2	CHILLER CONDITIONS AIR TO 40°F AND 15% RELATIVE HUMIDITY	RADON REMOVAL BASED ON K=13 AND 4 CARBON BEDS	FLOW IS CARBON BED EXHAUST PLUS FAN RECYCLE FLOW + MAKEUP AIR. INCL. FAN HEAT			TTA NOT FUNCTIONAL IN PHASE 1	TTA NOT FUNCTIONAL IN PHASE 1		FUTURE WASTE TREATMENT AREA NOT FUNCTIONAL IN PHASE 1	RELATIVE HUMIDITY= 14.2%	NOTE 2	RELATIVE HUMIDITY= 99.5%	FLOW ENTERS FAN SUCTION AFTER CARBON BEDS		INTERMITTENT FLOW; DECAYED BY STORAGE	EQUIPMENT ENCLOSURES NOT INSTALLED IN PHASE 1	EQUIPMENT ENCLOSURES NOT INSTALLED IN PHASE 1	EQUIPMENT ENCLOSURES NOT INSTALLED IN PHASE 1

PHASE 2A – SILO 1 RETRIEVAL, SILO 2 HEADSPACE REDUCTION, TTA VENTILATION

STREAM NUMBER	1	2	3	4	5	6	6A	7	8	9	9A	10	11	12	13	14	15	16	17	18	19	20
COMPONENT	AIR FLOW FROM SILO 1	AIR FLOW FROM SILO 2	AIR FLOW FROM TTA	AIR TO CHILLER	AIR TO CARBON BED	AIR FROM CARBON BED	FAN INLET (TREATED GAS + FAN RECYCLE + MAKEUP)	AIR TO SILO 1	AIR TO SILO 2	MAKEUP AIR TO TTA	RECYCLE AIR TO TTA	CONDENSATE TO HOLD-UP TANKS	AIR FROM FUTURE WASTE TREATMENT AREA	RCS TO STACK	BUILDING VENT TO STACK	AIR TO STACK	FAN RECYCLE FLOW	MAKE-UP AIR	CONDENSATE TO FILTRATE TANKS	EQUIPMENT ENCLOSURE AIR INFLOW	EQUIPMENT ENCLOSURE AIR INFLOW	EQUIPMENT ENCLOSURE AIR INFLOW
AIR (LBS/HR)	1081	1081	1081	3243	3243	3243	4326	--	976	1081	--	--	--	2267	40233	42511	1084	--	--	324	324	324
WATER (LBS/HR)	20	20	20	61	3	3	3	--	1	20	--	58	--	2	758	760	0	--	12519	6	6	6
TOTAL, (LBS/HR)	1101	1101	1101	3304	3246	3246	4329	--	977	1101	--	58	--	2269	40991	43271	1084	--	12519	330	330	330
FLOW (CFM)	250	250	250	750	681	681	960	--	225	250	--	--	--	525	9310	9835	250	--	--	75	75	75
FLOW (GPM)	--	--	--	--	--	--	--	--	--	--	--	0.12	--	--	--	--	--	--	25	--	--	--
RADON (PICOCURIES/L)	1665166	251623	272500	729763	803472	1701	1701	--	1701	0	--	401500	--	1701	0	90	1701	--	7106	0	0	0
RADON (CURIES/HR)	2.07E-01	1.07E-01	1.16E-01	9.30E-01	9.30E-01	1.97E-03	2.77E-03	--	6.56E-04	0.00E+00	--	1.07E-05	--	1.52E-03	0.00E+00	1.52E-03	7.07E-04	--	4.03E-05	0.00E+00	0.00E+00	0.00E+00
TEMPERATURE (DEG F)	75	75	75	75	36	40	51	--	73	75	--	40	--	73	75	75	73	--	--	75	75	75
PRESSURE (INCHES WC)	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
NOTES	RELATIVE HUMIDITY=100 % RADON CONCENTRATION STEADY STATE	RELATIVE HUMIDITY=100 % RADON CONCENTRATION STEADY STATE	RELATIVE HUMIDITY=100 % RADON CONCENTRATION STEADY STATE	FLOW REPRESENTS SILOS 1 AND 2 PLUS TTA	CHILLER CONDITIONS AIR TO 40°F AND 15% RELATIVE HUMIDITY	RADON REMOVAL BASED ON K=13 AND 4 CARBON BEDS	FLOW IS CARBON BED EXHAUST PLUS FAN RECYCLE FLOW + MAKEUP AIR. INCL. FAN HEAT	NO RECYCLE FLOW TO SILO1 IN PHASE 2A		NO FLOW IN STREAM 9 DURING RECIRC OF TTA	9A FLOW EQUAL TO STREAM 8 DURING RECIRC OF TTA		FUTURE WASTE TREATMENT AREA NOT FUNCTIONAL IN PHASE 2	RELATIVE HUMIDITY=4.4%	NOTE 2	RELATIVE HUMIDITY= 95.1%			INTERMITTENT FLOW; DECAYED BY STORAGE	SILO 1	SILO 1	SILO 1

PHASE 2B – SILO 1 RETRIEVAL, TTA VENTILATION

STREAM NUMBER	1	2	3	4	5	6	6A	7	8	9	9A	10	11	12	13	14	15	16	17	18	19	20
COMPONENT	AIR FLOW FROM SILO 1	AIR FLOW FROM SILO 2	AIR FLOW FROM TTA	AIR TO CHILLER	AIR TO CARBON BED	AIR FROM CARBON BED	FAN INLET (TREATED GAS + FAN RECYCLE + MAKEUP)	AIR TO SILO 1	AIR TO SILO 2	MAKEUP AIR TO TTA	RECYCLE AIR TO TTA	CONDENSATE TO HOLD-UP TANKS	AIR FROM FUTURE WASTE TREATMENT AREA	RCS TO STACK	BUILDING VENT TO STACK	AIR TO STACK	FAN RECYCLE FLOW	MAKE-UP AIR	CONDENSATE TO FILTRATE TANKS	EQUIPMENT ENCLOSURE AIR INFLOW	EQUIPMENT ENCLOSURE AIR INFLOW	EQUIPMENT ENCLOSURE AIR INFLOW
AIR (LBS/HR)	--	1081	2161	3242	3242	3242	4326	--	--	2161	--	--	--	3242	40233	43487	1084	--	--	324	324	324
WATER (LBS/HR)	--	20	41	61	2	2	3	--	--	41	--	58	--	2	758	760	1	--	12519	6	6	6
TOTAL, (LBS/HR)	--	1101	2202	3303	3244	3244	4329	--	--	2202	--	58	--	3246	40991	44247	1085	--	12519	330	330	330
FLOW (CFM)	--	250	500	750	681	681	960	--	--	500	--	--	--	750	9310	10060	250	--	--	75	75	75
FLOW (GPM)	--	--	--	--	--	--	--	--	--	--	--	0.12	--	--	--	--	--	--	25	--	--	--
RADON (PICOCURIES/L)	--	912497	211373	445081	490036	1037	1037	--	--	0	--	244872	--	1037	0	72	1037	--	4334	0	0	0
RADON (CURIES/HR)	--	3.88E-01	1.80E-01	5.67E-01	5.67E-01	1.20E-03	1.69E-03	--	--	0.00E+00	--	6.50E-06	--	1.32E-03	0.00E+00	1.32E-03	4.41E-04	--	2.46E-05	0.00E+00	0.00E+00	0.00E+00
TEMPERATURE (DEG F)	--	75	75	75	36	40	51	--	--	75	--	40	--	73	75	75	73	--	--	75	75	75
PRESSURE (INCHES WC)	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
NOTES	NO FLOW FROM SILO 1 IN PHASE 2B	RELATIVE HUMIDITY=100% RADON CONCENTRATION STEADY STATE	RELATIVE HUMIDITY=100% RADON CONCENTRATION STEADY STATE	FLOW REPRESENTS SILOS 1 AND 2 PLUS TTA	CHILLER CONDITIONS AIR TO 40F AND 15% RELATIVE HUMIDITY	RADON REMOVAL BASED ON K=13 AND 4 CARBON BEDS	FLOW IS CARBON BEQ EXHAUST + FAN RECYCLE FLOW + MAKEUP AIR. INCL. FAN HEAT	NO RECYCLE FLOW TO SILOS IN PHASE 2B	NO RECYCLE FLOW TO SILOS IN PHASE 2B	NO FLOW IN STREAM 9 DURING RECIRC OF TTA	9A FLOW EQUALS 2X STREAM 8 IN PHASE 2A DURING RECIRC OF TTA		FUTURE WASTE TREATMENT AREA NOT FUNCTIONAL IN PHASE 2B	RELATIVE HUMIDITY=4.4%	NOTE 2	RELATIVE HUMIDITY= 92.8%			INTERMITTENT FLOW; DECAYED BY STORAGE	SILO 2	SILO 2	SILO 2

NOTES:

1. FOR FLOW DIAGRAMS SEE DRAWINGS 20FMD003 THRU 20FMD011.
2. STREAM 13 FLOW FROM 77FMD002.
3. INFILTRATION INTO SILOS ASSUMED TO BE 10% OF EXHAUST FLOWRATE.
4. AIR STREAMS FROM CARBON BED DRYING FAN (FAN-20-003) TO DESICCANT DRYERS OR HEPA FILTERS ARE NOT INCLUDED IN THE MASS BALANCE. THESE FLOW STREAMS ARE NOT PART OF NORMAL OPERATIONS, BUT ARE USED FOR MAINTENANCE ACTIVITIES TO RECLAIM CARBON BED PERFORMANCE.

INFORMATION ONLY

000292

THE ORIGINAL DRAWING AND SUBSEQUENT REVISIONS THEREOF, WITH APPROVAL NAMES, INITIALS, AND THE PE SEAL, IF APPLICABLE, ARE MAINTAINED IN THE FILES OF FWENC.

REV	DATE	BY	CHK'D	APR'VD	DESCRIPTION/ISSUE
2	05/15/00	BJD	GCH	KDR	REVISED PER CHANGE PROPOSAL CP-00-001
1	01/01/00	BJD	SWH	KDR	CERTIFIED FOR CONSTRUCTION
0	01/01/99	BJD	KR		PRELIMINARY DESIGN SUBMITTAL

PE: KENNETH D. RICKETT, P.E. NO. E-54418, 5/15/00, REVISION 2

DRAWN BY	B J DAVIS	DATE 01/07/00
DESIGNED BY	B J DAVIS	DATE 01/07/00
CHECKED BY	S W HUNGATE	DATE 01/07/00
APPROVED BY	KENNETH RICKETT	DATE 01/07/00
APPROVED BY	JOHN LAWSON	DATE 01/07/00

DEPARTMENT OF ENERGY
FERNALD ENVIRONMENTAL MANAGEMENT PROJECT
SILOS 1 AND 2 ACCELERATED WASTE RETRIEVAL PROJECT
FERNALD, OHIO
FDF CONTRACT NO. FSC 624

FOSTER WHEELER
FOSTER WHEELER ENVIRONMENTAL CORPORATION

TITLE: RADON CONTROL SYSTEM PROCESS FLOW DIAGRAM MASS BALANCE TABLES – SHT 1

SIZE: D | SCALE: NONE | DWG. NO. 20FMD001 | REV 2

000406

FILENAME: 20FMD001.DWG

3387

PHASE 2C – TTA VENTILATION

STREAM NUMBER	1	2	3	4	5	6	6A	7	8	9	9A	10	11	12	13	14	15	16	17	18	19	20	21
COMPONENT	AIR FLOW FROM SILO 1	AIR FLOW FROM SILO 2	AIR FLOW FROM TTA	AIR TO CHILLER	AIR TO CARBON BED	AIR FROM CARBON BED	FAN INLET (TREATED GAS + FAN RECYCLE + MAKEUP)	AIR TO SILO 1	AIR TO SILO 2	MAKEUP AIR TO TTA	RECYCLE AIR TO TTA	CONDENSATE TO HOLD-UP TANKS	AIR FROM FUTURE WASTE TREATMENT AREA	RCS TO STACK	BUILDING VENT TO STACK	AIR TO STACK	FAN RECYCLE FLOW	MAKE-UP AIR	CONDENSATE TO FILTRATE TANKS	EQUIPMENT ENCLOSURE AIR INFLOW	EQUIPMENT ENCLOSURE AIR INFLOW	EQUIPMENT ENCLOSURE AIR INFLOW	AIR FLOW FROM DECANT SUMP
AIR (LBS/HR)	--	--	2161	2161	2161	2161	2919	--	--	2161	--	--	--	2161	40233	42401	758	0.00	--	--	--	--	360.12
WATER (LBS/HR)	--	--	41	41	2	2	2	--	--	41	--	39	--	1	758	759	1	0.00	12519	--	--	--	6.78
TOTAL (LBS/HR)	--	--	2202	2202	2163	2163	2921	--	--	2202	--	39	--	2162	40991	43160	759	0.00	12519	--	--	--	366.90
FLOW (CFM)	--	--	500	500	454	454	649	--	--	500	--	--	--	500	9310	9810	175	0.00	--	--	--	--	83.00
FLOW (GPM)	--	--	--	--	--	--	--	--	--	--	--	0.08	--	--	--	--	--	--	25	--	--	--	--
RADON (PICOCURIES/L)	--	--	211373	211373	232723	23	23	--	--	0	--	116292	--	23	0	1	23	0	2058	--	--	--	--
RADON (CURIES/HR)	--	--	1.80E-01	1.80E-01	1.80E-01	1.75E-05	2.50E-05	--	--	0.00E+00	--	2.06E-06	--	1.93E-05	0.00E+00	1.93E-05	6.7E-06	0.00E+00	1.17E-05	--	--	--	--
TEMPERATURE (DEG F)	--	--	75	75	36	40	51	--	--	75	--	40	--	73	75	75	73	75	--	--	--	--	75
PRESSURE (INCHES WC)	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
NOTES	NO FLOW FROM SILO IN PHASE 2C	NO FLOW FROM SILO IN PHASE 2C		FLOW REPRESENTS WTA PLUS TTA	CHILLER CONDITIONS AIR TO 40F AND 15% RELATIVE HUMIDITY	RADON REMOVAL BASED ON K=13 AND 4 CARBON BEDS	FLOW IS CARBON BED EXHAUST PLUS FAN RECYCLE FLOW + MAKEUP AIR. INCL. FAN HEAT	NO FLOW TO SILOS IN PHASE 2C	NO FLOW TO SILOS IN PHASE 2C	NO FLOW IN STREAM 9 DURING RECIRC OF TTA	9A FLOW EQUALS 2X STREAM 8 IN PHASE 2A DURING RECIRC OF TTA		FUTURE WASTE TREATMENT NOT FUNCTIONAL IN PHASE 2C	RELATIVE HUMIDITY=4.4%	NOTE 2	RELATIVE HUMIDITY= 95.1%			INTERMITTENT FLOW; DECAYED BY STORAGE	EQUIPMENT ENCLOSURES NOT INSTALLED IN PHASE 2C	EQUIPMENT ENCLOSURES NOT INSTALLED IN PHASE 2C	EQUIPMENT ENCLOSURES NOT INSTALLED IN PHASE 2C	DECANT SUMP NOTE 3

HOLD

PHASE 3 – TTA VENTILATION, FUTURE WASTE TREATMENT

STREAM NUMBER	1	2	3	4	5	6	6A	7	8	9	9A	10	11	12	13	14	15	16	17	18	19	20
COMPONENT	AIR FLOW FROM SILO 1	AIR FLOW FROM SILO 2	AIR FLOW FROM TTA	AIR TO CHILLER	AIR TO CARBON BED	AIR FROM CARBON BED	FAN INLET (TREATED GAS + FAN RECYCLE + MAKEUP)	AIR TO SILO 1	AIR TO SILO 2	MAKEUP AIR TO TTA	RECYCLE AIR TO TTA	CONDENSATE TO HOLD-UP TANKS	AIR FROM FUTURE WASTE TREATMENT AREA	RCS TO STACK	BUILDING VENT TO STACK	AIR TO STACK	FAN RECYCLE FLOW	MAKE-UP AIR	CONDENSATE TO FILTRATE TANKS	EQUIPMENT ENCLOSURE AIR INFLOW	EQUIPMENT ENCLOSURE AIR INFLOW	EQUIPMENT ENCLOSURE AIR INFLOW
AIR (LBS/HR)	--	--	2161	4321.4	4321	4321	4321	--	--	2161	--	--	2161	4321	48233	44551	--	--	--	--	--	--
WATER (LBS/HR)	--	--	41	82	3	3	3	--	--	41	--	78	41	3	758	761	--	--	12519	--	--	--
TOTAL (LBS/HR)	--	--	2202	4403	4324	4324	4324	--	--	2202	--	78	2202	4324	40991	45312	--	--	12519	--	--	--
FLOW (CFM)	--	--	500	1000.00	908	908	908	--	--	500	--	--	500	979	9310	10289	--	--	--	--	--	--
FLOW (GPM)	--	--	--	--	--	--	--	--	--	--	--	0.16	--	--		--	--	--	25	--	--	--
RADON (PICOCURIES/L)	--	--	710019	565009	622078	6140	6140	--	--	0	--	310854	420000	6140	0	584	--	--	5501	--	--	--
RADON (CURIES/HR)	--	--	6.03E-01	9.60E-01	9.60E-01	9.47E-03	9.47E-03	--	--	0.00E+00	--	1.10E-05	3.57E-01	1.02E-02	0.00E+00	1.02E-02	--	--	3.12E-05	--	--	--
TEMPERATURE (DEG F)	--	--	75	75	36	40	40	--	--	75	--	40	75	62	75	75	--	--	--	--	--	--
PRESSURE (INCHES WC)	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
NOTES	NO FLOW FROM SILO IN PHASE 3	NO FLOW FROM SILO IN PHASE 3		FLOW REPRESENTS WTA PLUS TTA	CHILLER CONDITIONS AIR TO 40F AND 15% RELATIVE HUMIDITY	RADON REMOVAL BASED ON K=13 AND 4 CARBON BEDS	FLOW IS CARBON BED EXHAUST PLUS FAN RECYCLE FLOW + MAKEUP AIR. INCL. FAN HEAT	NO FLOW TO OR FROM SILOS IN PHASE 3	NO FLOW TO OR FROM SILOS IN PHASE 3	NO FLOW IN STREAM 9 DURING RECIRCULATION OF TTA	9A FLOW EQUALS 2X STREAM 8 IN PHASE 2A DURING RECIRC OF TTA			RELATIVE HUMIDITY=6.4%	NOTE 2	RELATIVE HUMIDITY= 93.9%	NO FAN RECYCLE IN PHASE 3			EQUIPMENT ENCLOSURES NOT INSTALLED IN PHASE 3	EQUIPMENT ENCLOSURES NOT INSTALLED IN PHASE 3	EQUIPMENT ENCLOSURES NOT INSTALLED IN PHASE 3

HOLD

INFORMATION ONLY

NOTES:

1. FOR FLOW DIAGRAMS SEE DRAWINGS 20FMD003 THRU 20FMD011.
2. STREAM 13 ORIGINATES ON 77FMD002.
3. STREAM 21 IN PHASE 2C – FOR INFORMATION ONLY – NOT INCLUDED IN OVERALL MASS BALANCE DUE TO DURATION OF DECANT SUMP ACTIVITIES BEING LESS THAN ONE WEEK WITH LIMITED KNOWLEDGE OF RADON CONCENTRATIONS IN TANK.
4. AIR STREAMS FROM CARBON BED DRYING FAN (FAN-20-003) TO DESICCANT DRYERS OR HEPA FILTERS ARE NOT INCLUDED IN THE MASS BALANCE. THESE FLOW STREAMS ARE NOT PART OF NORMAL OPERATIONS, BUT ARE USED FOR MAINTENANCE ACTIVITIES TO RECLAIM CARBON BED PERFORMANCE.

HOLD

000293

000407

THE ORIGINAL DRAWING AND SUBSEQUENT REVISIONS THEREOF, WITH APPROVAL NAMES, INITIALS, AND THE PE SEAL, IF APPLICABLE, ARE MAINTAINED IN THE FILES OF FWENC.

REV	DATE	BY	CHK'D	APR'VD	DESCRIPTION/ISSUE
2	05/15/00	BJD	GCH	KDR	REVISED PER CHANGE PROPOSAL CP-00-001
1	01/07/00	BJD	SWH	KDR	CERTIFIED FOR CONSTRUCTION
0	01/01/95	BJD	KR		PRELIMINARY DESIGN SUBMITTAL

PE: KENNETH D. RICKETT
P.E. NO. E-64418
5/15/00
REVISION 2

		DATE
DRAWN BY	B J DAVIS	01/07/00
DESIGNED BY	B J DAVIS	01/07/00
CHECKED BY	S W HUNGATE	01/07/00
APPROVED BY	KENNETH RICKETT	01/07/00
APPROVED BY	JOHN LAWSON	01/07/00

DEPARTMENT OF ENERGY
FERNALD ENVIRONMENTAL MANAGEMENT PROJECT
SILOS 1 AND 2 ACCELERATED WASTE RETRIEVAL PROJECT
FERNALD, OHIO
FDF CONTRACT NO. FSC 824

FOSTER WHEELER
FOSTER WHEELER ENVIRONMENTAL CORPORATION

TITLE: RADON CONTROL SYSTEM PROCESS FLOW DIAGRAM MASS BALANCE TABLES – SHT 2

SIZE	SCALE	DWG. NO.	REV
D	NONE	20FMD002	2

FILENAME: 20FMD002.DWG

3387

RCS BUILDING VENTILATION

STREAM NUMBER	1	2	3	3A	4	5	13
COMPONENT	TOTAL RCS BLDG. SUPPLY	RCS BUILDING 1ST FLOOR SUPPLY	RCS BUILDING 2ND FLOOR SUPPLY	HVAC SUPPLY TO CARBON BED BLDG.	RCS BUILDING 2ND FLOOR EXHAUST	RCS BUILDING 1ST FLOOR & CARBON BED BLDG. COMBINED EXHAUST	BUILDING VENTILATION EXHAUST TO STACK
AIR (LBS/HR)	33,703	24,864	8,837	3,898	9,834	30,497	40,331
WATER (LBS/HR)	619	458	162	72	181	561	741
TOTAL (LBS/HR)	34,322	25,322	8,999	3,970	10,015	31,058	41,072
FLOW (CFM)	7,780	5,740	2,040	900	2,270	7,040	9,310
FLOW (GPM)	--	--	--	--	--	--	--
RADON (PICOCURIES/L)	0	0	0	0	0	0	0
RADON (CURIES/HR)	0	0	0	0	0	0	0
TEMPERATURE (DEG F)	75	75	75	60	75	75	75
PRESSURE (INCHES WC)	--	--	--	--	--	--	--
NOTES	RELATIVE HUMIDITY = 100%						NOTE 2

NOTES:

1. FOR FLOW DIAGRAMS SEE DRAWINGS 77FMD003, & 77FMD005.
2. STREAM 13 ALSO APPEARS ON 20FMD002.
3. RCS BUILDING WILL BE VENTILATED TO MAINTAIN A SLIGHTLY NEGATIVE PRESSURE WITHIN EACH BUILDING. DISCHARGE WILL BE APPROXIMATELY 10% GREATER THAN SUPPLY TO MAINTAIN NEGATIVE PRESSURE BOUNDARY.

000408

THE ORIGINAL DRAWING AND SUBSEQUENT REVISIONS THEREOF, WITH APPROVAL NAMES, INITIALS, AND THE PE SEAL, IF APPLICABLE, ARE MAINTAINED IN THE FILES OF FWENC.

REV	DATE	BY	CHK'D	APR'VD	DESCRIPTION/ISSUE
0	08/10/00	BJP	KDR	KDR	CERTIFIED FOR CONSTRUCTION

RPE: STATE OF OHIO, KENNETH D. RICKETT, E-64419, REGISTERED PROFESSIONAL ENGINEER

		DATE
DRAWN BY	B.J. Davis	08/10/00
DESIGNED BY	B.J. Davis	08/10/00
CHECKED BY	Kenneth D. Rickett	08/10/00
APPROVED BY	Kenneth D. Rickett	08/10/00
APPROVED BY	John Rancor	8/10/00

DEPARTMENT OF ENERGY
FERNALD ENVIRONMENTAL MANAGEMENT PROJECT
SILOS 1 AND 2 ACCELERATED WASTE RETRIEVAL PROJECT
FERNALD, OHIO
FDF CONTRACT NO. FSC 624

FOSTER WHEELER
FOSTER WHEELER ENVIRONMENTAL CORPORATION

TITLE
MISC FACILITIES HVAC SYSTEM
HVAC FLOW DIAGRAM
MASS BALANCE TABLE

SIZE	SCALE:	DWG. NO.	REV
D	NONE	77FMD002	0

000294