REMEDIAL DESIGN WORK PLAN

FOR THE

SILOS 1 AND 2 ACCELERATED WASTE RETRIEVAL (AWR) PROJECT

FERNALD ENVIRONMENTAL MANAGEMENT PROJECT
FERNALD OHIO

JANUARY 2000

U.S.DEPARTMENT OF ENERGY
FERNALD AREA OFFICE

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INTRODUCTION

Background and Purpose

The Silos 1 and 2 Accelerated Waste Retrieval (AWR) Project resides in the Silos Project Division and is one of the first steps toward the remediation of Operable Unit 4 (OU4). Fluor Daniel Fernald (FDF) awarded a contract to the Foster Wheeler Environmental Corporation (FWENC) to transfer approximately 8,900 yd^3 of K65 material from Silos 1 and 2 to temporary transfer tanks. The goal of this work is to separate retrieval of material from Silos 1 and 2 from the selection and implementation of a treatment alternative. Added benefits of the AWR Project include the reduction of radon exposure from the existing silos, the mitigation of the silos integrity issue, and acceleration of the Silos Project D&D activities. The FDF AWR Project Team will manage and oversee the FWENC Team in the accomplishment of the project in a safe, cost-effective, and timely manner.

Project Description and Scope

FERMCO (Predecessor to FDF) Subcontract (FSC) 624, Silos 1 and 2 Accelerated Waste Retrieval (AWR) Project, was issued to FWENC on February 26, 1999. Under the terms and conditions of this contract, FWENC is to design, construct, test, start-up, operate, and maintain a radon control system (RCS), a retrieval and transfer system, and a temporary storage facility for the Silos 1 and 2 residues. The project will involve standard slurry mining technology utilizing off-the-shelf equipment and materials. Work scope also includes on-site, full-scale mock-up testing of the FWENC's systems; using Silo 4 with a benign, non-radioactive surrogate (identified as the AWR Surrogate) that simulates the physical characteristics of the Silos 1 and 2 material. FWENC will utilize Greater Cincinnati Building Construction Trades Council (GCBCTC) labor to construct needed systems and facilities, and FAT&LC labor to start-up, operate and maintain the AWR Project systems during the residue removal and transfer from Silos 1 and 2 into the Transfer Tank Area (TTA). Once Silos 1 and 2 are emptied, FWENC will perform gross decontamination of the silos and silos area before turning over the area and demobilizing from the FEMP.

FDF, under the Facilities and Integration work scope, will maintain the TTA in an interim storage mode until a final remediation facility is ready to accept and process the Silos 1 and 2 material for final disposition. The RCS will operate throughout the AWR Project, the post-AWR standby period, and it is anticipated that the RCS will also support the final remediation facility.

Available Technical Data

AVAILABLE TECHNICAL DATA

This section provides the technical data that is available and applicable to the design process for the AWR Project. This section includes a characterization of K-65 material, details of radon emanation from the K-65 silo material, descriptions, and history of the silos, descriptions of previous remediation work, characterization of the FEMP site, characterization of the site infrastructure, and results of supporting pilot studies.

Characterization of K-65 Silo material

The K-65 material found in Silos 1 and 2 was originally transferred there in slurry form. The slurry eventually settled and formed two layers: a layer of settled solids (the K-65 material) covered by a layer of the slurry liquid. To remove the layer of clear liquid following settling, the silos were equipped with a series of decant ports. The decant ports for the silos were valved into a pipe that led to the 9000-gallon carbon steel decant sump tank.

A summary of the K-65 material characterization data gathered to date can be found in Appendix A of Fluor Daniel Fernald's (FDF's) Technical Requirements Document (TRD) titled *Silos 1 and 2 Accelerated Waste Retrieval (AWR) Project.*

Radon Emanation from the K-65 Silo Material

The K-65 material in the silos is only moderately radioactive. However, the handling of this material presents significant health, safety, and environmental issues. The reason for these issues is the constant production of Radon-222 from the decay of Radium-226 in the K-65 material. Given that the silos have a combined inventory of approximately 4000 curies of radium and that the concentration ranges from 300 to 900 nanocuries per gram, containment and treatment of radon involves high concentrations of radon in significant volumes of air. Appendix D of the TRD presents a summary of the radon emanation characteristics of the K-65 material.

Description and History of the Silos

The silos were designed by Preload Engineering, Inc., and constructed by Catalytic Construction Company between 1951 and 1952. The silos have an approximate 80-foot inside diameter, a 27-foot height next to the wall, and a 36-foot height to the top of the dome at the center of the silo. The walls are 8 inches thick and were cast in place with 4500-pounds-per square-inch concrete. The walls are wrapped on the outside surface with pre-stressed steel wires and covered with 1-inch-thick Gunite™. The wall is tied to the floor and dome with reinforcement steel. The dome is 8 inches thick near the edge, tapering to 4 inches thick at the center. It was cast in place with 4500-pound-per-square-inch concrete. Dome reinforcement consists primarily of welded wire mesh. The floors of the silos are constructed of 4-inch-thick reinforced concrete. Relevant drawings of the silos, silo domes, the silo superstructure, and the decant sump system are available.

The silos were equipped with a series of valved decant ports. These decant ports were used to separate the K-65 material from the slurry used to originally transport the material to the silos. The ports were arranged in two vertical lines located on diametrically opposing sides of each silo. Each vertical line contained 25 ports---making a total of 50 ports per silo. The two bottom decant ports on each silo are 1 foot from the silo bottom. The remaining 48 ports are located at 6-inch intervals.

The decant ports for the silos were, at the time of the filling, each valved into a pipe that led to the 9000-gallon, carbon-steel decant sump tank. The decant sump tank is located between the silos at a level below the base of the silos to allow for gravity drainage.

At the bases of the silos, at the original ground surface, are skirts drains used to contain any seepage through the walls of the silos or leakage from the decant ports. These shirt drains directed any collected water through a concrete pipe trench to an in-ground concrete-lined sump located adjacent to the Drum Handling Building formerly located between Silos 2 and 3.

Beneath the floor of the silos is a drain system. The drain system consists of a 2-inch slotted pipe in an 8-inch gravel layer. The gravel layer overlays a 2-inch thick layer of asphaltic concrete that, in turn, overlays a 17-inch-thick layer of compacted clay. The drain system is connected to the decant sump tank, which collects any liquids seeping through the base of the silos. Detailed drawings showing the interconnection of the drain system and the silo foundation are available.

Descriptions of Previous Remediation Work

Previous remediation work includes: (1) the creation of a BentoGrout™ cap over the K-65 silo materials to reduce radon gas emissions, (2) the creation of berms to improve structural integrity of the silos, and (3) the use of dome covers to improve structural integrity and to control the escape of radon gas.

<u>The BentoGrout™ Cap</u>

In November of 1991, approximately 730 metric tons of BentoGrout™ and water slurry were pumped into Silos 1 and 2 to create a BentoGrout™ cap over the K-65 material inside. The purpose of the BentoGrout™ cap was to reduce or control routine, low-level emissions of radon from the silos to the maximum extent practical. In addition, by reducing or controlling the radon gas inventory in the silos, the catastrophic failure of a dome would not result in a significant release of radon gas to the environment.

The BentoGrout™ used in this remediation work is a proprietary product of the American Colloid Company. The product contains the sodium form of bentonite clay and several inorganic additives. When dry, BentoGrout™ is highly hygroscopic.

The BentoGrout™ slurry that was originally pumped into the silos contained between 25 and 32 weight percent solids. The slurry remains workable for approximately 45 to 60 minutes after its initial preparation, and then it sets up to form a gelatinous mass. As it

dries, it becomes thicker and develops a consistency similar to peanut butter. The surface layer (perhaps the first 6 inches down) of each BentoGrout™ cap is now likely to be somewhat dry, cracked, and stiff. This surface layer contains approximately 50 weight percent solids. Below the surface layer, the BentoGrout™ is likely to retain its original gelatinous consistency and contain approximately 25 to 35 weight percent solids.

In Silo 1, at the center the BentoGrout™ cap is approximately 26 feet above the silo floor. Next to the silo wall, the top of the BentoGrout™ cap is approximately 26.5 feet above the floor and only a few inches below the top of the silo's inner wall. Because of the surface contour of the underlying K-65 material, the thickness of the BentoGrout™ cap varies from 0.5 feet to 3.5 feet. The thickness of the cap averages approximately 2 feet. At the center of the silo, the thickness of the BentoGrout™ cap ranges between 0.5 feet and 1.5 feet. Next to the silo wall, the thickness is as much as 3.5 feet. Silo 1 contains approximately 3280 cubic meters (115,900 cubic feet) of K-65 material (both residue and discrete objects) and approximately 360 cubic meters (12,600 cubic feet) of BentoGrout™.

In Silo 2 at the center, the BentoGrout™ cap is approximately 26 feet above the silo floor. Next to the silo wall, the top of the Bento Grout cap is 21 to 22 feet above the floor. The thickness of the BentoGrout™ cap is a minimum of 0.5 feet at the center of the silo and a maximum of 3 feet near the wall. Silo 2 contains approximately 2840 cubic meters (100,400) cubic feet) of K-65 material (both residue and discrete objects) and approximately 310 cubic meters (11,100 cubic feet) of BentoGrout™.

BERM CREATION

In 1964, large areas of spalling (i.e., exfoliation) occurred on the exterior surface of the silos, particularly on Silo 2. Prestressed wires on the outside of the silos were exposed to the weather and corroded. Remediation of the silo's exterior surfaces was initiated. The exterior surfaces were patched with a 0.75-inch-thick coat of cement mortar, and a waterproofing was applied.

Then, a berm embankment was built (1) to surround the silos walls and provide weather protection, (2) to reduce tensile stresses that had developed within the walls, (3) to reduce radon emissions, and (4) to increase shielding against penetrating radiation. The berm was originally constructed in 1964 on a slope of 1.5 to 1(H: V). In 1983, the slope was subsequently modified to 3 to 1 (H: V) to reduce soil erosion.

The soils used in the original 1964 construction of the berms were surface soils and underlying clays removed from an area directly south of the concrete trench and north of a small drainage ditch running parallel to this trench. The soils used in the 1983 modification of the berm slope originated from two locations: the area of the Biodenitrification Surge Lagoon and a borrow area west of Pit 5. No surveys were performed by site personnel to determine the potential presence of radiological contamination of these soils before excavation and placement in the berms.

Before creating the silo berms in 1964, the decant pump was disconnected from the sump tank, but the drain system remained intact. The decant pump transferred collected liquids

in the sump into the drain system. Access to the sump tank was maintained by placing a 30-inch diameter corrugated metal pipe from the sump to the surface of the berm. This corrugated metal pipe extended upward approximately 33 feet. The berm soils were placed around this pipe as the berm was built up around the silos.

DOME COVERS

In January 1986, two load-spreading dome covers, 30 foot in diameter, were installed to span a deteriorated portion of the concrete domes of the silos. The dome covers were installed so that the radon gas at the top of the silos would be confined in the event of a dome collapse. The covers are self-supporting and sit on a rolled plate-steel skirt. The covers are constructed of structural steel beams that support 0.75-inch-thick plywood sheeting that is covered with a weatherproof membrane.

The dome cover, however, increased the stresses in the existing concrete structure. And, the dome covers were not designed to be airtight. Therefore, the dome covers would not contain the radon in the event of a dome collapse.

In 1987, the silo domes were covered with a 3-inch minimum thickness layer of rigid polyurethane foam and then topped with a 45-mil membrane.

FOAM INSULATION

The 1987 foam seal had lost its seal in several areas due to shrinkage, damage or other work activities. Radiological surveys of the dome surfaces indicated raised levels of radon concentrations in the area. A maintenance action was initiated to repair 28 areas identified on both silos ranging in size from approximately 2 inches in diameter to a 112 inch x 96 inch rectangle. An encasement system was designed to safely seal the identified areas and provide long term protection that is airtight, seamless, waterproof and impact resistant. Application of the encasement material began first on Silo 2, May 26, 1999, and was completed June 4, 1999 on Silo 1. Over 420 square feet of area on both Silos was sealed upon completion of this activity.

Site Preparation

SITE PREPARATION

The following activities constitute the site preparation phase for the AWR project. Along with the description of the activity is a reference to the drawing or other document giving further details relative to that activity.

- Set up office trailers and construction facilities.
  { Drawing 05FMD010 Misc. Facilities General Arrangement }

- Erect erosion controls and temporary fencing.
  {Work Areas 1&2 and 3&4 from Stormwater Drainage Calculations,
  Drawing 11FCD009 Silo Waste Retrievel System Erosion Control Plan Ph I,
  Drawing11FCD010Silo Waste Retrievel System Erosion Control Plan Ph 2 A&B

- Build access roads and gravel parking areas.
  {Drawing 06FCD001 Support Facilities Grading Plan Trailer Layout }

- Run site utilities.
  {Drawing 51FMD001 Potable/Domestic Water System Process Flow Diagram Make-up Water,
  Drawings 61FCD001 and 2 Sanitary Sewer System Layout Plan,
  Drawings 51FCD001 and 2 Domestic Water System Underground Layout Plan
  Drawing 05FCDD013 Misc. Facility Tie-in Locations}

- Install facilities for storm water management.
  {Drawing 66FCD001 Storm Water System Overall Drainage Plan,
  Drawing 66FCD006 Storm Water System Misc. Details Sheet 1 }

- Perform site grading and prepare laydown areas.
  {Drawing 05FCD014 Misc. Facility Site Space Allocation }

- Perform excavations and prepare subgrade for foundations.
  {Drawing 12FCD002Transfer Tank System Excavation Plan
  Drawing 12FCD003 Transfer Tank System Site Layout Plan}

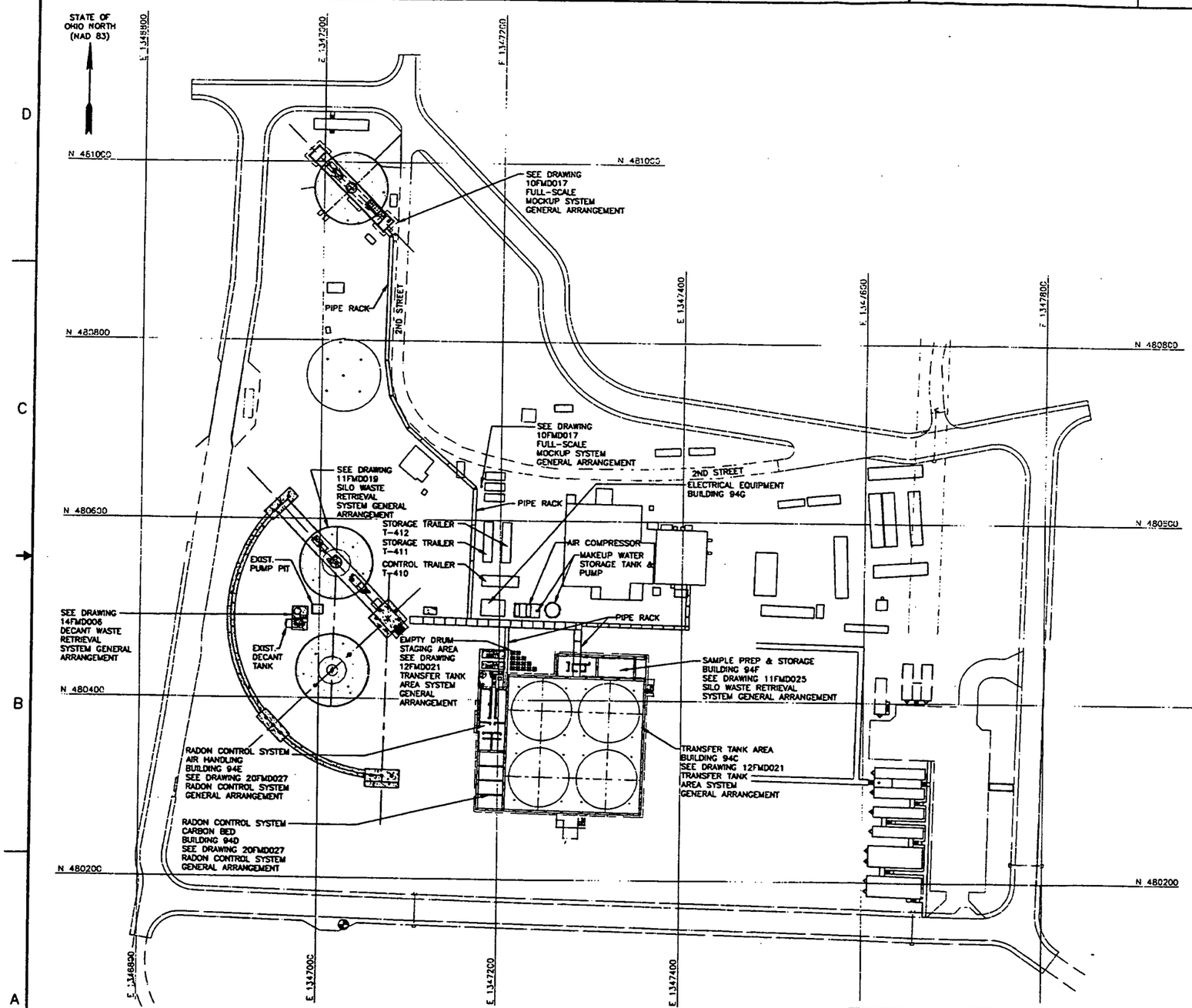
- Install gravel, vapor barriers, and mud slabs for foundations.
  {Drawings 12FCD-005-7 Transfer Tank System Cross Sections Sheet 1 to 3 }

- Install pre-cast sumps, reinforcing steel, embedded items, piping and grounding related to the foundations.
  {Drawing 12FSD103Transfer Tank System Sample Building FDN Embedded Plates, ,
  Drawing 20FSD051Radon Control System Air Handling Building Base Slab Embedded Plates}

- Perform demolition of the existing enclosure on bridge over Silo 4.
  { Drawing 10FSD001 Full Scale Mockup System Silo 4 Bridge Structure Equipment Room Demolition }

- Perform upgrades of structural steel bridging over Silo 4.
  { Drawing 10FCD003 Full-Scale Mockup System Silo 4 Cross Section,
  Drawing 10FSD002 Full-Scale Mockup System Silo 4 Bridge Structural Equipment Room Demolition}

- Place concrete mat foundation for the TTA/RCS/Sampling building.
  {Drawing 12FSD010 & 011Transfer Tank System Concrete Slab, Sheets 1&2,
  Drawing 12FSD016 Transfer Tank Area System Base Slab and Foundations Sections and Details,
  Drawing 12FSD102 Transfer Tank System Sample Building Foundation Plan,
  Drawing 12FSD110 Transfer Tank System Sample Building Foundation Section,
  Drawing 20FSD005 Radon Control System Carbon Bed Building Foundation Plan,
  Drawing 20FSD014 & 15 Radon Control System Carbon Bed Building Foundation Section View,
  Plan Drawing 20FSD050 Radon Control System Air Handling Building Foundation,
  Drawing 20FSD065Radon Control System Air Handling Building Foundation Section View}



275 B

000011

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
2	01/07/00	WCB	SWH		CERTIFIED FOR CONSTRUCTION
1	12/01/99	WCB	SWH		REVISED FOR NOZZLE LOCATIONS
0	11/99	WCB	SWH		PRELIMINARY DESIGN SUBMITTAL

KENNETH D. RICKETT PROFESSIONAL ENGINEER No. 102742 STATE OF TENNESSEE

		DATE
DRAWN BY	WCB	01/07/00
DESIGNED BY	WCB	01/07/00
CHECKED BY	SWH	01/07/00
APPROVED BY	Kenneth Rickett	01/07/00
APPROVED BY	John Emerson	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
MISC FACILITIES
GENERAL ARRANGEMENT
KEY PLAN

SIZE: D | SCALE: 1"=60'-0" | DWG. NO. 05FMD010 | REV 2

FILENAME: 05FMD010.DWG

XREF DRAWINGS: 00-PROP.DWG 00-EXIST.DWG

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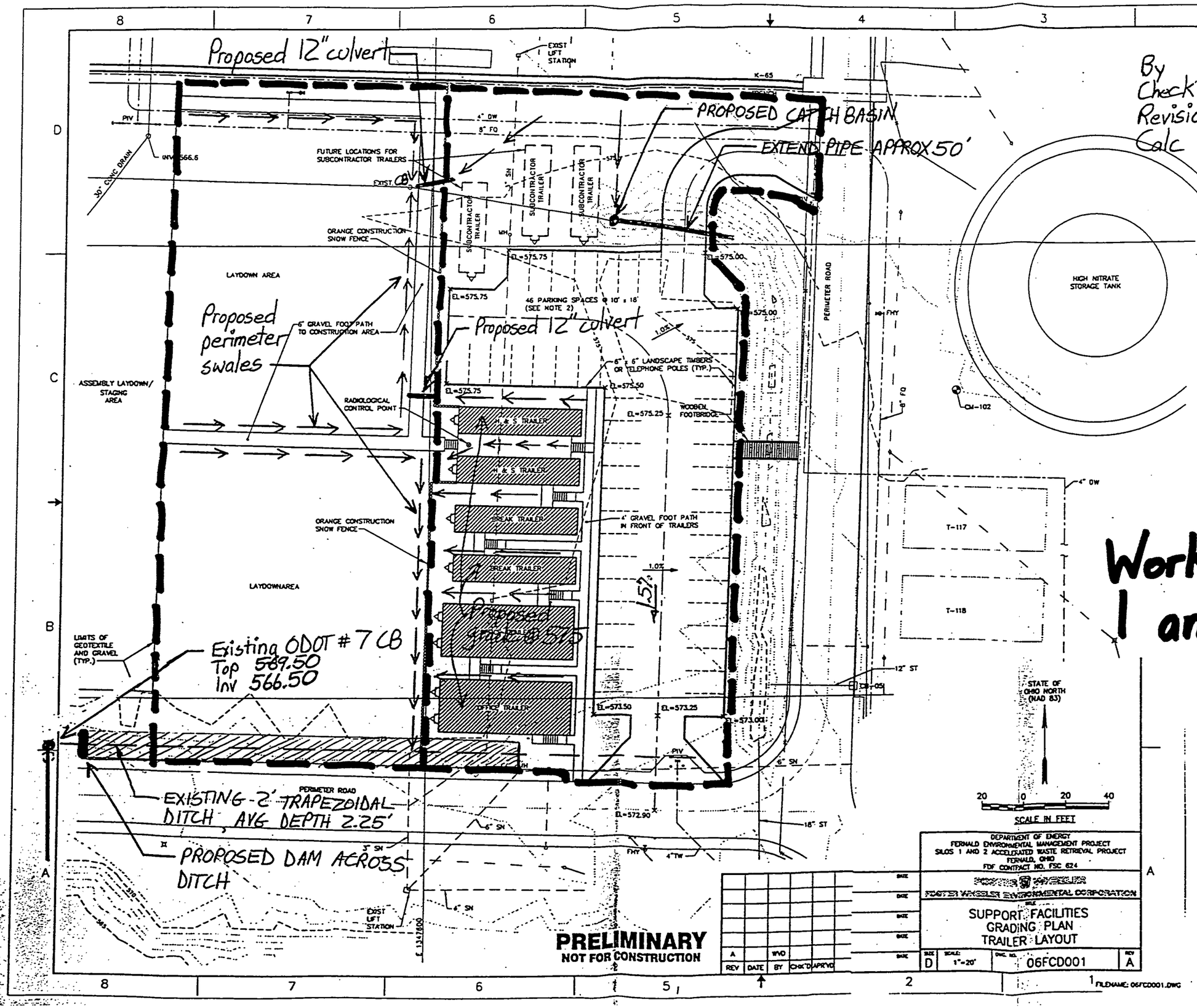
2753 A8

By : KEO 11/08/99
Check : 4/9/99
Revision : A
Calc : CA-FSC624-FC-0

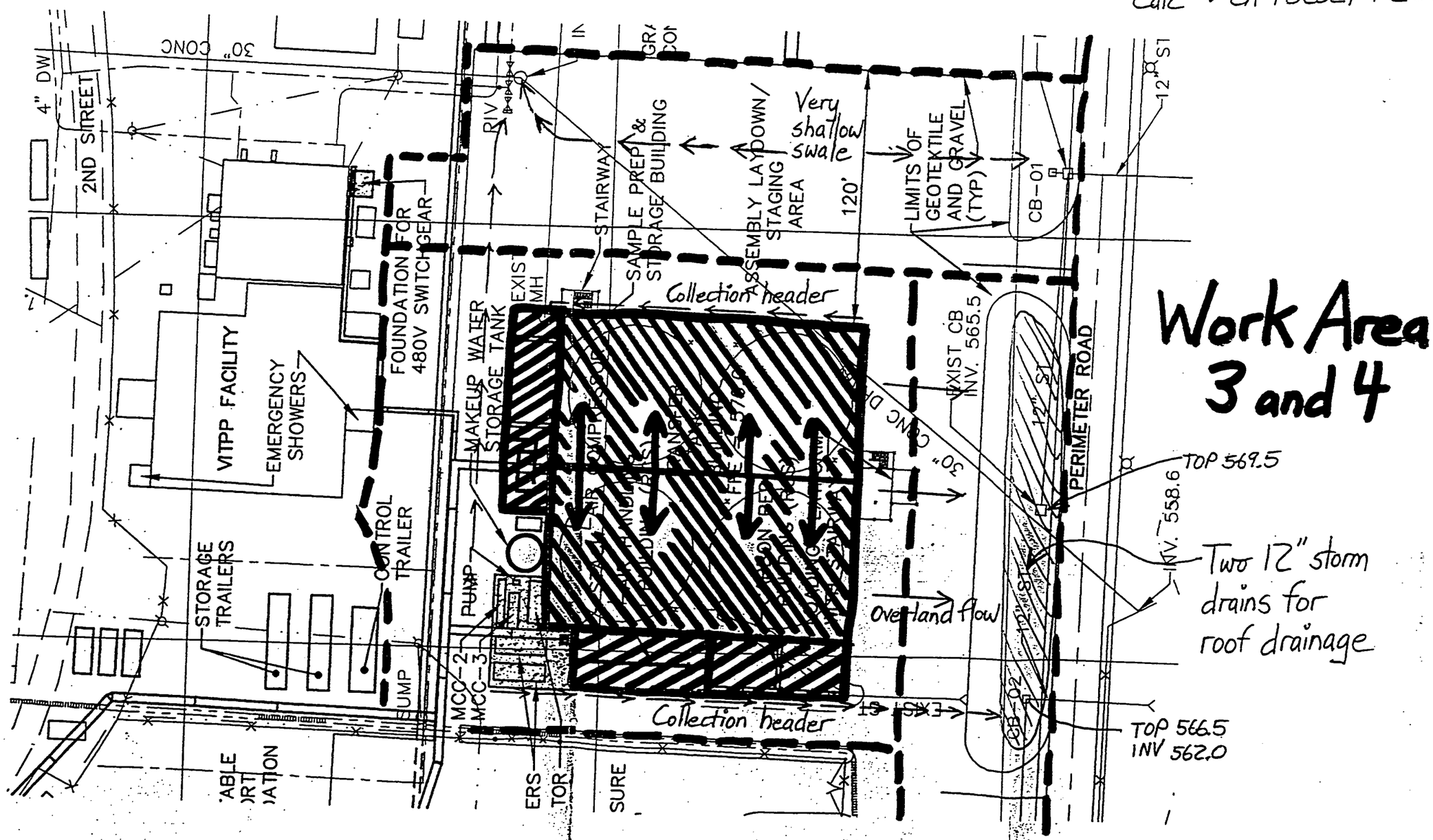


Work Areas 1 and 2

000012

2753 **A9**

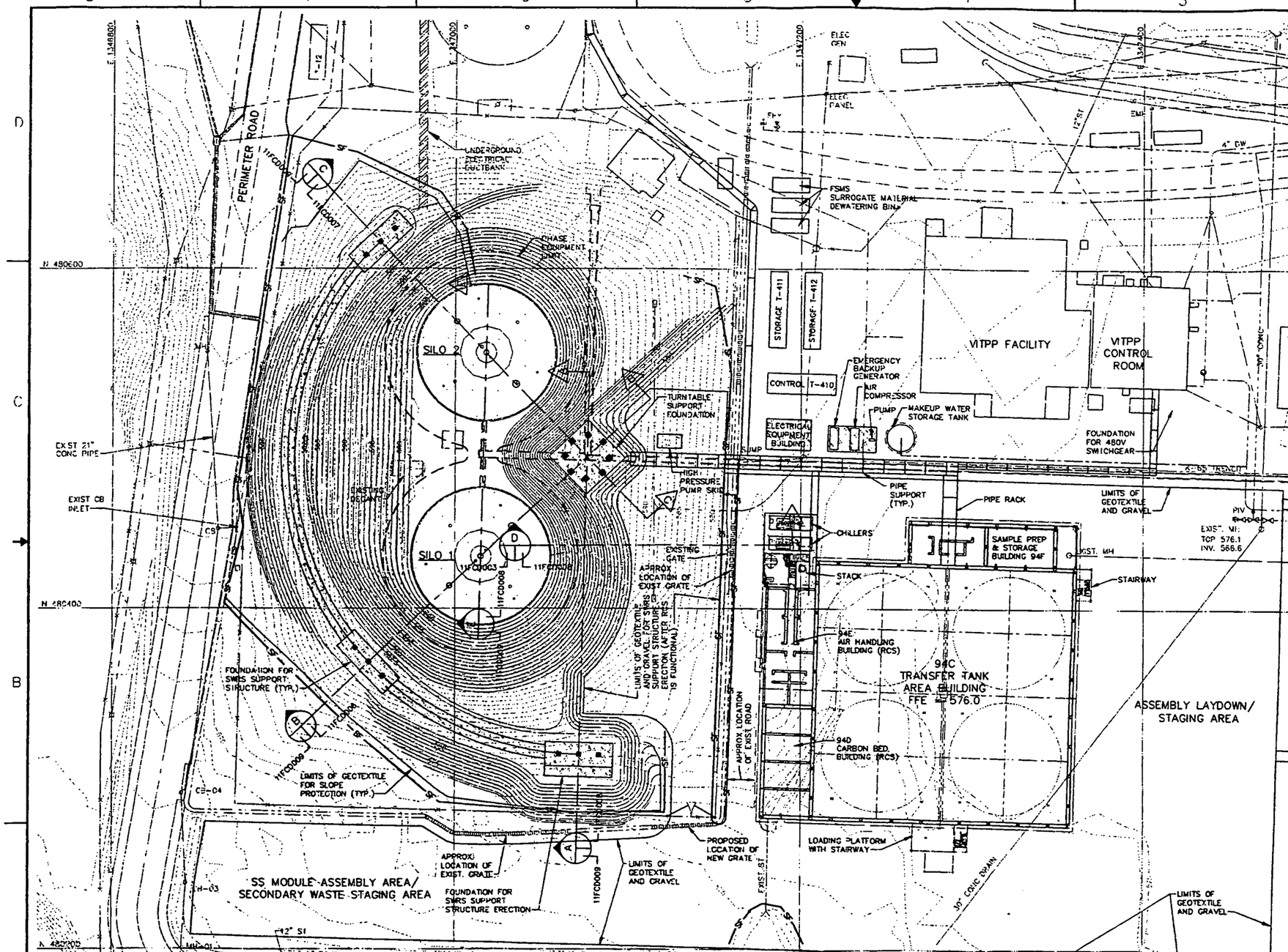
By : KEO 11/08/99
Check : 11/9/99
Revision : A
Calc : CA-FSC624-FC-0



2753

NOTES:

1. SEE DRAWING 05FCD011 FOR GENERAL NOTES AND LEGEND.



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

30 0 30 60

SCALE IN FEET

PRELIMINARY
NOT FOR CONSTRUCTION

REV	DATE	BY	CHK'D	APR'VD	DESCRIPTION/ISSUE
B	1/7/00	WVD			ISSUED FOR OHIO EPA REVIEW
A		WVD			PRELIMINARY DESIGN SUBMITTAL

RPE

DRAWN BY WVD DATE
DESIGNED BY KEO 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

FLUOR FERNALD ENVIRONMENTAL RESTORATION CORPORATION

TITLE
SILO WASTE RETRIEVAL SYSTEM
EROSION CONTROL PLAN
PHASE 1

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

000014

FILENAME: 11FCD009.DWG

G:\DWGREV\FDF\SILOS\2\11\11fcd009.dwg Fri Jan 07 15:19:15 2000

2753

STATE OF OHIO NORTH (NAD 83)

PERIMETER ROAD

UNDERGROUND ELECTRICAL DUCTBANK

FSWS SURROGATE MATERIAL DEWATERING BIN

PHASE 2B EQUIPMENT LIMIT

SILO 2

SILO 1

TURNTABLE SUPPORT FOUNDATION

HIGH PRESSURE PUMP SKID

2' WIDE HAND EXCAVATION AREA

EXIST 21" CONC PIPE

EXIST CB INLET

EXISTING GATE

APPROX LOCATION OF EXIST GRATE

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

FOUNDATION FOR SWRS SUPPORT STRUCTURE (TYP.)

PHASE 2A EQUIPMENT LIMIT

APPROX. LOCATION OF EXIST. ROAD

PROPOSED LOCATION OF NEW GRATE

APPROX. LOCATION OF EXIST. GRATE

FOUNDATION FOR SWRS SUPPORT STRUCTURE ERECTION

LIMITS OF GEOTEXTILE AND GRAVEL

EQUIPMENT PAD FOR DWRS

N 480600

N 480400

N 480200

SCALE IN FEET

NOTES:

1. SEE DRAWING 05FCD011 FOR GENERAL NOTES AND LEGEND.

PRELIMINARY
NOT FOR CONSTRUCTION

REV	DATE	BY	CHK'D	APR'VD	DESCRIPTION/ISSUE
B	1/7/00	WVD			ISSUED FOR OHIO EPA REVIEW
A		WVD			PRELIMINARY DESIGN SUBMITTAL

RFC

DRAWN BY WVD DATE
DESIGNED BY KEO 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

FLUOR FERNALD, INCORPORATED

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

SIZE D | SCALE 1"=30' | DWG. NO. 11FCD010 | REV B

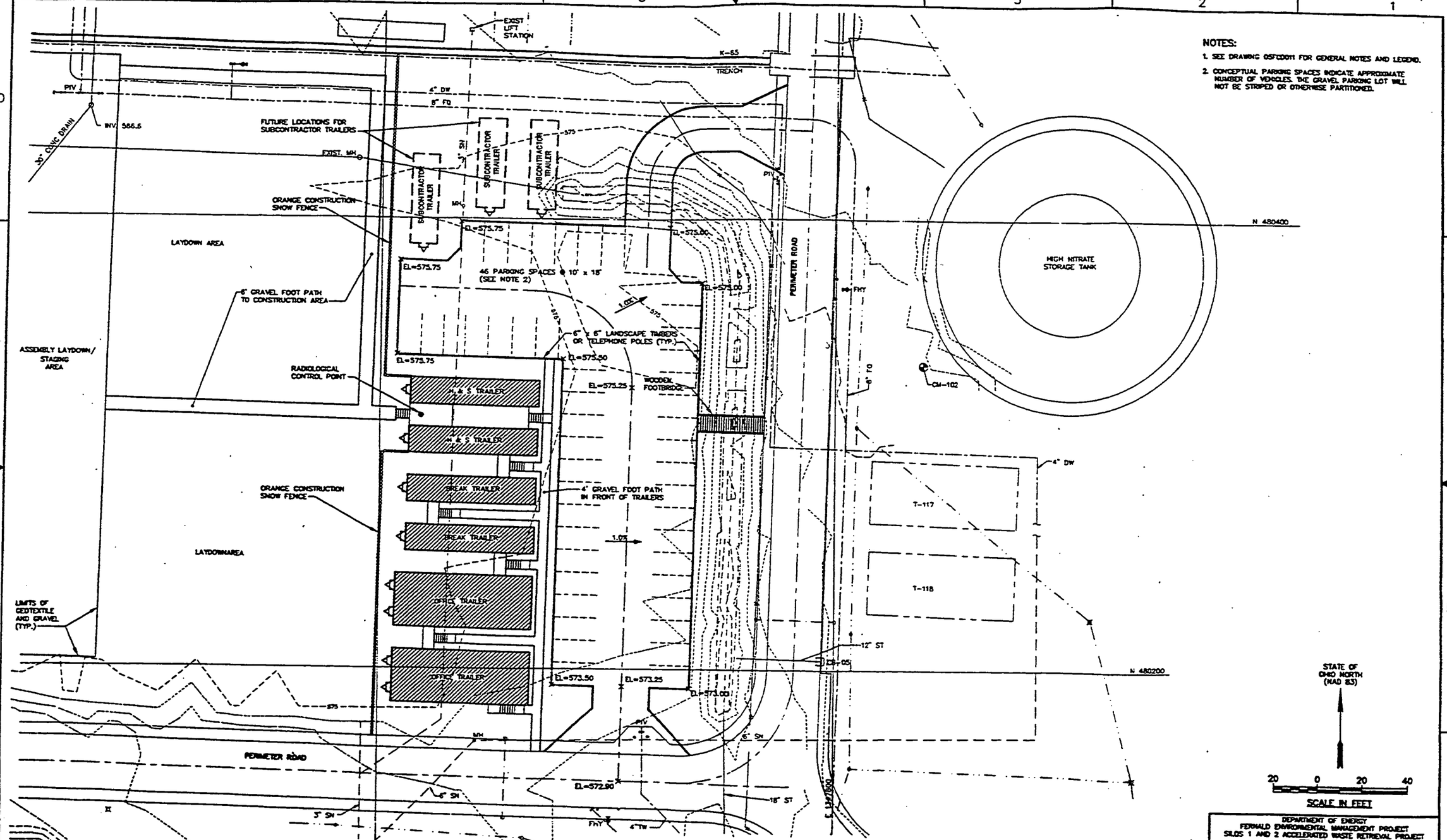
000015

FILENAME: 11FCD010.DWG

S:\CAMBER\FDF\SILOS\CAD\SILO11\11fcd010.dwg Fri Jan 07 11:18:16 2000

NOTES:

1. SEE DRAWING 05FCD011 FOR GENERAL NOTES AND LEGEND.
2. CONCEPTUAL PARKING SPACES INDICATE APPROXIMATE NUMBER OF VEHICLES. THE GRAVEL PARKING LOT WILL NOT BE STRIPED OR OTHERWISE PARTITIONED.



PRELIMINARY
NOT FOR CONSTRUCTION

REV	DATE	BY	CHK'D/APR'VD	DESCRIPTION/ISSUE
A		WVD		PRELIMINARY DESIGN SUBMITTAL

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DESIGNED BY RED
CHECKED BY
APPROVED BY
APPROVED BY

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
SUPPORT FACILITIES
GRADING PLAN
TRAILER LAYOUT

SIZE D | SCALE 1"=20' | DWG. NO. 06FCD001 | REV A

FILENAME: 06FCD001.DWG

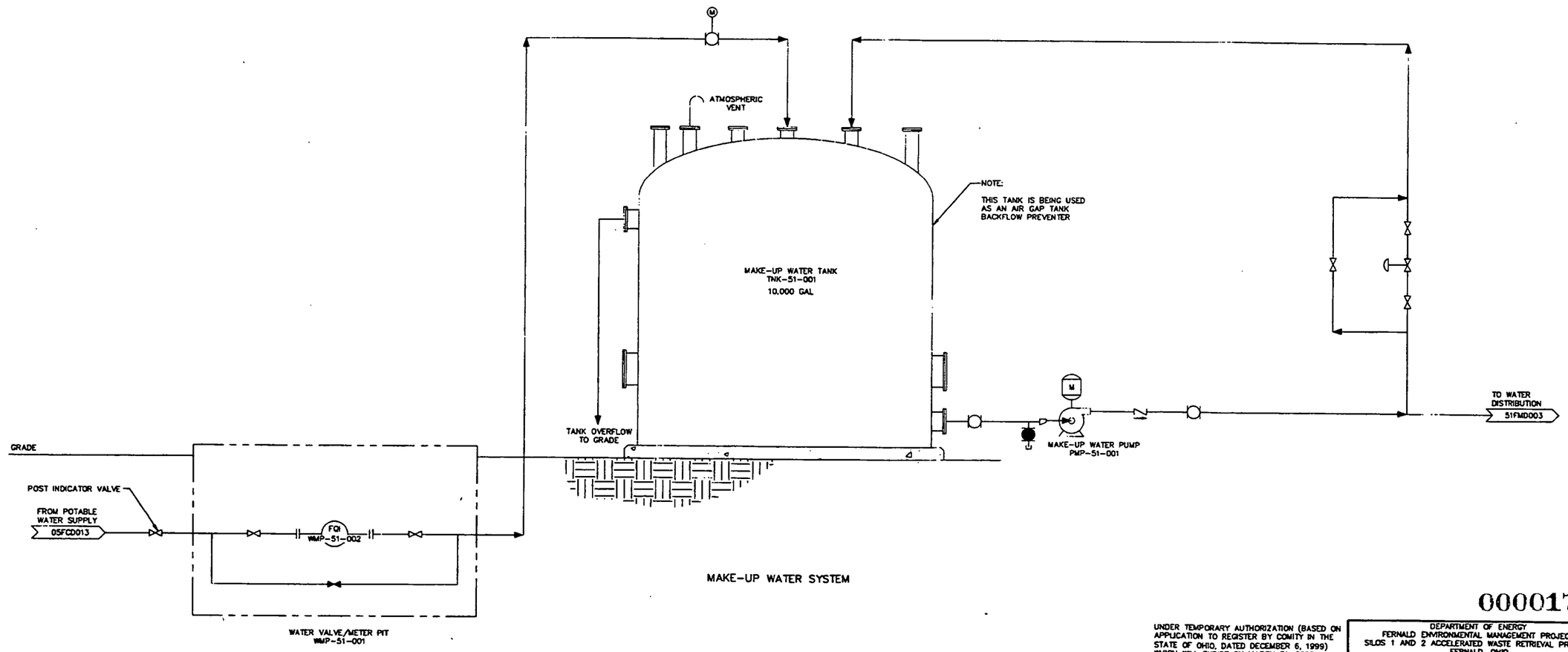
000016

NOTES:

1. FOR GENERAL NOTES SEE DRAWING 05FMD004.
2. FOR MASS BALANCE TABLES SEE DRAWING 11FMD001 & 11FMD002.

REFERENCE DRAWINGS:

05FMD001	PIPING & INSTRUMENT DIAGRAM – INSTRUMENT IDENTIFICATION
05FMD002	PIPING & INSTRUMENT DIAGRAM – CONTROL SYSTEM STANDARDS
05FMD003	PIPING & INSTRUMENT DIAGRAM – PIPING & EQUIPMENT IDENTIFICATION



MAKE-UP WATER SYSTEM

000017

UNDER TEMPORARY AUTHORIZATION (BASED ON APPLICATION TO REGISTER BY COMITY IN THE STATE OF OHIO, DATED DECEMBER 5, 1999) WHICH WILL EXPIRE ON MARCH 31, 2000.

REV	DATE	BY	CHK'D	APR'VD	DESCRIPTION/ISSUE
1	[illegible]	[illegible]	[illegible]		CERTIFIED FOR CONSTRUCTION
0	01/01/99	BJD	SWH		PRELIMINARY DESIGN PACKAGE

KENNETH D. RICHARDS — PROFESSIONAL ENGINEER — STATE OF TENNESSEE — No. 103745

		DATE
DRAWN BY	B.J. Davis	01/07/00
DESIGNED BY	B.J. Davis	01/07/00
CHECKED BY	S.W. Hampton	01/07/00
APPROVED BY	Kenneth D. Richards	01/07/00
APPROVED BY	John Dawson	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
POTABLE/DOMESTIC WATER SYS
PROCESS FLOW DIAGRAM
MAKE-UP WATER

SIZE	SCALE	DWG. NO.	REV
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FILENAME: 51FMD001.DWG

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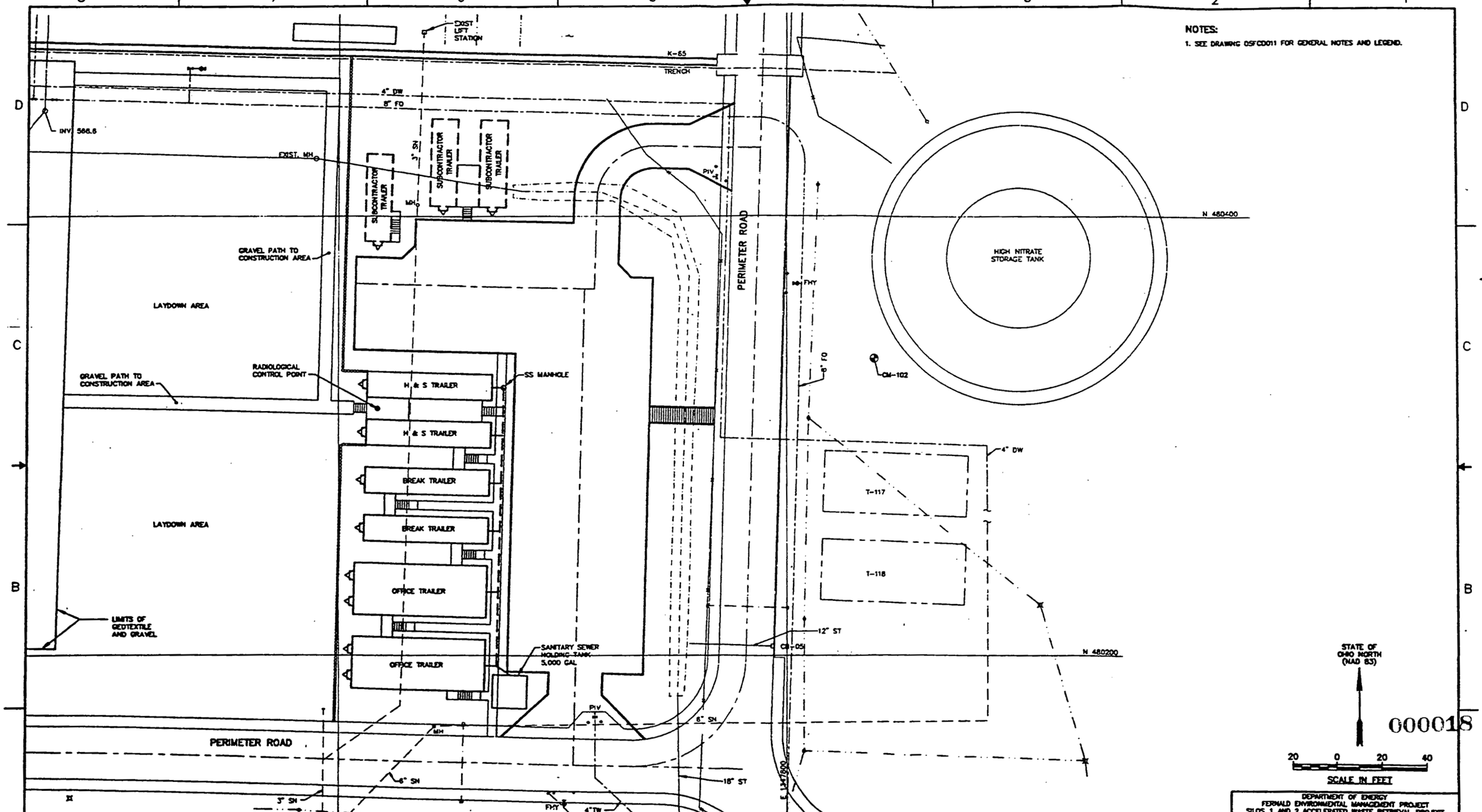
NOTES:

1. SEE DRAWING 05FCD011 FOR GENERAL NOTES AND LEGEND.



000018

PRELIMINARY
NOT FOR CONSTRUCTION

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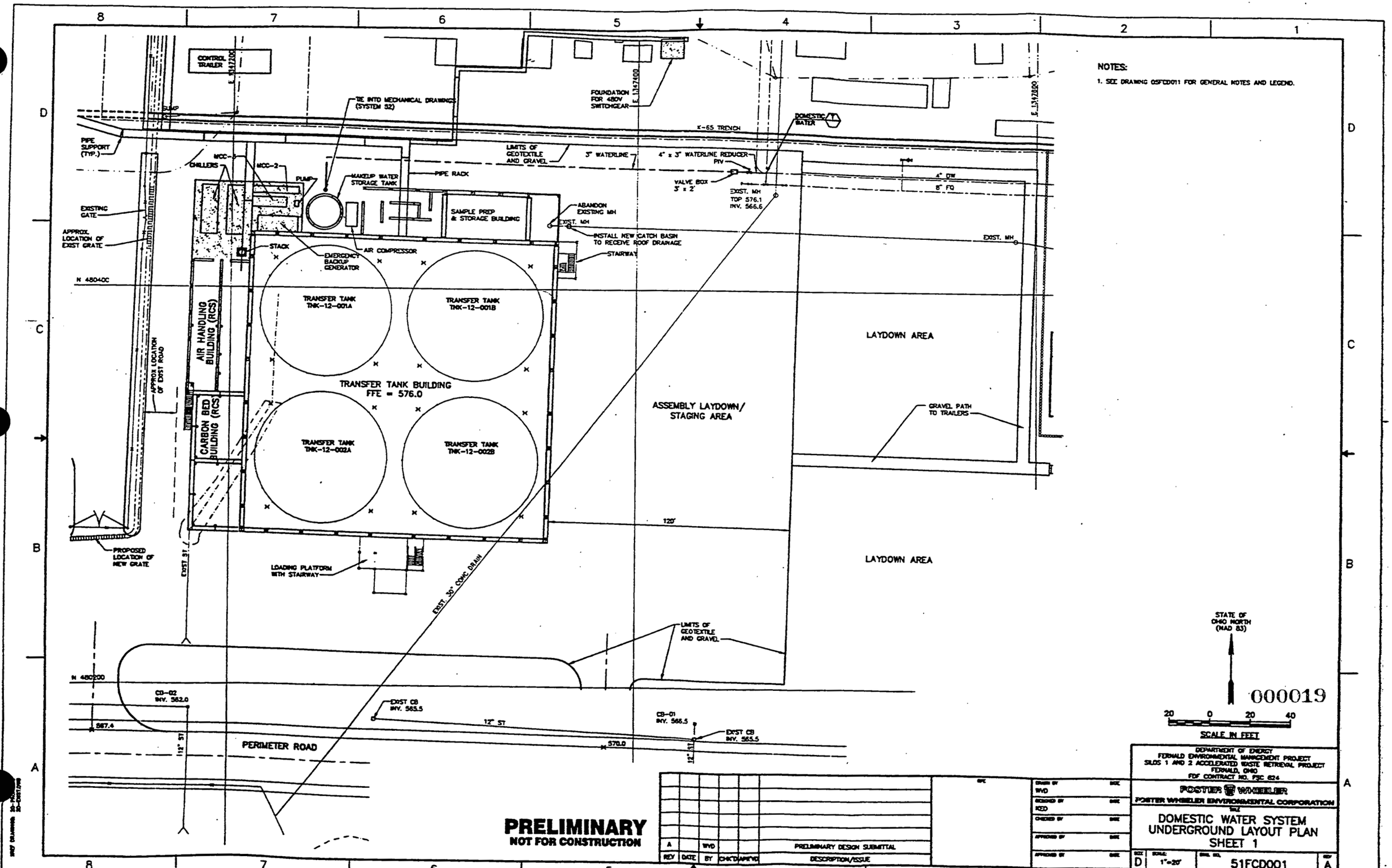
DEPARTMENT OF ENERGY
FERNALD ENVIRONMENTAL MANAGEMENT PROJECT
SILOS 1 AND 2 ACCELERATED WASTE RETRIEVAL PROJECT
FERNALD, OHIO
FDF CONTRACT NO. FSC 624

FOSTER WHEELER
FOSTER WHEELER ENVIRONMENTAL CORPORATION

TITLE
SANITARY SEWER SYSTEM LAYOUT PLAN

SIZE D | SCALE 1"=20' | DWG. NO. 61FCD001 | REV A



NOTES:

1. SEE DRAWING 05FCD011 FOR GENERAL NOTES AND LEGEND.

000019

PRELIMINARY
NOT FOR CONSTRUCTION

REV	DATE	BY	CHK'D	APR'VD	DESCRIPTION/ISSUE
A		WVD			PRELIMINARY DESIGN SUBMITTAL

DRAWN BY WVD
DESIGNED BY KED
CHECKED BY
APPROVED BY
APPROVED BY

DEPARTMENT OF ENERGY
FERNALD ENVIRONMENTAL MANAGEMENT PROJECT
SILOS 1 AND 2 ACCELERATED WASTE RETRIEVAL PROJECT
FERNALD, OHIO
FDF CONTRACT NO. F3C 624

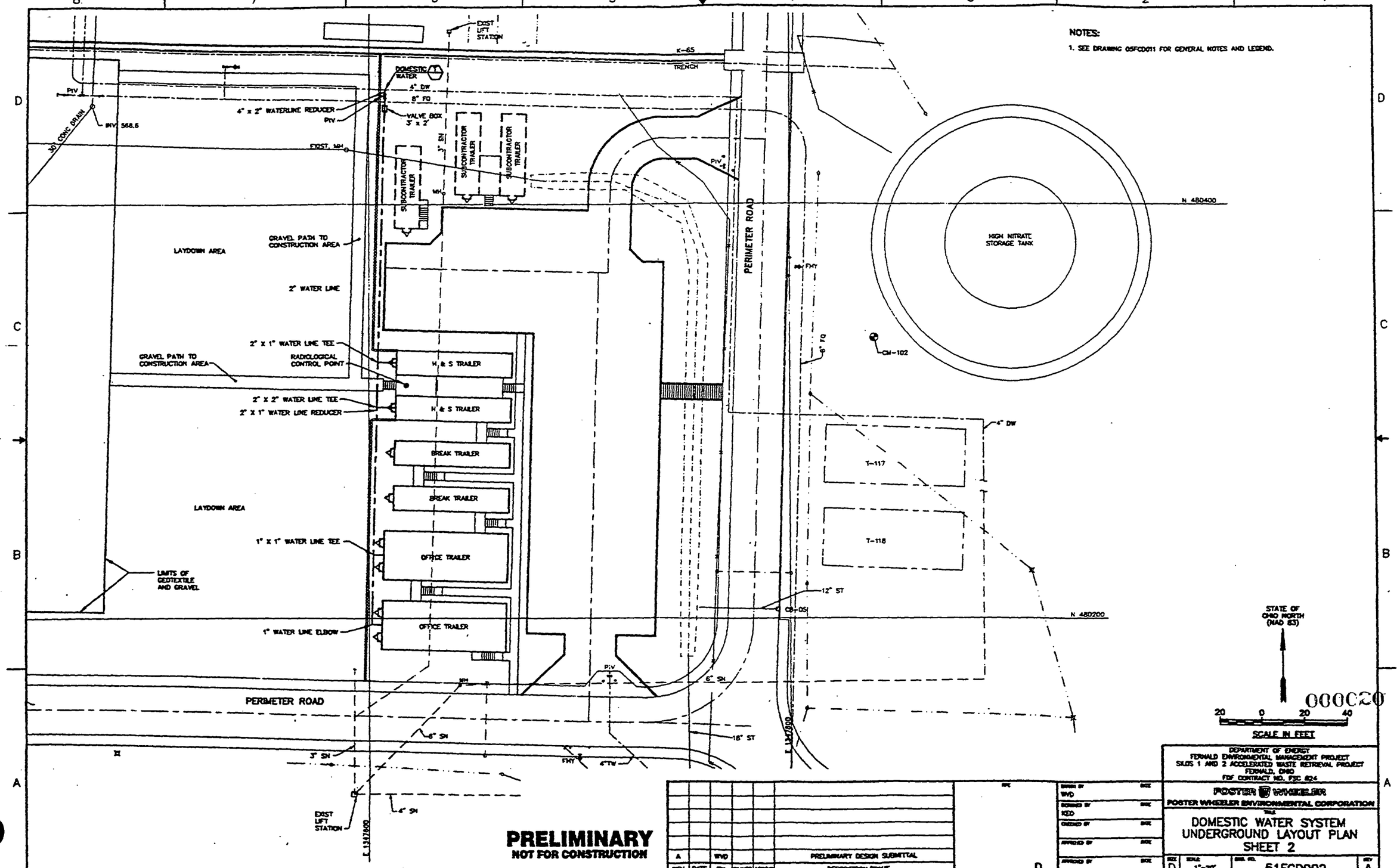
FOSTER WHEELER
FOSTER WHEELER ENVIRONMENTAL CORPORATION

TITLE
DOMESTIC WATER SYSTEM
UNDERGROUND LAYOUT PLAN
SHEET 1

SIZE D | SCALE 1"=20' | DWG NO. 51FCD001 | REV A

NOTES:

1. SEE DRAWING 05FCD011 FOR GENERAL NOTES AND LEGEND.



000020

PRELIMINARY
NOT FOR CONSTRUCTION

REV	DATE	BY	CHK'D	APR'VD	DESCRIPTION/ISSUE
A		WVD			PRELIMINARY DESIGN SUBMITTAL

SIZE D

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DESIGNED BY KED
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APPROVED BY
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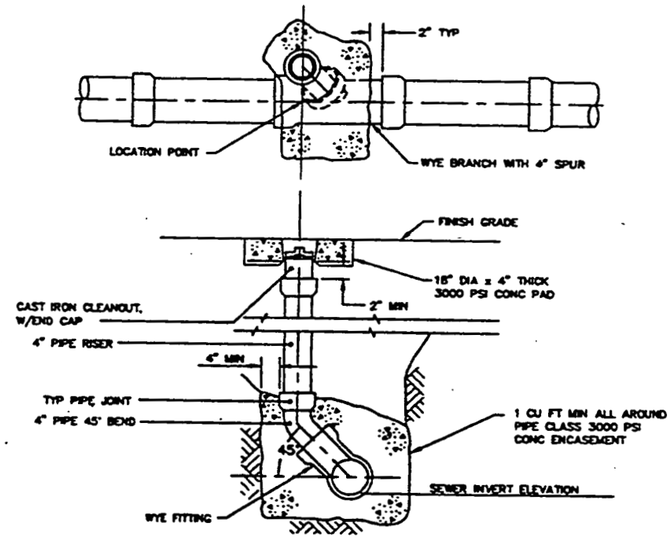
DEPARTMENT OF ENERGY
FERNALD ENVIRONMENTAL MANAGEMENT PROJECT
SILOS 1 AND 2 ACCELERATED WASTE RETRIEVAL PROJECT
FERNALD, OHIO
FDF CONTRACT NO. F3C 824

FOSTER WHEELER
FOSTER WHEELER ENVIRONMENTAL CORPORATION

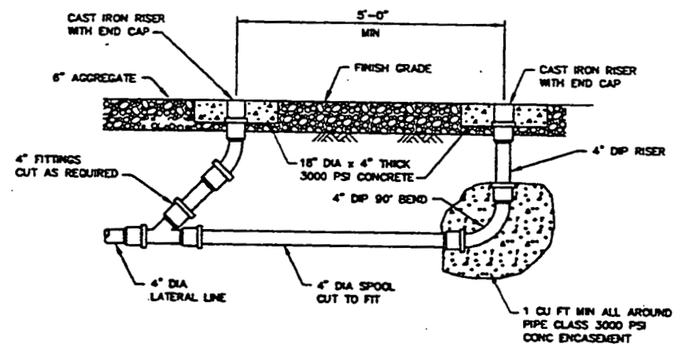
TITLE
DOMESTIC WATER SYSTEM
UNDERGROUND LAYOUT PLAN
SHEET 2

SIZE D | SCALE 1"=20' | DWG NO. 51FCD002 | REV A



SEWER CLEANOUT

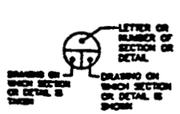
NOT TO SCALE



TRAILER CONNECTION

NOT TO SCALE

000021



SECTION & DETAIL KEY

PRELIMINARY
NOT FOR CONSTRUCTION

REV	DATE	BY	CHK'D	APP'D	DESCRIPTION/ISSUE
A		WVD			PRELIMINARY DESIGN SUBMITTAL

SPC

DRAWN BY WVD DATE
DESIGNED BY KED DATE
CHECKED BY DATE
APPROVED BY DATE
APPROVED BY DATE

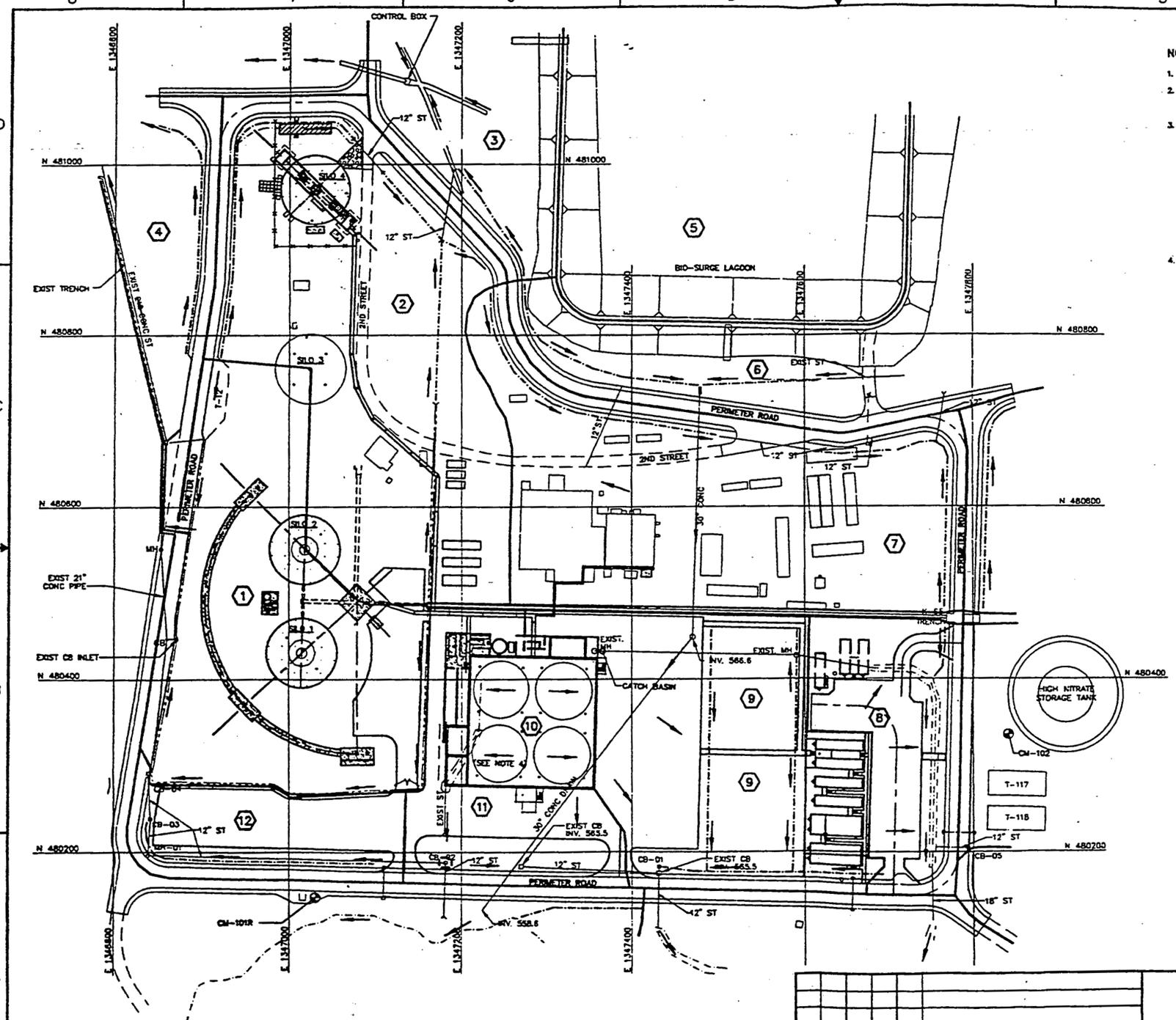
DEPARTMENT OF ENERGY
FERNALD ENVIRONMENTAL MANAGEMENT PROJECT
SILOS 1 AND 2 ACCELERATED WASTE RETRIEVAL PROJECT
FERNALD, OHIO
FDF CONTRACT NO. FSC 624

FOSTER WHEELER
FOSTER WHEELER ENVIRONMENTAL CORPORATION

TITLE
SANITARY SEWER SYSTEM
DETAILS

SIZE D | SCALE AS SHOWN | DWG. NO. 61FCD002 | REV A

FILENAME: 61FCD002.DWG



NOTES:

1. SEE DRAWING 05FCD011 FOR GENERAL NOTES AND LEGEND.
2. DRAINAGE AREAS 1 THROUGH 4 DRAIN TO THE WEST TO AN EXISTING CONCRETE SUMP WITH APPROXIMATE CAPACITY OF 390,000 GALLONS. THE CONCRETE SUMP CONTAINS A 12" DIA FORCE MAIN TO THE BIO-SURGE LAGOON.
3.

DRAINAGE AREA	DESCRIPTION OF DRAINAGE AREA	OUTLET
1	SILOS 1 & 2 – PERIMETER TRENCH	CONCRETE SUMP TO BIO-SURGE LAGOON
2	SILOS 3 & 4 – PERIMETER TRENCH	CONCRETE SUMP TO BIO-SURGE LAGOON
3	GRASS STORM BASIN	CONCRETE SUMP TO BIO-SURGE LAGOON
4	WEST OF SILOS 3 & 4	CONCRETE SUMP TO BIO-SURGE LAGOON
5	BIO-SURGE LAGOON	BIO-SURGE LAGOON
6	OUT DRAINAGE SOUTH TO 30 IN. RCP	30 IN. RCP
7	DRAINS NORTH TO 30 IN. RCP	30 IN. RCP
8	GRASS FIELD	EXISTING STORMWATER BASIN
9	GRASS FIELD AND LAYDOWN AREA	EXISTING STORMWATER BASIN
10	TTA AND RCS BUILDINGS – GUTTERS	PROPOSED ROOF DRAINAGE
11	EXTERIOR AREAS OF TTA AND RCS BUILDINGS	EXISTING STORMWATER BASIN
12	SOUTH OF SILO 1	12 IN. OUTLET FROM CB-02

4. ROOF DRAINAGE FROM TRANSFER TANK AREA BUILDING AND RCS BUILDING WILL BE ROUTED SOUTH AND ALSO TO THE EAST THROUGH EXISTING 12" RCP.

STORMWATER LEGEND:

(1) DRAINAGE AREA

DRAINAGE DIVIDE

FLOW DIRECTION

STATE OF OHIO NORTH (NAD 83)

000022

60 0 60 120

SCALE IN FEET

PRELIMINARY
NOT FOR CONSTRUCTION

REV	DATE	BY	CHK'D	APRV'D	DESCRIPTION/ISSUE
A		WVD			PRELIMINARY DESIGN SUBMITTAL

DRAWN BY WVD
DESIGNED BY KED
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APPROVED BY
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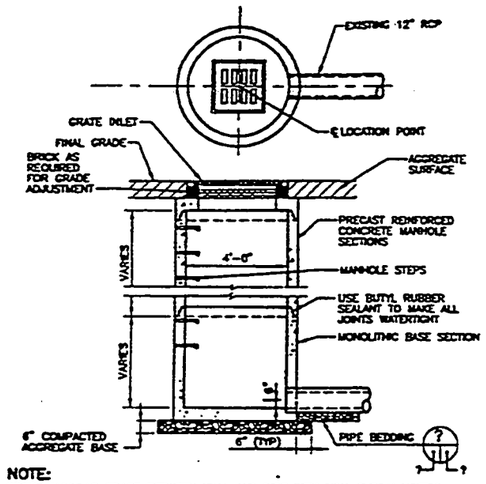
DEPARTMENT OF ENERGY
FERNALD ENVIRONMENTAL MANAGEMENT PROJECT
SILOS 1 AND 2 ACCELERATED WASTE RETRIEVAL PROJECT
FERNALD, OHIO
FDF CONTRACT NO. F3C 624

FOSTER WHEELER
FOSTER WHEELER ENVIRONMENTAL CORPORATION

TITLE
STORM WATER SYSTEM
OVERALL DRAINAGE PLAN

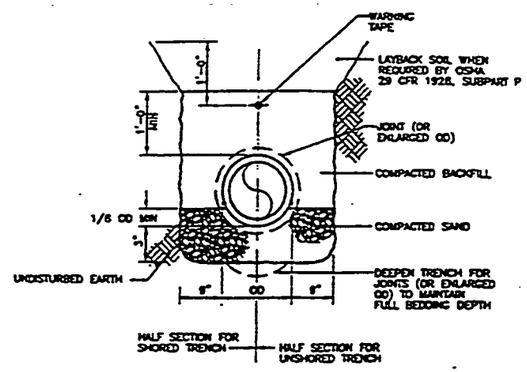
SIZE D | SCALE 1"=60' | DWG. NO. 66FCD001 | REV A



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 CATCH BASIN

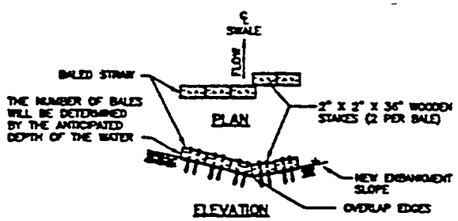
NOT TO SCALE

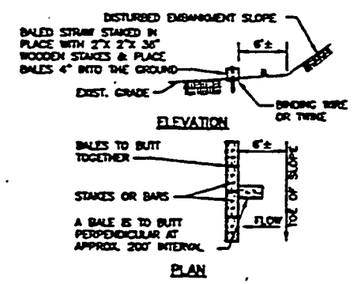


NOTE:
WARNING TAPE SHALL CONSIST OF A SOLID ALUMINUM CORE, A COATED IMPRINT, AND A REINFORCED PROTECTIVE PLASTIC JACKET BONDED TO THE FOIL CORE.

PIPE BEDDING DETAIL

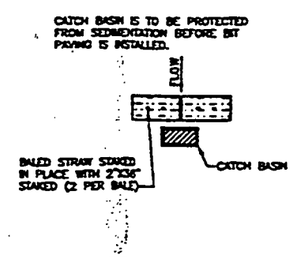
NOT TO SCALE





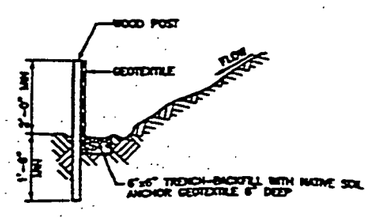
BALED STRAW EROSION CHECKS

NOT TO SCALE



CATCH BASIN PROTECTION

NOT TO SCALE



SILT FENCE DETAIL

NOT TO SCALE

SECTION & DETAIL KEY

PRELIMINARY
NOT FOR CONSTRUCTION

REV	DATE	BY	CHK'D	APRV'D	DESCRIPTION/ISSUE
A		WVD			PRELIMINARY DESIGN SUBMITTAL

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SCALE NTS
DESIGNED BY RED
CHECKED BY
APPROVED BY
APPROVED BY

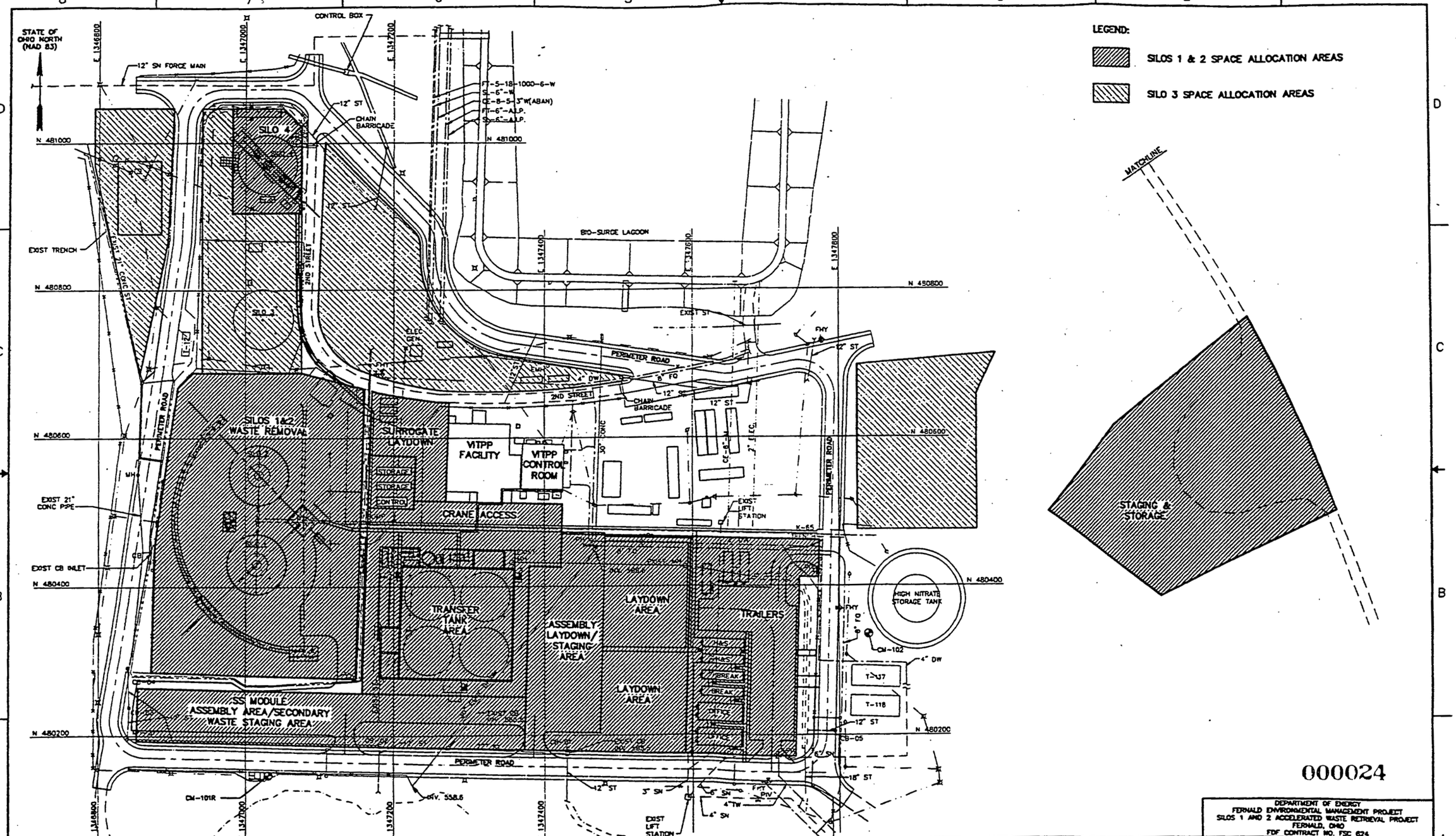
000023

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
STORM WATER SYSTEM
MISC DETAILS
SHEET 1

SIZE D | SCALE AS SHOWN | DWG. NO. 66FCD006 | REV A



000024

PRELIMINARY
NOT FOR CONSTRUCTION

REV	DATE	BY	CHK'D	APR'VD	DESCRIPTION/ISSUE
A		WVD			PRELIMINARY DESIGN SUBMITTAL

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

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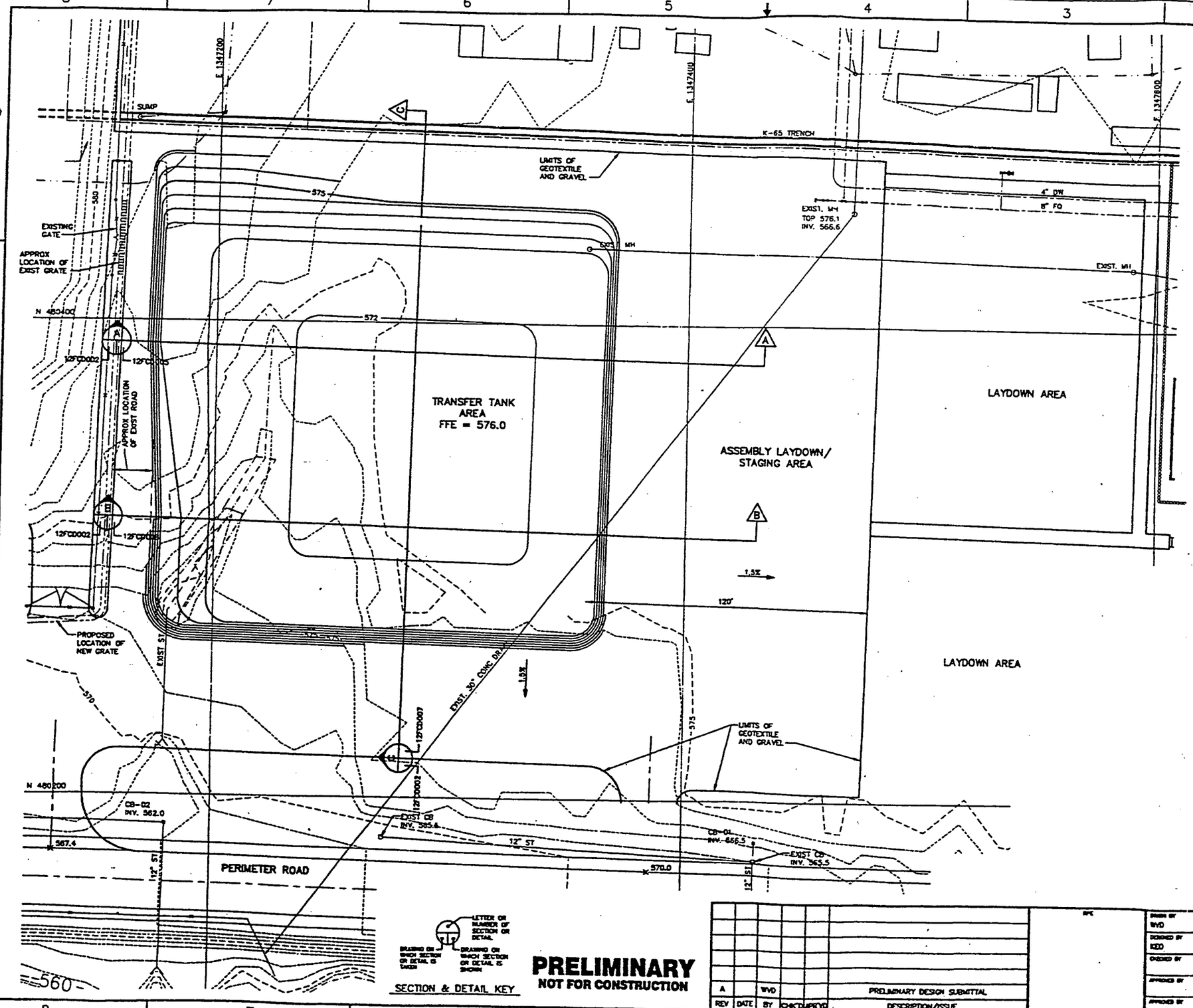
APPROVED BY
APPROVED BY

TITLE
MISC FACILITIES
SITE SPACE ALLOCATION

SIZE D | SCALE 1"=60' | DWG. NO. 05FCD014 | REV A

NOTES:

1. SEE DRAWING 05FCD011 FOR GENERAL NOTES AND LEGEND.



LETTER OR NUMBER OF SECTION OR DETAIL

DRAWING ON WHICH SECTION OR DETAIL IS SHOWN

DRAWING ON WHICH SECTION OR DETAIL IS SHOWN

SECTION & DETAIL KEY

PRELIMINARY
NOT FOR CONSTRUCTION

REV	DATE	BY	CHK'D	APR'VD	DESCRIPTION/ISSUE
A		WVD			PRELIMINARY DESIGN SUBMITTAL

DRAWN BY WVD
DESIGNED BY KDD
CHECKED BY
APPROVED BY
APPROVED BY

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

TRANSFER TANK SYSTEM
EXCAVATION PLAN

SIZE D | SCALE 1"=20' | DWG NO. 12FCD002 | REV A

FILENAME: 12FCD002.DWG

NOTES:

1. SEE DRAWING 05FCD011 FOR GENERAL NOTES AND LEGEND.

CONTROL TRAILER
E 1347200
EMERGENCY SHOWER
MTPP FACILITY
FOUNDATION FOR 480V SWITCHGEAR
E 1347400
E 1347600
DOMESTIC WATER
SUMP
K-65 TRENCH
PIPE SUPPORT (TYP.)
APPROX. SIZE PIPE RACK
LIMITS OF GEOTEXTILE AND GRAVEL
3" WATERLINE
PIV
VALVE BOX 3' x 2'
FIRE WATER
EXIST. MH TOP 575.1 INV. 566.6
4" DW
8" FO
CHILLERS
MCC-3
MCC-2
PUMP
MAKEUP WATER STORAGE TANK
EXISTING GATE
APPROX. LOCATION OF EXIST GRATE
SAMPLE PREP & STORAGE BUILDING
ABANDON EXISTING MH
EXIST. MH
INSTALL NEW CATCH BASIN TO RECEIVE ROOF DRAINAGE
STAIRWAY
EXIST. MH
STACK
AIR COMPRESSOR
EMERGENCY BACKUP GENERATOR
N 480400
TRANSFER TANK TNK-12-001A
TRANSFER TANK TNK-12-001B
TRANSFER TANK BUILDING FFE = 576.0
LAYDOWN AREA
12FCD003
12FCD002
AIR HANDLING BUILDING (BCS)
APPROX. LOCATION OF EXIST ROAD
ASSEMBLY LAYDOWN/ STAGING AREA
GRAVEL PATH TO TRAILERS
TRANSFER TANK 2A TNK-12-002A
RIDGE LINE
TRANSFER TANK 2B TNK-12-002B
12FCD006
CARBON TOD (BURNING KOSK)
1.5%
120'
PROPOSED LOCATION OF NEW GRATE
EXIST. ST
LOADING PLATFORM WITH STAIRWAY
EXIST. 30" CONC. DRAIN
570
575
12FCD007
12FCD003
LIMITS OF GEOTEXTILE AND GRAVEL
LAYDOWN AREA
N 480200
CB-02 INV. 562.0
EXIST. CB INV. 565.6
CD-01 INV. 566.5
EXIST. CD INV. 565.5
567.4
11068
12" ST
570.0
PERIMETER ROAD
560

STATE OF OHIO NORTH (NAD 83)

20 0 20 40

SCALE IN FEET

000026

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

SECTION & DETAIL KEY

PRELIMINARY
NOT FOR CONSTRUCTION

REV	DATE	BY	CHK'D	APR'VD	DESCRIPTION/ISSUE
A		WVD			PRELIMINARY DESIGN SUBMITTAL

DRAWN BY WVD	DATE
DESIGNED BY KED	DATE
CHECKED BY	DATE
APPROVED BY	DATE
APPROVED BY	DATE

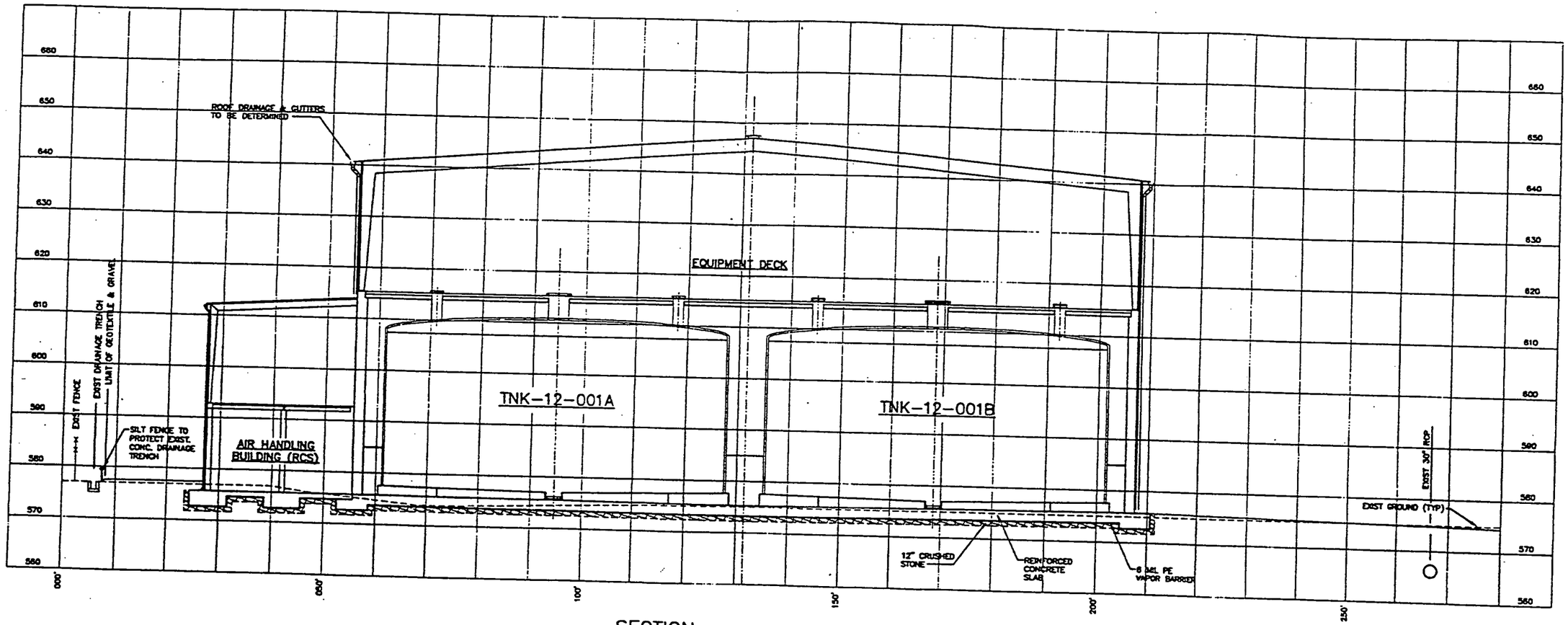
DEPARTMENT OF ENERGY
FERNALD ENVIRONMENTAL MANAGEMENT PROJECT
SILOS 1 AND 2 ACCELERATED WASTE RETRIEVAL PROJECT
FERNALD, OHIO
FDF CONTRACT NO. FSC 624

FOSTER WHEELER
FOSTER WHEELER ENVIRONMENTAL CORPORATION

TITLE
TRANSFER TANK SYSTEM SITE LAYOUT PLAN

SIZE	SCALE	DWG. NO.	REV
D	1"=20'	12FCD003	A

E-2753



SECTION

SCALE: 1"=10'

A

12FCD002
12FCD003

12FCD005

000027

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

PRELIMINARY
NOT FOR CONSTRUCTION

REV	DATE	BY	CHK'D	APR'VD	DESCRIPTION/ISSUE
A		WVD			PRELIMINARY DESIGN SUBMITTAL

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DRAWN BY WVD — DATE
DESIGNED BY KEO — 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

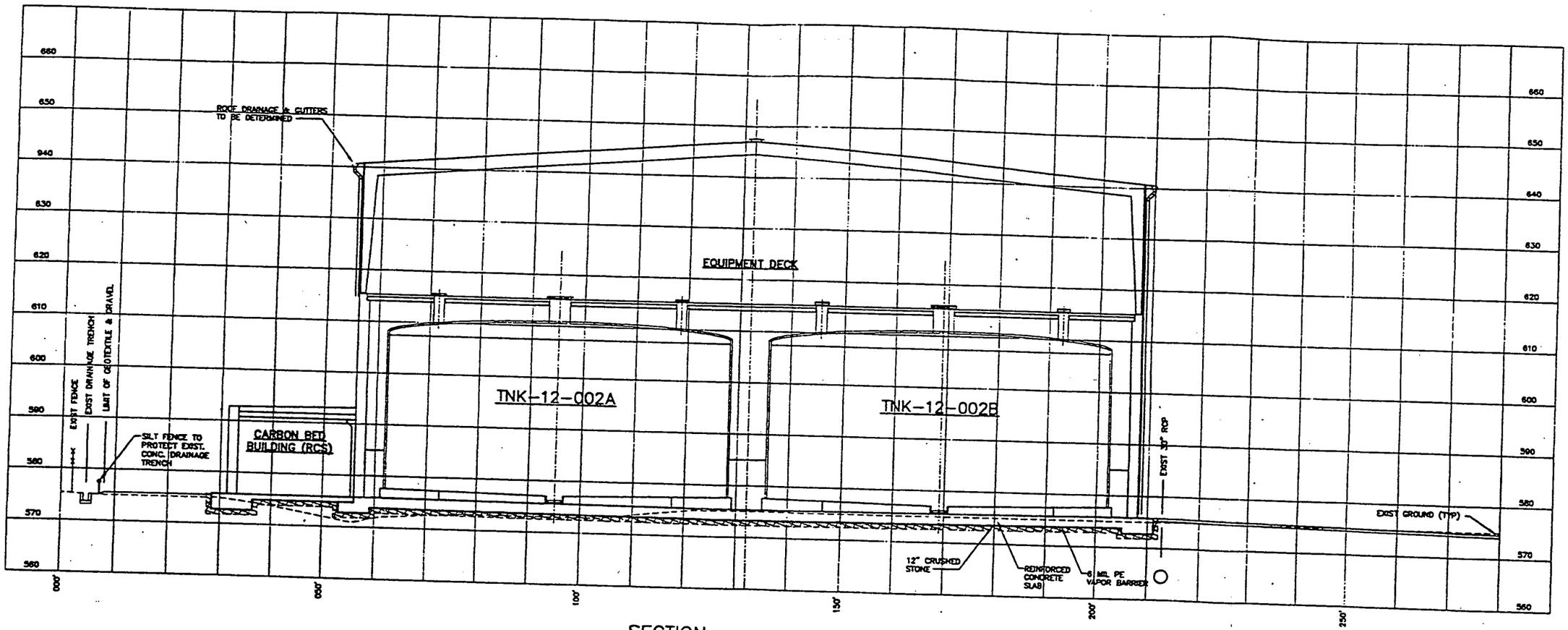
FOSTER WHEELER
FOSTER WHEELER ENVIRONMENTAL CORPORATION

TITLE
TRANSFER TANK SYSTEM
CROSS SECTIONS
SHEET 1

SIZE D — SCALE 1"=10' — DWG NO. 12FCD005 — REV A

FILENAME: 12FCD005.DWG

2753



SECTION

SCALE: 1"=10'

B

12FCD002
12FCD003

12FCD006

000028

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

PRELIMINARY
NOT FOR CONSTRUCTION

REV	DATE	BY	CHK'D	APRV'D	DESCRIPTION/ISSUE
A		WVD			PRELIMINARY DESIGN SUBMITTAL

DATE

DRAWN BY WVD — DATE

DESIGNED BY KED — DATE

CHECKED BY — DATE

APPROVED BY — DATE

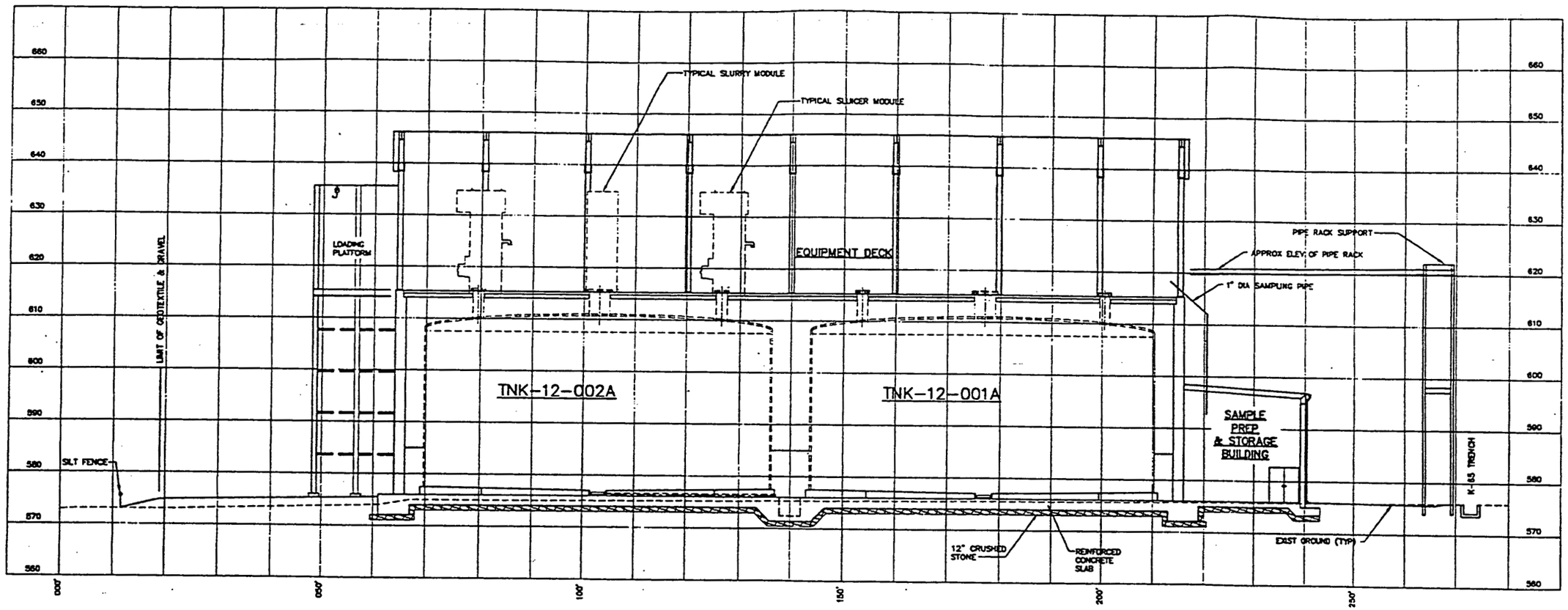
APPROVED BY — DATE

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
CROSS SECTIONS
SHEET 2

SIZE D — SCALE 1"=10' — DWG. NO. 12FCD006 — REV A



SECTION

SCALE: 1"=10'

C

12FCD002
12FCD003

12FCD007

000029

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

PRELIMINARY
NOT FOR CONSTRUCTION

REV	DATE	BY	CHK'D	APR'VD	DESCRIPTION/ISSUE
A		WVD			PRELIMINARY DESIGN SUBMITTAL

SIZE

DRAWN BY WVD SIZE
DESIGNED BY KED SIZE
CHECKED BY SIZE
APPROVED BY SIZE
APPROVED BY SIZE

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
CROSS SECTIONS
SHEET 3

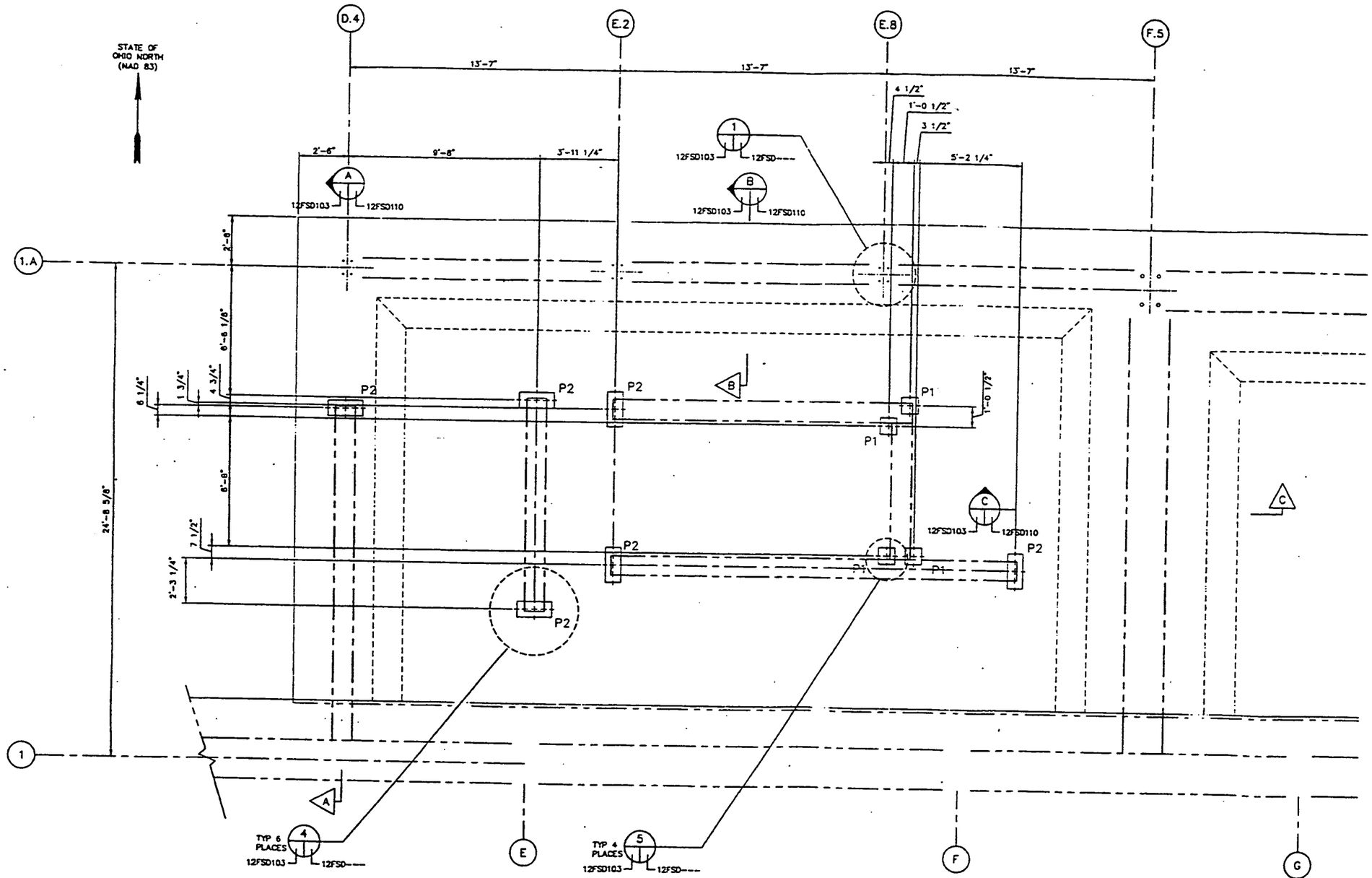
SIZE D | SCALE 1"=10' | DWG. NO. 12FCD007 | REV A

FILENAME: 12FCD007.DWG

2753

NOTES:

1. FOR GENERAL NOTES SEE DRAWING 12FSD100.
2. TTA BUILDING FDN TO BE PLACED PRIOR TO PLACING SAMPLE BLDG FOUNDATIONS.



FDN EMBEDDED PLATES PLAN
(T.O. CONCRETE EL. 576'-0")
SCALE: 3/8"=1'-0"

000030

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

PRELIMINARY
NOT FOR CONSTRUCTION

REV	DATE	BY	CHK'D	APR'VD	DESCRIPTION/ISSUE
A					PRELIMINARY DESIGN SUBMITTAL

DRAWN BY RS DATE
DESIGNED BY RS DATE
CHECKED BY DATE
APPROVED BY DATE
APPROVED BY DATE

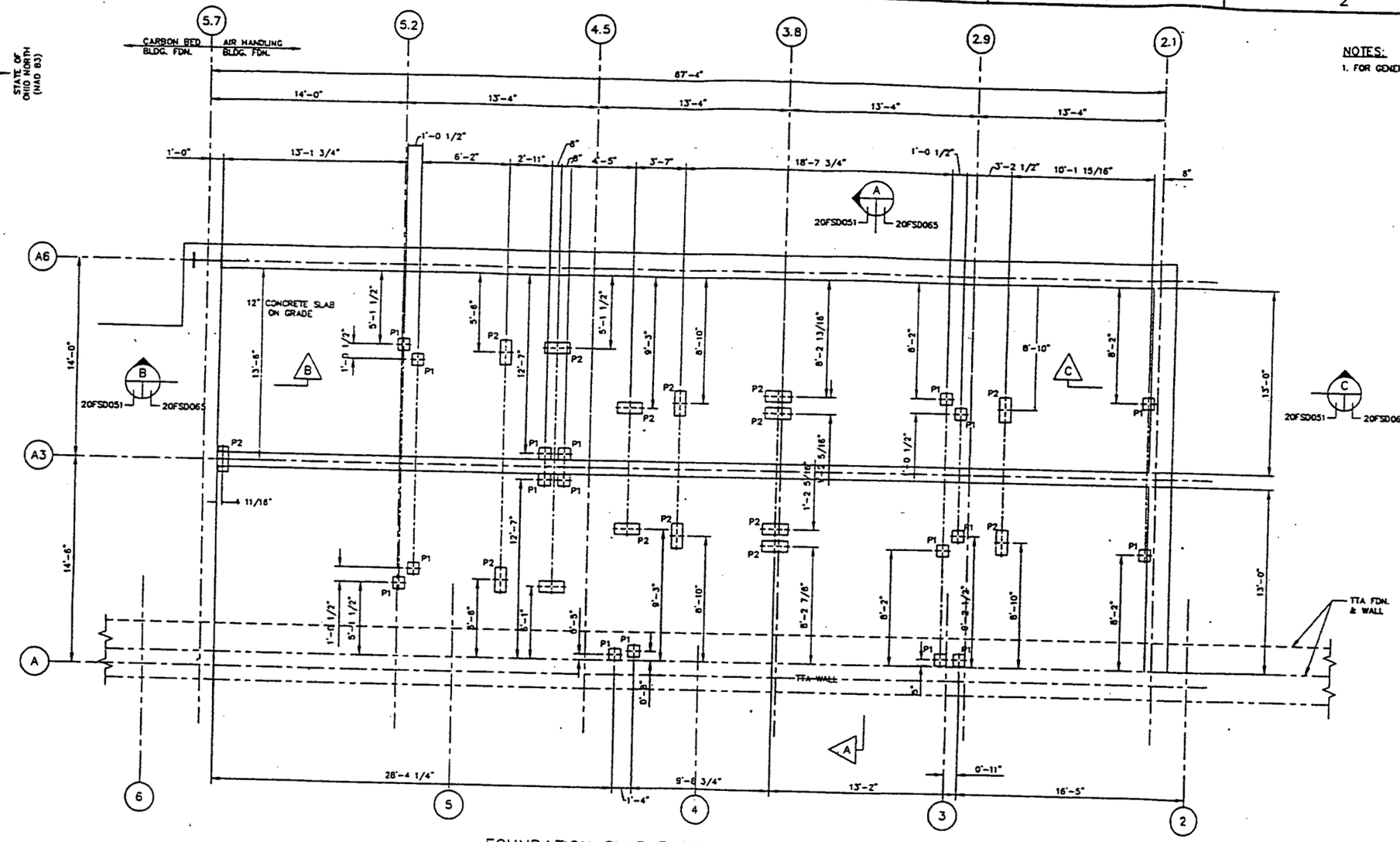
DEPARTMENT OF ENERGY
FERNALD ENVIRONMENTAL MANAGEMENT PROJECT
SILOS 1 AND 2 ACCELERATED WASTE RETRIEVAL PROJECT
FERNALD, OHIO
FDF CONTRACT NO. FSC 824

FOSTER WHEELER
FOSTER WHEELER ENVIRONMENTAL CORPORATION

TRANSFER TANK SYSTEM
SAMPLE BUILDING
FDN EMBEDDED PLATES

SIZE D | SCALE: 3/8"=1'-0" | DWG. NO. 12FSD103 | REV A

2753



FOUNDATION SLAB EMBEDDED PLATES

SCALE: 1/4" = 1'-0"

NOTES:

1. FOR GENERAL CONSTRUCTION NOTES SEE DRAWING 20FSD001.

PRELIMINARY
NOT FOR CONSTRUCTION

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
A					PRELIMINARY DESIGN SUBMITTAL

RPC

DRAWN BY: KS — DATE
DESIGNED BY: RS / WIC — DATE
CHECKED BY — DATE
APPROVED BY — DATE
APPROVED BY — DATE

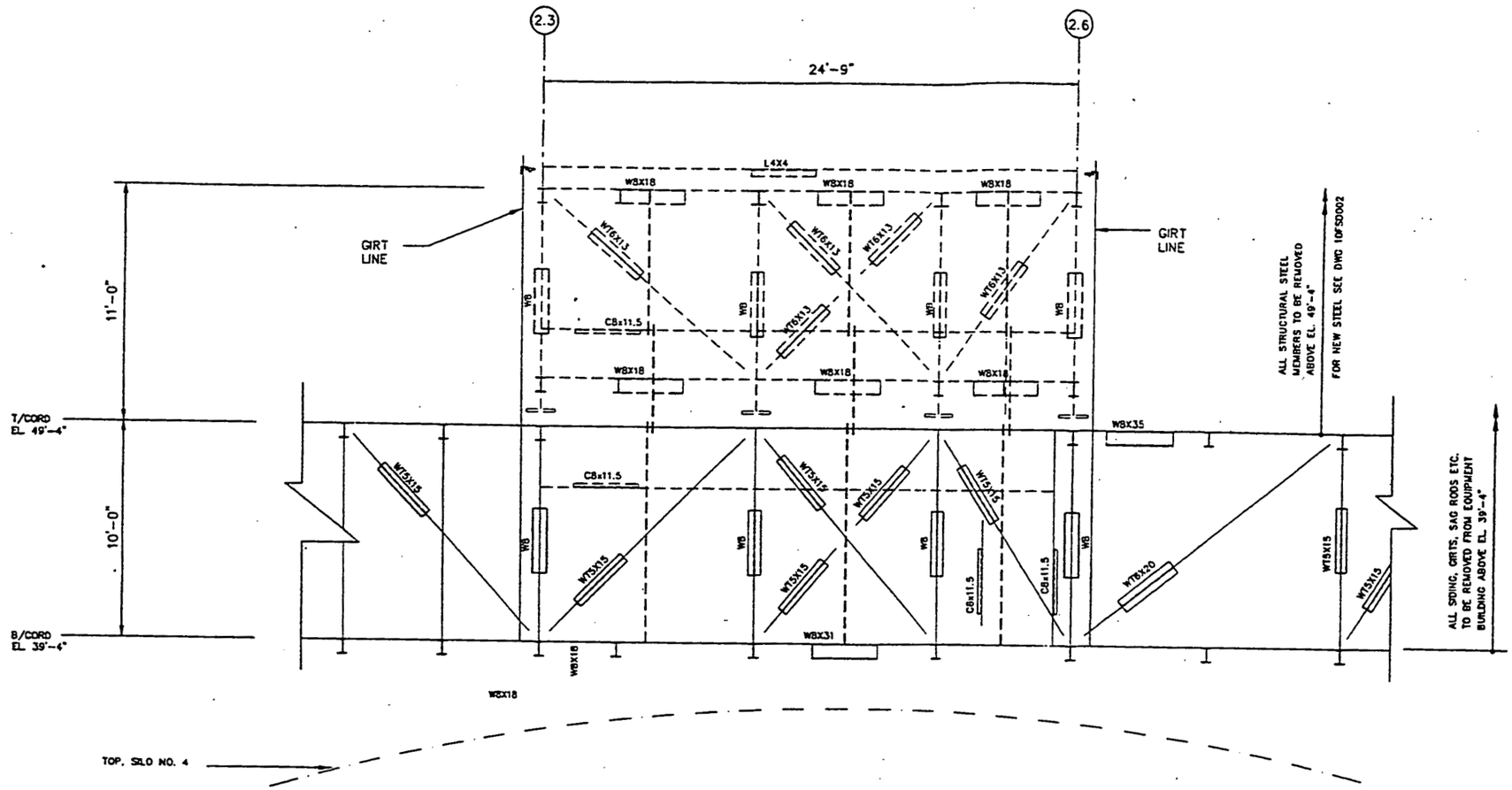
000031

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
AIR HANDLING BUILDING
BASE SLAB, EMBEDDED PLATES

SIZE: D | SCALE: 1/4"=1'-0" | DWG. NO. 20FSD051 | REV A



SOUTHWEST ELEVATION

NOTES:

1. FOR GENERAL NOTES SEE DWG 20FSD001.
2. THE SILO 4 BRIDGE IS ON EXISTING STRUCTURE SEE (SEE DWG 10FSD005) PREVIOUSLY CONSTRUCTED FOR SILO WASTE REMOVAL DEMONSTRATION.
3. STRUCTURAL MODIFICATIONS THAT ENTAIL REMOVAL, STRENGTHENING, OR ADDITION OF STEEL MEMBERS ARE REQUIRED TO ACCOMMODATE THE CURRENT PROJECT FULL SCALE MOCKUP SYSTEM.

LEGEND:

- - - - - EXISTING MEMBERS TO BE REMOVED
——— EXISTING MEMBERS TO REMAIN IN PLACE
——— NEW MEMBERS TO BE ADDED

000032

PRELIMINARY
NOT FOR CONSTRUCTION

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
A					PRELIMINARY DESIGN SUBMITTAL

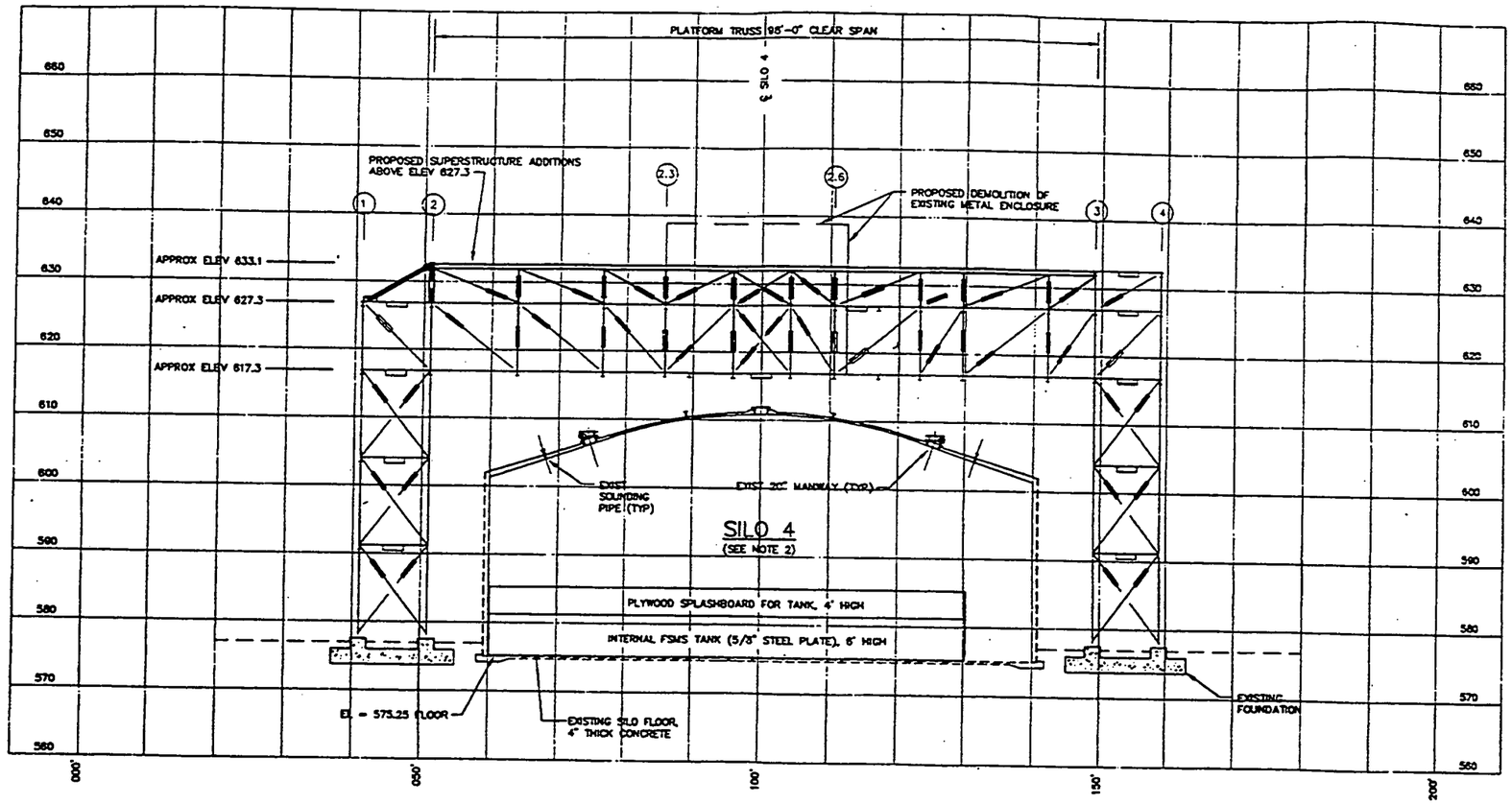
DEPARTMENT OF ENERGY
FERNALD ENVIRONMENTAL MANAGEMENT PROJECT
SILOS 1 AND 2 ACCELERATED WASTE RETRIEVAL PROJECT
FERNALD, OHIO
FDF CONTRACT NO. FSC 624

FOSTER WHEELER
FOSTER WHEELER ENVIRONMENTAL CORPORATION

DRAWN BY CRC
DESIGNED BY RRC
CHECKED BY
APPROVED BY
APPROVED BY

TITLE: FULL-SCALE MOCKUP SYSTEM SILO 4 BRIDGE STRUCTURE EQUIPMENT ROOM DEMOLITION

SIZE D | SCALE: 1/4" = 1'-0" | DWG. NO. 10FSD001 | REV A



SECTION

SCALE: 1"=10'

A

10FCD002 — 10FCD003

NOTES:

1. CROSS SECTION IS BASED UPON PARSONS DRAWINGS (DECEMBER 1993) ENTITLED, "SILO 4 WASTE REMOVAL AND TRANSPORTING SYSTEM, CRU4", DWG 94X-5900-A-00485.
2. SILO 4 WAS NEVER USED FOR THE STORAGE OF HAZARDOUS MATERIALS. IT IS CURRENTLY EMPTY. SILO 4 CONSTRUCTION IS VERY SIMILAR TO SILOS 1 AND 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

PRELIMINARY
NOT FOR CONSTRUCTION

REV	DATE	BY	CHK'D	APR'VD	DESCRIPTION/ISSUE
A		WVD			PRELIMINARY DESIGN SUBMITTAL

SPC

DRAWN BY WVD — SIZE
DESIGNED BY KEO — SIZE
CHECKED BY — SIZE
APPROVED BY — SIZE
APPROVED BY — SIZE

000033

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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

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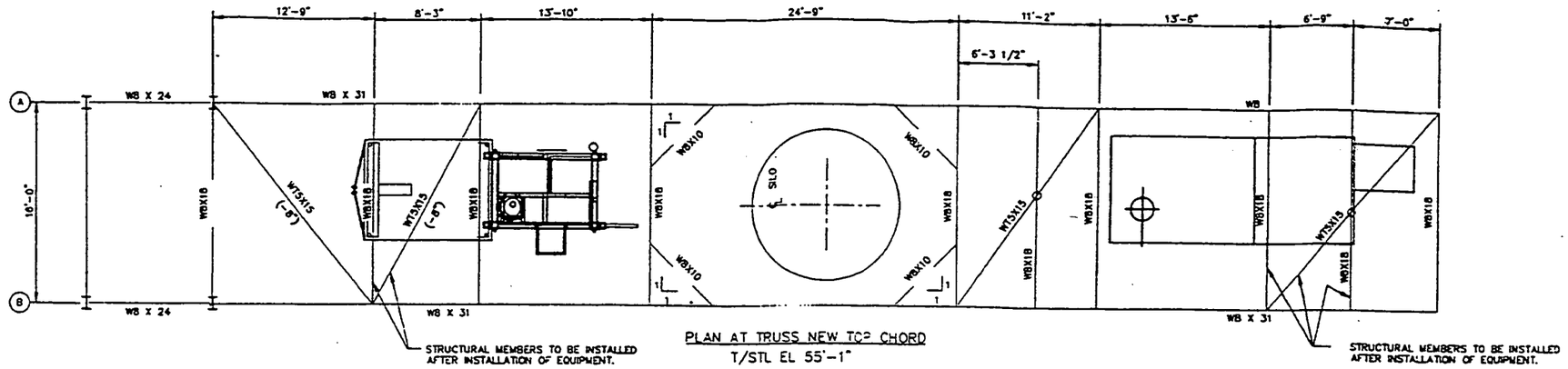
TITLE
FULL-SCALE MOCKUP SYSTEM
SILO 4
CROSS SECTION

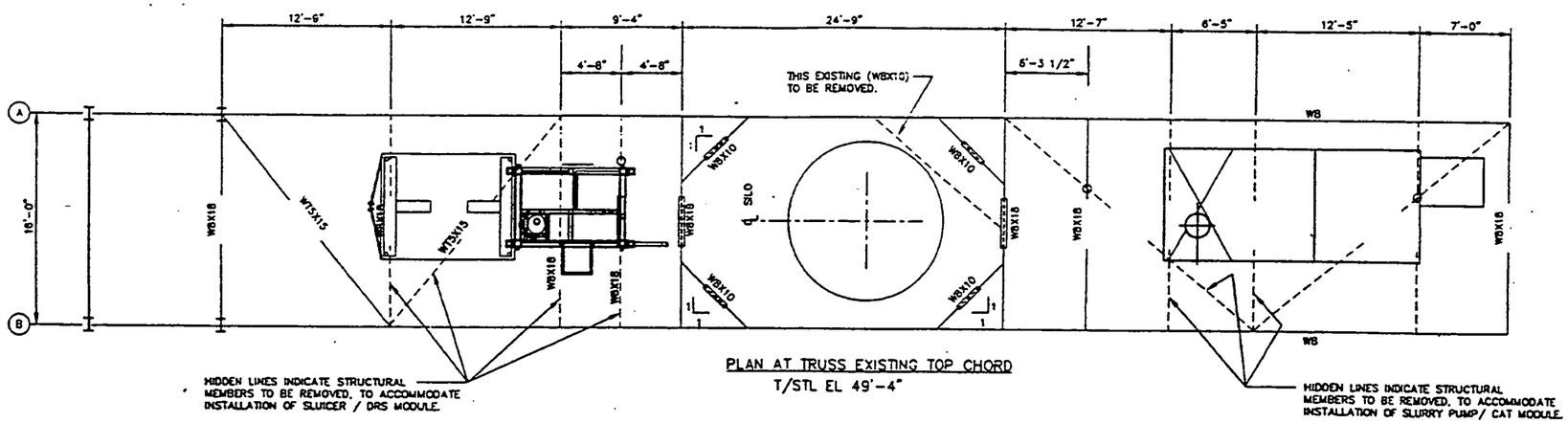
SIZE D — SCALE 1"=10' — DWG NO. 10FCD003 — REV A

FD FNAME: 10FCD003.DWG

2753



PLAN AT TRUSS NEW TOP CHORD
T/STL EL 55'-1"

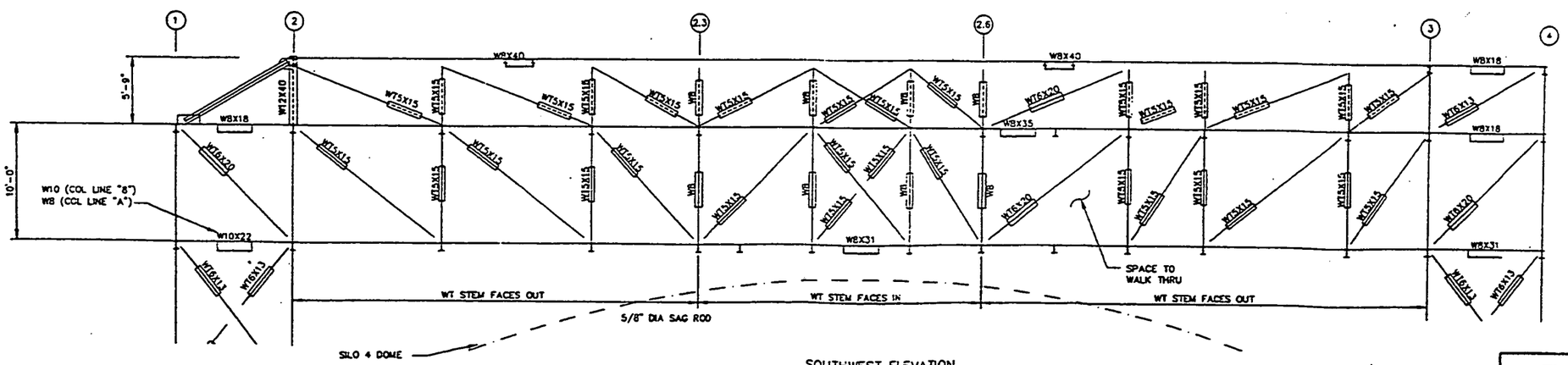


PLAN AT TRUSS EXISTING TOP CHORD
T/STL EL 49'-4"

HIDDEN LINES INDICATE STRUCTURAL MEMBERS TO BE REMOVED, TO ACCOMMODATE INSTALLATION OF SLUICER / DRS MODULE.

NOTES:

1. FOR NOTES SEE DWG. 10FSD001
2. FOR LEGEND SEE DWG 10FSD001



SOUTHWEST ELEVATION
LOOKING NORTHEAST ALONG COL LINE "B"

000034

PRELIMINARY
NOT FOR CONSTRUCTION

REV	DATE	BY	CHK'D	APR'D	DESCRIPTION/ISSUE
A					PRELIMINARY DESIGN SUBMITTAL

DRAWN BY CG DATE
DESIGNED BY RRC DATE
CHECKED BY DATE
APPROVED BY DATE
APPROVED BY DATE

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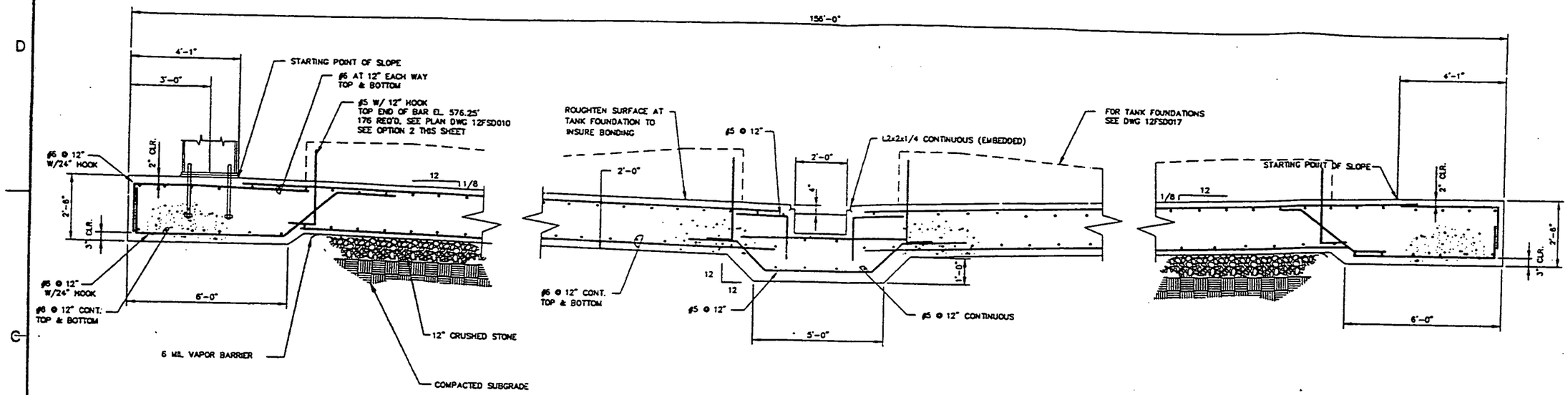
SILOS 1 AND 2 ACCELERATED WASTE RETRIEVAL PROJECT
FERNALD, OHIO
FDF CONTRACT NO. FSC 624

FOSTER WHEELER
FOSTER WHEELER ENVIRONMENTAL CORPORATION

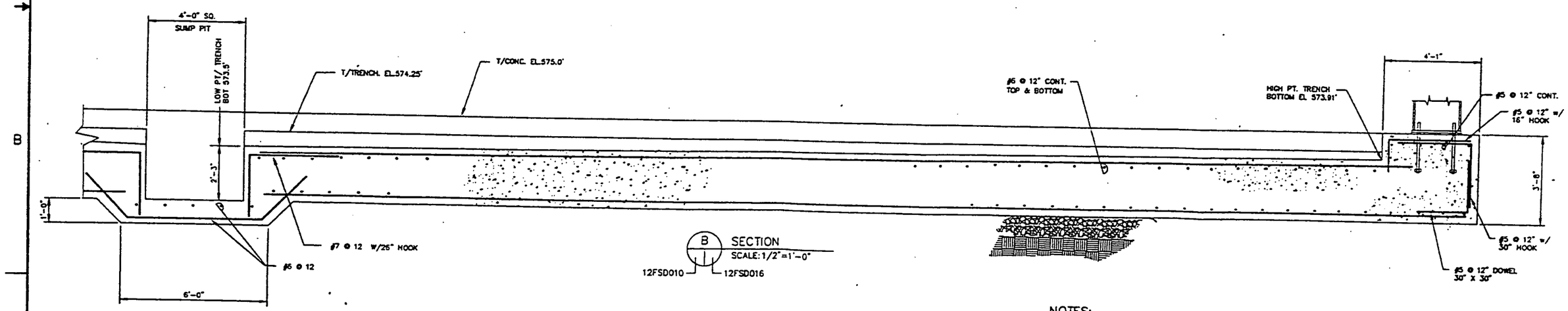
TITLE
FULL-SCALE MOCKUP SYSTEM
SILO 4 BRIDGE STRUCTURE
STEEL MODIFICATIONS

SIZE D | SCALE: 3/16" = 1'-0" | DWG. NO. 10FSD002 | REV A

2753



A SECTION
SCALE: 1/2"=1'-0"
12FSD010 — 12FSD016



B SECTION
SCALE: 1/2"=1'-0"
12FSD010 — 12FSD016

NOTES:

1. FOR GENERAL NOTES SEE DWG 20FSD001
2. NORTH ARROW APPLIES ONLY TO THE ERECTION POSITION OF SILO BRIDGE BEFORE IT IS MOVED TO THE SILO NO.1 OR SILO NO. 2 POSITIONS.

PRELIMINARY
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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
A					PRELIMINARY DESIGN SUBMITTAL

DRAWN BY CG	DATE 10/20/99
DESIGNED BY CRG	DATE 10/20/99
CHECKED BY	DATE
APPROVED BY	DATE
APPROVED BY	DATE

12FSD016 000035

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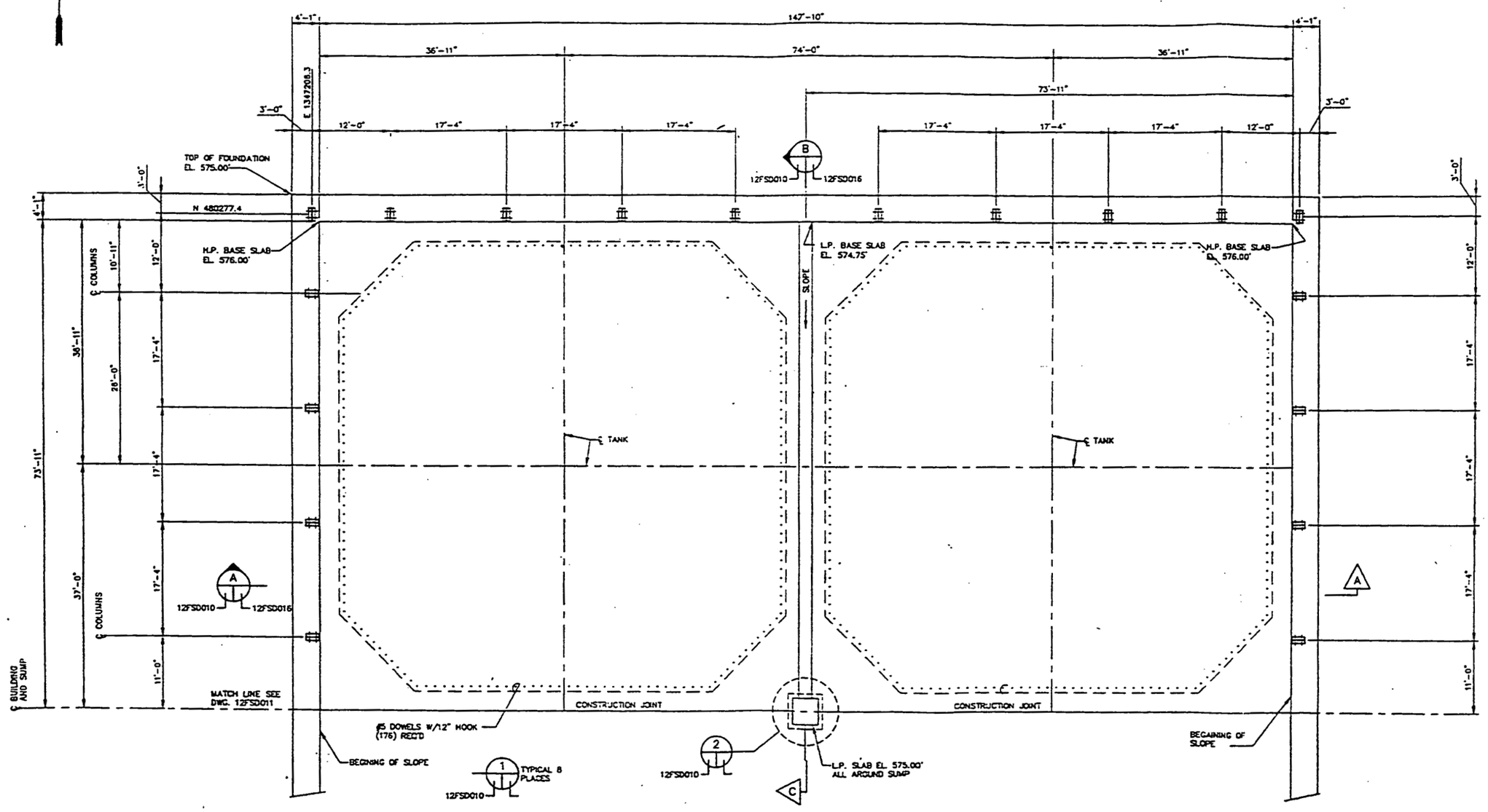
FERNALD ENVIRONMENTAL MANAGEMENT PROJECT
SILOS 1 AND 2 ACCELERATED WASTE RETRIEVAL PROJECT
FERNALD, OHIO
FDF CONTRACT NO. FSC 624.

FOSTER WHEELER
FOSTER WHEELER ENVIRONMENTAL CORPORATION

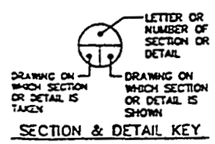
TITLE
TRANSFER TANK AREA SYSTEM
BASE SLAB AND FOUNDATIONS
SECTIONS AND DETAILS

SIZE | SCALE

NOTES:
FOR GENERAL NOTES SEE DWG 20FSD001



FOUNDATION PLAN
TRANSFER TANK BUILDING
SCALE: 1/8" = 1'-0"



SECTION & DETAIL KEY

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A					PRELIMINARY DESIGN SUBMITTAL

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000036
12FSD010

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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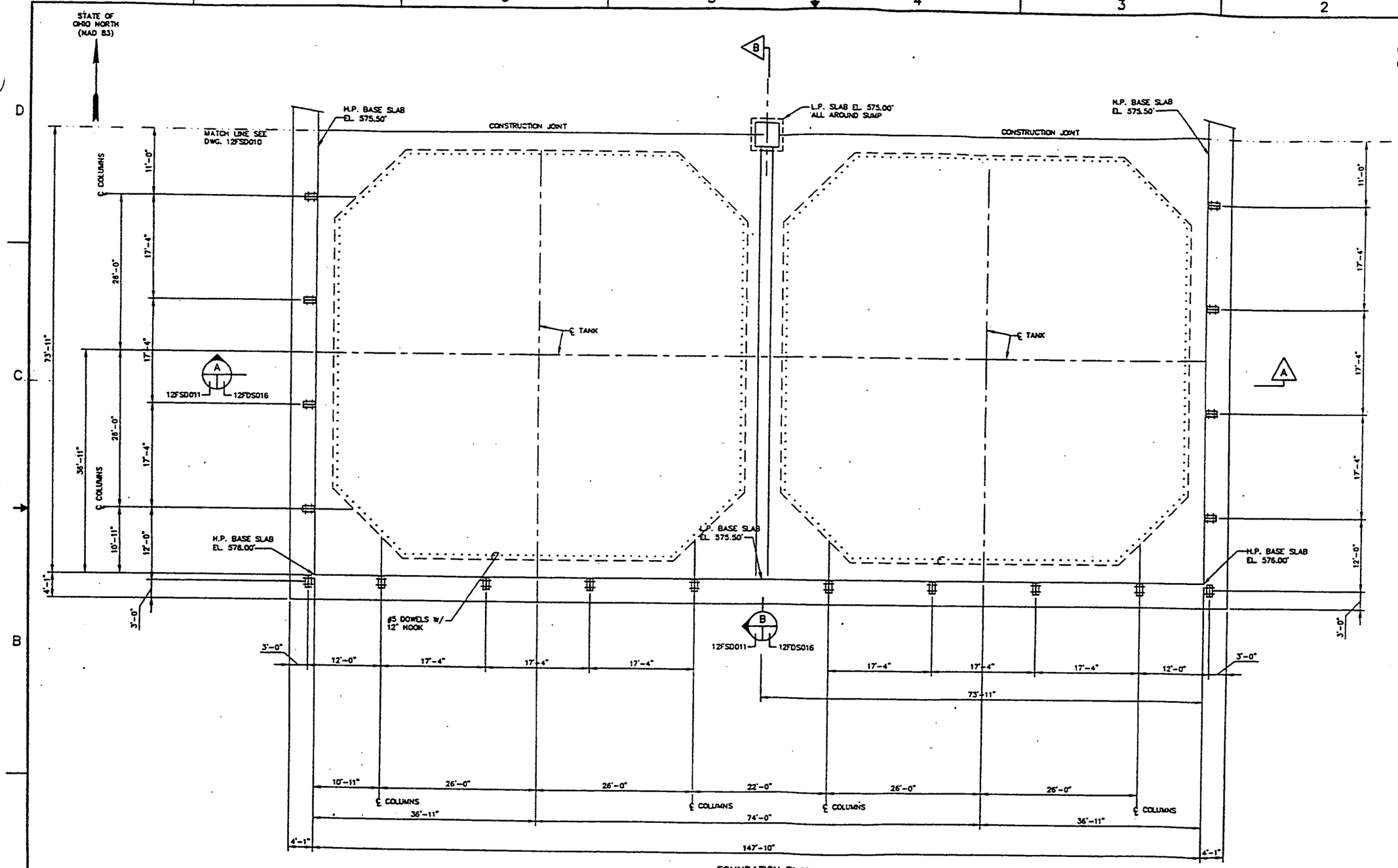
TRANSFER TANK SYSTEM
CONCRETE SLAB – SH. 1

DRAWN BY: RLB
DESIGNED BY: VB

2753

NOTES:
FOR GENERAL NOTES SEE DWG 20FSD001



FOUNDATION PLAN
TRANSFER TANK BUILDING
SCALE: 1/8" = 1'-0"

000037

PRELIMINARY
NOT FOR CONSTRUCTION

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
A					PRELIMINARY DESIGN SUBMITTAL

DRAWN BY RLB DATE
DESIGNED BY VB 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

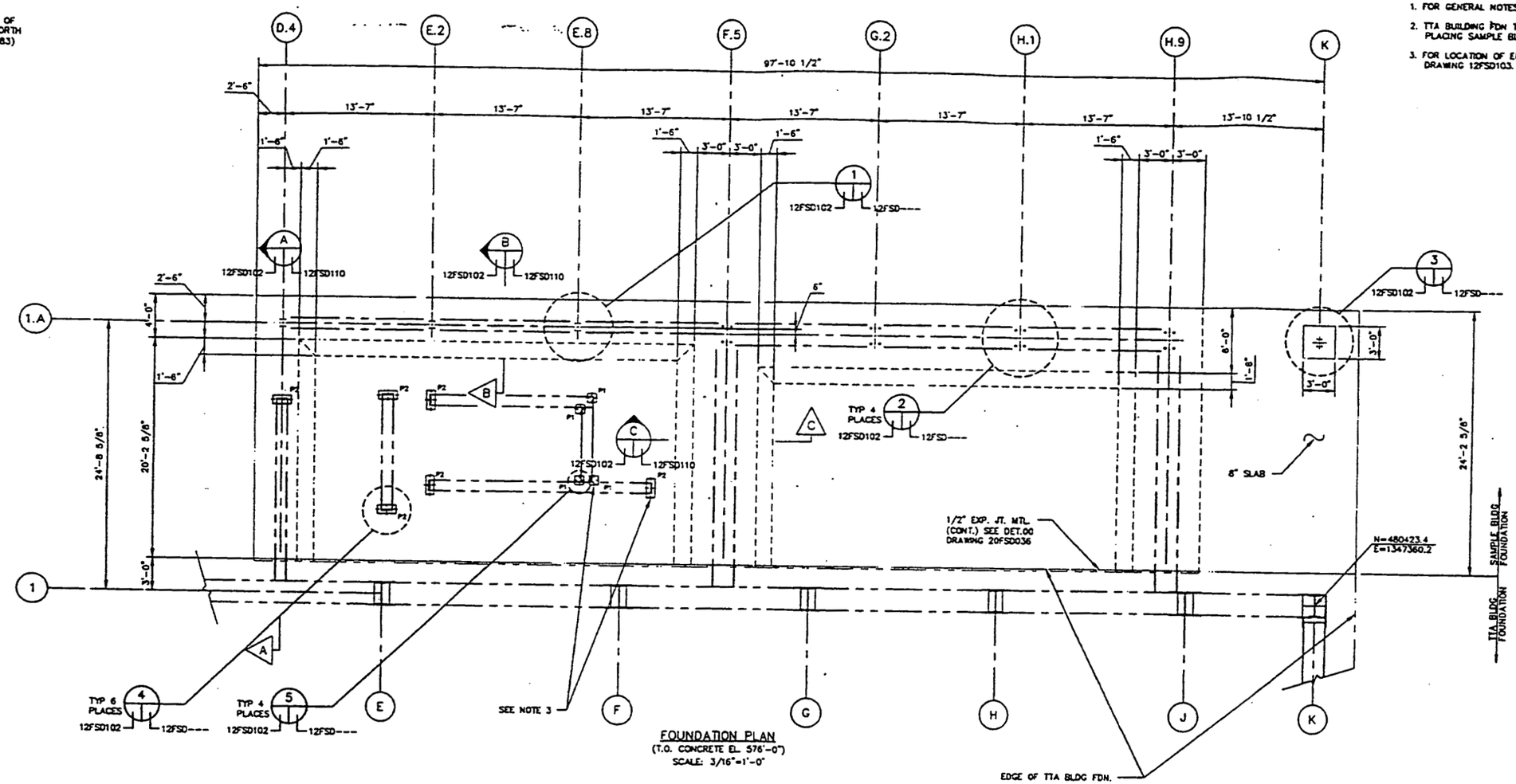
FOSTER WHEELER
FOSTER WHEELER ENVIRONMENTAL CORPORATION

TITLE
TRANSFER TANK SYSTEM
CONCRETE SLAB – SH. 2

SIZE D | SCALE: 1/8" = 1'-0" | DWG. NO. 12FSD011 | REV A

NOTES:

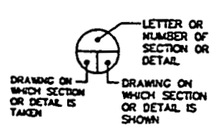
1. FOR GENERAL NOTES SEE DRAWING 12FSD100.
2. TTA BUILDING FDN TO BE PLACED PRIOR TO PLACING SAMPLE BLDG FOUNDATIONS.
3. FOR LOCATION OF EMBEDDED PLATES SEE DRAWING 12FSD103.



FOUNDATION PLAN
(T.O. CONCRETE EL. 576'-0")
SCALE: 3/16"=1'-0"

000038

PRELIMINARY
NOT FOR CONSTRUCTION



SECTION & DETAIL KEY

REV	DATE	BY	CHK'D	APR'VD	DESCRIPTION/ISSUE
A					PRELIMINARY DESIGN SUBMITTAL

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

FOSTER WHEELER
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CHECKED BY
APPROVED BY
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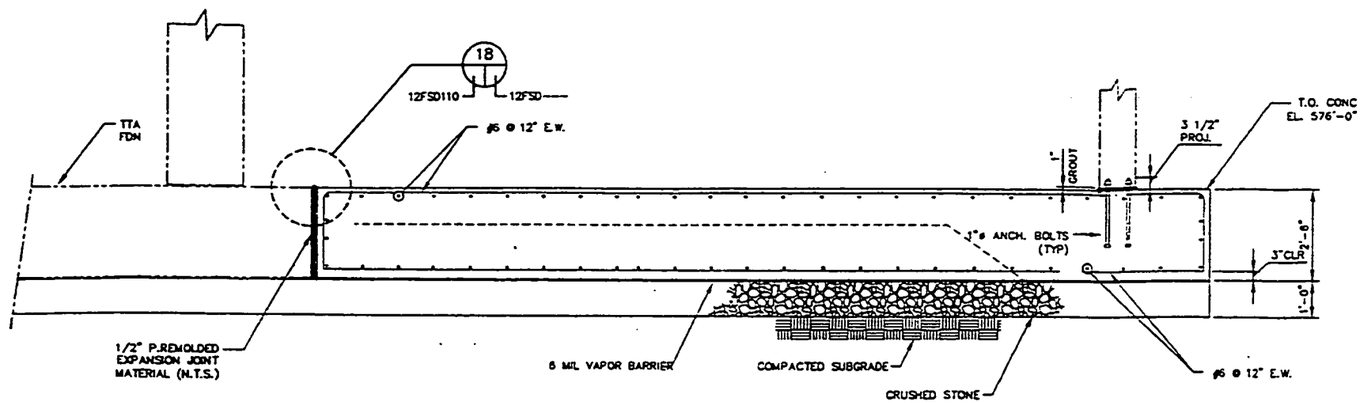
TRANSFER TANK SYSTEM
SAMPLE BUILDING
FOUNDATION PLAN

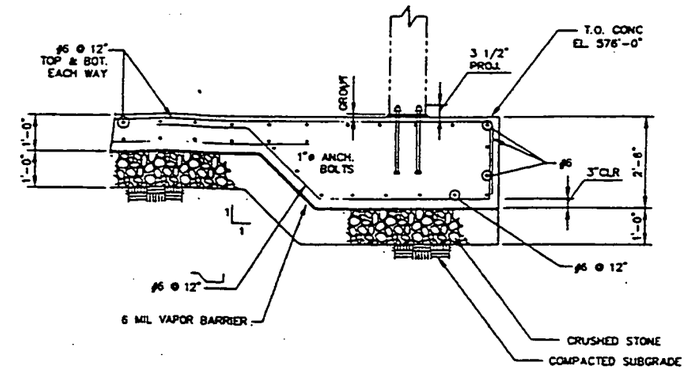
SIZE D | SCALE 3/16" = 1'-0" | DWG. NO. 12FSD102 | REV A

2753

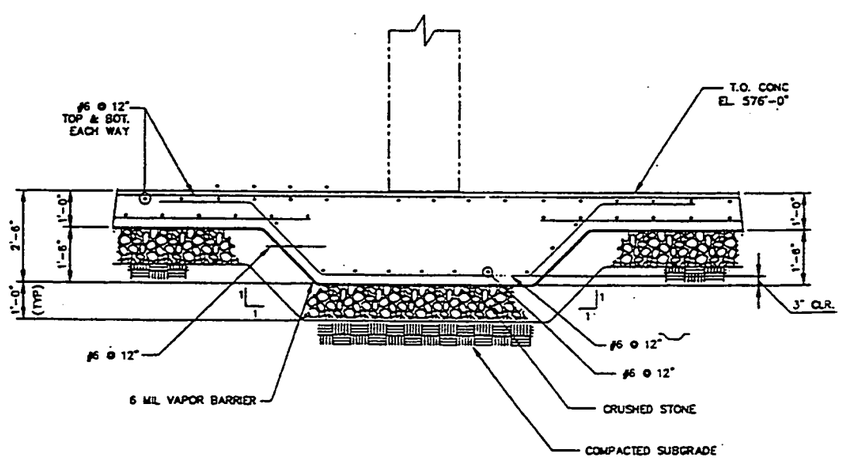
NOTES
1. FOR GENERAL NOTES SEE DRAWING ⊕FSD0001.



A SECTION
SCALE: 1/2"=1'-0"
12FSD102
12FSD103
12FSD110



B SECTION
SCALE: 1/2"=1'-0"
12FSD102
12FSD103
12FSD110



C SECTION
SCALE: 1/2"=1'-0"
12FSD102
12FSD103
12FSD110

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

PRELIMINARY
NOT FOR CONSTRUCTION

REV	DATE	BY	CHK'D	APR'VD	DESCRIPTION/ISSUE
A					PRELIMINARY DESIGN SUBMITTAL

RPE

DRAWN BY RS DATE
DESIGNED BY RS DATE
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APPROVED BY DATE

000039

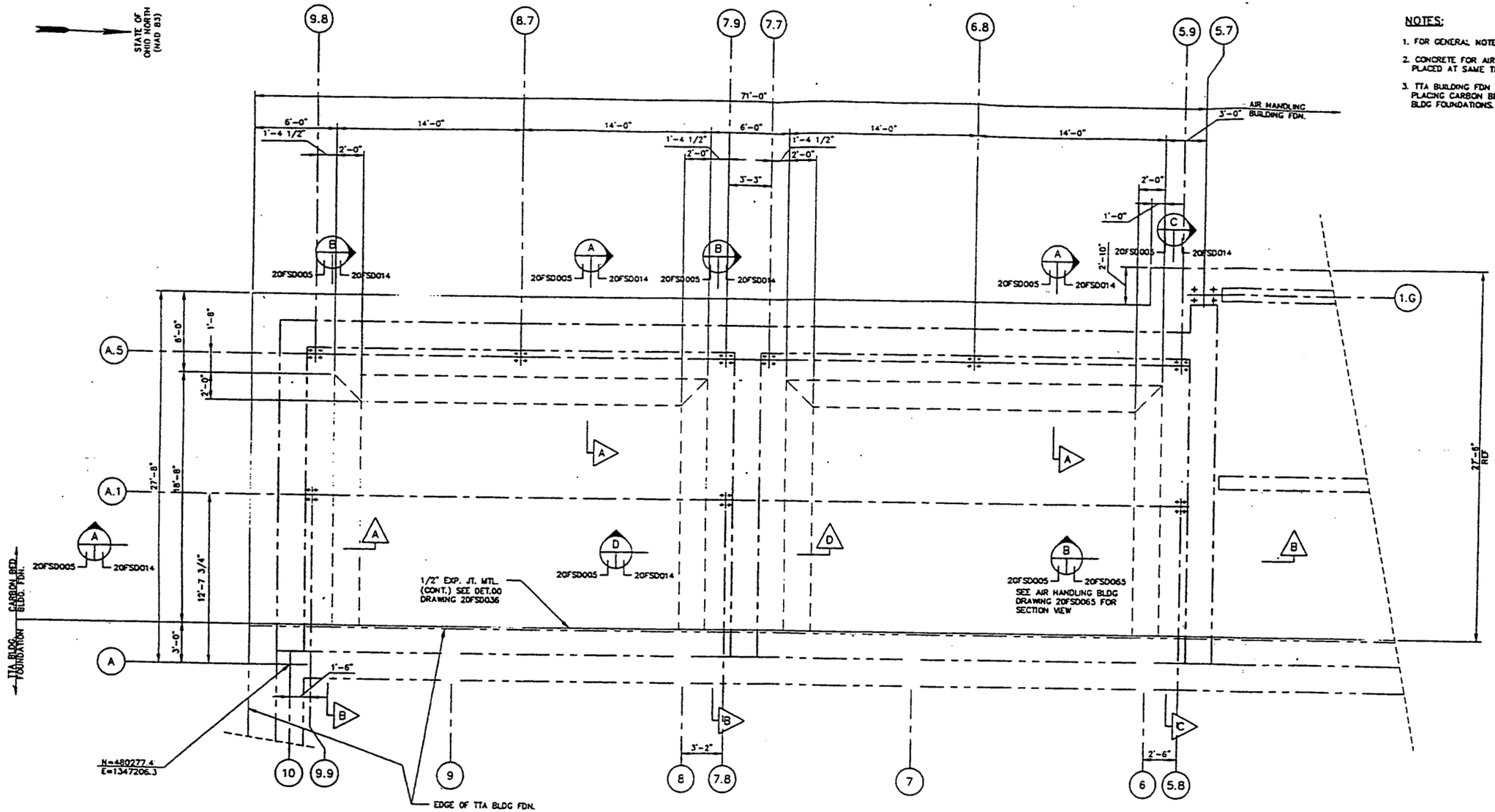
DEPARTMENT OF ENERGY
FERNALD ENVIRONMENTAL MANAGEMENT PROJECT
SILOS 1 AND 2 ACCELERATED WASTE RETRIEVAL PROJECT
FERNALD, OHIO
FDF CONTRACT NO. FSC 624

FOSTER WHEELER
FOSTER WHEELER ENVIRONMENTAL CORPORATION

TITLE
TRANSFER TANK SYSTEM
SAMPLE BUILDING
FOUNDATION SECTION VIEW

SIZE	SCALE:	DWG. NO.	REV
D	1/2"=1'-0"	12FSD110	A

2753



FOUNDATION PLAN
(T.O. CONCRETE EL. 576'-0")
SCALE: 1/4" = 1'-0"

NOTES:

1. FOR GENERAL NOTES SEE DRAWING 20FSD001.
2. CONCRETE FOR AIR HANDLING BUILDING TO BE PLACED AT SAME TIME AS CARBON BED BLDG FDN.
3. TTA BUILDING FDN TO BE PLACED PRIOR TO PLACING CARBON BED BLDG & AIR HANDLING BLDG FOUNDATIONS.

000040

PRELIMINARY
NOT FOR CONSTRUCTION

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	APRV'D	DESCRIPTION/ISSUE
A					PRELIMINARY DESIGN SUBMITTAL

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DESIGNED BY RS DATE
CHECKED BY DATE
APPROVED BY DATE
APPROVED BY DATE

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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

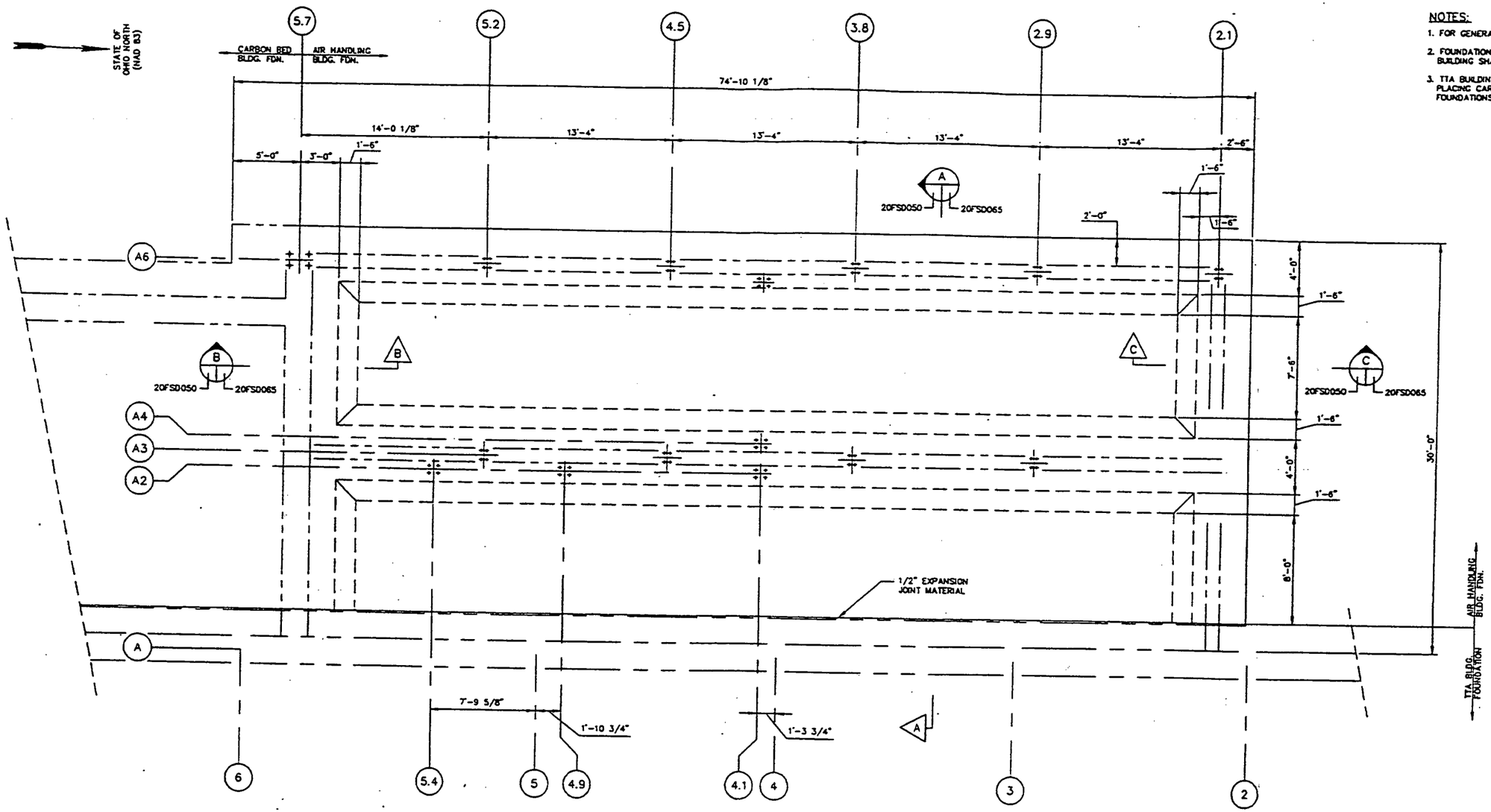
TITLE
RADON CONTROL SYSTEM
CARBON BED BUILDING
FOUNDATION PLAN

SIZE D | SCALE: 1/4"=1'-0" | DWG. NO. 20FSD005 | REV A

2753

NOTES:

1. FOR GENERAL NOTES SEE DRAWING 20FSD001.
2. FOUNDATIONS FOR AIR HANDLING AND CARBON BED BUILDING SHALL BE PLACED AT THE SAME TIME.
3. TTA BUILDING FOUNDATION SHALL BE PLACED PRIOR PLACING CARBON BED AND AIR HANDLING BUILDING FOUNDATIONS.



FOUNDATION PLAN
(T.O. CONCRETE EL. 576'-0")
SCALE: 1/4" = 1'-0"

000041

PRELIMINARY
NOT FOR CONSTRUCTION

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

REV	DATE	BY	CHK'D	APR'VD	DESCRIPTION/ISSUE
A					PRELIMINARY DESIGN SUBMITTAL

DRAWN BY: RS
DESIGNED BY: RS / WIC
CHECKED BY
APPROVED BY
APPROVED BY

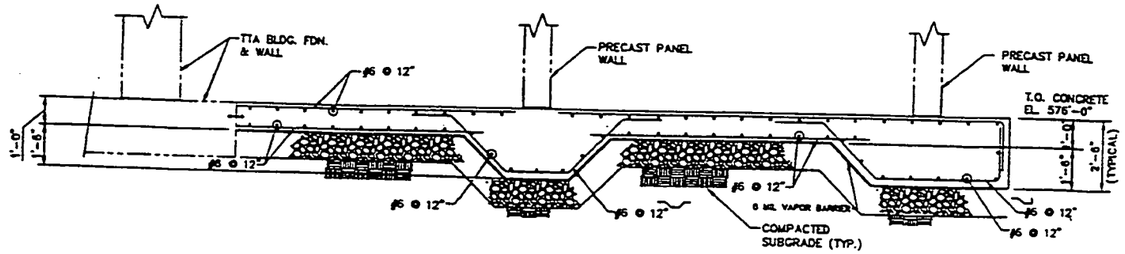
DEPARTMENT OF ENERGY
FERNALD ENVIRONMENTAL MANAGEMENT PROJECT
SILOS 1 AND 2 ACCELERATED WASTE RETRIEVAL PROJECT
FERNALD, OHIO
FDF CONTRACT NO. FSC 624

FOSTER WHEELER
FOSTER WHEELER ENVIRONMENTAL CORPORATION

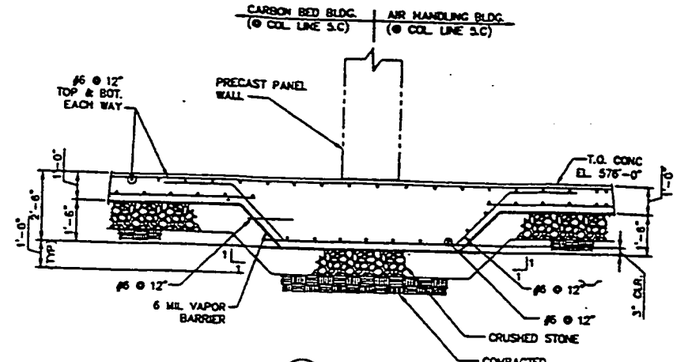
TITLE: RADON CONTROL SYSTEM
AIR HANDLING BUILDING
FOUNDATION PLAN

SIZE: D | SCALE: 1/4"=1'-0" | DWG. NO. 20FSD050 | REV A

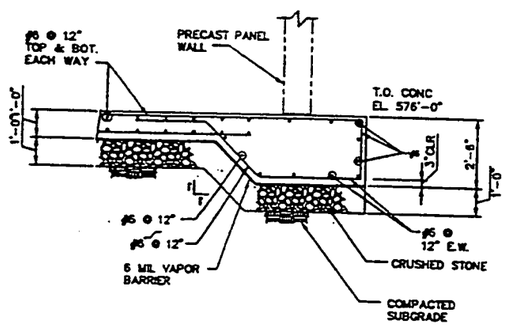
2753



A SECTION
SCALE: 3/8"=1'-0"
20FSD050 — 20FSD065



B SECTION
SCALE: 3/8"=1'-0"
20FSD050 — 20FSD065



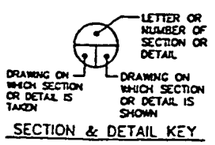
C SECTION
SCALE: 3/8"=1'-0"
20FSD050 — 20FSD065

NOTES:

1. FOR GENERAL CONSTRUCTION NOTES SEE DRAWING 20FSD001.

000042

PRELIMINARY
NOT FOR CONSTRUCTION



SECTION & DETAIL KEY

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A					PRELIMINARY DESIGN SUBMITTAL

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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
RADON CONTROL SYSTEM
AIR HANDLING BUILDING
FOUNDATION SECTION VIEW

SIZE D | SCALE: 3/8"=1'-0" | DWG. NO. 20FSD065 | REV A

FOSTER WHEELER

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ENVIRONMENTAL CONTROL PLAN

DOCUMENT NO.
624-P621-10, Rev. 0

FOR THE

SILOS 1 AND 2 ACCELERATED WASTE RETRIEVAL (AWR) PROJECT

SUBMITTED TO:

FLUOR DANIEL FERNALD (FDF)

CONTRACT NO. FSC 624

September 27, 1999

FOSTER WHEELER ENVIRONMENTAL CORPORATION

ENVIRONMENTAL CONTROL PLAN

Revision 0

Recommended by:

Robert A. Riordan
Foster Wheeler Engineering Manager

9/28/99
Date

Approved by:

Foster Wheeler Project Manager

9/28/99
Date

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2.0 METHODS AND CONTROLS 2
2.1 Air Emissions Control 2
2.2 Dust Control 2
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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
CAA	Clean Air Act
CCB	Change Control Board
CCWW	City of Cincinnati Water Works
CERCLA	Comprehensive Environmental Response, Compensation and Liability Act
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
RCS	Radon Control System
SDWA	Safe Drinking Water Act
SOPs	Standard Operating Procedures
SWMUs	Solid Waste Management Units
SWPPP	Storm Water 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

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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 project 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, storm water, erosion, and secondary waste generation resulting from AWR Project activities at the U.S. Department of Energy (DOE) Fernald Environmental Management Project (FEMP) site.

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 the AWR Project. This ECP describes the design and operational control strategies used for the AWR Project to ensure compliance with these ARARs, as well as the FEMP functional area requirements for environmental protection (EP) and environmental restoration/waste management (EW). Compliance with ARARs is summarized in Section 3.0, and compliance with EP and EW functional area requirements is summarized in Section 4.0.

Overall FEMP site environmental monitoring is performed by Fluor Daniel Fernald (FDF). Data or information collected by Foster Wheeler in performance of the AWR Project environmental control activities, as described herein, are to be made available to FDF for support of the FEMP site environmental monitoring efforts and for assessing compliance with the project ARARs and FEMP functional area requirements. Information is to be provided to FDF from Foster Wheeler via the interfaces described in the Project Management Plan, Document No. 40710-624-P621-01, for the AWR Project.

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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 project activities on the environment. These impacts are mitigated through the use of controls associated with air emissions, dust, wastewater, storm water, erosion, and secondary waste generation.

2.1 Air Emissions Control

Air emissions are controlled for the AWR Project by the Radon Control System (RCS). The RCS system is designed to operate at a negative pressure. Downstream of the carbon beds most of the radon will have been removed so that leakage, if any, will be air suitable for discharge through the stack.

Isokinetic sampling, monitoring, and recording of stack exhaust 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 provided in the horizontal run of duct is located between the high efficiency particulate air (HEPA) filters and the stack. The HEPA filters are designed to remove 99.97% of particles with an aerodynamic diameter of 0.3 microns. A sufficient length of straight duct is provided 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 redundant sampling pumps with automatic switch-over, 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 that flows through the filter paper is directed through a continuous radon monitor that measures the concentration of radon in the stack effluent. Analytical instruments provide for separately distinguishing radon daughters from other alpha and beta emitting radionuclides.

Monitoring data is collected and analyzed by a local computer, then transferred to the AWR Control Room 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. The radon monitor has an alarm setpoint established to maintain radon as low as reasonably achievable (ALARA). 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. More detailed analysis of emissions from material handling and process equipment is described in the Environmental ALARA Report for the AWR Project (Document No. 40710-624-P622-10B).

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 State regulations for restricting emissions of fugitive dust [i.e., Ohio Administrative Code (OAC) 3745-17-08] and the FEMP fugitive dust control requirements. The FEMP requirements include the development of a Fugitive Dust Control Plan for the AWR Project (Document No. 40710-624-P6455-01), which is to be prepared and provided to FDF 30 days prior to construction for compliance review.

The Fugitive Dust Control plan addresses the reasonably available control measures, such as wetting with limited amounts of water or other suitable dust suppression chemicals, that are

necessary to prevent loose soil particles from becoming airborne in moderate to heavy winds, and thereby creating fugitive dust problems at the site. The potential for fugitive dust is the highest during soil removal, staging, stockpiling, and transporting activities associated with the AWR Project. Demolition activities can also generate fugitive dust.

The Fugitive Dust Control Plan is to be prepared in accordance with the FEMP Requirements Manual (RM) – 0047. As described in RM-0047, Project personnel shall proactively suppress dust releases from field activities by applying Best Available Technology (BAT) dust control (such as the application of water, dust suppression agents, or other appropriate methods approved by appropriate FDF personnel) and/or implementing BAT work practices at the beginning and during field activities.

BAT dust controls/work practices to be implemented must be approved by the Ohio Environmental Protection Agency (OEPA). Some BAT dust control/work practice strategies include:

- Apply water or other dust suppression or crusting agents in sufficient quantity to prevent dust generation but limited so that the application does not result in migration of the agent beyond work area boundaries, ponding, or disruption of other portions of work.
- As soon as fugitive dust emissions are visible, BAT dust controls and/or work practices must be implemented or increased.
- If the standard is exceeded, all mechanical dust-generating activities in the observed area must cease immediately. An increase of BAT dust controls and/or work practices needs to be implemented to bring the fugitive emissions to, at a minimum, below the standard during dust-generating activities (including wind erosion).

Some BAT dust controls and/or work practices include:

- Application of dust suppression materials approved by appropriate FDF personnel such as: water, resin, or equivalent combination of surfactant or crusting agents.
- Minimize the amount of unnecessary traffic in and around field activities.
- Limit speed of vehicles or equipment to 15 miles per hour or less during operation.
- Reduce rate of excavation.
- Minimize the height of drop during loading and unloading.
- Change method of excavation/transport (e.g., from a front-end loader dumping into a truck to a self-propelled pan).
- Apply appropriate dust suppression agents such as water or surfactants, to the materials being transported by truck load beds to ensure the transported materials will not become airborne. Cover truck load beds when transported materials are still likely to become airborne.

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- Apply dust suppression agents such as surfactants or crusting agents to storage piles.

- Wheel wash at the point of origin prior to entering any defined paved or unpaved roadways.

- Remove clods, clumps, tracks, or visible deposits of soils, mud or other materials that could readily become visible fugitive emissions from paved and treated unpaved roadways/parking areas. Apply appropriate dust control measures to suppress the generation of visible dust that may result from the removal process.

- Apply appropriate dust control mechanism such as water or surfactants to the materials being transported by truck load beds to ensure the transported materials will not become airborne. Cover truck load beds when transported materials are still likely to become airborne.

In addition, AWR Project field activities should be continuously 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 similarly. All waste retrieval/transfer system components are provided with secondary 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 for up to 40 days for radon decay, and returned to the waste retrieval/transfer system for reuse or pumped to 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 2-1) prior to pumping. This characterization ensures that the wastewater does not exceed the parameters specified in Exhibit 2-1.

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 2-1: Wastewater Acceptance Criteria for AWR Liquid Discharge to AWWT

METALS PARAMETER	DISCHARGE LIMIT (kg/day)	(lb/day)	RADINUCLIDE 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)	0.03	0.06	Thorium-232 (^{232}Th)	50
			Uranium-234 (^{234}U)	5 ppm
			Uranium-235/236 ($^{235/236}$U)	
			Uranium-238 (^{238}U)	
MAXIMUM FLOW				5 gpm (7,200 gpd)
TOTAL SUSPENDED SOLIDS (TSS)				1,000 ppm

2.4 Storm Water Control

The existing site-wide Storm Water Pollution Prevention Plan (RM-0039, Rev. 0) describes the current management of storm water within the project site. The AWR Project area is contained within two drainage watersheds. The following paragraphs describe the existing and proposed storm water control measures at the AWR Project site to ensure the segregation of uncontaminated and contaminated storm water.

Existing—A perimeter channel was constructed around the four silos in the early 1990s, as part of the Comprehensive Environmental Response, Compensation and Liability Act (CERCLA) Removal Action No. 2 (Waste Pit Area Runoff Control). The perimeter channel consists of a combination of small rectangular concrete channels, concrete curb, grates, and pipes. The perimeter channel leads to a concrete sump with a capacity of 350,000 gallons, which is located 1,000 feet west-northwest of the silos. This concrete sump also receives drainage from the waste pits to the north. A 12-in. main leads from the concrete sump into the Bio-Surge Lagoon, which is the first treatment step in the process of handling potentially contaminated storm water throughout the FEMP site.

Areas not surrounded by the perimeter channel drain to the south into an unnamed tributary of Paddy's Run, which is National Pollutant Discharge Elimination System (NPDES) outlet STRM 4005, and drains a total of approximately 78 acres. A few culverts cross the southern perimeter road and discharge storm water to the unnamed tributary.

Proposed—AWR Project activities do not change or move the drainage divides for both watersheds. Erosion and siltation in the concrete channels is to be prevented. Erosion mats and silt fences are to be used extensively with efficient grading and loading emphasized. The perimeter road functions as the outer limit of operations. Some culverts, foundation drains, and

french drains are necessary to control storm water for the TTA process area. Rainfall should not directly contact the TTA process area since it is equipped with a roof and gutter system to preclude such contact, and therefore, contaminated storm water is not anticipated.

The following sections describe the best management practices (BMPs) to be used during the construction and operation of the AWR Project Facilities. These BMPs include employee training, good housekeeping procedures, spill prevention and control countermeasures, and inspections and recordkeeping, as described in the following paragraphs. In addition, storm water and erosion controls are shown on the Storm Water Drainage Plan, Document No. 40710-624-P622-17, for the AWR Project. These controls are based on standards specified in the Ohio Department of Natural Resources (ODNR) Rainwater and Land Development Plan.

2.4.1 Employee Training

Construction personnel receive appropriate environmental and safety training based 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.

2.4.2 Good Housekeeping Procedures

Good housekeeping procedures are to be observed by personnel at the project site. Paper trash and refuse are to be managed on a daily basis. No unpermitted wastewater of any type are to be discharged on-site. Trucks hauling material are not to be overfilled and loads are to be covered to minimize dust generation. Loose debris are to be contained within the vehicles to prevent littering of highways and haul roads.

Fueling operations are to be conducted so that fuel/oil releases are minimized and cleaned up. Appropriate precautions are to be taken to minimize discharge of fuel, oil, lubricants, grease, and other hydrocarbons. Vehicles are to be maintained in good working order so that the leakage of automotive fluids is minimized.

2.4.3 Spill Prevention and Control Countermeasures

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.

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Heavy equipment and mechanical equipment are to be maintained in good repair so as to minimize the release of engine, transmission, or other oils. 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 soon 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 storm water drainage channels. Spills are to be reported immediately to FDF. 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 readily available on-site for use, as appropriate, without risking personnel safety.

2.4.4 Inspections and Recordkeeping

The Construction Manager, or designee, is to conduct weekly site inspections of the site during construction activities to confirm compliance with BMPs. 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 poor fueling practices;
- Evidence of leaking tanks or equipment; and
- Storm water channels inspected for oil sheen, debris, siltation, or other disturbance.

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

2.5 Erosion Control

Erosion controls are placed during the construction phase to minimize soil movement from excavated areas. These controls are to be installed as early as possible during the construction

phase. All site work must conform to the applicable CFC drawings and the construction specifications, which incorporates ODNR Rainwater and Land Development standards. Deviations from the design require prior authorization from FDF.

Several actions to lessen the environmental impact due to erosion are to be taken during AWR Project construction and operation:

- Every effort is to be made to keep disturbed areas to a minimum;
- [illegible] areas with vegetation;
- Silt fences are to be placed at the bottom of disturbed slopes;
- Culvert entrances and exits are to be protected with riprap or geofabric;
- Seeding and mulching will follow construction as soon an practical;
- Overseeding or reseeding (including fertilizing when necessary) are to be performed as necessary until vegetation is established;
- 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 the weekly site inspection are to be completed in a timely manner.

2.6 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. This waste is to be categorized as either hazardous (or mixed) secondary waste or as clean secondary waste.

The management of secondary waste, both hazardous and clean, is described in detail in the Waste Handling Work Plan (Document No. 40710-624-ACR007-01) for the AWR Project. General criteria for waste container sizes, materials, and shapes are contained in FEMP Procedure EW-0006, Management of Above-Grade Debris, Revision 5 (July 15, 1998), FDF. This document also contains maximum container weight limits and a list of materials prohibited from delivery to the FEMP On-Site Disposal Facility. 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, Document No. 40710-624-P621-11, for the AWR Project.

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3.0 ARAR COMPLIANCE SUMMARY

The following exhibits provide compliance matrices for the ARARs or To Be Considered (TBC) requirements associated with the AWR Project. These matrices provide an assessment and general description of the compliance strategy for each ARAR or TBC requirement, along with references to specific AWR Project documents that more fully describe the related compliance strategy and methods.

Exhibit 3-1 contains ARARs and TBC requirements that are defined as being chemical-specific to the AWR Project. Exhibit 3-2 contains ARARs and TBC requirements that are defined as being location-specific to the AWR Project. And finally, Exhibit 3-3 contains ARARs and TBC requirements that are defined as being action-specific to the AWR Project.

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Exhibit 3-1: Chemical-Specific Applicable or Relevant And Appropriate Requirements (ARARs) and To Be Considered (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 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 Radon Control System (RCS) and the Heating, Ventilating, and Air Conditioning (HVAC) Systems of the Functional Requirements Document (FRD), Document No. 40710-624-P622-02. Also, see the AWR Project Environmental ALARA Report, Document No. 40710-624-P622-10B, and Section 2.1, Air Emissions Control, of this ECP for additional information.
Radon-222 Emissions	40 CFR 61, Subpart Q. No source at a DOE facility shall emit more than 20 pCi/m^2-s of radon-222 as an average for the entire source during periods of storage and disposal.	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. A radon monitor is installed in the horizontal run of duct between the HEPA filters and the stack, and will draw air samples from the stack, with results fed back to the AWR Control Room for readout and recording. Continuous radon monitoring is provided. Emissions are to be controlled to result in a maximum annual average fence line impact of 0.5 pCi/L.	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.

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Exhibit 3-1: Chemical-Specific Applicable or Relevant And Appropriate Requirements (ARARs) and To Be Considered (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. Water sent to the AWWT is first sampled, analyzed, and radiologically surveyed to meet the AWWT 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 Applicable or Relevant And Appropriate Requirements (\RARs) and To Be Considered (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.	Se sections on the Storm Water Sy tem and the Wastewater System of he FRD, as well as Sections 2.3 an 2.4 of this ECP for additional inf rmation.
*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.	FDF, 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.	Se sections on the Storm Water Sy tem and the Wastewater System of he FRD, as well as Sections 2.3 an 2.4 of this ECP for additional inf rmation.

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Exhibit 3-2: Location-Specific Applicable or Relevant and Appropriate Requirements (ARARs) and To Be Considered (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. 40710-624-P8B21-01, which is to be submitted to FDF 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 Applicable or Relevant and Appropriate Requirements (A ARs) and To Be Considered (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.	Th CFC drawings and specifications re ect mitigation of NEPA concerns if id ntified.
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.	S the CFC drawings and co istruction specifications regarding d ineation of work areas and related m igation measures to implement d ing 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.	S section on the Storm Water S stem of the FRD, as well as S tion 2.4 of this ECP for additional in rmation.

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Exhibit 3-3: Action-Specific Applicable or Relevant and Appropriate Requirements (ARARs) and To Be Considered (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 Applicable or Relevant and Appropriate Requirements (ARARs) and To Be Considered (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 ARARA 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. 40710-624-ACR007-01, for additional information.

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Exhibit 3-3: Action-Specific Applicable or Relevant and Appropriate Requirements (ARARs) and To Be Considered (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 Applicable or Relevant and Appropriate Requirements (A ARs) and To Be Considered (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.	S the Waste Handling Work Plan fo the AWR Project for additional in rmation.

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Exhibit 3-3: Action-Specific Applicable or Relevant and Appropriate Requirements (ARARs) and To Be Considered (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. 40710-624-P621-09), which is to be submitted 60 days prior to construction, and other various AWR Project operating procedures.

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Exhibit 3-3: Action-Specific Applicable or Relevant and Appropriate Requirements (ARARs) and To Be Considered (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 is to be submitted 60 days prior to construction, and other various AWR Project operating procedures.

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Exhibit 3-3: Action-Specific Applicable or Relevant and Appropriate Requirements (ARARs) and To Be Considered (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 is to be submitted 60 days prior to construction, and other various AWR Project operating procedures.

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Exhibit 3-3: Action-Specific Applicable or Relevant and Appropriate Requirements (A ARs) and To Be Considered (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.	D contamination wastes are d cribed in the AWR Project Waste H ndling Work Plan.

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Exhibit 3-3: Action-Specific Applicable or Relevant and Appropriate Requirements (ARARs) and To Be Considered (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 Applicable or Relevant and Appropriate Requirements (ARARs) and To Be Considered (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. 40710-624-P622-20) for the AWR Project.

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Exhibit 3-3: Action-Specific Applicable or Relevant and Appropriate Requirements (ARARs) and To Be Considered (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 Applicable or Relevant and Appropriate Requirements (ARARs) and To Be Considered (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 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.

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Exhibit 3-3: Action-Specific Applicable or Relevant and Appropriate Requirements (ARARs) and To Be Considered (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.

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Exhibit 3-3: Action-Specific Applicable or Relevant and Appropriate Requirements (A ARs) and To Be Considered (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.	S: the ALARA Analysis for the A R Project.

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Exhibit 3-3: Action-Specific Applicable or Relevant and Appropriate Requirements (ARARs) and To Be Considered (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 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. 40710-624-P6455-01, for additional information.

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Exhibit 3-3: Action-Specific Applicable or Relevant and Appropriate Requirements (ARARs) and To Be Considered (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 ARAR Report and Section 2.1, Air Emissions Control, of this ECP for additional information.

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Exhibit 3-3: Action-Specific Applicable or Relevant and Appropriate Requirements (ARARs) and To Be Considered (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. 40710-624-P6315-02.
Permit to Install (PTI)	OAC 3745-31-05 (A)(3). The Director of Ohio Environmental Protection Agency (EPA) 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. Ohio EPA 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 Ohio EPA 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 Ohio EPA with a mechanism to require the evaluation of toxic air contaminants from new sources. The Ohio EPA 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 Ohio EPA 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.

4.0 FUNCTIONAL AREA REQUIREMENTS COMPLIANCE SUMMARY

This section summarizes the design and operational control strategy related to the AWR Project to ensure compliance with the appropriate FEMP functional area requirements. The FEMP functional areas are listed in Section 4.1. Two of the functional areas (EP and EW) are within the primary scope of this ECP, and are addressed in Sections 4.2 and 4.3. Most of the functional area requirements are previously addressed in the ARAR Compliance Summary, Section 3.0.

4.1 Description of Functional Areas

Project work at the FEMP site is organized into 24 functional areas. Each functional area consists of related activities or processes with similar environmental, health, or safety concerns. In addition to the ARARs and TBC requirements listed in Section 3.0, the project design must meet requirements that are defined by a functional area. Exhibit 4-1 contains the complete list of the 24 functional areas, and identifies the 15 functional areas that interface directly with ED (Engineering Design), as specified in the AWR Technical Requirements Document (TRD).

Exhibit 4-1: FEMP Functional Area Descriptions

Number	Interfaces with ED	Functional Area (Acronym and Name)	
1	Yes	CM	Configuration Management
2	Yes	ED	Engineering Design
3	No	EM	Emergency Preparedness and Management
4	No	RD	Research and Development and Experimental Activities
5	Yes	EP	Environmental Protection *
6	Yes	FP	Fire Protection
7	No	MT	Maintenance
8	Yes	MS	Management Systems
9	Yes	NS	Nuclear and System Safety
10	Yes	SH	Occupational Safety and Health
11	Yes	OP	Operations
12	No	PT	Packaging and Transportation
13	Yes	QA	Quality Assurance
14	Yes	RP	Radiological Protection
15	Yes	SE	Security
16	Yes	TR	Training and Qualification
17	Yes	EW	Environmental Restoration and Waste Management **
18	Yes	CT	Construction
19	Yes	AC	Acquisition
20	No	HR	Human Resources and Employee Relations
21	No	PC	Project Control
22	No	PM	Property Management
23	No	PI	Public Involvement
24	No	FM	Financial Management

Notes:
* EP functional area requirements are described in Exhibit 4-2.
** EW functional area requirements are described in Exhibit 4-3.

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4.2 Compliance Summary for EP Functional Area

Exhibit 4-2 identifies the AWR Project requirements for the Environmental Protection (EP) functional area and matches the EP requirement to the associated ARAR or TBC requirement. The EP functional area requirements (listed in Appendix B of the TRD) are adequately addressed within the ARAR compliance matrices of Section 3.0, except for four instances, which are addressed in Exhibit 4-4.

The EP functional area is concerned with various environmental laws and regulations that protect the land, water, air, biota, flora, and other components of the natural environment. The EP requirements are not specifically defined in terms of engineering activities, but are focused on allowable human interactions with the natural environment.

Exhibit 4-2: AWR Project Requirements Summary for EP Functional Area

Regulation	EP Functional Area Requirement	Matching ARAR/TBC Requirement
National Environmental Policy Act (NEPA)	10 CFR 1022; Compliance Floodplain/Wetlands Environmental Review	Exhibit 3-2
	10 CFR 1021.2; NEPA Implementation	Exhibit 3-3
Federal Water Pollution Control Act (FWPCA) and Clean Water Act (CWA)	40 CFR 122.26 (OAC 3745-38); Discharge of Storm Water Runoff	Exhibit 3-3
	40 CFR 125.100 and 125.104; Best Management Practices	Exhibit 3-3
	33 CFR 330, Appendix A; USACE Nationwide Permits and Conditions	Exhibit 3-3
	OAC 3745-31; Permits to Install New Sources of Pollution	Exhibit 3-3
	OAC 3745-1-04; Protection of Surface Waters	Exhibit 3-1
Safe Drinking Water Act (SDWA)	OAC 3745-95; Backflow Prevention and Cross-Connection Control	Exhibit 4-4
	OAC 3745-9-10; Ohio Water Well Standards	Exhibit 3-3
Superfund, Emergency Planning, and Community Right-to-Know Programs	40 CFR 302; Designation, Reportable Quantities, and Notification	Exhibit 4-4

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Exhibit 4-2: AWR Project Requirements Summary for EP Functional Area 2753

Regulation	EP Functional Area Requirement	Matching ARAR/TBC Requirement
Clean Air Act (CAA)	40 CFR 61, Subpart H; National Emission Standards for Emission of Radionuclides Other Than Radon from Department of Energy Facilities	Exhibit 3-1
	40 CFR 61, Subpart Q; National Emission Standards for Radon Emission from Department of Energy Facilities	Exhibit 3-1
	OAC 3745-15-07 and ORC 3704.01 thru.05; Prohibitions of Violations and Air Pollution Nuisance	Exhibit 3-3
	OAC 3745-17-07; Control of Visible Particulate Emissions from Stationary Sources	Exhibit 3-3
	OAC 3745-17-08; Control of Fugitive Dust	Exhibit 3-3
	OAC 3745-31-05(A); Permits to Install New Sources of Pollution, Criteria for Decision	Exhibit 3-3
	OAC 3745-31-35-02(C); Criteria for Air Permits to Operate	Exhibit 4-4
Radiation Protection of the Public and the Environment	DOE Order 5400.5, Chapter II.1.a; Requirements for Radiation Protection of the Public and the Environment (Radiation Does Limit, All Pathways)	Exhibit 3-3
	DOE Order 5400.5, Chapter III; Derived Concentration Guides for Radionuclides in Air and in Water	Exhibit 4-4

4.3 Compliance Summary for EW Functional Area

Exhibit 4-3 addresses the AWR Project requirements for the Environmental Restoration and Waste Management (EW) functional area. The EW functional area requirements (listed in Appendix B of the TRD) are adequately addressed within the ARAR compliance matrices of Section 3.0, except for one instance, which is addressed in Exhibit 4-4.

The EW functional area is focused on the performance of many different projects at the FEMP project site to safely decontaminate and commission the various DOE facilities. Remediated areas are generally restored to natural conditions whenever feasible. The treatment, storage, disposal, transportation, and management of hazardous wastes will continue for many years.

The Comprehensive Environmental Response, Compensation and Liability Act (CERCLA, or Superfund) is the statutory driver for remediation at the FEMP, and requires the establishment of project-specific ARARs for all portions of remediation. Since CERCLA itself offers no specific

ARARs for the AWR Project, it is not included in Exhibit 4-3. In addition, the Amended Consent Agreement, September 20, 1991 (as modified by Dispute Resolution 1997) for the FEMP site establishes milestones and schedules, but does not specify ARARs, and therefore, it is also not included in Exhibit 4-3.

Exhibit 4-3 AWR Project Requirements Summary for EW Functional Area

Regulation	EW Functional Area Requirement	Matching ARAR/TBC Requirement
Resource Conservation and Recovery Act (RCRA)	40 CFR 262 and OAC 3745-52; Standards Applicable to Generators of Hazardous Waste	Exhibit 3-3
	40 CFR 263 and OAC 3745-53; Transportation Requirements	Exhibit 3-3
	40 CFR 264 and OAC 3745-54; Standards for Treatment, Storage, and Disposal Facilities • Subpart B (General Facility Standards); • Subpart C (Preparedness and Prevention); • Subpart D (Contingency Plan); • Subpart I (Container Storage); • Subpart J (Tank Systems); • Subpart S (Corrective Action Management Units); and • Part 264.1101 (Containment Buildings).	Exhibit 3-3
	OAC 3745-400; Ohio Construction Demolition Debris Rule	Exhibit 4-4
DOE Orders	DOE Order 5400.5, Chapter IV.6.b; Control of Residual Radioactive Material (Radon) During Interim Storage	Exhibit 3-1

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Exhibit 4-4: EP and EW Functional Requirements Summary (not otherwise referenced to ARs or TBCs)

Category / Description	Functional Requirement	Requirement Assessment	Compliance Strategy	Cross Reference Index
EP / Backflow Prevention and Cross-Connection Control	ORC 6109; and OAC 3745-95.	The SDWA establishes national standards for regulation of drinking water. The FEMP now has a public drinking water system due to the connection with City of Cincinnati Water Works (CCWW) in 1996. Therefore, backflow protection is required to protect CCWW from process water entering.	Fresh water is supplied to the process from the Fresh Water Surge Tank, which is designed to prevent backflow into the FEMP site fresh water supply. This design also meets the criteria for air gap separation per OAC 3745-95. Check valves are also designed into the system at the point of connection.	See description in the section on the AWR Utility Systems of the FRD regarding domestic water system for the AWR Project.
EP / Designation, Reportable Quantities, and Notification	40 CFR 302.	This regulation designates under CERCLA those hazardous substances with reportable quantities and their respective notification requirements if released to the environment. This regulation also applies to the hazardous substances designated under the CWA.	Secondary containment is provided for the various systems involved in the processing of the silo wastes. Leak detection and pump shutdown interlocks are provided on secondary containment transfer lines. Process tank fill levels are remotely monitored and alarmed. Redundancies are provided for key pieces of equipment. All unplanned releases are evaluated for notification and reporting in accordance with 40 CFR 302 requirements. 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 TTA and the AWR Control Systems of the FRD. Also, a Contingency Plan and Emergency Response is to be prepared for the AWR Project and provided to FDF for review 60 days prior to start of construction.

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Exhibit 4-4: EP and EW Functional Requirements Summary (not otherwise referenced to ARARs or TBCs)

Category / Description	Functional Requirement	Requirement Assessment	Compliance Strategy	Cross Reference Index
EP / Criteria for Air Permits to Operate	OAC 3745-35-02 (C).	No permit to operate will be granted by the State of Ohio until the applicant demonstrates: • The source is in compliance with applicable air pollution control laws; • The source is equipped with instrumentation and sensing devices to monitor and record emission data (if required by the Ohio EPA Director); and • Performance tests were made in accordance with Ohio EPA methods (if required by the Ohio EPA Director).	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 ARARs relating to radionuclide emissions). Foster Wheeler is to conduct performance tests of air pollution control systems to demonstrate compliance for Ohio EPA 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.
EP / Derived Concentration Guides for Radionuclides in Air and in Water	DOE Order 5400.5, Chapter III, Derived Concentration Guides (DCGs) for Air and Water.	The DCG values listed in this chapter are provided as reference values for conducting radiological environmental protection programs at operational DOE facilities and sites.	As previously described, any wastewater resulting from the AWR Project is treated to meet the AWWT WAC, and therefore, achieves compliance with the DCG values for water and the parameters of the NPDES permit for the FEMP site. Also, the RCS controls air emissions to levels such that compliance with the air immersion DCGs are achieved.	See Sections 2.1 and 2.3 of the ECP for additional information.
EW / Ohio Construction Demolition Debris Rule	OAC 3745-400.	Construction and demolition debris shall be disposed of only by the methods listed in OAC 3745-400-04, such as landfilling or other methods approved by the licensing authority.	Construction and demolition debris is staged and stored according to approved AWR SOPs. Temporary management of these materials is performed per the Waste Handling Work Plan. FDF is to provide final disposal of such materials.	See the AWR Project Waste Handling Work Plan for additional information.

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FOSTER WHEELER

FOSTER WHEELER ENVIRONMENTAL CORPORATION

STORMWATER DRAINAGE PLAN

DOCUMENT NO.
624-P622-17, Rev. C

FOR THE

SILOS 1 AND 2 ACCELERATED WASTE RETRIEVAL (AWR) PROJECT

SUBMITTED TO:
FLUOR DANIEL FERNALD (FDF)
CONTRACT NO. FSC 624

January 13, 2000

Stormwater Drainage Plan

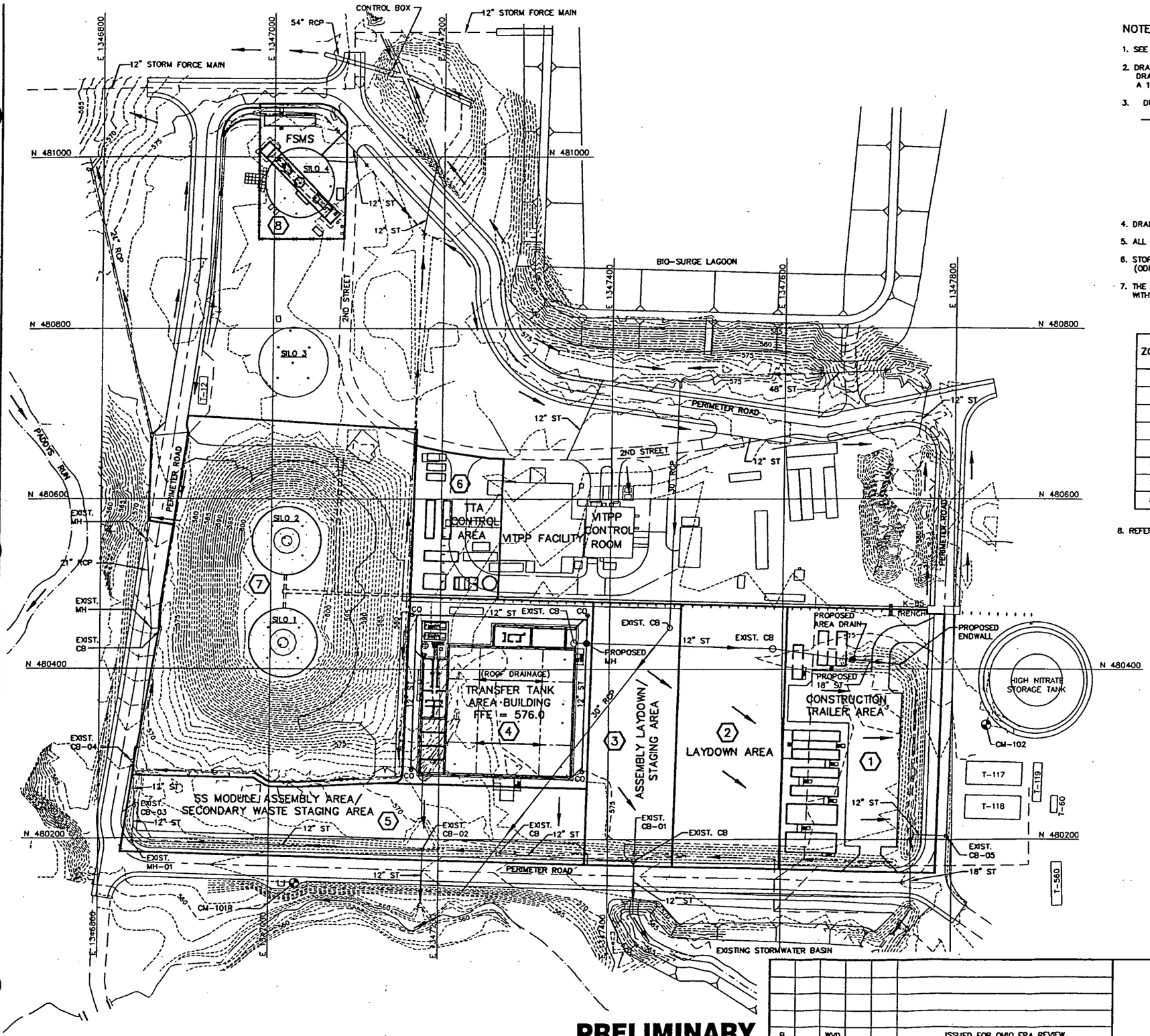
DOCUMENT NO. 624-P622-17

DRAWING NUMBER	DRAWING TITLE	REVISION
66FCD001	STORM WATER SYSTEM OVERALL DRAINAGE PLAN	B
66FCD002	STORM WATER SYSTEM SWRS-DRAINAGE PLAN PHASE 1	A
66FCD003	STORM WATER SYSTEM TRAILER AREA - DRAINAGE PLAN	A
66FCD004	STORM WATER SYSTEM FSMS-DRAINAGE PLAN	A
66FCD006	STORM WATER SYSTEM MISC. DETAILS SHEET 1	B

CALCULATION NUMBER	TITLE	REVISION
CA-FSC624-FC-001	STORMWATER DRAINAGE	0

[ ] A - Conforms to the Subcontract Requirements
[ ] B - Minor Comment - Incorporate and Resubmit
[ ] C - Revise and Resubmit
Sig:_____ Date:_____

000085



PRELIMINARY
NOT FOR CONSTRUCTION

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 CONCTRTE SUMP CONTAINS A 12" DIA FORCE MAIN TO THE BIO-SURGE LAGOON.
3.

DRAINAGE AREA	DESCRIPTION OF DRAINAGE AREA	OUTLET
1	GRASS FIELD	EXISTING STORMWATER BASIN AT 18"ø OUTLET
2	GRASS FIELD	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 FROM CB-02
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	0.51	7.27	14.0 CFS
2	37,978	0.40	1.88	11.0 CFS
3	31,405	0.50	1.94	11.0 CFS
4	47,539	0.78	0.89	11.0 CFS
5	48,287	0.50	3.00	11.0 CFS
6	17,616	0.57	1.23	11.0 CFS
7	123,437	0.69	12.89	53.2
8	16,287	0.56	1.12	53.2

8. REFERENCE CALCULATION NO. CA-FSC624-FC-001.

STORMWATER LEGEND:

- (1) DRAINAGE AREA
- DRAINAGE AREA BOUNDARY
- FLOW DIRECTION
- CO PROPOSED CLEANOUT
- ● PROPOSED MANHOLE
- PROPOSED ENDWALL

STATE OF OHIO NORTH (NAD 83)

60 0 60 120
SCALE IN FEET

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

REV	DATE	BY	CHK'D	APR'VD	DESCRIPTION/ISSUE
B		WVD			ISSUED FOR OHIO EPA REVIEW
A		WVD			PRELIMINARY DESIGN SUBMITTAL

RPE

DRAWN BY WVD DATE
DESIGNED BY KEO DATE
CHECKED BY DATE
APPROVED BY DATE
APPROVED BY DATE

SIZE D | SCALE: 1"=60' | DWG. NO. 66FCD001 | REV B

FILENAME: 66FCD001

XREF DRAWINGS: 50-EXIST.DWG 60-PROP.DWG

2753

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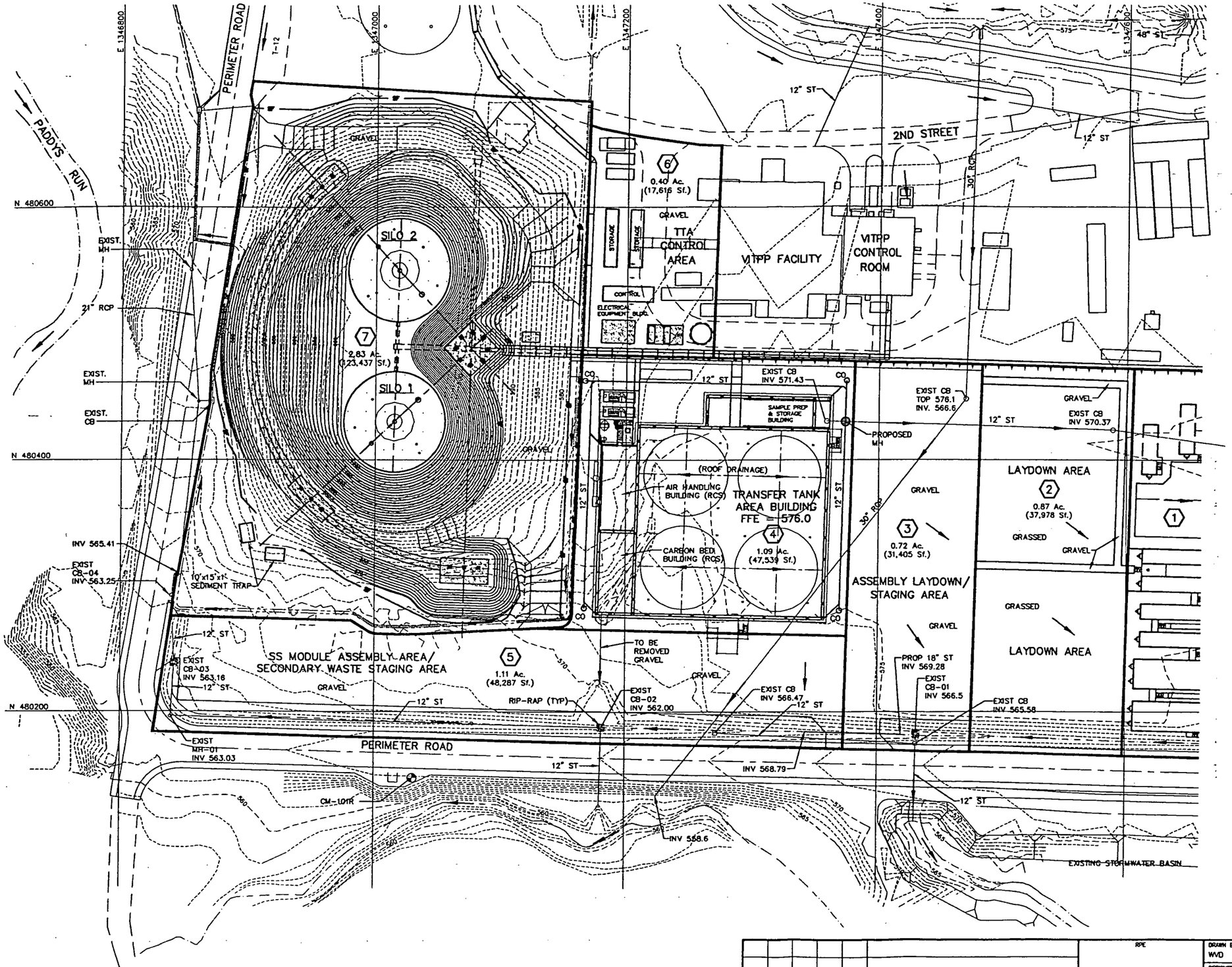

NOTES:

1. SEE DRAWING 05FCD011 FOR GENERAL NOTES AND LEGEND.
2. SILT FENCE TO BE INSTALLED AT THE BOTTOM OF ALL DISTURBED SLOPES.
3. CULVERT ENTRANCES AND EXITS TO BE PROTECTED BY RIP-RAP AND GEO FABRIC.
4. AREAS DISTURBED BY EXCAVATION ACTIVITIES ARE TO BE SEEDED AND MULCHED AS SOON AS PRACTICAL.
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. EROSION CONTROL MEASURES ARE TO BE INSPECTED WEEKLY AND WITHIN 24 HOURS OF A 0.5 INCH RAINFALL.
8. REMEDIATION OF PROBLEMS IDENTIFIED IN THE INSPECTION ARE TO BE COMPLETED IN A TIMELY MANNER.
9. AWR PROJECT ACTIVITIES DO NOT SIGNIFICANTLY ALTER EXISTING DRAINAGE PATTERNS.
10. THE TTA PROCESS AREA ROOF DRAINAGE WILL BE DIRECTED TO THE EXISTING 12" STORM DRAIN SYSTEM AT THE NORTHEAST SECTION OF THE BUILDING.
11. EROSION AND SILTATION INTO THE CONCRETE CHANNEL IS TO BE PREVENTED.

STORMWATER LEGEND:

- DRAINAGE AREA
- DRAINAGE AREA BOUNDARY
- FLOW DIRECTION
- PROPOSED CLEANOUT
- PROPOSED MANHOLE

STATE OF OHIO NORTH (NAD 83)

SECTION & DETAIL KEY

SCALE IN FEET

000087

REV	DATE	BY	CHK'D	APR'VD	DESCRIPTION/ISSUE
A		WVD			ISSUED FOR OHIO EPA REVIEW

RPE

DRAWN BY WVD DATE
DESIGNED BY MSH 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
STORM WATER SYSTEM
SWRS – DRAINAGE PLAN
PHASE 1

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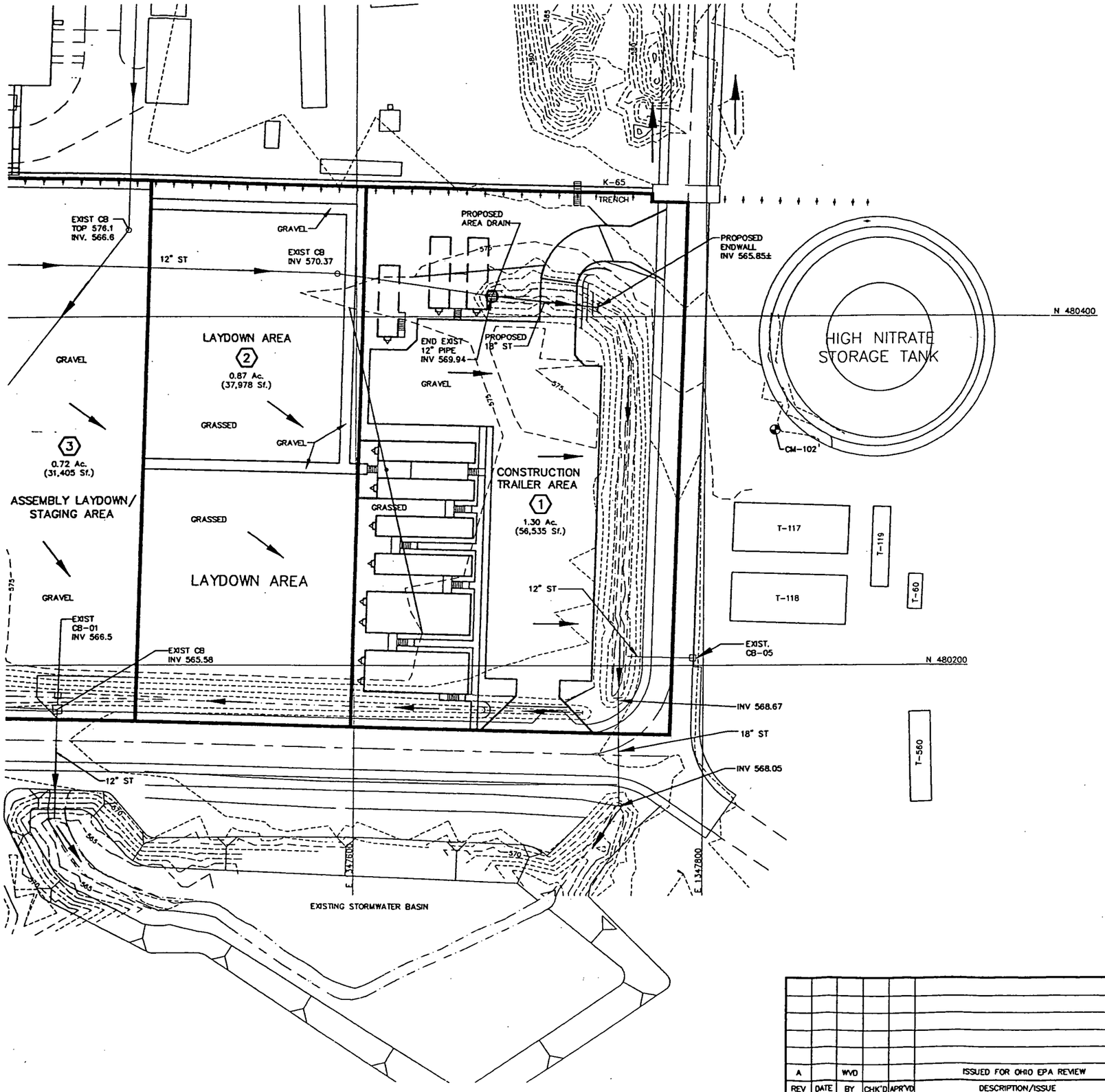

NOTES:

1. SEE DRAWING 05FCD011 FOR GENERAL NOTES AND LEGEND.
2. SILT FENCE TO BE INSTALLED AT THE BOTTOM OF ALL DISTURBED SLOPES.
3. CULVERT ENTRANCES AND EXITS TO BE PROTECTED BY RIP-RAP AND GEO FABRIC.
4. AREAS DISTURBED BY EXCAVATION ACTIVITIES ARE TO BE SEEDED AND MULCHED AS SOON AS PRACTICAL.
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. EROSION CONTROL MEASURES ARE TO BE INSPECTED WEEKLY AND WITHIN 24 HOURS OF A 0.5 INCH RAINFALL.
8. REMEDIATION OF PROBLEMS IDENTIFIED IN THE INSPECTION ARE TO BE COMPLETED IN A TIMELY MANNER.
9. AWR PROJECT ACTIVITIES DO NOT SIGNIFICANTLY ALTER EXISTING DRAINAGE PATTERNS.

2753

STORMWATER LEGEND:

- (1) DRAINAGE AREA
- DRAINAGE AREA BOUNDARY
- FLOW DIRECTION
- PROPOSED MANHOLE
- PROPOSED ENDWALL

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

000088

30 0 30 60

SCALE IN FEET

REV	DATE	BY	CHK'D	APR'VD	DESCRIPTION/ISSUE
A		WVD			ISSUED FOR OHIO EPA REVIEW

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DESIGNED BY MSH	DATE	
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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
STORM WATER SYSTEM
TRAILER AREA – DRAINAGE PLAN

SIZE	SCALE:	DWG. NO.	REV
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FILENAME: 66FCD00

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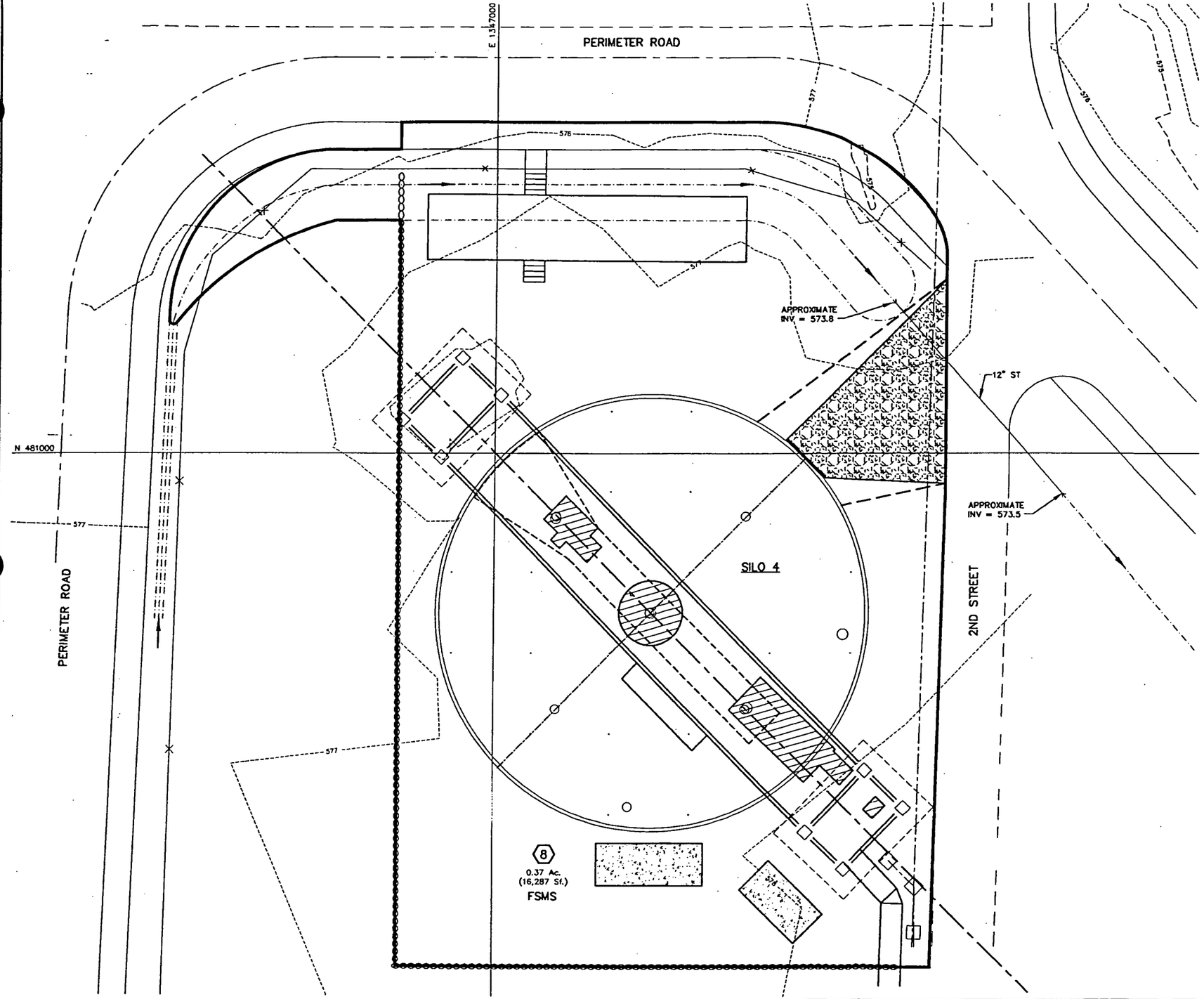


NOTES:

1. SEE DRAWING 05FCD011 FOR GENERAL NOTES AND LEGEND.
2. CONTROL TRAILER WILL BE INSTALLED AFTER MODIFICATIONS TO SILO 4 SUPERSTRUCTURE HAVE BEEN MADE AND THE EMMA UNIT HAS BEEN INSTALLED.
3. GRAVEL ENTRANCE WILL BE INSTALLED AFTER MODIFICATIONS TO SILO 4 SUPERSTRUCTURE HAVE BEEN MADE AND THE EMMA UNIT HAS BEEN INSTALLED.
4. SEE DRAWINGS 10FSD001 THROUGH 10FSD005 FOR SUPERSTRUCTURE DEMOLITION AND MODIFICATIONS.
5. SILT FENCE TO BE INSTALLED AT THE BOTTOM OF ALL DISTURBED SLOPES.
6. CULVERT ENTRANCES AND EXITS TO BE PROTECTED BY RIP-RAP AND GEO FABRIC.
7. AREAS DISTURBED BY EXCAVATION ACTIVITIES ARE TO BE SEEDED AND MULCHED AS SOON AS PRACTICAL.
8. OVERSEEDING AND RESEEDING ARE TO BE PERFORMED AS NECESSARY UNTIL VEGETATION IS ESTABLISHED.
9. SILT IS TO BE REMOVED FROM DIVERSION DITCHES AND SILT FENCE INSTALLED AS REQUIRED BY THE SPECIFICATIONS AND AT THE END OF CONSTRUCTION.
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 IN A TIMELY MANNER.
12. AWR PROJECT ACTIVITIES DO NOT SIGNIFICANTLY ALTER EXISTING DRAINAGE PATTERNS.
14. THE TTA PROCESS AREA ROOF DRAINAGE WILL BE DIRECTED TO THE EXISTING 12" STORM DRAIN SYSTEM AT THE NORTHEAST SECTION OF THE BUILDING.
15. EROSION AND SILTATION INTO THE CONCRETE CHANNEL IS TO BE PREVENTED.

2753

STORMWATER LEGEND:

- (1) DRAINAGE AREA BOUNDARY
- DRAINAGE DIVIDE
- FLOW DIRECTION

STATE OF OHIO NORTH (NAD 83)

000089

10 0 10 20

SCALE IN FEET

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

PRELIMINARY
NOT FOR CONSTRUCTION

REV	DATE	BY	CHK'D	APR'VD	DESCRIPTION/ISSUE
A		WVD			ISSUED FOR OHIO EPA REVIEW

RPE

DRAWN BY WVD	DATE	
DESIGNED BY MSH	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
STORM WATER SYSTEM
FSMS – DRAINAGE PLAN

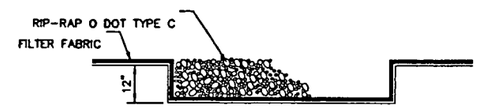
SIZE	SCALE:	DWG. NO.	REV
D	1"=10'	66FCD004	A

FILENAME: 66FCD004.D

NOTES:

2753

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. THE CONSTRUCTION MGR. 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, REV. 0.



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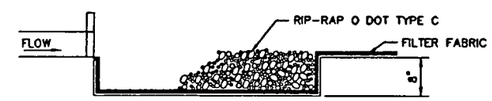
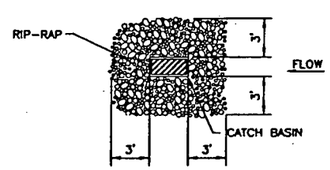


CATCH BASIN IS TO BE PROTECTED FROM SEDIMENTATION BEFORE BIT PAVING IS INSTALLED.



CATCH BASIN PROTECTION
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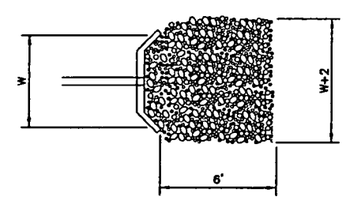

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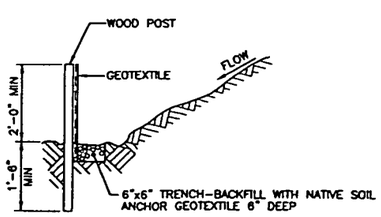
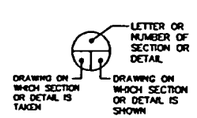
NOT TO SCALE



SILT FENCE DETAIL
NOT TO SCALE



SECTION & DETAIL KEY

PRELIMINARY
NOT FOR CONSTRUCTION

REV	DATE	BY	CHK'D	APR'VD	DESCRIPTION/ISSUE
B		WVD			ISSUED FOR OHIO EPA REVIEW
A		WVD			PRELIMINARY DESIGN SUBMITTAL

RPE

DRAWN BY WVD	DATE	
DESIGNED BY KEO	DATE	
CHECKED BY	DATE	
APPROVED BY	DATE	
APPROVED BY	DATE	

000090

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	A

FILENAME: 66FCD006

--2753

FOSTER WHEELER

FOSTER WHEELER ENVIRONMENTAL CORPORATION

KEY CALCULATIONS

DOCUMENT NO.
624-P622-28, Rev. C

FOR THE

SILOS 1 AND 2 ACCELERATED WASTE RETRIEVAL (AWR) PROJECT

SUBMITTED TO:
FLUOR DANIEL FERNALD (FDF)
CONTRACT NO. FSC 624

January 14, 2000

Silos 1 & 2 AWR
Structural Calculations

CALCULATION NO.	DESCRIPTION
CA-FSC624-FS-001	Geotechnical Design Parameters
CA-FSC624-FS-002	New Access Opening in Wall of Silo 4
CA-FSC624-FS-003	New Dome Openings, Silos 1,2, & 4
CA-FSC624-FS-004	SWRS Support Structure
CA-FSC624-FS-005	Silo 4 Super Structure
CA-FSC624-FS-006	TTA

Silos 1 & 2 AWR
Mechanical Process Calculations

CALCULATION NO.	DESCRIPTION
CA-FSC624-FM-001	RCS Performance
CA-FSC624-FM-002	TTA Tank Sizing Analysis

Silos 1 & 2 AWR
Radiation Protection Calculations

CALCULATION NO.	DESCRIPTION
CA-FSC624-FR-001	Carbon Beds Shielding
CA-FSC624-FR-002	Pivoting Bridge Shielding
CA-FSC624-FR-003	TTA Shielding
CA-FSC624-FR-004	Roughing Filters Shielding
CA-FSC624-FR-005	Condensate Storage Shielding
CA-FSC624-FR-006	Sample Storage Shielding

Silos 1 & 2 AWR
Civil Calculations

CALCULATION NO.	DESCRIPTION
CA-FSC624-FC-001	Stormwater Drainage

ATTACHMENT 1

FOSTER WHEELER ENVIRONMENTAL CORPORATION
CALCULATION COVER SHEET

Sheet 1 of 6

PROJECT FDF Silos 1&2 AUR SUBJECT Stormwater Drainage

CLIENT Fluor Daniel Fernald

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

NO OF SHEETS 6 + 19 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 1/13/00	
0	Attach. A	M. Hughes MSH 1/13/00	V. Bhatt 1/18/00	

PROJECT: Fernald Silos 1 and 2 AWR									SUBJECT: Stormwater Drainage		
Revision	0										Sheet 2 of 6
By / Date	MSN	1/13/00									Project No: 2122.0308
Ch / Date	LGY	1/13/00									Calc: CA-FSC624-FC-001

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Item	Sheet No.
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METHODOLOGY	3
ASSUMPTIONS	3
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CALCULATIONS	5
CONCLUSIONS	6
ATTACHMENT A	A1 to A19

Criteria:

The purpose of this calculation is to analyze existing and proposed stormwater drainagefor 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 .

4. Capacity calculations are based on 2 headwaters at discharge culverts located in the perimeter trenches.

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:

1. Hydraulic Design of Highway Culverts, FHWA Hydraulic Design Series No. 5, Federal Highway Administration, September 1985.

this section is 41.7 cfs. The capacity of the 21" dia. culvert pipe draining the rest of the concrete perimeter ditch is 11.5 cfs. The total stormwater outlet capacity for Area 7 is 53.2 cfs. Areas 6 and 8 are subject to minimal grading and construction activities which will not alter the existing SWS drainage for these areas. 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.

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 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 and 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" st pipe and then through the proposed 18" pipe into the detention basin at the southeast portion of the Site. Although the post-development runoff is greater in each of the five areas, diversion of the roof drainage through the existing storm drain to the perimeter ditch to the east actually reduces the stormwater runoff into the perimeter ditch to the south from 8.19 cfs to 7.71 cfs. A 12" culvert pipe at two headwaters is capable of 5.5 cfs of flow. 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 except Area 2 is 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. Further soil and erosion control measures will be deployed as noted on the Stormwater Drainage Plan Drawings. Proposed modifications to the existing SWS are also shown on the Drawings and are made to facilitate existing drainage paths on the site.

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 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 1/7/00 SHEET 2 OF 7

CHKD. BY [illegible] DATE 1/13/00 OFS NO. DEPT. NO.

CLIENT

PROJECT AWR CALC # CA-FSC624-FC-001

SUBJECT existing storm water runoff

AREA 7 A = 2.83 AC

composite C : 2.59 (0.70) (steep, grassed)
0.12 (0.90) (site roofs)

$$\Rightarrow \frac{2.59(0.70) + 0.12(0.90)}{2.83} = 0.68$$

i = 6.6 (contaminated

Q = 0.68 (6.6) 2.83 = 12.68 CFS

AREA 8 A = 0.37 AC

composite C $\pi(41)^2$ = 0.12 (.90) site
0.25 (0.4) grass

$$C = \frac{0.12(0.90) + 0.25(0.40)}{0.37} = 0.56$$

Q = 0.56 (5.4) 0.37 = 1.12 CFS

000100

FOSTER WHEELER ENVIRONMENTAL CORPORATION

2753

BY MSH DATE 1/5/00 SHEET 4 OF 7

CHKD. BY KV DATE 1/13/00 OFS NO. DEPT. NO.

CLIENT

PROJECT CALC #CA-FSC624-FC-001

SUBJECT

AREA 7 A = 2.83 AC

70x220 = 0.35 AC, C = 0.50 (gravel)

20x200 = 0.09 AC, C = 0.90 (bare soil

$\pi(40)^2$ = 0.12 AC, C = 0.90 (silo)

2.27 AC, C = 0.70 (steep, grassed)

comp. $C = \frac{0.35(0.5) + 0.21(0.90) + 2.27(0.70)}{2.83}$

C = 0.69

Q = 0.69 (6.4)(2.83) = 12.89 cfs

AREA 2 A = 0.87 AC

C = 0.4 (turf)

i = 5.4

Q = 0.4(5.4)(0.87) = 1.88 cfs

AREA 1 A = 1.30 AC

(60x235) + (175x60) + (22x90) = 20,580 SF (GRAVEL)

0.47 AC @ C = 0.50

(60x12)(7) + (60x25)(2) = 8,040 SF (trailers)

0.18 AC @ C = 0.90

1.30 - 0.47 - 0.18 = 0.65 AC @ C = 0.4 (turf)

Composite $C = \frac{.47(0.50) + 0.18(0.9) + 0.65(0.4)}{1.30}$

C = 0.51

Q = 0.51(5.4)(1.30) = 3.58 CFS

ATTACHMENT H, SHT H6 of H7

FOSTER WHEELER ENVIRONMENTAL CORPORATION

2753

BY MSH DATE 1/6/00 SHEET 6 OF 7

CHKD. BY KJV DATE 1/13/00 OFS NO. DEPT. NO.

CLIENT

PROJECT CALC # CA-FSC624-FC-001

SUBJECT Trench Calcs

K-65 TRENCH → North

1' BOT DEPTH VARIES (1' MIN SIDES)

9+97.30	7+68.80	= 228.50'
inv = 576.90	inv = 575.76	1.14' fall

S = 0.50%

K-65 Trench → south

1' BOT 1.5' SIDES

10+02.70	11+58	155.30
576.40	574.50	1.9'

S = 1.22%

1' BOT 1.5' SIDES PERIMIZ.±

11+58 →	12+15.27	57.27'
574.50	569.40	5.1'

S = 8.91%

12+15.27 →	14+41.50	226.23'
569.40	567.50	1.9'

S = 0.84%

14+41.50 →	15+30.10	88.60'
567.50	565.50	2.0

S = 2.26%

15+30.10 →	15+47.40	17.3'
565.50	569.41	0.09'

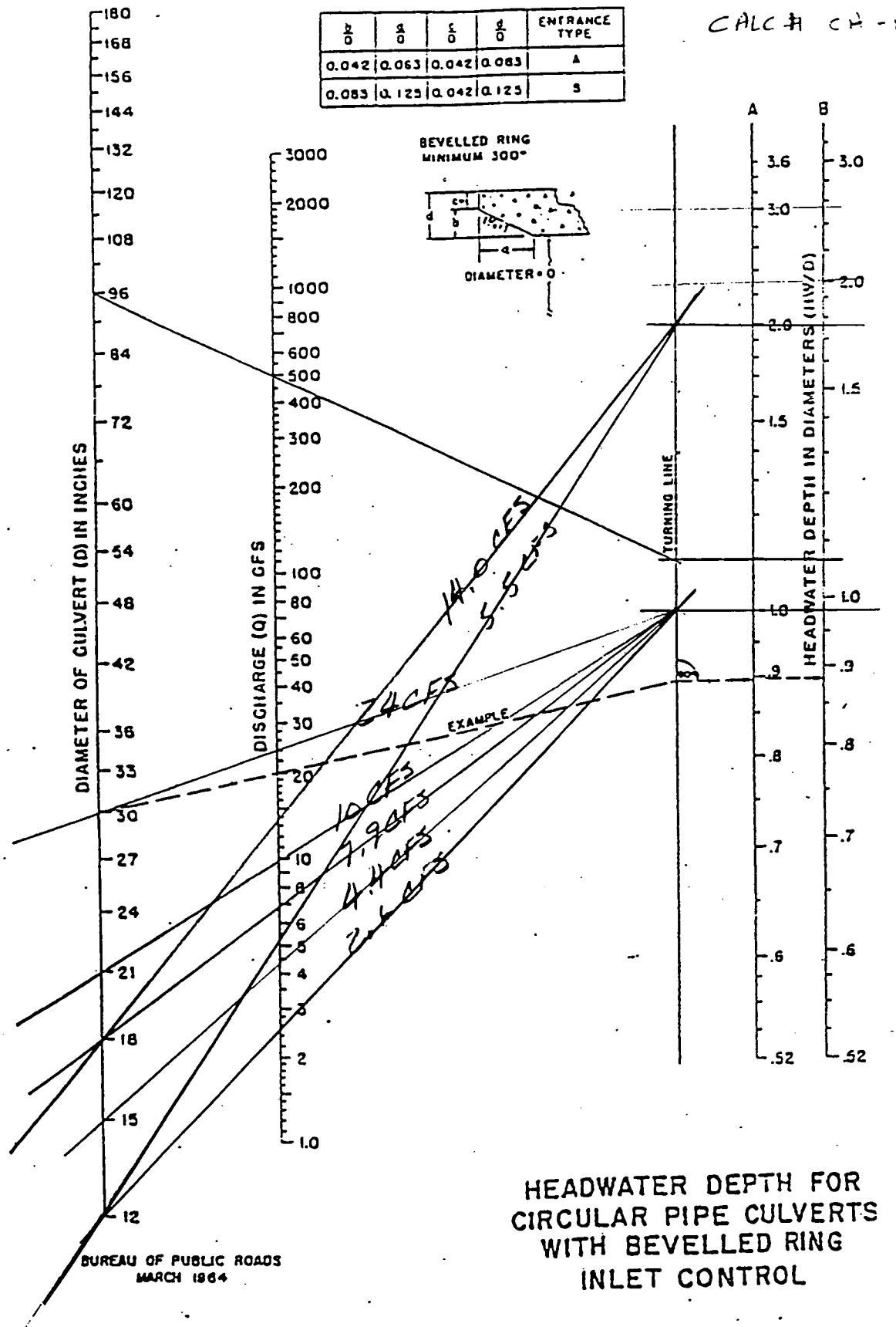
S = 0.52%

BEGIN 21"φ RCP : 146.00' @ 0.5%

BY MSH DATE 4/24/00
CHKD BY DEV DATE 1/13/00

CHART 7 -- 2753 SH. A, 2 OF AA

CALC # CH-FSC 524-F2



$\frac{x}{D}$	$\frac{a}{D}$	$\frac{c}{D}$	$\frac{d}{D}$	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

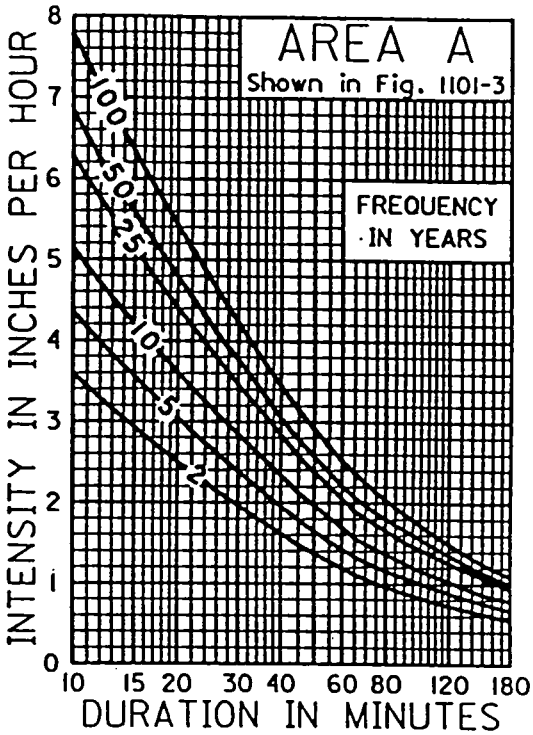
HEADWATER DEPTH FOR CIRCULAR PIPE CULVERTS WITH BEVELLED RING INLET CONTROL

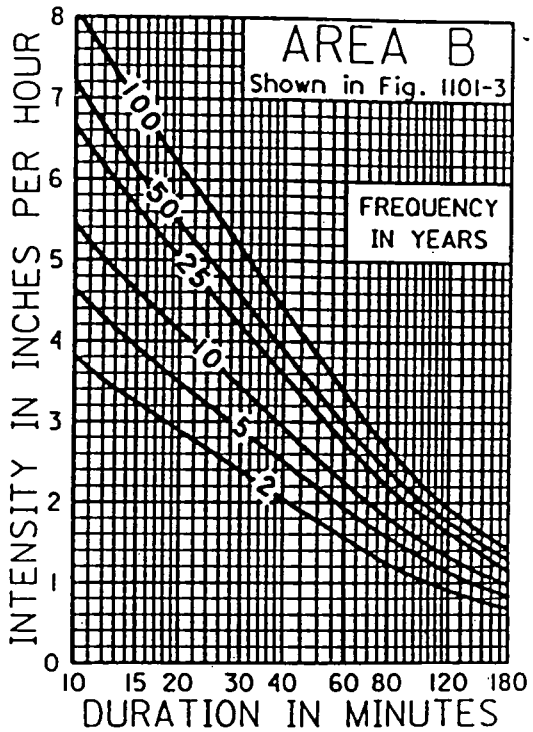
000103

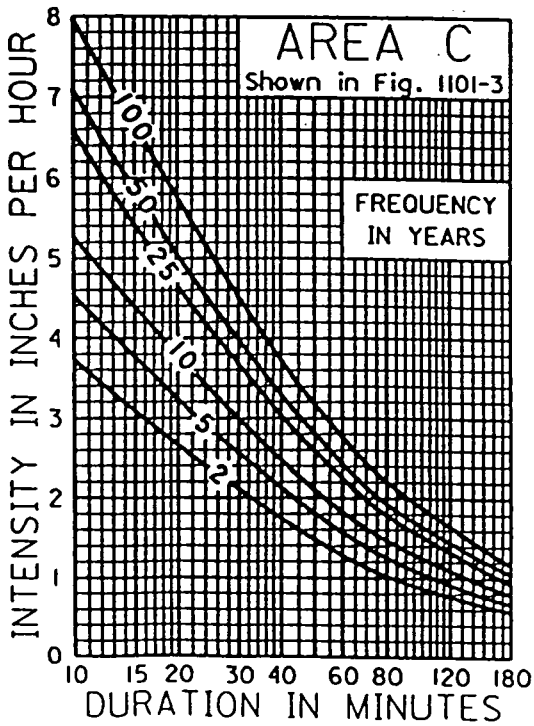
CHKD BY [illegible] DATE 1/13/00 --2753 SH. A14 OF A19
CALC# CH-FSC624-FC-001

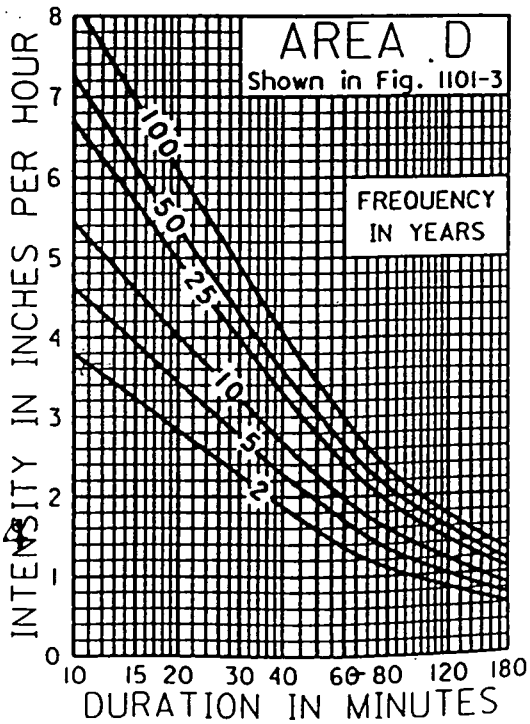
RAINFALL INTENSITY-FREQUENCY-DURATION CURVES	1101-2
	REFERENCE SECTION 1101.24

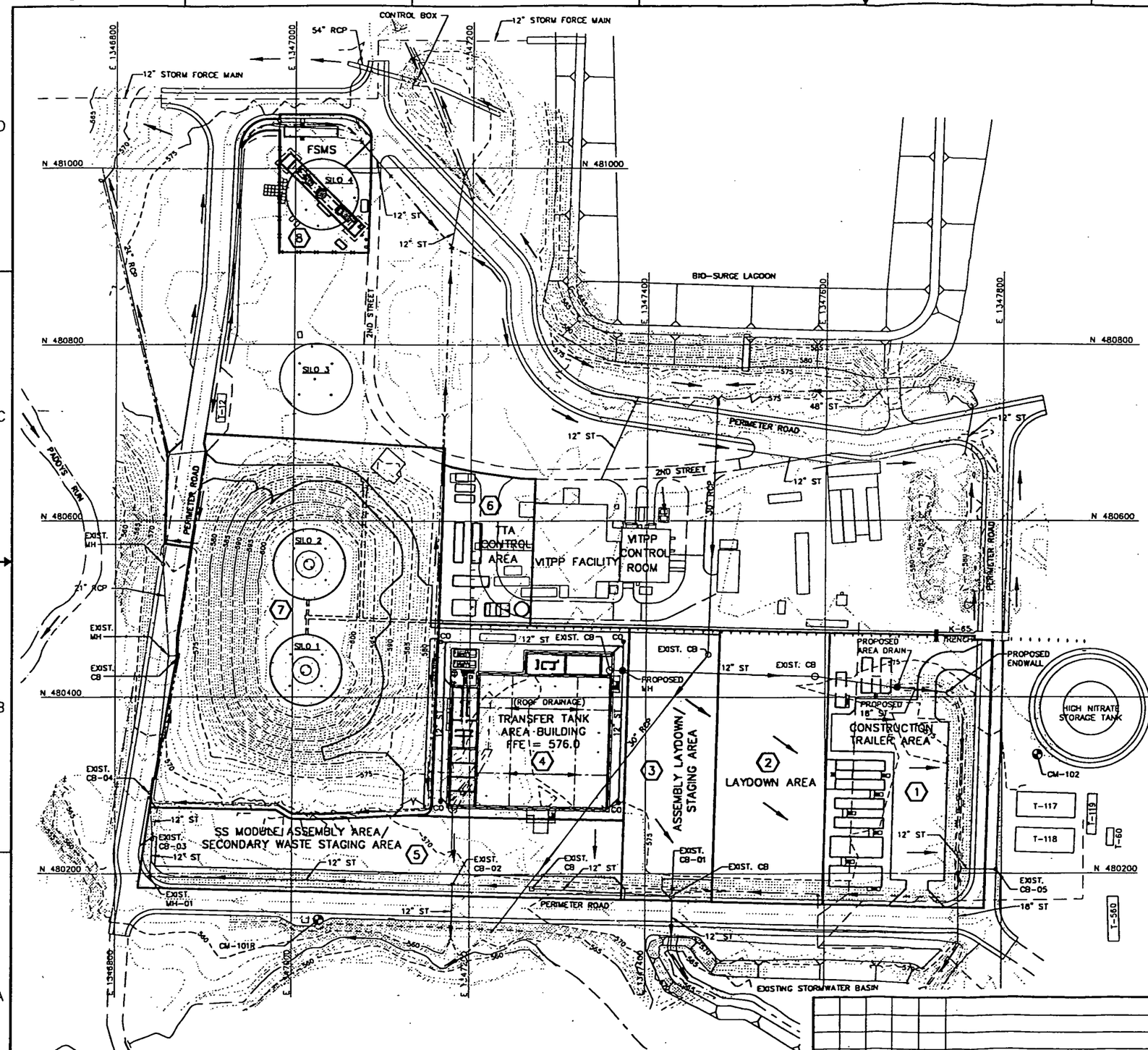
RAINFALL INTENSITY-FREQUENCY-DURATION CURVES











PRELIMINARY
NOT FOR CONSTRUCTION

* THIS DRAWING IS PART OF ATTACHMENT A, SHEET A15 OF A19, OF CALCULATION NO. CA-FSC624-FC-001

—2753

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 CONCTRTE SUMP CONTAINS A 12" DIA FORCE MAIN TO THE BIO-SURGE LAGOON.
3.

DRAINAGE AREA	DESCRIPTION OF DRAINAGE AREA	OUTLET
1	GRASS FIELD	EXISTING STORMWATER BASIN AT 18"ø OUTLET
2	GRASS FIELD	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 FROM CB-02
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	0.51	7.27	14.0 CFS
2	37,978	0.40	1.88	11.0 CFS
3	31,405	0.50	1.94	11.0 CFS
4	47,539	0.78	0.89	11.0 CFS
5	48,287	0.50	3.00	11.0 CFS
6	17,616	0.57	1.23	11.0 CFS
7	123,437	0.69	12.89	53.2
8	16,287	0.56	1.12	53.2

8. REFERENCE CALCULATION NO. CA-FSC624-FC-001.

STORMWATER LEGEND:

- (1) DRAINAGE AREA
- DRAINAGE AREA BOUNDARY
- FLOW DIRECTION
- CO PROPOSED CLEANOUT
- ● PROPOSED MANHOLE
- PROPOSED ENDWALL

STATE OF OHIO NORTH (NAD 83)

0001.05

60 0 60 120
SCALE IN FEET

REV	DATE	BY	CHK'D	APR'VD	DESCRIPTION/ISSUE
B		WVD			ISSUED FOR OHIO EPA REVIEW
A		WVD			PRELIMINARY DESIGN SUBMITTAL

RFC

DRAWN BY WVD	DATE
DESIGNED BY KEO	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

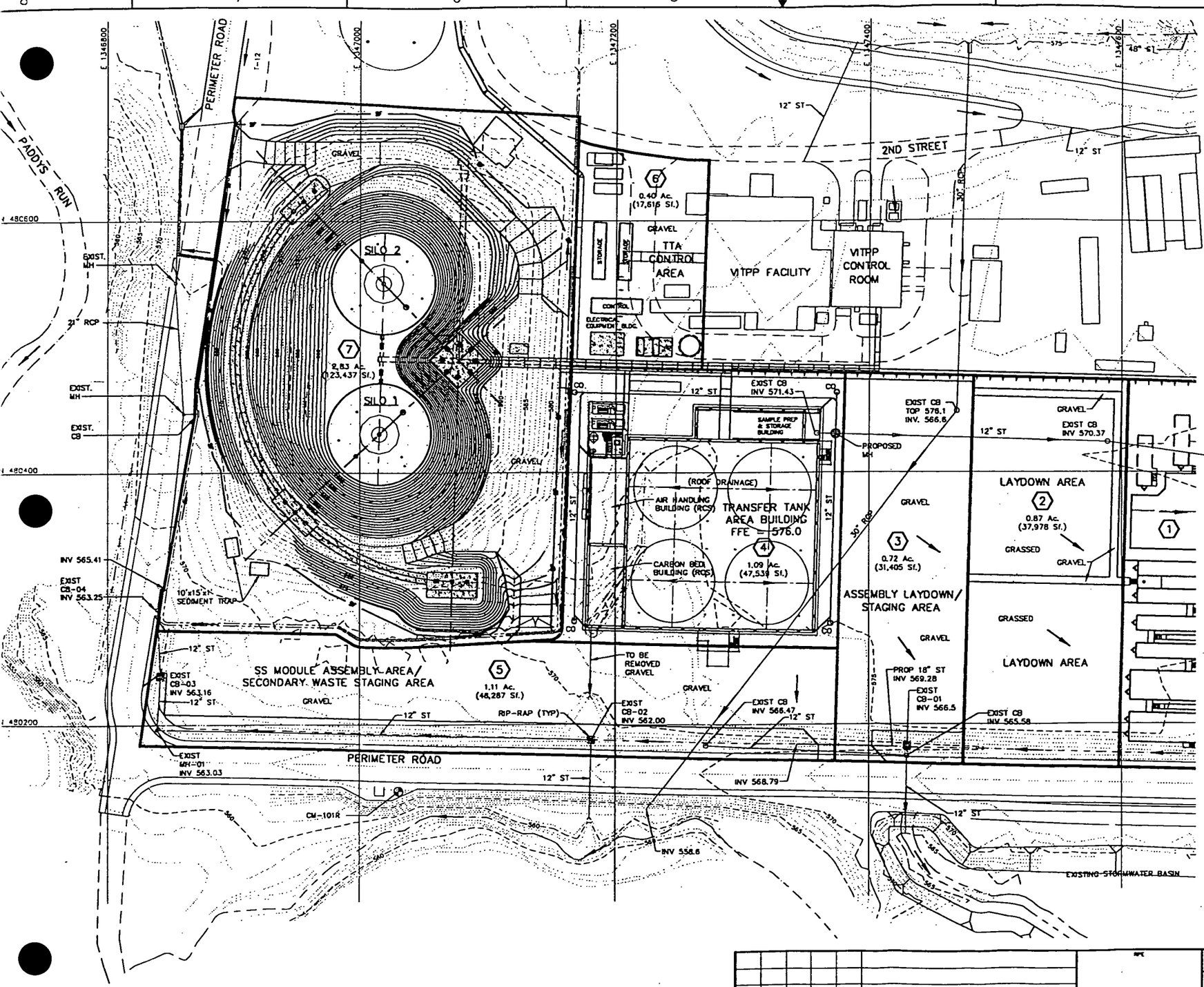
FOSTER WHEELER
FOSTER WHEELER ENVIRONMENTAL CORPORATION

TITLE
STORM WATER SYSTEM
OVERALL DRAINAGE PLAN

SIZE	SCALE:	DWG. NO.	REV
D	1"=60'	66FCD001	B

FILENAME: 66FCD001.DWG

2753



* THIS DRAWING IS PART OF ATTACHMENT A, SHEET A16 OF A19, OF CALCULATION NO. CA-FSC624-FC-001

NOTES:

1. SEE DRAWING 05FCD011 FOR GENERAL NOTES AND LEGEND.
2. SILT FENCE TO BE INSTALLED AT THE BOTTOM OF ALL DISTURBED SLOPES.
3. CULVERT ENTRANCES AND EXITS TO BE PROTECTED BY RIP-RAP AND GEO FABRIC.
4. AREAS DISTURBED BY EXCAVATION ACTIVITIES ARE TO BE SEEDED AND MULCHED AS SOON AS PRACTICAL.
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. EROSION CONTROL MEASURES ARE TO BE INSPECTED WEEKLY AND WITHIN 24 HOURS OF A 0.5 INCH RAINFALL.
8. REMEDIATION OF PROBLEMS IDENTIFIED IN THE INSPECTION ARE TO BE COMPLETED IN A TIMELY MANNER.
9. AWR PROJECT ACTIVITIES DO NOT SIGNIFICANTLY ALTER EXISTING DRAINAGE PATTERNS.
10. THE TTA PROCESS AREA ROOF DRAINAGE WILL BE DIRECTED TO THE EXISTING 12" STORM DRAIN SYSTEM AT THE NORTHEAST SECTION OF THE BUILDING.
11. EROSION AND SILTATION INTO THE CONCRETE CHANNEL IS TO BE PREVENTED.

STORMWATER LEGEND:

- (1) DRAINAGE AREA
- DRAINAGE AREA BOUNDARY
- FLOW DIRECTION
- CO PROPOSED CLEANOUT
- PROPOSED MANHOLE

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

40 0 40 80
SCALE IN FEET

REV	DATE	BY	CHK'D	APR'VD	DESCRIPTION/ISSUE
A		WVD			ISSUED FOR OHIO EPA REVIEW

RFE

DRAWN BY WVD DATE
DESIGNED BY WSH 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

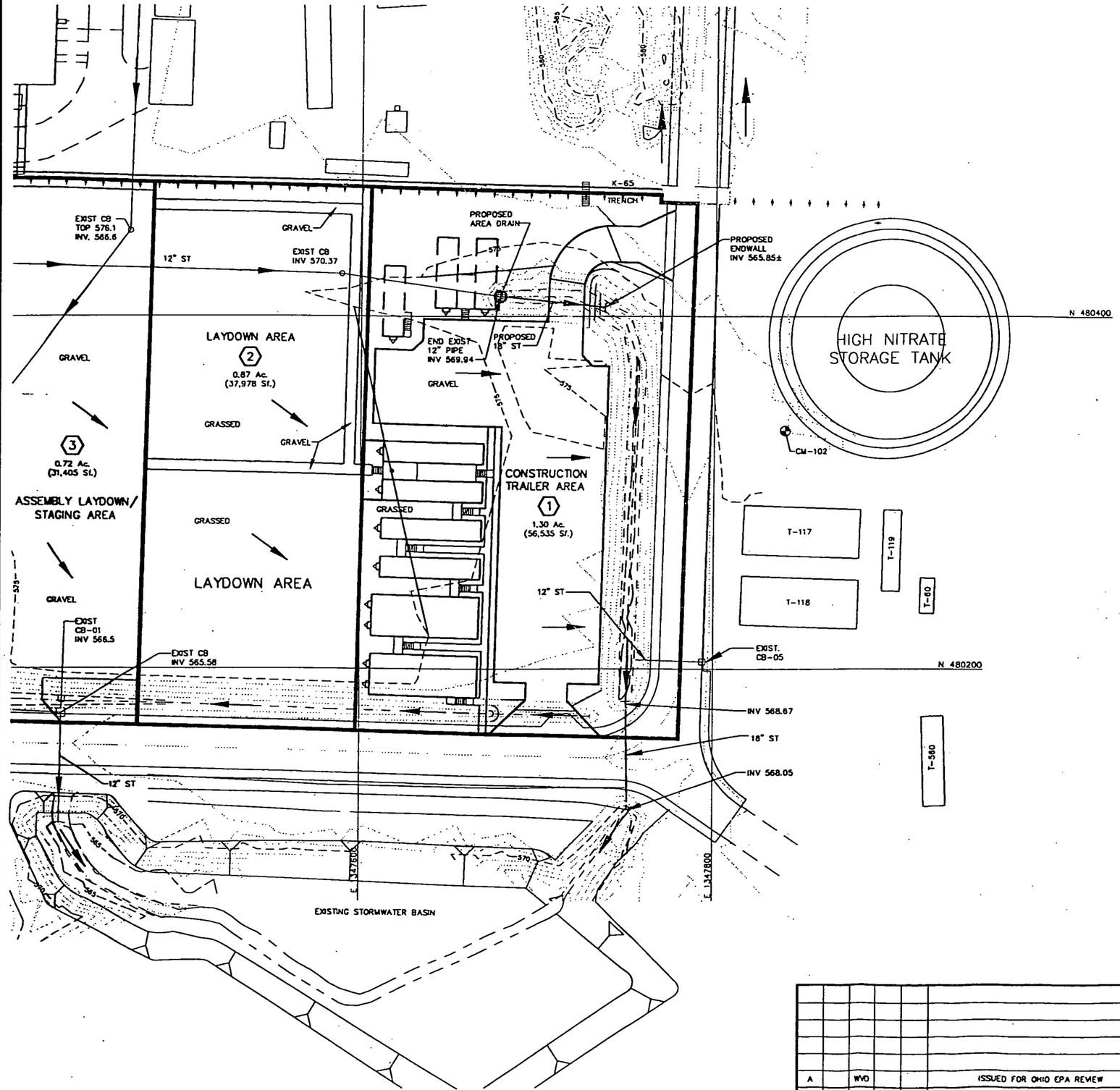
FOSTER WHEELER
FOSTER WHEELER ENVIRONMENTAL CORPORATION

TITLE
STORM WATER SYSTEM
SWRS – DRAINAGE PLAN
PHASE 1

SIZE	SCALE:	DWG. NO.	REV
D	1"=30'	66FCD002	A

000106

FILENAME: 66FCD002.DWG



* THIS DRAWING IS PART OF ATTACHMENT A, SHEET A17 OF A19, OF CALCULATION NO. CA-FSC624-FC-001

2753

NOTES:

1. SEE DRAWING 05FCD011 FOR GENERAL NOTES AND LEGEND.
2. SILT FENCE TO BE INSTALLED AT THE BOTTOM OF ALL DISTURBED SLOPES.
3. CULVERT ENTRANCES AND EXITS TO BE PROTECTED BY RIP-RAP AND GEO FABRIC.
4. AREAS DISTURBED BY EXCAVATION ACTIVITIES ARE TO BE SEEDED AND MULCHED AS SOON AS PRACTICAL.
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. EROSION CONTROL MEASURES ARE TO BE INSPECTED WEEKLY AND WITHIN 24 HOURS OF A 0.5 INCH RAINFALL.
8. REMEDIATION OF PROBLEMS IDENTIFIED IN THE INSPECTION ARE TO BE COMPLETED IN A TIMELY MANNER.
9. AWR PROJECT ACTIVITIES DO NOT SIGNIFICANTLY ALTER EXISTING DRAINAGE PATTERNS.

STORMWATER LEGEND:

- DRAINAGE AREA
- DRAINAGE AREA BOUNDARY
- FLOW DIRECTION
- PROPOSED MANHOLE
- PROPOSED ENDWALL

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

30 0 30

SCALE IN FEET

000107

REV	DATE	BY	CHK'D	APR'VD	DESCRIPTION/ISSUE
A		WVO			ISSUED FOR OHIO EPA REVIEW

RFE

DRAWN BY WVO DATE
DESIGNED BY MSH DATE
CHECKED BY DATE
APPROVED BY DATE
APPROVED BY DATE

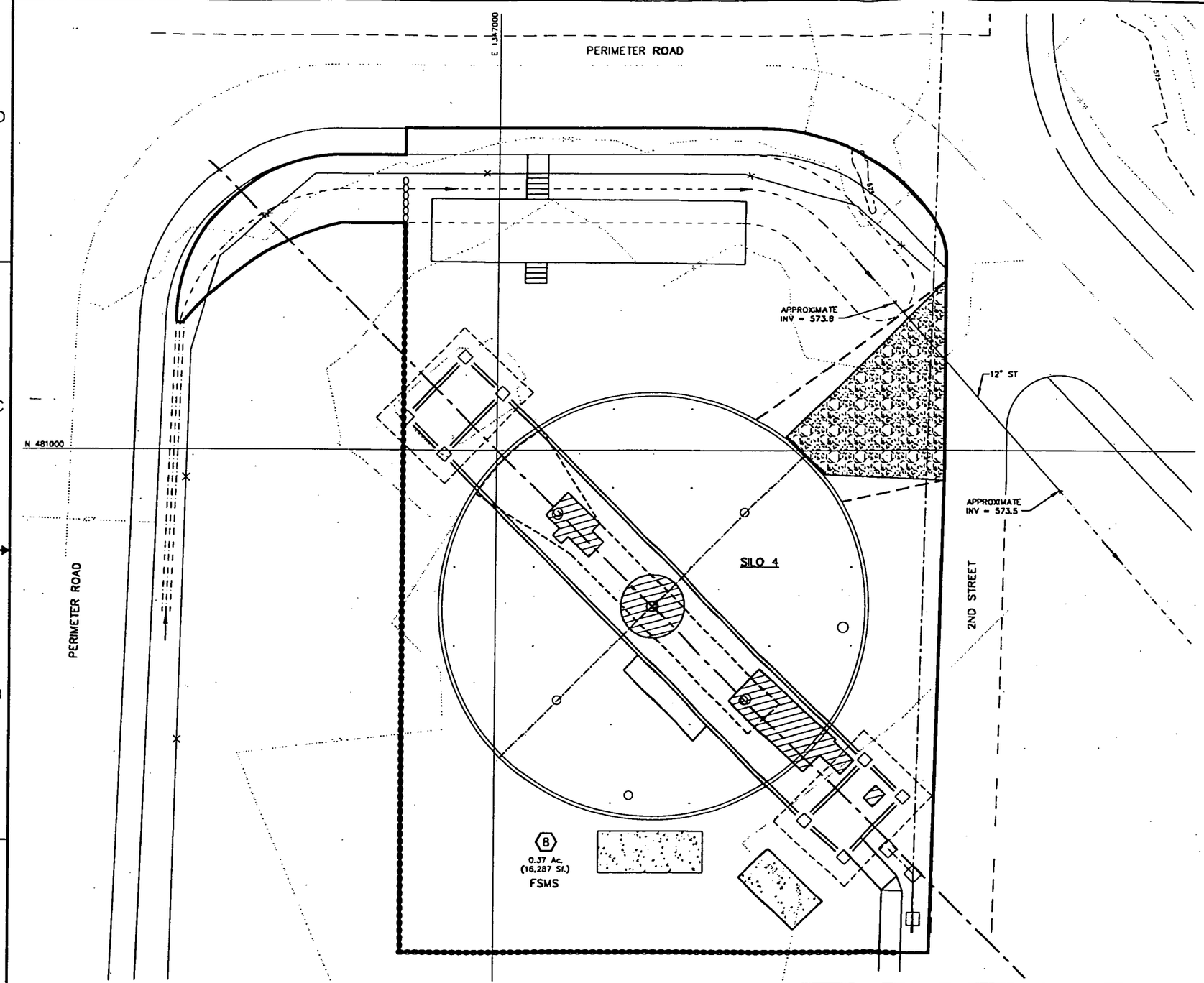
DEPARTMENT OF ENERGY
FERNALD ENVIRONMENTAL MANAGEMENT PROJECT
SILOS 1 AND 2 ACCELERATED WASTE RETRIEVAL PROJECT
FERNALD, OHIO
FDF CONTRACT NO. FSC 624

FOSTER WHEELER
FOSTER WHEELER ENVIRONMENTAL CORPORATION

TITLE
STORM WATER SYSTEM
TRAILER AREA – DRAINAGE PLAN

SIZE D | SCALE: 1"=30' | DWG. NO. 66FCD003 | REV A

FILENAME: 66FCD003.DWG



* THIS DRAWING IS PART OF ATTACHMENT A, SHEET A18 OF A19, OF CALCULATION NO. CA-FSC624-FC-001

—2753

NOTES:

1. SEE DRAWING 05FCD011 FOR GENERAL NOTES AND LEGEND.
2. CONTROL TRAILER WILL BE INSTALLED AFTER MODIFICATIONS TO SILO 4 SUPERSTRUCTURE HAVE BEEN MADE AND THE EMMA UNIT HAS BEEN INSTALLED.
3. GRAVEL ENTRANCE WILL BE INSTALLED AFTER MODIFICATIONS TO SILO 4 SUPERSTRUCTURE HAVE BEEN MADE AND THE EMMA UNIT HAS BEEN INSTALLED.
4. SEE DRAWINGS 10FSD001 THROUGH 10FSD005 FOR SUPERSTRUCTURE DEMOLITION AND MODIFICATIONS.
5. SILT FENCE TO BE INSTALLED AT THE BOTTOM OF ALL DISTURBED SLOPES.
6. CULVERT ENTRANCES AND EXITS TO BE PROTECTED BY RIP-RAP AND GEO FABRIC.
7. AREAS DISTURBED BY EXCAVATION ACTIVITIES ARE TO BE SEEDED AND MULCHED AS SOON AS PRACTICAL.
8. OVERSEEDING AND RESEEDING ARE TO BE PERFORMED AS NECESSARY UNTIL VEGETATION IS ESTABLISHED.
9. SILT IS TO BE REMOVED FROM DIVERSION DITCHES AND SILT FENCE INSTALLED AS REQUIRED BY THE SPECIFICATIONS AND AT THE END OF CONSTRUCTION.
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 IN A TIMELY MANNER.
12. AWR PROJECT ACTIVITIES DO NOT SIGNIFICANTLY ALTER EXISTING DRAINAGE PATTERNS.
14. THE TTA PROCESS AREA ROOF DRAINAGE WILL BE DIRECTED TO THE EXISTING 12" STORM DRAIN SYSTEM AT THE NORTHEAST SECTION OF THE BUILDING.
15. EROSION AND SILTATION INTO THE CONCRETE CHANNEL IS TO BE PREVENTED.

STORMWATER LEGEND:

(1) DRAINAGE AREA BOUNDARY

DRAINAGE DIVIDE

FLOW DIRECTION

STATE OF OHIO NORTH (NAD 83)

10 0 10 20

SCALE IN FEET

000108

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

PRELIMINARY
NOT FOR CONSTRUCTION

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A		WVD			ISSUED FOR OHIO EPA REVIEW

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DESIGNED BY MSH	DATE
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APPROVED BY	DATE
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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
STORM WATER SYSTEM
FSMS – DRAINAGE PLAN

SIZE	SCALE:	DWG. NO.	REV
D	1"=10'	66FCD004	A

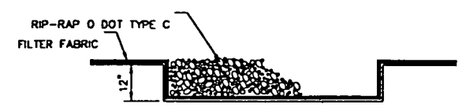
FILENAME: 66FCD004.DWG

* THIS DRAWING IS PART OF ATTACHMENT A, SHEET A19 OF A19, OF CALCULATION NO. CA-FSC624-FC-001

2703

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. THE CONSTRUCTION MGR. 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, REV. 0.



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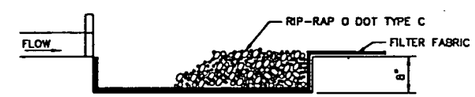

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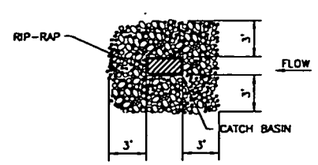

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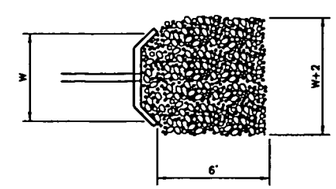
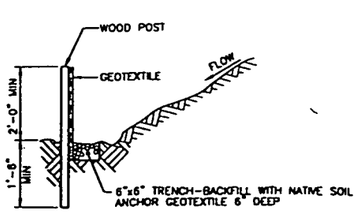


CULVERT INLET & OUTLET PROTECTION
NOT TO SCALE



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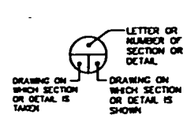

SECTION & DETAIL KEY

PRELIMINARY
NOT FOR CONSTRUCTION

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A		WVD			PRELIMINARY DESIGN SUBMITTAL

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DESIGNED BY KEO	DATE
CHECKED BY	DATE
APPROVED BY	DATE
APPROVED BY	DATE

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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
STORM WATER SYSTEM
MISC DETAILS
SHEET 1

SIZE	SCALE:	DWG. NO.	REV
D	AS SHOWN	66FCD006	A

FILENAME: 66FCD006.DWG

2753

FOSTER WHEELER

FOSTER WHEELER ENVIRONMENTAL CORPORATION

SYSTEM DESIGN DESCRIPTION

DOCUMENT NO.
624-P622-30, Rev. B

FOR THE

SILOS 1 AND 2 ACCELERATED WASTE RETRIEVAL (AWR) PROJECT

SUBMITTED TO:

FLUOR DANIEL FERNALD (FDF)

CONTRACT NO. FSC 624

January 7, 2000

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ACRONYMS

ALARA	as low as reasonably achievable
API	American Petroleum Institute
ASI	actuator sensor interface
AWR	Accelerated Waste Retrieval
AWWT	Advanced Wastewater Treatment Plant
BRS	Bulk Retrieval System
CATS	Conditioning and Transfer System
CCTV	closed circuit television
CFC	Continuous Function Chart
CPU	Central processor unit
DIN	Deutsches Institute Normung
DRS	Debris Retrieval System
DWRS	Decant Waste Retrieval System
EMMA™	Easily Manipulated Mechanical Arm™
FDF	Fluor Daniel Fernald
FDS	Facility Decontamination System
FSMS	Full-Scale Mock-Up System
gpm	gallons per minute
HMI	Human-machine interface
HVolt AC	Heating, ventilating, and air conditioning
I/O	Input/output
ICAT	Integrated Construction Acceptance Test
ISO	International Standards Organization
MCC	Motor control center
MEES	master equipment enable switch
MOV	motor-operated valves
MPI	multi-purpose interface
NEMA	National Electrical Manufacturers Association
NPSH	net positive suction head
P&IDs	piping and instrumentation diagrams
PLC	programmable logic controller
RH	relative humidity
RCS	Radon Control System
rpm	revolutions per minute
SAIE	Silo-Arm Interface Enclosure
SOT	System Operability Test
SPSA	Sample Preparation and Storage Area
SREE	Silo Retrieval End-Effector
SSI	synchro-serial interface
SWRS	Silo Waste Retrieval System
TEFC	totally enclosed, fan-cooled
TTA	Transfer Tank Area
TWRS	Transfer Tank Area Waste Retrieval System
UF	ultra-filtration
UPS	Uninterruptible Power Supply
VitPP	Vitrification Pilot Plant
WG	water gauge

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1.0 INTRODUCTION

This System Design Description document provides detailed descriptions of the process systems comprising the Accelerated Waste Retrieval (AWR) Project at the U.S. Department of Energy (DOE) Fernald Environmental Management Project (FEMP) site. This document includes information from the Process Descriptions, Document no. 624-P622-20, for the AWR Project, as well as a complete description of equipment and instrumentation in each system and the applicable codes and standards for the systems, structures, and components (SSCs) used in the systems. It has been prepared as a component or subset of the preliminary design package for the AWR Project and in conjunction with the Design Criteria Package, Functional Requirements Document, and other AWR Project design submittals.

1.1 Document Purpose and Organization

As part of the Preliminary Design submittal for the AWR Project, the System Design Description document describes each AWR Project system in terms of process, equipment and instrumentation descriptions required to meet the applicable scope of work requirements, including applicable codes and regulations. It is formatted in the following manner. Section 1 provides an introduction that includes the system identification for the AWR Project. Section 2 provides a general overview of the AWR Project that includes the mining strategy of how the waste is retrieved from the silos. Section 3 lists the requirements and bases for design. Section 4 describes each major system design component, with Section 5 describing the distributed control system and system components for the AWR Project. And finally, Section 6 lists the applicable references used in the development of the System Design Descriptions.

1.2 Systems Identification

The AWR Project includes six major systems listed below and depicted in Exhibit 1-1.

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 1000 gallons of residue/solids in a heel), segregates materials and transfers/packages them, 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 transfer to the future remediation facility. Provisions will be made for sampling and sample storage.

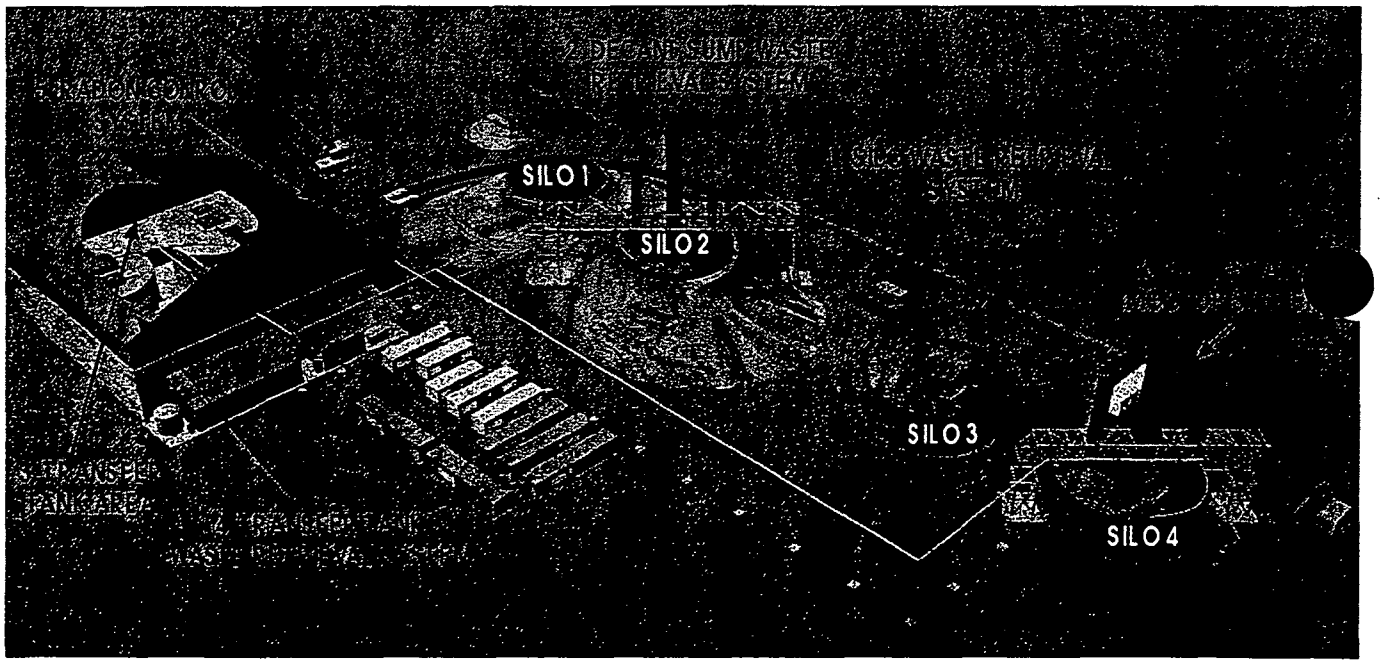
Transfer Tank Waste Retrieval System (TWRS). In the future, the TWRS will retrieve the K-65 Material/BentoGrout™ slurry from the TTA and transfer it to processing at a future waste treatment facility that is not in scope (NIS) of the AWR Project.

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.

000113

FSMS. A Full-Scale Mock-Up (FSM) Integrated Construction Acceptance Test (ICAT)/System Operability Test (SOT) is to be performed with the Silo 4 Full-Scale Mock-Up System (FSMS). Foster Wheeler 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.

Facilities Decontamination System (FDS). The Facilities Decontamination System (not shown in Exhibit 1-2) 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.



Note: The Facility Decontamination System (the seventh system) is an inherent part of Systems 1, 2, and 3. A decontamination trailer is also available for small parts and equipment.

Exhibit 1-1: Major Systems in AWR Project

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2.0 GENERAL OVERVIEW

Silos 1 and 2 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. 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 before 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.

2.1 Scope

As the contractor, Foster Wheeler is designing, constructing, testing, and directing the operation and maintenance of the AWR Project. FDF 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 before 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 this 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 than the stages defined in the Technical Requirements Document (TRD), but more accurately reflect Foster Wheeler's approach to managing the AWR Project.

2.2 Mining Strategy

The mining strategy describes how the waste will be retrieved from the silos from a philosophical standpoint as opposed to a procedural and operational standpoint. This information is used to help guide test planning and operational planning for the CAT, ICAT, and actual silo deployment.

2.2.1 Introduction and Purpose

A revision of the evolving retrieval mining strategy for the Fernald Silos Accelerated Waste Retrieval Project is on the basis of known information about the retrieval system during the conceptual design phase. This section evolves as information is provided and details of all the retrieval system components are developed. This section is used as a general guide towards the development of objectives for safe and cost-effective retrieval of the silo waste. The scope of this section is limited to equipment specifically related to in-tank retrieval; therefore, other important items such as the Radon Control System, the Transfer Tank Area, and many others are outside its scope. The contents of this section does not add, change, modify, or in any way affect the technical requirements of any system, subsystem, or component. This is an evolving strategy that will be updated as necessary throughout the life of the project.

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This is a brief introduction to the mining strategy and major equipment that is associated with successfully completing the retrieval operations. While Silos 1 and 2 contain two distinct layers of material that need to be retrieved, the intent is to retrieve them simultaneously. The first layer is a bentonite (trade name BentoGrout™) cap that was placed in the silos to prevent radon migration into the dome space and out of the silos. The Bentonite layer varies, but in general it is approximately 6-inches deep in the center of the silo and 3-feet near the silo walls. The material may have dried out on the surface, and may still be wetted near the bottom of the bentonite layer. The K-65 ore tailings, that were slurried into the tanks, are the remainder of the waste that is over 20-feet in depth.

2.2.2 Baseline Modifications since the Proposal

During the proposal phase, we evaluated two concepts for retrieval of the waste. The first concept involves selectively removing the bentonite cap and preventing mixing with the K-65 waste material. Storage of the two waste streams occurs in separate TTA tanks. The Silo Retrieval End-Effector (SREE) deployed with the Easily Manipulated Mechanical Arm™ (EMMA) is used to mine the bentonite, followed by the use of past-practice sluicing techniques for the bulk retrieval, and the use of SREE and EMMA™ for heel removal. The second concept starts with past-practice sluicing techniques for bulk retrieval. This method allows the bentonite to mix with the K-65 material, and does not violate technical requirements. Upon successful completion of bulk sluicing, the SREE and EMMA™ remove the remaining heel. In both concepts, EMMA™ is equipped with a small arm-based sluicer nozzle to assist in bulk sluicing and wall and floor washdown. Also, EMMA™ reduces in size remaining debris and collects it in both concepts. After reviewing these concepts, the second concept that allows for the mixing of bentonite and K-65 material combined, was selected. The main reason for selecting this option was the minimization of the size of the TTA. Two additional separate tanks for the bentonite material are eliminated. Also, the schedule for the waste retrieval operations is shorter with concept 2 as there are essentially five operational phases rather than six. Several discussions were held during the conceptual design phase to debate the effectiveness of SREE and EMMA™ to selectively remove the bentonite cap. There are questions related to the ability of the bulk sluicing nozzle to adequately overcome the strength of the dried bentonite. While these discussions have led the team to carefully look at past sluicing tests performed by the Hanford EM30 and Tanks Focus Area EM50. The baseline is still to use the bulk sluicer unless there is data that conclusively shows that bentonite is resistant to a large jet and wetting/backflushing activities.

The current baseline is to retrieve the bulk waste from the silos using past-practice sluicing, that is accomplished through the use of (1) a low- to medium-pressure, high-volume nozzle through one peripheral riser and (2) a retrieval pump through the second peripheral riser. The proposal states that the retrieval pump and sluicer are removed, and the Conditioning And Transfer System (CATS) with the SREE, jet pump, and conveyance hose attached are deployed through the peripheral riser. However, the CATS and the retrieval pump are now being integrated into a single enclosure, thus eliminating two crane lifts. EMMA™ is deployed through the center riser, and it grasps the SREE and maneuvers it within the tank for heel removal and floor cleaning. Upon completion of heel removal, EMMA™ deploys the arm-based sluicer to wash down the walls and the floor. EMMA™ is also used to reduce in size any remaining debris and place it in the debris basket that is deployed through the same riser that the bulk sluicing nozzle was deployed. The proposal indicated that the sluicing nozzle enclosure and the silos Debris Retrieval System (SDRS) enclosure are separate, necessitating lifts off of and onto the bridge respectively. Currently, both the sluicer nozzle assembly the SDRS are combined into a single

enclosure that requires no lifts from the bridge. Finally, the past-practice sluicing nozzle and jet pump will deploy into the decant sump tank for removal of the remaining residue and liquid, as a final project transfer operation.

2.2.3 Retrieval Equipment Description

The baseline description of the equipment is as follows.

2.2.3.1 EMMA™, Gripper, and Debris Cutting Tool

There are three manways in each silo that will be modified for the deployment of the SWRS system. The center riser is where the EMMA™ is deployed. The cable-driven EMMA™ is housed in the Silo Arm Interface Enclosure (SAIE) on the platform structure above the silos. EMMA™ is equipped with a gripping End-Effector (GEE) that is used to grasp tools (like the Silo Retrieval End-Effector) and support the use of the debris cutting system. The GEE is also used to pick up debris for placement in a debris basket that is lowered through a separate riser. EMMA™ has an integral "small" arm-based sluicing nozzle that provides assistance to the bulk sluicer during bulk retrieval as well as for wall washdown. The arm-based sluicing nozzle is designed to operate at approximately 50 gallons per minute at 200 pounds per square inch. The nozzle is remotely operated such that a variable spray can be produced that ranges from a fairly coherent stream up to a wide spray pattern. A separate debris cutting system is available for EMMA™ to reduce the size of small pipes and other debris for eventual removal from the silos, using the basket.

2.2.4 Bulk Retrieval System - Sluicing Nozzle And Retrieval Pump

The majority – approximately 90 percent – of the silo waste is sluiced using past-practice sluicing techniques. These techniques have been used at Hanford, Savannah River, and Oak Ridge to remove large volumes of waste. The bulk retrieval system consists of two basic components. The first component is the sluicing nozzle that is approximately ¾-inches in diameter and is operated at 150 pounds per square inch and 300 gallons per minute. The nozzle is remotely articulated to allow for both vertical channel cutting as well as horizontal sweeping as necessary. A simple, hoist-driven system allows the sluicer to be vertically raised and lowered into the silo. The sluicing nozzle and deployment system is housed in one of the peripheral manways. While not discussed here, the sluicing nozzle is housed in the same enclosure as the debris retrieval system.

The second half of the bulk retrieval system is the slurry pump. The slurry pump removes all sluiced slurries from the tank during bulk retrieval operations. The slurry pump is matched to remove waste at the same rates as the bulk sluicing nozzle and arm-based sluicer nozzle operating simultaneously, that is approximately 350 gallons per minute. The pump is deployed through the third manway located co-linear with the Sluicing and EMMA™ manways. While not discussed here, the slurry pump is integrated with the Conditioning and Transfer System (CATS) enclosure.

2.2.5 Heel Retrieval System - Conditioning and Transfer System (CATS), SREE, Conveyance, and Hose Management

The waste that remains in the silos upon completion of past-practice sluicing activities is called the heel. The heel may consist of remaining liquids, supernatant that is below the net positive

suction head (NPSH) of the retrieval pump, soft residue, hard residue, and any agglomerated waste piles and includes debris. The heel is removed by the CAT System.

EMMA™ grasps and maneuvers the SREE in the tank. The SREE is designed on the basis of two systems. The first system is the Confined Sluicing End-Effector that was developed and operated at Oak Ridge for the Gunite and Associated Tanks retrieval project. The second system is the Waste Retrieval End-Effector that was designed and fabricated for the C-106 heel retrieval effort for the Hanford Tanks Initiative. The SREE consists of three rotating jets that are used to locally slurry material and direct the slurry to a central inlet that is a 2-inch-diameter. The nozzles operate at up to a maximum 10,000 pounds per square inch at approximately 10 gallons per minute. To vacuum the slurry out of the central inlet port, a radial waterjet pump is integrated as close to the SREE as possible. The jet pump requires approximately 10,000 pounds per square inch of water at approximately 10 gallons per minute. When the SREE inlet is submerged in liquid, the jet pump can remove up to 100 gallons per minute 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. The basic premise of the waterjet pump is that three radial waterjets are placed such that they converge in the discharge nozzle of the jet pump, thus creating a vacuum (for a short distance). 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 (demonstrated to pump well greater than 60 feet) and into the CATS, that is located as close to the floor as possible. The CATS allows for conditioning of the waste before transfer to the TTA. The CATS monitors the waste level and solids loading in the slurry and adds additional water if necessary to meet transfer requirements. CATS is additionally used to separate any air from the slurry and exhaust the air back into the silo. A hose management system between the SREE and the CATS ensures that the heel retrieval hoses do not create undue loading to EMMA™. Hose management is accomplished through a simple cable system to allow for the SREE to be operated within the entire silo floor area.

2.2.6 Debris Removal System

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 that the sluicing nozzle is deployed. 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 platform and disposition by FDF.

2.2.7 Retrieval Mining Strategy

The retrieval operation occurs in five basic steps. The first step is the bulk sluicing of the K-65 waste and bentonite cap material; the second step is the removal of the heel; the third step is the collection and removal of the debris; the fourth step is wall and dome washdown; and the final step is decant sump retrieval. The first four steps occur on each of the two silos, and the last step occurs one time only upon completion of the silo retrieval.

2.2.8 Bulk Sluicing and Retrieval

The sluicing nozzle and the integrated slurry pump/CATS (Note: These items are approximately 50 feet apart) are used for sluicing the bentonite cap and K-65 waste material. Sluicing is a common practice across the DOE Complex and easily allows for bulk retrieval. Initially, the sluicing stream is directed as close to the pump inlet as possible to induce a slurry pool for slurry to flow into. Additionally, the slurry pump has the capability to operate in reverse using sluice water to assist in making a slurry pool. The slurry pump also has a high pressure water jet ring at the pump suction which can blast hard material into a pumpable slurry. The sluicing jet, from time to time, will impinge upon and impact the retrieval pump, that is able to withstand the jet during operation. Upon creating the cavity, the nozzle cuts a canyon for slurry to flow through to the pump. The canyon will progress in depth and length toward the sluicer. The slurry pool size at the pump suction will be minimized to minimize free water in the silo. The sluicer will "push" the slurry towards the pump 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 pump is periodically lowered (remotely) further into the tank, until it reaches the bottom. The sluicing nozzle is also lowered periodically further into the tank. Lowering the sluicing nozzle allows for EMMA™ to be up higher in the tank dome area doing other activities including dome and upper wall washing without impingement by the large sluicing nozzle waterjet. At times, if the sluicing nozzle is inadequate to break up a waste agglomeration, the EMMA™ assists the large sluicing nozzle 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 is the same as the return supply supernatant. Upon a determination that effective sluicing is complete, the pumping operation is modified to the CATS mode. The bulk sluicing nozzle is retracted back into its containment housing above the silo on the platform.

2.2.9 Heel Removal

Heel removal follows the sluicing operation. The heel is defined as anything left over after sluicing is completed. This includes slurry, supernate, K-65 material, and debris at the silo bottom. The containment housing of the CAT System is an integration of the slurry pump system. The Heel Waste Surge Tank, Hose Bundle, and SREE, is lowered through the manway for deployment. The system is then deployed such that EMMA™ can reach and grasp the handles of the SREE. EMMA™ is then used to place the SREE in various locations along the tank floor. EMMA™ also is required to work with the conveyance hose and cable tether to grasp the hose and move it into position for operation at a given location within the silo. The hose is most likely to be lying in the liquid and residue waste. Initially, the jet pump is turned on, and the SREE (without its cutting jets on) is submerged into the heel to remove all of the free liquid. Then, the SREE jets are activated to slurry and pump any remaining waste into the CATS. The CATS accumulates the slurry in preparation for transfer to the TTA. The exit of the slurry from the conveyance hose is open to CATS to separate any entrained air from the waste. In this manner, there is no net addition of air into the tank; thus ensuring that the RCS is not overcome by additional airflow. The CAT system remains in place until all of the walls and floor are washed down and the free liquid removed.

Two methods are possible for operating the SREE. The first method is on the basis of the approach taken at Oak Ridge in the Gunite Tanks. Essentially, slurry pools are created in that the SREE is worked around in the slurry pool. Then the SREE is moved to another location in the same proximity and a nearby slurry pool is created. This continues until the slurry pools are

eventually merged together. When no further progress is made in one sector, the SREE and hose is moved to another sector where the process is started again until the waste is removed from the silo. The second method is on the basis of using the SREE in a more systematic "machining" fashion where "high" points of residue piles are selectively machined to a nearly flat condition. Then, the End-Effector is moved across the silo floor "machining" off a layer of waste at a time. Currently, the slurry pool method is the preferred approach because of the flexibility of the EMMA™ arm, but either is available.

2.2.10 Wall and Dome Washdown

Wall and dome washing will be occurring partially during sluicing operations. The small sluicing nozzle attached to EMMA™ has a variable geometry nozzle that can be remotely changed and allow for either a coherent jet (for sluicing assistance as described earlier) or in a wide spray to gently and quickly wash down the tank walls, dome, and floor.

2.2.11 Debris Retrieval

Debris retrieval is accomplished during heel removal. After successful heel removal has been completed, any debris left on the floor of the silo will be removed. The debris consists of small items that cannot be pumped out of the tank as well as larger items such as pieces of pipe. Any large pieces of debris are reduced in size to fit the retrieval basket. All debris is collected and placed in the basket. The debris retrieval system and the debris basket are deployed through the manway for deployment of the bulk sluicing nozzle because all are housed in the same enclosure. A cable and winch lowers the basket and debris cutting tool into the silo. EMMA™ reaches and grabs the debris-cutting tool and reduces all piping pieces to manageable sizes. EMMA™ then sets the debris cutting tool aside and collects the debris and places it inside the basket. EMMA™ washes down the debris and basket, then the wash ring washes the basket as it is retrieved, and the radiation-monitoring ring checks the radiation level. The basket is raised back into the containment housing and a remotely operated jib crane moves the full basket into a drum where the basket and contents are sealed and prepared for transport from the platform. Additional baskets are lowered into the silo as needed until all the debris is removed.

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3.0 REQUIREMENTS AND BASES

The technical requirements and bases for the design of systems and components of the AWR Project are summarized in several project documents, and for that reason, are not specifically provided herein. These AWR Project documents include primarily the Functional Requirements Document, Document 624-P622-02, and the Design Criteria Package, Document 624-P622-03, for the AWR Project. Of note, the basic technical requirements for the system functions, as developed by DOE and Fluor Daniel Fernald (FDF) for the AWR Project and stipulated in Part 7 of the AWR Project contract (i.e., Technical Requirements Document), are summarized in the Functional Requirements Document for the AWR Project. Similarly, the specific criteria for designing the AWR Project systems and components are summarized in the Design Criteria Package for the AWR Project, that also include applicable codes and standards for the design. References for these documents related to the AWR Project design are provided in Section 6.0 of this document.

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4.0 SYSTEM DESIGN DESCRIPTION

4.1 Silo Waste Retrieval System (SWRS)

The Silo Waste Retrieval System (SWRS) recovers the waste in the silos and transfers the waste to the TTA. The recovery of the waste occurs in three basic steps. The first step is the bulk sluicing of the K-65 waste and BentoGrout™ material; the second step is the retrieval of the heel; the third step is the collection and removal of the debris. Wall washdown occurs as the waste is retrieved. Following Fluor Daniel Fernald (FDF) concurrence that a silo has been cleaned sufficiently as determined by visual inspection by the system cameras, a fixative is applied to the walls and floor of the silo. To provide the global view required to maneuver and control in-silo equipment during waste retrieval and cleaning assessments, three video cameras with lights are deployed through new 12-inch risers located approximately 120° apart at the silo perimeter and independent from the risers used to deploy the SWRS.

The SWRS main systems and components used with each system are;

- EMMA™ System
  - EMMA™ Deployment Tower System,
  - Actuation package,
  - Mast, and
  - EMMA™.
- Bulk Retrieval System (BRS).
  - Sluicer,
  - Sluicer enclosure,
  - Slurry pump,
  - Slurry pump enclosure,
  - Slurry transport piping,
  - EMMA™ System, and
  - Slurry pump.
- Conditioning And Transfer System (CATS).
  - Silo Retrieval End-Effector (SREE),
  - Heel Waste Surge Tank,

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- Conveyance hose management system,
- EMMA™ System, and
- Slurry Pump.

• Debris Retrieval System (DRS).

- Debris retrieval enclosure,
- Waste size reduction tool,
- Debris basket and winch assembly,
- Drum loading station,
- Debris retrieval spray washer, and
- EMMA™ System.

4.1.1 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 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 from Bento-Grout 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. Waste and debris retrieval operations using the EMMA™ System is achieved by:

- Deploying the high-pressure Arm Deployed Sluicing System (ADSS) nozzles to breach the Bento-Grout™ layer and force the dislodged material toward the sluicing pump;
- Forcing the waste and debris away from the sluicing pump and Silo Retrieval End-Effector (SREE) to facilitate continuous operations;
- Deploying the GEES camera and lighting system and ADSS to inspect and clean 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;
- Mobilizing bulk waste and debris from behind the sluicing pump and water cannon;
- 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;

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- 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.

4.1.1.1 EMMA™ Deployment Tower (EDT) System

The primary purposes of the EDT are to provide containment for the EMMA™ and its support systems during transport, maintenance, and system shutdown, house the mechanical operating systems (azimuth and z-drives) that provide gross positioning of the EMMA™, and still provide a maintenance and local operating control station area. The EDT is also designed to provide a redundant containment system in the unlikely event of a Radon Control System (RCS) failure. Additionally, the tower has an integrated airlock system and equipment replacement area. The mounting of the control and power distribution cabinet, as well as the hydraulic pump unit, is done at the tower base. They will be connected after the erection of the tower and will add area to the system footprint.

The deployment tower structure is a large cylindrical tower made of A36 carbon steel with an airlock room attached to one side of the tower base. The cylindrical structure is a 90-foot tall shell with a wall thickness of 5/16" for the lower 20 feet and ¼" for the remaining 70 feet. The tower shell provides the structural support and is constructed to provide secondary shielding and containment. Buckling concerns associated with a structure of this magnitude have been addressed through tower bracing. Tower bracing is achieved through ovalling rings placed at 12-foot intervals throughout the tower structure. Each ovalling ring has a 12' inner diameter and a 13'- 4" outer diameter. The disc-shaped ovalling ring is then welded to the outside of the tower at designated points in accordance with AWS welding standards. The ovalling rings maintain the circular profile of the structure and prevent shell buckling. GreyPilgrim has performed the critical calculations, which are moment load, weight, height, and the center of gravity. Two lifting points are provided, one at the end, and the other 60 feet from the base.

The tower will attach to the bridge using eight separate bolt patterns equally spaced around a 12'-4.5" circle at the base of the tower. Each bolt pattern consists of two 1.25" bolts located 4.5" apart. The bolts attach to a base chair design that expands the diameter at the base of the structure to 12' 9".

4.1.1.2 Actuation Package

The actuation package is constructed of the same carbon steel box tubing as the mast. The actuation package's primary purpose is to house the hydraulic actuators and route the cables to their appropriate positions for EMMA™ segment attachment. The actuation package is divided into two sections, the inner frame and the outer frame. The inner frame rotates inside of the outer frame as it is driven by the azimuth drive.

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4.1.1.3 Mast

The mast is a welded truss structure made of various sizes of carbon steel box tubing that attaches between the actuation package and the EMMA™. The primary function of the mast is

to provide rigid support when supporting the EMMA™ as it is deployed into the silo, and during in-silo operations. The mast is 13-feet long, weighs approximately 2000 pounds, and can be accommodated by a 30-inch-diameter opening. In addition to supporting the EMMA™, the mast also routes the EMMA™ cables that are fed through the actuation package, and provides a bearing surface against the guide bearing during full insertion of the EMMA™. The mast attaches to the actuation package with eight 1-inch bolts.

4.1.1.4 EMMA™

EMMA™ is a 52.5-foot long, 30-inch diameter, cylindrical serpentine manipulator composed of five independent stages and a wrist. Each stage contains three segments. Stages 1 through 3 are single degree of freedom (1 DOF) stages, capable of bending only in a vertical direction. 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 configurations. The 2 DOF wrist at the end of the manipulator provides local dexterity for gripper, end effector, and other special tooling used for silo waste retrieval activities. The wrist and five stages of the manipulator are expected to weigh approximately 7500 lbs.

The manipulator is designed to operate under the following parameters:

- Operate reliably for 1,000 hours (no scheduled maintenance activities)
- Able to reach the sluicing pump silo when the headroom has reached a height of 23 feet
- Perform waste retrieval activities in operating temperature ranges of 32°F to 100°F with a humidity range of 10-100% humidity
- Manage, as a minimum, a 200 lb. payload (includes GEES and ADSS weight)
- Provide a maximum horizontal-reach of 42' from on-center riser access location to effectively reach the silo walls
- Provide a maximum vertical-reach of 42' from the bottom of the deployment tower to effectively reach the entire silo floor
- Capable of remaining in the silo between operating shifts to minimize insertion/retraction times and maximize in-silo operating periods

This system, when combined with the z- and azimuth-drives located in the deployment tower, results in a manipulator with sufficient dexterity and lifting capability to carry out operations required for successful mission completion. The manipulator's mechanical behavior is based on the actuation of stages (all stages are controlled with steel cables and connected via termination segments; the bending moment is transmitted from segment to segment via elastomeric couplings). There are 5 stages in the manipulator that have 9 total segment. Stages 1-3 are constructed from a single segment. Stages 4 and 5 are constructed from 3 segments. When a single stage is actuated, all three segments in the stage go through similar motion (for example, the motion of stages 1, 2, and 3 are coupled, and putting stage 3 in motion also applies force to stages 1 and 2 which puts them in motion. Putting stage 2 in motion would put stage 1 in motion, but would not affect stage 3). This reduces the force requirements of the actuators for the first segments.

The drive cables for stages 4 and 5 are isolated from the previous stages by conduit, thus actuating these stages does not affect the previous stages other than changing the transmitted movement due to gravity. The drive cables for stages 1, 2, and 3 are not housed in conduit, so the forces applied to one stage are transmitted back to the previous stages. This reduces the overall cable tensions required to lift the manipulator, but also requires the use of back tension to prevent undesired motion of previous stages. This means that an additional cable is run

opposite to the main cables to provide the control of the position of all of the stages despite the fact that they are coupled.

Manipulator Segment Components—The segments contain cable routing bushings, bushing mounting fittings, and connection fittings. The cable routing bushings are constructed of hardened steel to reduce wear on the bushing surfaces as the actuation cable passes through the bushing.

The bushing mounting fittings provide ease of assembly and maintenance. These fittings are affixed to the exterior of the segments, and allow easy cable removal and insertion. These fittings transfer the load from the guide bushings to the structural components of the segments. The connection fittings enable the transfer of both compression and torsion. In stages 1, 2, and 3, segment structure is designed to take these loads through separate load paths.

Stages 1 through 3- The first three stages of the manipulator provide the basic positioning and major lifting capacity of the system. These stages are rather specialized in that they are designed only to provide motion in one direction (1 DOF). Stages 1, 2, and - 3 are 132 inches and each weigh approximately 1000 pounds.

Stage construction is accomplished through a thick curved backplate and an aluminum honeycomb structure that provides support against the guide bearing and is resistant against the shear, compression, and torsional forces experienced in the segments. Plates at the end of the segments contain the bushings and hinges that are used to link stages, attach cables, and rout cables through the segments. Umbilicals, conduit, and cable for stages and end tooling located farther down the arm are routed through the sides of the segments. This area is accessible through hatches in the outer shell of the segments.

Stages 1, 2, and 3 use couplings that restrict movement to one degree of freedom. Each of these stages uses a rotational hinge joint.. A hard stop will limit the rotation between an angle of 0 and 45(or 60) degrees with respect the to vertical axis. As a result, the stage can only bend in one direction and cannot reverse its direction of bend as is possible in the universal stages (stages 4 and 5). This significantly simplifies the kinematics of the system and allows for more accurate tracking of the position of the first three stages. This also allows for the addition of simple and robust encoders on the manipulator that will further increase the accuracy of the forward kinematics calculations.

No conduit is used in the first three stages, so cables actuating distal stages affect the dynamics of the preceding stages. Termination segments for proximal stages act as pass through segments for more distal stages. The result is that the more proximal cable sets do not need to pull with as much force because distal cable sets are supporting a significant amount of the weight of the manipulator. However, proximal cable sets will be sized to support the full weight of the system in the event of a cable failure.

Stages 4 and 5- While stages 1, 2, and 3 are intended to provide the basic positioning of the manipulator, stages 4 and 5 are designed for finer positioning of the end effector. These stages are intended to bend in all directions and are isolated from other stages through the use of conduit. Stages 4 and 5 of the arm use elastomer 2 DOF couplings to provide the bend in the stage. Unlike the joints in stages 1, 2, and 3, these couplings are free to bend in any direction. These stages rely on the flexing of elastomer cylinders to provide bending capabilities. The use of conduit effectively isolates the cables used to drive these stages from

the motion of the previous stages. Stages 4 and 5 do not aid in the lifting of any of the other stages.

Wrist- The wrist sockets into the termination segment of stage 5). The cable assemblies are routed through the length of the manipulator and finally into the central segment member where they meet the main portion of the wrist. The wrist provides roll and pitch motion for the GEES.

A flexible protective covering (sheath) will surround the wrist and protect the gripper umbilicals. Additionally, the umbilical section at the wrist will be fitted with quick disconnects for easy replacement.

The wrist is designed in accordance with the following design criteria:

- Maneuver, at a minimum, a 200 lb. payload
- Provide roll motion of up to ±180°
- Provide pitch motion of up to ±60°
- Withstand the radiation and humidity expected in the silo environment
- Withstand operations in temperature ranges of 0°F to 110°F

The wrist design will include two electrical motors that use a gearbox to provide the drive for the roll and pitch axes. This will provide the torque and speed requirements of the application, and will be protected from the silo environment through the use of a sheath. A device that can de-couple the motor from the roll and pitch axes will be used to ensure that a wrist position that will allow for the extraction of the EMMA™ from the silo in an emergency situation can be maintained. The roll of the system uses a slip key system, which will easily allow for the +/- 360 degree rotation. Electrical trigger switches will be used for the end of travel. Drives for the electrical motors will be contained in the actuation package.

4.1.2 Bulk Retrieval System (BRS).

The majority (approximately ninety percent) of the silo waste is removed by sluicing using the BRS. Bulk retrieval of the silo waste material is accomplished by a sluicing nozzle and a slurry pump (these items are approximately 50-feet apart in the silo). The operators to all the systems' control valves are electric and controlled normally from the control trailer and also from local control panels. Sluicing fluid comes from the TTA Decant Pumps. Initially, the sluicing nozzle is directed as close to the Slurry Pump inlet as possible to create a slurry pool (6-foot diameter by 1½ to 3-feet deep) and form a cavity for slurry to flow into. The Slurry Pump is lowered into the cavity and turned on when sufficient submergence has been achieved. Additionally, the sluice water can be directed to the slurry pump and the pump operated in reverse to assist in developing a slurry pool, as well as to backflush the screened intake. The slurry pump also has a high pressure water jet ring at the pump suction which can blast hard material into a pumpable slurry. The sluice nozzle then begins cutting a vertical "canyon" into to the silo waste, pushing it towards the pump. The width, depth, and length of the "canyon" will be increasing while trying to minimize the diameter of the slurry pool around the slurry pump (See Section 2 for Mining Strategy details). After each day's sluicing operations, the slurry line, slurry pump, sluicer line, and sluicer are back flushed with decant water then rinsed with filtered water. If plugging occurs during normal operations, the decant water to the sluicers is directed into the slurry line to clear the pluggage.

As the waste in the silo is lowered, the slurry pump is periodically lowered further into the tank, until it reaches the bottom. As the pump is lowered, liquid-level instrumentation mounted on the pump is monitored to ensure proper submergence before the pump is started to avoid cavitation and minimize plugging. The pump is also fitted with a lower-travel-limit switch that prevents it from being driven into solid K-65 material.

The pump has a discharge pressure gauge, and a coriolis effect mass flowmeter. The mass flowmeter measures the slurry mass flow rate and density. It is equipped with a "net flow" computer that converts instrument measurements into a total mass of solids transferred through the slurry line. The mass flow rate and density measurements are used to maintain the critical solids loading in the slurry line. The measurements are necessary to ensure the slurry transfer pipeline flow is in the turbulent flow region to prevent plugging. The accuracy of the flowmeter at the nominal process solids loading (10 to 20 weight percent) and volumetric flow rate (300 to 350 gallons per min) is estimated at ± 0.11 percent. If the solids weight percent increases either sharply or on an increasing trend, sluice water is injected directly into the slurry transfer line to maintain the target solids content and to help ensure solids do not settle.

The sluicing nozzle is also lowered periodically as the waste level is decreased. Lowering the sluicing nozzle allows EMMA™ to operate freely in the upper tank dome area and perform other tasks like dome and upper wall washing without being impacted by the large sluicing nozzle waterjet. Lowering the nozzle also increases waste mobilization efficiency by attacking the waste at a more direct angle and shorter distance. The sluicing flow is matched with the slurry pump discharge rate to achieve a steady state of slurry in the silo. The normal operating range is between 300 to 350 gallons per minute. The sluicer is equipped with pan and tilt capability for fine control of angle of attack.

There may be times that the sluicing nozzle is not adequate to break up the waste. The EMMA™ assists the large sluicing nozzle with its smaller (½-inch) sluicing nozzle integrated into the arm. This allows a focused stream to be applied close to the waste. EMMA™ has a second nozzle set for a wide spray to gently and quickly washdown the tank walls, dome, and floor. The fluid for this sluicing and washdown comes from the Filtrate Storage Tank using the high-pressure pumps. The sluicing operation continues until the Slurry Pump can no longer continue pumping slurry because of head limitations or cavitation occurs because it is at the silo floor.

4.1.2.1 Sluicer

The sluicer's nozzle is approximately ¾-inches inside diameter and is normally operated at 150 pounds per square inch and 300 gallons per minute that creates a sluicing stream velocity of approximately 140-feet per second. The nozzle is remotely articulated from the control trailer in an automatic or manual mode to allow for both vertical channel cutting or horizontal sweeping as necessary. The sluicer has a ±170° horizontal rotation and a +100° and -5° vertical rotation capability from the six o'clock position. As the level of the waste decreases, the sluicer is lowered to achieve the proper angle of attack on the waste. Sections of mast containing sluicing piping are manually added with the assistance of a hoist to raise and lower the nozzle. The fine adjustment of the nozzle elevation is accomplished by the mast hoist in the sluicer enclosure. The mast hoist is normally operated from the control trailer, but may also be operated locally when adding or removing sections.

4.1.2.2 Sluicer Enclosure

The sluicing deployment system is housed in a Sluicer Enclosure. The enclosure measures approximately 6-feet × 10-feet × 20-feet high. The enclosure serves as secondary containment and drains to the silo. It weighs approximately 15000 pounds, has several glove port panels, an 11-feet × 3-feet access door and a 2-feet × 2-feet pass through.

The weight of the sluicing system is supported off the silo bridge platform. The sluicing system is connected to the silo by a flexible coupling or bellows that allows for small vertical or horizontal bridge platform movement without inducing stresses to the silo.

When the sluicer is no longer needed, it is removed from the silo while being decontaminated by a high-pressure spray ring that is mounted on top of the riser flange then passed through a radiation-monitoring ring. Manual washing with a spray wand occurs through the glove ports as the equipment is removed to ensure the equipment is properly cleaned. Water to the spray ring and manual spray wand is filtered water and comes from the high-pressure decontamination pump. The sluicer has a large interface flange on one end for mating to the SDRS. During sluicing, the interface opening is covered by a panel. After sluicing, the panel is removed and the SDRS is bolted to the sluicer interface flange. The sluicer mast sections are stored and the mast support table is unbolted and moved away from the silo riser opening allowing the SDRS to access the riser for its retrieval operations.

4.1.2.3 Slurry Pump

The slurry pump is a progressive cavity pump with a capacity of 500 gallons per minute of water at 100 pounds per square inch of discharge pressure. Normal operation of the pump is expected to be approximately 350 gallons per minute and 80 pounds per square inch. The pump is approximately 13 feet long, including gear motor drive, with vertical profile dimensions of 19.5 inches by 15-inches. The pump weighs approximately 2300 pounds. The pump housing is cast iron. The stator is Buna-n and the rotor is hard-coated stainless steel. A strainer basket is mounted on the suction of the pump with a ½-inch mesh size. The pump is supported from one or two 12-foot-long mast sections. The mast sections contain piping or hoses for the slurry discharge, flush water, SREE utilities, and heel waste retrieval jet pump. The drive motor is variable-speed (0 to 250 revolutions per minute) and approximately 50 horsepower. The motor and pump assembly is mounted on a vertical positioning table that is raised and lowered by an open loop, remotely controlled, single-speed AC drive motor. When the pump is lowered to the bottom of the table's travel, the assembly is manually secured and disconnected from the table; the table is raised and a new section of mast is installed. A level instrument remotely displays the table's elevation. The pump has liquid-level and lower-travel-limit instrumentation that indicates when the pump has been adequately submersed in the slurry to avoid cavitation, and prevents driving the pump into solid K-65 material. The total weight of the slurry pump system, support equipment, and enclosure is estimated at approximately 18,000 pounds.

4.1.2.4 Slurry Pump Enclosure

The slurry pump deployment assembly is housed in a Slurry Pump Enclosure. The enclosure measures approximately 9 feet wide × 18 feet long × 20 feet high. The enclosure serves as secondary containment and drains to the silo. The enclosure has a horizontal sliding carrier that assists with pump and mast section assembly, and stowage. The enclosure has multiple glove port panels, an 10-feet × 3-feet access door, and a 2-feet × 2-feet pass through. The

enclosure is designed to store the slurry pump equipment and is used as containment while transferring the equipment between the silos and to the TTA tanks.

The weight of the Slurry Pump System is supported off the silo bridge platform. The Slurry Pump System is connected to the silo by a flexible coupling that allows for vertical or horizontal bridge platform movement without inducing stresses to the silo.

When the slurry pump is no longer needed, it is retracted from the silo while being decontaminated by a high-pressure spray ring that is mounted at the bottom of the enclosure. Manual washing with a spray wand and radiation-monitoring occurs through the glove ports as the equipment is removed, to ensure the equipment is properly cleaned. Water to the spray ring and manual spray wand is filtered water from the high-pressure decontamination pumps.

4.1.2.5 Slurry Transport Pipeline

The slurry transport pipeline is routed overhead from the waste silos to the TTA. The slurry transport pipeline is a pipe-in-pipe design that provides for secondary containment. The slurry transport pipeline is provided with freeze protection and instrumentation to detect leaks into the secondary containment, and monitor pressure drop and slurry density. The slurry transport volumetric throughput is designed to maintain a minimum velocity to deter solids settling. The pipeline is sloped to the TTA from the support bridge to allow self-draining.

The slurry transport pipeline terminates at a valve box centrally located to the waste storage tanks and the slurry is discharged into the TTA storage tanks. The lines are designed to vent on low pressure to eliminate any siphon effects. The lines are also provided with a highpoint vacuum breaker to ensure drainage.

4.1.3 Conditioning And Transfer System (CATS).

The waste that remains in the silos upon completion of the bulk retrieval process is called the heel. The heel may consist of remaining liquids, decant that is below the NPSH of the slurry pump, soft residue, hard residue, and any agglomerated waste piles. The CATS consists of a heel tank and slurry pump assembly, SREE, hose management system, and EMMA™ System.

When bulk retrieval is complete, the slurry pump is removed from the silo. A SREE cradle is manually lowered into the silo and placed on the bottom by EMMA. With the pump removed, the pump inlet screen is replaced with a cap that creates a heel waste surge tank. Then the SREE is attached to the end of the CATS hose bundle and is lowered down the slurry pump's riser. The jet pump is then installed into the hose bundle. The hose bundle hoses are connected to the heel waste surge tank before it is inserted into the silo. The slurry pump tank assembly is then lowered until it reaches the bottom of the silo. The sluicer from the bulk retrieval system is removed and an SDRS is installed in the riser. The SREE is grasped by the EMMA™ gripper and manipulated to mobilize and remove the remaining heel. A waterjet pump provides the motive force to pump the waste through the discharge hose and into the heel waste surge tank. The water for the jet pump and SREE comes from the filtrate storage tank using the high-pressure pumps. Approximately 200–250 gallons per minute of sluice tank water is directed into the heel waste surge tank and comes from the decant pump. When the jet pump is started, the slurry pump is turned on and the waste is transferred to the TTA tanks. A continuous flow of sluice water is maintained into the surge tank to ensure that the slurry pump maintains a continuous flow through the slurry transport line at the appropriate velocity to minimize potential for line plugging. The water and waste added to the hopper by the SREE

and waterjet are then transported by the slurry pump along with the sluice water flow. The heel waste surge tank uses the same level detection device used by the slurry pump during bulk retrieval. This level data is used by the operator to maintain the tank level by adjusting the slurry pump speed.

When the heel removal activities are completed for the day, the slurry pump, the slurry line, decant line, and SREE are flushed with decant water and then rinsed with filtrate water.

4.1.3.1 Heel Waste Surge Tank

The heel waste surge tank receives the waste from the SREE and the decant supply line to vent out the air that was entrained in the waste mixture from the SREE and jet pump.

The heel waste surge tank has approximately a 200-gallon capacity and is located under the slurry pump to create a reservoir from which the slurry pump can pump. It is equipped with level instrumentation, sluice water addition, slurry pump suction piping, and a vortex plate.

When the heel has been removed, the surge tank, slurry pump, and mast sections are removed from the silo while being decontaminated by a high-pressure spray ring that is mounted at the bottom of the slurry pump enclosure. Manual washing with a spray wand and radiation-monitoring occurs through the glove ports as the equipment is removed to ensure the equipment is properly cleaned. Water to the spray ring and manual spray wand comes from the high-pressure decontamination pump.

4.1.3.2 Silo Retrieval End-Effector (SREE).

The SREE consists of three rotating jets that are used to locally slurry material and direct the slurry to a central inlet that has a 2-inch-diameter. The nozzles operate at up to a maximum 10000 pounds per square inch at approximately 10 gallons per minute. Water to the nozzles comes from the SREE high-pressure pump. To vacuum the slurry out of the central inlet port, a radial waterjet pump is integrated as close to the SREE as possible. The jet pump requires approximately 10000 pounds per square inch of water at approximately 10 gallons per minute. Water to the nozzles and jet pump comes from the SREE high-pressure pumps. The basic premise of the waterjet pump is that three radial waterjets are placed such that they converge in the discharge nozzle of the jet pump, thus creating a vacuum (for a short distance). The slurry from the SREE inlet port is vacuumed into the three jets, at that time it is then pressurized and "pushed" through the jet pump discharge nozzle and into the heel waste surge tank.

A flexible skirt design is used on the SREE to confine spray when operating on hard surfaces at higher pressures during final floor cleaning. This reduces mist generation and its impact on performance of visual surveillance systems.

The SREE has flow passage geometry and a vacuum relief to maintain airflow in the event of a plugged inlet, thereby preventing settling in the conveyance line. The conveyance line has backflush capabilities to clear any plugs.

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4.1.4 Silo Debris Retrieval System (SDRS).

When the bulk waste retrieval is complete and the heel retrieval process is underway, there will be debris such as plastic bottles and metal pipe sections at the bottom of the silo. The SDRS removes this waste.

The debris will fall as the waste level falls and will be left on the silo floors. The in-silo SDRS consists of a steel cage basket and hydraulically actuated waste size reduction tool. EMMA™ places large debris, such as pipes that will not fit in a debris basket, into the waste size reduction tool. Following size reduction, EMMA™ places the smaller pieces into a debris basket. The basket is washed using the EMMA™ spray nozzle, lifted into a decontamination spray ring station, passed through a radiation-monitoring ring, and lifted into a packaging enclosure. If the debris is not sufficiently decontaminated a second washing in the spray ring or manual wand washing is executed.

The baskets are then raised into the SDRS enclosure, where they are automatically loaded into 30-gallon drums by a hoist system. When a drum is filled, a worker in Personal Protective Equipment enters the SDRS enclosure to seal the drum. The entire process is automated except for the final tightening of the 30-gallon drum lid bolt and the installation of a new 30-gallon drum in the enclosure load-in station. One end of the SDRS enclosure has a flanged interface opening covered by a removable panel. When sluicing is finished, the panel is removed and the SDRS is mated to the sluicer to allow access to the sluicer's silo riser.

4.1.4.1 Waste Size Reduction Equipment

The waste size reduction equipment consists of water hydraulic powered shears. The hydraulic power supply remains in the debris removal system enclosure and the shears are located in the silo. Operation of the cutting device is performed remotely from the control station.

4.1.4.2 Silo Debris Retrieval System Enclosure

The debris removal system enclosure houses the lifting hoists, manual spray wash station, 30-gallon packaging equipment, and all waste removal support equipment. It serves as secondary containment and drains to the silo. It is supported by the silo bridge and connects to the silo by a flexible coupling or bellows through the same opening as the sluicer.

The SDRS enclosure is fabricated from a standard 20-foot International Standards Organization (ISO) container modified with a double door for ease of ingress and egress. The doors are airtight. A teleoperated ½-ton hoist assembly is installed onto the roof of the container. Racks and clips are provided to hold the debris baskets and drums in position.

4.1.4.3 30-Gallon Drum Packaging Equipment

The packaging equipment consists of a hoist system that offloads the waste baskets into a 30-gallon drum. This system is fully automatic except for unloading of a full drum from the silo, loading of a new drum in the load-in station, and clamping the lids on the containers. A grasping bridle mechanism will grasp the top ring of the baskets. This allows the winch bridle to pick up an empty basket, and set it into the drum after filling. This bridal mechanism is also designed on the top to prevent anything catching on the manway protective cover as the basket is hoisted up. The waste basket is steel mesh and not reusable. A new basket is used for each retrieval effort. A pan and tilt camera mounted on the wall provides full-room coverage, and a second

camera mounted on the hoist provides the view necessary to see down the manway and into the basket.

4.2 Radon Control System (RCS)

The Radon Control System (RCS) receives gas streams from the following sources:

- Silos 1 and 2 (including during decontamination of the silos),
- Silo Waste Retrieval System (SWRS),
- Decant Sump Waste Retrieval System (DWRS),
- Transfer Tank Area (TTA) System,
- Transfer Tank Area Waste Retrieval System (TWRS), and
- Future Waste Treatment Facility.

The RCS is designed to remove radon-laden air from the various system components, reduce radon releases to the atmosphere, detect and measure releases to the atmosphere, and mitigate system upsets. Contaminated gases removed from the sources described above are drawn through the RCS by redundant centrifugal fans. The fans and ducting system are designed to prevent over or under pressurization of the silos and transfer tanks beyond +0.5 inch water gauge (WG) and -2.0 inch WG. The ducting system recirculates process air through the system during certain operational phases, while maintaining the required silo and tank pressures. The ducting system is balanced using a redundant programmable logic control (PLC) system that monitors the prevailing pressure and volumetric air flow conditions. The control system automatically controls fan speeds and the damper system. The automated damper system discharges air from the system, draws fresh air into the system, and isolates process areas, as required to maintain the appropriate operating conditions. 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 ventilation of 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 before entering a 95%-efficient ASHRAE roughing filter (FLT-20-001A and FLT-20-001B) for particulate removal.

Upon exiting the roughing filter, the ventilation air enters a desiccant drying system (DDS-20-001A and DDS-20-001B) at 90°F and 100% relative humidity where the air stream is cooled and dehumidified to 40°F and 15% relative humidity . This conditioning of the ventilation air in the desiccant drying system is achieved by using a precooling coil, regenerative desiccant wheel, post-cooling coil, closed loop reactivation system, and a condensate collection and transfer system. The precooling coil cools and dehumidifies the ventilation air to a stream that is 55°F saturated air. From the precooling coil, the air flows through a desiccant impregnated wheel where the air is dehumidified. The temperature of the air exiting the wheel is 98°F with a moisture content of 5 grains per pound (moisture content that corresponds to 15% relative

humidity and 40°F). Ventilation air from the desiccant wheel flows through a post-cooling coil where the air is cooled to the target temperature of 40°F before exiting the desiccant drying system. Refrigerant streams for cooling coils within the desiccant drying system are provided by a chiller located outside the RCS building. Redundant chilling/desiccant systems are provided to ensure continuous availability. The desiccant wheel has a closed-loop reactivation system for regeneration of the desiccant. This reactivation system includes a blower, heater, and condensing coil. The gas is cooled and dehumidified to enhance the dynamic adsorption capacity of the activated carbon.

Condensed liquids from the desiccant drying system are transferred to a 3000-gallon hold-up tank (TNK-20-002A and TNK-20-002B) by a condensate pump located within the desiccant drying system. The liquid is held for as much as 40 days to allow for radon decay. Subsequently the liquid is dispositioned by a transfer pump (PMP-20-001A and PMP-20-001B) in one of two ways:

1. Transfer to the TTA Distribution Equipment Enclosure for subsequent distribution to one of the four Transfer Storage Tanks.

2. Transfer to the Advanced Wastewater Treatment (AWWT) Plant after sampling, analysis, and radiological survey indicate the condensate meets the waste acceptance criteria (WAC).

The chilled/dehumidified ventilation air stream exiting the desiccant drying system flows to the carbon adsorption units (CBD-20-001A, CBD-20-001B, CBD-20-002A, and CBD-20-002B). The carbon adsorption system consists of four beds (two government-furnished equipment and two new) and contains a total of 160,000 pounds of carbon. The four carbon beds are operated in parallel. 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 design flow for the RCS system is 1000 cubic feet per minute. Ventilation airflow rates and sources vary during different phases of RCS operation. The modulating dampers provide for flow distribution among the beds. Each carbon bed is physically isolated. The treated air stream through each carbon bed is monitored individually for radon. In the event that elevated levels of radon are detected downstream of a carbon bed, the airflow through the affected bed will be reduced by adjusting the automatic air damper on the inlet side of the carbon bed. If performance of the bed continues to degrade, the motor operated damper downstream of the affected bed will be closed automatically and the airflow will be redistributed through the other carbon beds.

In the event a carbon bed needs to be dried, the RCS has the capability to isolate the individual bed from the others. A take-off stream from the recirculation fans will be heated and passed through the affected carbon beds using and induced fan (FAN-20-003). From this fan the drying air stream is transferred to the RCS system for treatment in the carbon beds that remain on line.

The treated gas stream flows from the carbon adsorption units through a redundant high efficiency particulate air (HEPA) filtration unit (FLT-20-002A and FLT-20-002B) before entering the redundant Recirculation Fans (FAN-20-001A and FAN-20-001B) for redistribution to the silos or exhaust through the monitored stack (STK-20-001). The HEPA filtration system employs bag-in and bag-out features to minimize the potential of releases during filter changes. The stack is provided with an isokinetic sampling system and will include monitoring for both particulate radionuclides and continuous monitoring for radon. 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, or reducing the airflow in the RCS system. 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.

The RCS PLC is provided with software that is compatible with the overall process control system through a networking software package (Siemens POFIBUS or other suitable technology). The RCS PLC human-machine interface computer exhibits the following software capabilities:

- Scanning the input and output signals received by each of the individual unit operations.
- Providing input data to registers at each individual unit operation controller to enable or disable control functions at the respective unit operation controller.
- Providing graphic screens that display the relevant operating parameters and status of the individual unit operations controlled by the RCS PLC, as well as the complete process control system as a total.

The PLC programming is designed to:

- Automatically monitor and control the unit operations within the RCS operating system to ensure correct operating conditions are maintained.
- Automatically switch between redundant process trains when operational, maintenance, or mechanical problems occur.
- Initiate carbon bed isolation and/or recirculation mode upon detection of an out-of-parameter radon level from radon monitoring instrumentation.
- Enunciate warning status alarms to inform operational personnel that conditions exist that are within acceptable design parameters but outside desired operating conditions.
- Enunciate emergency status alarms and automatically initiate system shutdown if conditions exist that are outside design parameters (e.q., unrelieved high-pressure in silos).

Alarms are enunciated at both the local PLC interface and at the overall process system control interface. Backup power is provided by an Uninterruptible Power Supply (UPS) to all control system components to ensure uninterrupted operation.

The RCS building has a partial second-story and a nominal footprint of 30-feet by 146-feet. Outside the RCS building, there is an exterior pad upon which a set of redundant chillers is installed. The RCS building is separated into two areas, one containing the carbon beds and one containing the process equipment. These two areas are separated by a concrete partition wall that is 24- inches thick. The air conditioning area contains the roughing filters, desiccant drying systems, condensate hold-up tanks, and condensate transfer pumps associated with the cooling and drying operations that are being performed in this area. The air conditioning process train is redundant to allow for maintenance activities on one train while the other operates. The air conditioning process trains are separated by a 12-inch concrete shielding

wall. The operation of equipment located within the air-conditioning vaults will be cycled on the basis of maintenance, mechanical, and operational considerations. The carbon bed area is shielded by 24-inches of concrete. The air conditioning areas are shielded by 12-inches of concrete.

Space is provided to perform maintenance on all equipment. A nominal 1 foot of concrete shielding is provided between each set of redundant equipment to account for radon that may be absorbed and trapped in the condensate, and radon daughters that may be deposited on any of the internal surfaces of the process system. Separate access is provided for each equipment train.

The building heating and ventilation system for the interior space of the RCS building is a once through system. The H & V system is comprised of separate supply and exhaust systems. The ducted supply air system draws outside air into the building by the RCS building supply fan (FAN-77-003). The outside air enters through a filter (FLT-77-001) that reduces the amount of particulate loading in the intake system. An electric duct heater (HTR-77-012) heats the supply air when the outside temperature falls below design conditions.

Redundant centrifugal Building Ventilation Exhaust Fans (FAN-77-001A and FAN-77-001B) ventilate the interior space of the RCS building. The fans and ducting system maintain the RCS building at a negative pressure. The RCS building ducting system is manually balanced. The direction of airflow is from areas of low potential contamination to areas of higher potential contamination. The prevailing pressure of the carbon bed area and the air conditioning area is monitored. The Building Ventilation Exhaust Fans maintain an induced draft (negative pressure) throughout the RCS Building, and are located downstream of redundant HEPA filters (FLT-77-002A and FLT-77-002B). An emergency generator in conjunction with the redundant fans, chillers, carbon beds, HEPA filters, and PLCs provide the 100% availability requirement.

A separate exhaust register is supplied to each carbon bed area to extract ventilation air in the event of a leak of radon into the carbon bed rooms. This air is transferred to the RCS system for treatment via the carbon bed drying line.

The redundant HEPA filters and fans for the RCS and for the RCS building ventilation are mounted in a pre-engineered structure located over the air conditioning areas. The stack (approximately 150 feet above grade) is also mounted on the concrete pad.

The RCS is used in five phases:

- Phase 1 Silo 1 and Silo 2 Headspace Reduction
- Phase 2A Silo 1 Retrieval, Silo 2 Headspace Reduction, TTA Ventilation
- Phase 2B Silo 2 Retrieval, TTA Ventilation
- Phase 2C TTA Ventilation
- Phase 3 TTA Ventilation, Future Waste Treatment

The functional description of the various phases is provided in the following paragraphs.

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4.2.1 Phase 1 - Radon Control in the Silo Headspaces

During Phase 1, the ventilation air is withdrawn from Silos 1 and 2 and transferred to the Radon Control System. The treated ventilation air is returned to the silos for sweep ventilation. The desired pressure conditions are maintained by using an automatically controlled fan and damper system. The RCS will continue to operate in this scheme until the radon concentration in the silo headspaces has been reduced to a concentration that will allow safe access for work activities in the silo area. The following paragraph provides details for this phase.

The air from the two silos is pulled out by one of the down stream redundant recirculation fans, FAN-20-001A or FAN-20-001B, through an existing opening in the top of the silos. The air from each silo passes through the respective damper, LVR-20-001 or LVR-20-004 that serves to help maintain a negative pressure (vacuum) in each silo. The air passes through one train of the redundant roughing filters and desiccant drying systems FLT-20-001A, FLT-20-001B and DDS-20-001A, and DDS-20-001B, respectively. Within the desiccant drying system the air stream is conditioned to 40°F and approximately 15% relative humidity. The air then passes through the carbon beds, CBD-20-001A, CBD-20-001B, CBD-20-002A, and CBD-20-002B. The beds are operated in parallel. Air leaving the carbon beds passes through one of the redundant HEPA filters, FLT-20-002A or FLT-20-002B, and then to one of the redundant recirculation fans, FAN-20-001A or FAN-20-001B. A tee in the flow path before the exhaust fans provides makeup air to the closed air system through damper LVR-20-015. Damper LVR-20-020 allows recycled air back to the active fan. This allows the fan to run near its rated speed (in revolutions per minute) to reduce strain and thus potential maintenance on the system. A tee in the flow path after the exhaust fans allows excess air to exit the system to the stack through damper LVR-20-016. This configuration allows the flow path of the air to:

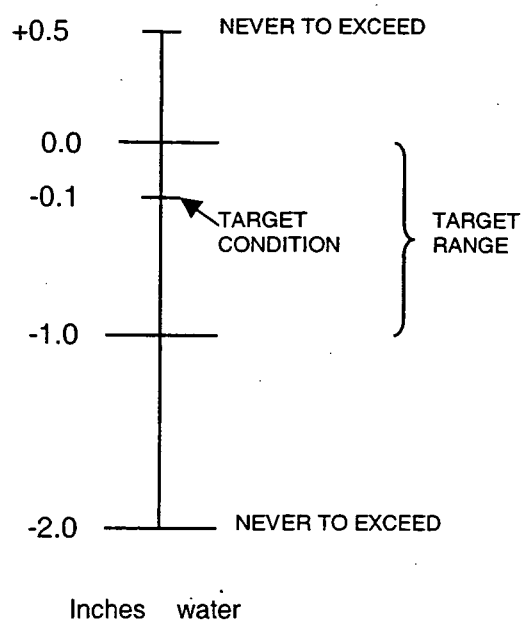
- Return to the silos,
- Be exhausted to the stack,
- Be modulated to reduce total flow through the entire system, and
- Allow fresh air makeup to take place.

Dampers LVR-20-001 and LVR-20-002 work in conjunction with dampers LVR-20-003 and LVR-20-004, respectively, to maintain the desired pressure conditions in each silo. These dampers are motor-operated devices and are operated in a master and slave arrangement. Dampers, LVR-20-001 and LVR-20-002, are designated as the master devices and generally provide full authority to modulate the silo pressure. During periods of system flux or other transient episodes the dampers, LVR-20-003 and LVR-20-004, offer additional control in the event the other dampers exhaust their full range of authority before the target pressure is attained.

The silos are further protected from an out-of-parameter pressure condition by two methods. In the event that a positive pressure spike remains unmitigated before attaining the desired condition, the supply is terminated and the system briefly goes into return-only mode to damp the spike. Subsequently the supply is bled back online and the desired condition is restored. Additionally, the silos are protected by pressure and vacuum relief devices. These devices provide the final relief from over-pressurization and under-pressurization. In an over-pressurization condition the device allows flow out of the silo. The effluent is routed back into

the return line that has been put into a return-only mode as described previously. In an under-pressurization condition the device allows fresh air in and thus relieves the condition. Any 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 issues so that operational adjustments can be identified and implemented.

The normal operating target pressure is –0.1 inches water gauge. The targeted range of operation is from 0.0 to –1.0 inches water gauge. The control system responds to maintain the target condition. Normal operations occur within the targeted range. Excursions beyond the targeted range are mitigated as discussed. The control devices, control strategy, and the pressure and vacuum relief mechanism ensure the "never-to-exceed" values.



Entry of the supply air into the silos is achieved through an opening opposite the one through which the air exited. By using opposing openings for the inlet and outlet airflow, and using a diffuser integrated into the silo supply opening, the flushing of the radon-laden air from the silos is maximized.

4.2.2 Phase 2A, 2B - Radon Control during Material Transfer

When 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. Silo 2 continues to operate as before in Phase 1.

At the start of Phase 2A, the damper in the supply air duct to Silo 1 (the first silo to be emptied), LVR-20-003, closes automatically upon opening of the automatic dampers on the enclosures. Inlet air for Silo 1 is provided directly through the three manways used in this phase for:

- Sluicing,
- Slurry Transfer, and
- EMMA™ Operations.

Each manway is served by a secondary containment, that is attached to the opening using a seal arrangement that avoids placing any load on the silo dome. The enclosures are structurally supported by the moveable bridge that is positioned first over Silo 1 and subsequently over Silo 2. Each of the three enclosures has an air inlet equipped with a roughing filter, HEPA filter, automatic damper, and flowmeter. 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.

At the inception of Phase 2A, the TTA is tied 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 waste transfer tanks by modulating dampers. The filtrate storage tanks and the sample station tanks are vented to the RCS system. 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 those tanks can be reduced but not eliminated. During material retrieval activities of Silo 2 the active waste storage tanks are TNK-12-002A and TNK-12-002B. The majority of the TTA flow is committed to them.

At the beginning of Phase 2B the material retrieval activities shift to Silo 2, Silo 1 activities having been completed and ventilation of Silo 1 is stopped. The bridge is positioned over Silo 2 and material retrieval activities ensue. The ventilation strategy of Silo 2 during retrieval activities is identical to that of Silo 1. During Phase 2B, the increase in the availability of ventilation air, paused by stopping flow to Silo 1 increases the ability of the RCS to better control radon from other sources.

At the conclusion of Phase 2B, ventilation of Silo 2 is discontinued and the decant sump waste retrieval begins. During this activity (approximately one week duration) the modified sluicer module will be used to retrieve solid and liquid wastes from the decant sump. As in Phase 2A and Phase 2B operations, the module enclosure provides the ventilation air for the decant sump. A temporary holdup tank used to receive decant sump wastes will also be vented to the RCS system. Because of the transient nature of this operation, steady-state material balances were not required but RCS system ventilation is balanced accordingly.

4.2.3 Phase 2C - Radon Control During Interim Storage

At the conclusion of the material retrieval campaigns the Radon Control System ventilates various TTA components as required. Limited air flow can be maintained through TTA components during this phase. The system 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 2 feet of water on top for shielding that reduces the radon release to the headspace.

4.2.4 Phase 3 - Radon Control During Future Material Treatment

During Phase 3, the RCS accommodates an airflow of 500 cubic feet per minute from the future treatment system in addition to the design flow of 500 cubic feet per minute from the TTA. 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. Input from the waste treatment system would not ordinarily be accepted during periods of recycle. Airflow through a TTA waste storage tank could be discontinued after transfer from that tank to the Future Waste Treatment Facility is complete.

4.3 Decant Sump Waste Retrieval System (DWRS)

The Decant Waste Retrieval System (DWRS) will retrieve the waste from the Decant Sump located just west of and between the silos. The Decant Sump is a carbon steel, 18-foot-long, 9-

foot-diameter cylindrical tank with dished ends. The tank is buried horizontally with a 20-inch opening centered at the top or the tank. A 30-inch corrugated manway centered over the 20-inch opening extends approximately 33 feet to the ground surface.

Before silo recovery is initiated, a submersible pump and level indicator will be lowered into the 20-inch opening. The pump and level indicator will remain in the Decant Sump throughout the Silo 1 and 2 retrieval campaigns. If the Decant Sump's level rises during SWRS operations a tanker truck will be mobilized and the liquid will be pumped from the Decant Sump into the tanker truck. The pumping system will have the capability of removing liquid at the rate of 50 gallons per minute and at all times keep the liquid-level below the 70% fill level.

The berm soil above the Decant Sump will be excavated during SWRS operations from an elevation of 603 feet to 586 feet, leaving approximately16.5 feet of ground cover above the Decant Sump. A concrete pad will be poured around the riser to support the retrieval equipment. The retrieval method will be similar to the bulk retrieval method used in the SWRS with the exception that, because of the small amount of waste and small size of any expected debris, a mechanical arm will not be deployed. The sluicer will inject filtered water at a rate of 40 gallons per minute into the Decant Sump to create a slurry. A jet pump will retrieve the slurry from the Decant Sump and pump it into an atmospheric holding tank at a rate of approximately 44 gallons per minute. The jet pump will use 10 gallons per minute of high-pressure filtered water as its motive force. The hold-up tank will at the same time be receiving decant water from the sluicing header used during SWRS operations at a rate of 300 gallons per minute. The slurry will be mixed, deairated and pumped out of the hold-up tank by the Slurry Pump back to the TTA tanks by the slurry header used in the SWRS operation. A level indicator will be mounted in the hold up tank and the discharge rate will be varied to ensure the hold-up tank stays at a steady-state level. The waste will be monitored for volumetric slurry flow rate and mass flow similar to the SWRS' system measurements. The sluicing enclosure, decant sump, and slurry hold-up tank will be tied to a common ventilation header that vent to the RCS during normal operations.

During the sluicing operation, a camera and light will be mounted in the tank to ensure the system is operating as designed. If debris is located in the Decant Sump, the sluicer will be used to push it as close to the center of the sump as possible. Manually operated remote telescoping gripping tools will then be used to remove the debris.

The system will be capable of being operated locally or from the control trailer.

In general, this approach is similar to a standard tank cleaning application used frequently in similar situations.

Equipment Description:

The DWRS main system components are as follows:

- Sluicer Module and Sluicer,
- Jet Pump,
- 3000-gallon Slurry Hold-Up Tank,
- Slurry Pump,
- Camera System, and
- Submersible Pump.

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The sluicer and sluicer enclosure used in the SWRS will be used in the DWRS. Some modifications will be required to adapt the DWRS equipment and Decant Sump riser to the enclosure. The sluicer nozzle will also be modified to reduce the flow from the nozzle from 300 gallons per minute to 40 gallons per minute. The sluicer will get its supply from the filtrate storage tank by the high-pressure decontamination pumps.

The jet pump will be the same jet pump used in the SWRS. It will be he hung vertically with a 3/8 inch screen on the suction leg. It will use filtered water from the high-pressure jet supply pump at a rate of 10 gallons per minute.

The 3000-gallon slurry hold-up tank will be nonmetallic with a 30-degree sloping bottom. It will have penetrations in the top to accept a level indicator, ventilation, slurry discharge, recirculation flow, decant dilution water, and containment area sump pump discharge. The tank will be protected from over pressurization by a safety relief valve also mounted on the tank's top.

The slurry pump will be a high chrome iron centrifugal pump rated at 350 gallons per minute at 100 pounds per square inch. It will be driven by a 40 horsepower, 480-volt, three-phase motor.

The submersible pump used during the SWRS operation will be a 3-inch spherical solid handling centrifugal pump. It will be rated at 50 gallons per minute at 70 feet discharge pressure. It will be driven by a 1½ horsepower, 480-volt, three-phase motor.

The camera and lights will be the same camera and lighting used on the end of the EMMA™ in the SWRS. The camera is small and light enough to be mounted on the end of the sluicer. Because the sluicier has an articulating arm that rotates ±170 degrees horizontal +100 degrees and –5 degrees vertical, the camera will be capable of being directed to all locations in the Decant Sump.

4.4 Transfer Tank Area System (TTA)

The Transfer Tank Area (TTA) System is provided to store residues received from Silos 1 and 2. The TTA consists of a building that houses the Transfer Storage Tanks, a residue sampling system, a water makeup system, a water elimination system, and a piping network for receiving and transfer of residues from the silos to a future remediation facility. The TTA communicates directly with the following systems:

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

The TTA is comprised of the following major features:

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- Transfer Storage Tanks,
- Transfer Storage Tanks Enclosure,
- Equipment Deck,
- Equipment Deck Enclosure,
- Sample Preparation and Storage Area,
- Sampling Enclosure,
- Transfer Piping,
- Diverter Valves,
- Diverter Valve Enclosures,
- Ultra-Filtration Equipment, including the Filter Process Tank
- Filtrate Storage Tank,
- Filtrate Transfer Pumps,
- HP Decon Pump
- Decant Pumps,
- Decant Pump Enclosures,
- Sluicers,
- Sluicer Enclosures,
- Slurry Pumps,
- Slurry Pump Enclosures,
- Makeup Water Storage Tank, and
- Makeup Water Transfer Pump.

The TTA is used in support of four different retrieval operations; FSMS, SWRS, DWRS, and TWRS. The functional description of the TTA in support of each operation is provided in the following paragraphs. Refer to TTA Piping and Instrument Diagrams 12FMD009 through 12FMD016.

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4.4.1 Full Scale Mockup System (FSMS).

Transfer Storage Tanks TNK-12-002A and TNK-12-002B are used to supply sluice water and receive surrogate material from Silo 4 in support of the FSMS. For this operation, Tank 2B is used for the sluicing water and Tank 2A receives the surrogate material from Silo 4.

This is accomplished by first adding process water to Tank 2B from the Makeup Water Tank TNK-51-001. A Decant Pump is installed on Tank 2B, and a Slurry Pump and two Sluicers are installed on Tank 2A. The Slurry Pump and the Sluicers on Tank 2A are retracted and stored within their enclosures. The Decant Pump on Tank 2B is deployed into the tank.

Pump control is accomplished with the Programmable Logic Controller (PLC) and level transmitters in each tank. Valve alignments are selected by the PLC to set up the sluice water flow path from Tank 2B to the Sluicer located in Silo 4, and from the Slurry Pump located in Silo 4 to Tank 2A in support of surrogate Silo 4 bulk waste retrieval.

Silo 4 surrogate heel retrieval is accomplished in the CATS mode. 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. The level in the TTA Filtrate Storage Tank is maintained by water transferred from the Makeup Water Tank during this operation. The slurry received from Silo 4 in the CATS mode is transferred to Tank 2A. Sluice water for the Silo 4 sluicer is available from Tank 2B, if needed to support the CATS mode.

The Slurry Pump and the two Sluicers installed in Tank 2A are used for removal of the surrogate material to demonstrate TWRS mode. Sluice water for this operation is from the decant pump located in Tank 2B. The Slurry Pump in Tank 2A pumps the surrogate slurry back to Silo 4 where it is discharged into a Phase Separator for dewatering and disposal. This sluice water is noncontaminated and is released to the site drainage system.

4.4.2 Silo Waste Retrieval System (SWRS).

The received slurry waste will undergo a settle and decant operation to concentrate the waste slurry for interim storage in tanks to await the construction of the future remediation facility.

Transfer Storage Tanks TNK-12-001A and TNK-12-001B are used to supply slurry water and receive material from Silo 1. Transfer Storage Tanks TNK-12-002A and TNK-12-002B are used to supply slurry water and receive material from Silo 2. Silo 1 residues are removed before Silo 2 residues are removed. After Silo 1 has been emptied, the level instrumentation and pumps in Tanks 1A and 1B are moved to Tanks 2A and 2B. The process begins again, and is operated in the same manner as with Silo 1.

The following description is for TTA-Silo 1 operation; TTA-Silo 2 operation is similar. For retrieval operation, Decant Pumps are installed in Tanks 1A and 1B. Pump control is accomplished with the PLC and level transmitters in each tank. Valve alignments are selected by the PLC to set up the sluice water flow path from the tank being used for decant, either Tank 1A or 1B, to the Sluicer located in Silo 1; and from the Slurry Pump located in Silo 1 to the slurry feed tank, either Tank 1A or 1B.

The system is designed to allow the slurry feed tank and sluice water tank to change roles periodically. For example, sluice water may be supplied from Tank 1B during one period, while

slurry is being pumped into Tank 1A. The received slurry in Tank 1A is allowed to settle, and during the next operating period sluice water is the supernate from Tank 1A, and the slurry is pumped to Tank 1B. This tank switching sequence is performed during Bulk Retrieval and CATS modes, as required, typically once daily.

At the beginning of each operating period, tank levels are measured as well as the residue levels to determine retrieval progress from the previous operating period. At the conclusion of each operating day, the slurry transfer piping is flushed with sluice water. This is accomplished by diverting the sluice feed flow from the Sluicer to the slurry line.

Silo 1 heel retrieval is accomplished in the CATS mode. 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 from the Ultra-Filtration Unit. Makeup water for the TTA Filtrate Storage Tank is also available from the Makeup Water Tank. The slurry received from Silo 1 in the CATS mode is transferred to either Tank 1A or 1B. Sluice water for the Silo 1 Sluicer is available from either Tank 1A or 1B, as required to support the CATS mode.

4.4.3 Decant Sump Waste Retrieval System (DWRS).

TTA equipment to support the DWRS is the same as required for SWRS. Because the volume of residue contained in the Decant Sump is relatively small, and because the Decant Pumps are already installed in Tanks 2A and 2B, the DWRS residue is deposited in Tanks 2A and 2B. Sluicing water is pumped from one of the tanks, and the slurry is deposited in the other tank.

A modified Sluicer module is deployed for DWRS. High-pressure water 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 by the Ultra-Filtration Skid. Makeup water for the TTA Filtrate Storage Tank is also available from the Makeup Water Tank.

Pump control is accomplished with the PLC and the level transmitter on the affected tank. Valve alignments are selected by the PLC to set up the flow paths.

4.4.4 Transfer from Tank Waste Retrieval System (TWRS).

During the TWRS, the K-65/BentoGrout™ is slurried from the storage tanks to the remediation facility in the same way it was removed from the silos except two sluicing nozzles are deployed in the storage tank being emptied, and the CATS system and EMMA™ are not required. 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.

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4.4.5 Transfer Storage Tanks

Four Transfer Storage Tanks are provided for storage of wastes from Silos 1 and 2, and from the silos Decant Sump. 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 Decant Sump 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 750000 gallons and are constructed in accordance with American Petroleum Institute API-650. 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 1/8-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.

The two tanks designated for storage of Silo 1 wastes (TNK-12-001A and TNK-12-001B) are connected at their overflow nozzles by a 12-in diameter pipe. The tanks for storage of Silo 2 wastes (TNK-12-002A and TNK-12-002B) are likewise connected. This overflow arrangement together with the use of two level measurement devices in each tank minimizes the potential of exceeding the capacity of any one tank.

Tank ventilation is provided by the RCS. Pressure and vacuum relief devices limit the tank headspace pressure to a range of -2.0 inches to +0.5 inches of water gauge.

All tank nozzles, except for the overflow, are located on the tank roof. The roof nozzles are parallel to the tanks vertical axes and extend through sleeves in the equipment deck. Flexible boots are attached to the nozzles and the floor of the equipment deck to isolate the tank enclosure. These boots provide an air seal and allow independent movement between the deck and the nozzles, thereby virtually eliminating reaction forces and moments to the tank.

Each tank is provided with the following roof nozzles:

- One 48-inch-diameter located in the center for the Decant Pump or the Slurry Pump;
- Four 24-inch-diameter located 90 degrees apart for the Sluicers and RCS, two each;
- One 12-inch-diameter located near an RCS nozzle for press and vacuum relief;
- Four 6-inch-diameter located 90 degrees apart for fill, level, and two spares; and
- Two 6-inch-diameter located 90 degrees apart for cameras.
- Two 12-inch-diameter located 90 degrees apart for cameras.

Tank corrosion considerations include adding 1/8-inch additional thickness above that required for stress to the steel tanks, and painting the tank exterior steel surfaces. The use of an interior coating is being evaluated. An active cathodic protection system is not required for the tanks. The tanks are housed completely within the concrete and steel enclosure, and are grounded to the TTA grounding grid. The grounding grid maintains the building steel, including the reinforcing steel, and components at the same electrical potential.

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4.4.6 Transfer Storage Tanks Enclosure

The Transfer Storage Tanks Enclosure is a concrete structure that provides secondary containment of stored wastes and radiation shielding. This structure is 152-feet long, 152-feet wide, and approximately 40-feet tall with 24-inch-thick walls for shielding. Secondary containment is provided by coating the floor and walls with a sealant to a level above that that could be occupied by residue from one 750,000-gallon tank.

The floor is sloped to a centrally located sump to facilitate removal of any spills. A tank foundation sump is also provided under each tank to collect any leakage that may occur through or around the tank bottoms. The four tank foundation sumps drain by gravity to the main enclosure sump by embedded piping. Access to the sump pump is by a diverter valve enclosure located on the equipment deck above the main sump. The main sump is equipped with level instruments for spill detection. The sump pump discharge piping is routed to the slurry distribution manifold within the same diverter valve enclosure for transfer to any of the four tanks. Each tank has an exposed bottom sump drain line that empties into the central sump trench, thus allowing the operator to identify that tank is leaking by the camera system, that can see all four sump lines. There is no ventilation provided in the Transfer Storage Tank Enclosure, because this area does not require entry by personnel. For a detailed description for tank repairs see Contigency Plan and Emergency Response , Document No. 624-P621-09, Rev. A.

4.4.7 Equipment Deck

The equipment deck covers the storage tanks. The equipment deck is supported by a steel column and beam system designed to carry all floor and equipment loads. The support steel is primed and painted. The floor is concrete and 9-inches thick. The equipment deck provides radiation shielding from the stored residues during maintenance activities.

Equipment handling is a key element in the design of the TTA. A Loading Platform located on the south side of the TTA is provided for installation and removal of all equipment required to support SWRS, FSMS, and TWRS. The Sluicer modules, Slurry Pump modules and Decant Pump modules are installed in the TTA by first being lifted by portable crane from a ground transport vehicle to the Loading Platform where the modules are placed on and secured to air bearings. Access to the Equipment Deck is provided through a 16-feet wide, 24-feet-high roll-up door. Air hoses are connected to the air bearings and to the compressed air header located inside the Equipment Deck Enclosure. The air bearings allow the heavy loads to be easily moved on a near frictionless cushion of air. Workers manually guide each module to the desired location for interface with the Transfer Storage Tank riser nozzle.

The Loading Platform is also fitted with a 1.5-ton monorail type hoist for use when tools and equipment parts are to be taken in, or removed from, the TTA. Access to the Equipment Deck is provided by two staircases. One is located on the north end of the east side of the TTA, and the other is located adjacent to the Loading Platform on the south side of the TTA.

4.4.8 Equipment Deck Enclosure

The Equipment Deck Enclosure is a pre-engineered metal building constructed over the equipment deck to protect the TTA equipment and manage precipitation. Rain and melting snow runoff directly to the storm drainage system. The deck enclosure is insulated and provided with heaters to maintain a target temperature of 40°F during cold months. Natural

ventilation is provided by louvers and vents. The equipment deck area is typically occupied by personnel only when lines have been flushed, or when the transfer systems have been shutdown for maintenance. The deck enclosure is also provided with doors, lights, gutters, and downspouts. A compressed air header is routed around the perimeter of the enclosure with several drops provided to support maintenance activities.

4.4.9 Sample Preparation and Storage Area

A sample collection system is provided to collect samples of the waste residue that is transferred, before being received in the storage tanks. One pound of residue is required to be collected for every 1000 pounds of residue transferred to the TTA. This is accomplished on a volume basis by continuously collecting at a rate of 1 gallon for every 1000 gallons transferred. Samples are drawn from the transfer pipe using a Bristol Equipment ISOLOK 200-cubic centimeter sampler. The ISOLOK sampler is actuated by a timer that is controlled by a flow measuring device upstream of the sampler. For example, at the maximum flow rate of 350 gallons per minute, the sampler takes a 200-cubic centimeter sample about every 9 seconds. The samples are directed to one of two 185 gallon sample accumulation tanks. A mass meter and flowmeter upstream of the sampler will be used to determine the amount of solids that have been collected. Once 27 gallons of solids at 50 weight percent moisture have been collected, the sample stream will be diverted to the second tank. The tanks will be used in alternating fashion with the sample stream diverting back and forth between tanks once a tank has received a drum full of settled solids. After the samples are taken for the operating day, the solids are allowed to settle overnight. An operator loads an empty pre-packaged sample drum (30 gallon drum is inside 55 gallon overpack drum) on the inlet roller conveyor. The sample drum is conveyed and positioned under the discharge of the volumetric feeder. The decant pump then removes the supernate above the solids layer in the accumulation tank and transfers it to the storage tank currently in service. The sample drum is lifted (by lift table) to the discharge of the volumetric feeder. Slide gates open on the discharge of the accumulation tank and the volumetric feeder. The solids are transferred into the drum by the volumetric feeder. The volumetric feeder is designed to stop when 27 gallons has been discharged. If a spill occurs during the filling process, there is a sump centered between the accumulation tanks, and there will be water connections for a manual washdown. The slide gates close when the volumetric feeder stops and the drum is lowered and conveyed to the manual capping and bunging workstation. The drop chute through which solids fall into the sample drum has a connection to the decant pump, so that the tank and feeder can be rinsed. The 30-gallon drum is bunged, and the 55-gallon overpack is capped manually by an operator standing behind a shield wall. The operator applies a label that identifies the sample in accordance with the sampling program described in the Sampling Plan for the AWR Project. The sample will be placed in the storage area by a remotely operated bridge crane. The Sample Preparation and Storage Area (SPSA) is sized to accommodate 110+ drums, stacked two high.

4.4.10 Sampling Enclosure

The Sampling Enclosure is a concrete shielded structure that houses the sampling collection system and provides storage for the collected samples. The building is 24-feet 0-inches wide and 97-feet 0-inches long with 24-inch-thick walls. The building roof is an insulated steel shed design.

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4.4.11 Transfer Piping

The TTA System piping material is carbon steel. All sluice water lines and slurry transfer piping are double-walled, except within the diverter valve boxes where it is single-walled. The diverter valve boxes provide secondary containment. Piping insulation and heat trace is not required because the Equipment Deck Enclosure is heated.

4.4.12 Diverter Valves

The TTA is equipped with motor-operated diverter valves for selection of slurry and sluice water flow paths. A diverter valve is a three-ported double waterway valve. Use of diverter valves eliminates the concern for dead-legs in the piping system that may plug with residue. Diverter valves are also compact and can easily be arranged inside enclosures for maintenance and leak detection.

4.4.13 Diverter Valve Enclosures

There are two diverter valve enclosures, one on the TTA Equipment Deck, and one located on the pipe rack above the sampling enclosure. The enclosure on the pipe rack houses the automatic samplers and provides connections for sluice water and slurry feed to and from the future remediation facility.

The second enclosure is centrally located on the TTA Equipment Deck. It houses the diverter valves for connecting the primary and secondary slurry headers to the four storage tanks, as well as the sluice water distribution header. Connections for makeup water, water elimination to the Ultra-Filtration Unit, and building sump pump discharge are located within this enclosure. This enclosure also provides access to the building sump pump, and the camera for the Transfer Storage Tanks Enclosure

The piping within the enclosures is single-walled, therefore the enclosures are designed to provide secondary containment. The enclosures are constructed of steel, have hinged covers for access, and are anchored. They have a sloped bottom and sump equipped with level instrumentation to detect leaks and a sump pump. The sump pump discharge is connected to the sluice water header.

4.4.14 Ultra-Filtration Equipment

The ultra-filtration (UF) system is used to support water treatment from the TTA. Here suspended solids are removed from the effluent stream in a tubular membrane filtration unit. The unit is sized to process 20 gallons per minute and is located in a contained area on the TTA Equipment Deck. The UF system includes a 300 gallon per minute process pump that circulates water from the Filter Process Tank, through the filter producing 20 gallons per minute of filtrate, and returning 280 gallons per minute back to the Filter Process Tank. Filtrate discharged from the UF system is passed to the Filtrate Storage Tank where it is used to support other processes, or held for radon decay and eventual discharge to the Advanced Wastewater Treatment Plant (AWWT). Solids separated in the UF system are returned to the Filtrate Process Tank, and eventually to the Transfer Storage Tanks by the slurry distribution header.

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4.4.15 Filtrate Storage Tank

One 7500-gallon storage tank (TNK-12-004) is provided for storage of filtrate effluent from the UF system. This tank has sufficient capacity for a full day's production of the UF system at maximum capacity. Tank ventilation is provided by the RCS. Pressure and vacuum relief devices limit the tank headspace pressure to a range of -2.0 in. to +0.5 inch water gauge.

The tank is constructed in accordance with American Petroleum Institute API-650. It has a flat bottom supported on a concrete foundation, and the roof is dome shaped. The tank is equipped with level instruments to shutdown the UF system on high tank level. Corrosion considerations include painting all external tank steel surfaces, and providing a corrosion allowance of 1/16 inches. (The use of interior tank coatings is being evaluated)

4.4.16 Filter Process Tank

The Filter Process Tank (TNK-12-003) is used to store 7500 gallons of sluice water that is transferred from the Transfer Storage Tanks at the beginning of each operating period (day) to be used by the UF system to produce filtrate. As filtrate is produced at a nominal 20 gallons per minute, and transferred to the Filtrate Storage Tank, Filter Process Tank level is maintained by a bleed stream from the sluice water header. At the conclusion of the operating period, the thickened sluice water (approximately 4 weight percent) is returned to the Transfer Storage Tanks. The Filter Process Tank is equipped with a mixer that is used for solids suspension before transferring the thickened sluice water back to the Transfer Storage Tanks.

Tank ventilation is provided by the RCS. Pressure and vacuum relief devices limit the tank headspace pressure to a range of -2.0 in. to +0.5 in. water gauge. The tank is constructed in accordance with API-650. It has a flat bottom supported on a concrete foundation, and the roof is dome shaped. The tank is equipped with level instruments to shutdown the transfer pumps on level. Corrosion considerations include painting all external tank steel surfaces, and providing a corrosion allowance of 1/16 inches. (The use of interior tank coatings is being evaluated)

4.4.17 Filtrate Transfer

Filtrate is transferred from the Filtrate Storage Tanks by centrifugal pumps located on the TTA Equipment Deck. The Transfer Pumps can transfer the filtrate to the AWWT, and circulate the filtrate out to the silos and back as a feed stream for the high-pressure systems. The PLC automatically stops the pumps on low tank level.

4.4.18 Decant Pumps

The Decant Pump, used to power the Sluicers, is deployed from its enclosure located over the center nozzle of a Transfer Storage Tank. The pump is mounted on a floating platform consisting of two rigid pontoons connected by a folding frame. The spring loaded frame folds under its weight when lifted vertically. This folded configuration allows the deployment of the platform through a 48-inch-diameter nozzle. After the platform is placed in the tank, the pump, motor and base are lowered onto the platform and aligned by guide-plates and secured over taper pins. Slack hose and cable is suspended in the tank with enough length to allow the pontoon platform to reach the bottom of the tank. As the tank is filled and the platform raises, lengths of cable and hose are disconnected and retracted from the riser.

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The Decant Pump lowers into the Transfer Storage Tank using two hoists located on the ceiling of the Decant Pump Enclosure. Hoists are used only in manual control. The PLC does not control the hoists. Manual up and down buttons, located on the control panel, are used to control the hoists.

There are two independent Decant Pump systems. One decant pump is in Tank A and the other decant pump is in Tank B during SWRS operations. When SWRS operations are ready to begin on the other silo, the pumps move to the second set of A and B tanks in the TTA building. A sensor is mounted near the pump intake to determine liquid-level. If the liquid-level is low, the sensor detects the low-level and turns the pump off.

The pump is a single-speed, self-priming, ANSI centrifugal pump operating at 3500 revolutions per minute. The pump is sized to deliver 300 gallons per minute to the Sluicer at 150 pounds per square inch. All pump wetted parts are carbon steel or ductile iron, except the shaft that is stainless steel. The decant pump motor is rated at 60 horsepower. The motor requires 480-volt AC, three-phase power.

4.4.19 Decant Pump Enclosures

The Decant Pump Enclosure is built with a structural steel tubing frame, with steel sheet metal welded to the frame. It has one airtight access door, one equipment pass through, and sufficient glove ports and windows to allow equipment maintenance.

The enclosure contains the equipment needed to allow the pump to function. This includes two 1-ton hoists to install and remove the pump from the tanks, one hose reel to hold the pump discharge hose, one cable reel to hold the pump motor wiring, and two 3-inch, three-way ball valves and piping to direct the flow. The enclosure also contains a spray ring to decontaminate the pump assembly when it is removed from the tank. The circuit breaker box and terminal strip box for the electric components and motors is located on the outside wall of the enclosure.

The enclosure serves as secondary containment and drains to the storage tank. An air inlet damper is provided with HEPA filtration. The enclosure is connected to the RCS by connection to the Transfer Storage Tank to provide control of the enclosure atmosphere.

4.4.20 Sluicers

For a description of the Sluicers, see the Silo Waste Retrieval System Design Description (see Section 4.1.2.1).

4.4.21 Sluicer Enclosures

For a description of the Sluicer Enclosures see Silo Waste Retrieval System Design Description (see Section 4.1.2.2).

4.4.22 Slurry Pumps

For a description of the Slurry Pumps see Silo Waste Retrieval System Design Description (see Section 4.1.2.3).

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4.4.23 Slurry Pump Enclosures

For a description of the Slurry Pump Enclosures see Silo Waste Retrieval System Design Description (see Section 4.1.2.4).

4.4.24 Makeup Water Storage Tank

The Makeup Water Storage Tank is a 10,000-gallon, atmospheric, steel water tank. It is designed and constructed in accordance with API-650. It is located on a concrete ringwall foundation outside the TTA. The carbon steel tank has a painted exterior. (The use of interior tank coatings is being evaluated)

4.4.25 Makeup Water Transfer Pump

Makeup water is provided through a 3-inch-diameter pipe to the TTA systems by a connection in the sluice water distribution header. The connection is in the diverter valve enclosure located on the TTA Equipment Deck. An ANSI centrifugal pump designed to deliver 200 gallons per minute is located outside adjacent to the storage tank.

4.5 TTA Waste Retrieval System (TWRS)

The TWRS 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. Sluicers, Slurry Pumps and equipment used for the SWRS are also deployed for the TWRS. Refer to TWRS Process Flow Diagrams 13FMD001 through 13FMD004.

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 tanks will have two opposing sluicer assemblies per tank with a central slurry pump, thereby eliminating the need for heel removal. All of the equipment will be of the same design and fully interchangeable. Thereby, the sluicer assembly used in the silos will be the same as the sluicer assembly used in the TTA tanks. The two sluicer assemblies and the central slurry pump will permit a "swirl" movement of the waste within the tank as the waste is removed. This will result in providing a more uniform plain of waste material. This will also provide a continuous layer of water atop the waste providing shielding. By avoiding a fixed placement pump, the retractable slurry pump will avoid a central "well" within the waste and the possibility of exposed waste regions. This results in a continuous layer of water being maintained during retrieval operations over the entire tank.

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

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Personnel access is limited during retrieval operations. Cameras observe placement of each sluicer nozzle to permit remote operation. Controls are provided to limit individual exposures to less than 800 millirem per year. Operating controls for the TWRS are included in the AWR control room. These controls allow for the shutdown or startup of any piece of TWRS equipment. Local controls for the TWRS subsystems are provided on the TTA Equipment Deck.

All automated functions of the TWRS are controlled by PLC. System events that require alarming are processed by these controllers. Local evacuation alarms are staged on the TTA Equipment Deck. The alarms can also be activated from the Vitrification Pilot Plant (VitPP) control room and the AWR control room. Alarms are recorded and annunciated locally, in the VitPP control room and the AWR control room.

The TWRS is comprised of the following major features:

- Transfer Storage Tanks,
- Transfer Piping,
- Diverter Valves,
- Sluicers,
- Sluicer Enclosures,
- Slurry Pumps, and
- Slurry Pump Enclosure.

4.5.1 Transfer Storage Tanks

For a description of the Transfer Storage Tanks see the TTA System Design Description (see Section 4.4.5).

4.5.2 Transfer Piping

For a description of the Transfer Piping see the TTA System Design Description (see Section 4.4.11).

4.5.3 Diverter Valves

For a description of the Diverter Valves see the TTA System Design Description (see Section 4.4.12).

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4.5.4 Sluicers

For a description of the Sluicers see SWRS System Design Description (see Section 4.1.2.1).

4.5.5 Sluicer Enclosures

For a description of the Sluicer Enclosure see SWRS System Design Description (see Section 4.1.2.2).

4.5.6 Slurry Pumps

For a description of the Slurry Pumps see SWRS System Design Description (see Section 4.1.2.3).

4.5.7 Slurry Pump Enclosure

For a description of the Slurry Pump Enclosure see SWRS System Design Description (see Section 4.1.2.4).

4.6 Facilities Decontamination System (FDS)

The Facilities Decontamination System removes gross contamination from the silos, the decant sump tank, and contaminated process equipment as part of facility demobilization and closure. The FDS offers two categories of gross decontamination activities. First, the FDS provides 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 that the FDS provides is the processing of temporary tools, equipment, and facilities used on the project

4.6.1 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 a pump, hose, nozzle, and small, positive-displacement pump. The fixative, that is liquid and pumpable, is delivered in 55-gallon drums and placed next to the pump. The pump delivers the fixative at approximately 100 pounds per square inch (pounds per square inch) at less than 5-gallons per minute. A fixed length hose is connected to the outlet of the pump and leads up to the Silo Arm Interface Enclosure (SAIE) where it is connected to a hose in EMMA™. The hose terminates at a nozzle close to the end of the arm. The nozzle is similar to an industrial painting nozzle. The EMMA™ maneuvers the nozzle near the walls and floors to locally spray the fixative to the surfaces. The flexibility of the EMMA™ allows for fixative to be applied in a consistent and comprehensive manner over the entire surface area of the silo walls. Provisions are made to prevent the fixative material from being sprayed onto the cameras inside the silos that are used to observe the fixative application process.

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4.6.2 Access, Decontamination, and Packaging for Significant Structures and Components

Gross decontamination includes flushing and draining the lines used to transfer the waste slurry to the TTA, and gross decontamination of the interior surfaces of the silos and the decant tank. Material is removed from the interior surfaces of the silos to the visibly clean state before the application of the fixative as described above.

Gross decontamination will also include the cleaning of surfaces in the accessible areas of the sample room, the RCS and the TTA. Areas that are High Radiation Areas (i.e., the Carbon Bed Caves and the Tank Area of the TTA) are not included in this decontamination effort. However, the high radiation areas are not intended to be contamination areas. The decontaminated areas are cleaned of removable contamination, and the unremovable contamination is fixed in place.

Materials used in the performance of the gross decontamination process are water and wiping materials. Water is transferred to the TTA and processed along with that in the decant tank. Wiping materials are packaged for disposal as radioactive waste.

4.6.3 Decontamination and Demolition at Completion of FDS Operations

Facilities and equipment are surveyed, decontaminated, and presented to FDF health physics technicians for release survey. This process is enhanced by minimizing the potential for contamination of the equipment or facilities through such practices as painting surfaces with strippable paint, or wrapping them with plastic as allowed without affecting performance. The location and use of each object is tracked to help justify an exemption from complete disassembly when it can be shown that the potential for contamination is exceedingly small. A plan is prepared for decontaminating and surveying each piece or type of equipment/facility as appropriate, considering the use of the equipment/facility. These plans are submitted to FDF for review and concurrence before the performance of the decontamination and survey. After agreement is reached, FDF performs the verification survey on decontaminated and surveyed items.

4.6.4 Decontamination, Packaging, and Staging of Contaminated Materials

Wastes generated in the decontamination of temporary equipment and facilities consist primarily of wiping materials, water, and contaminated grit if abrasive blasting is needed to clear parts. These materials are packaged and disposed of as radioactive waste.

Decontamination of discrete objects and failed equipment will be performed in a portable, truck-mounted decontamination facility. It provides for cleaning of equipment as large as 18-feet × 30-feet, 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 FDF 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. An equivalent facility is provided for the FDF verification.

4.7 Full-Scale Mock-Up System (FSMS)

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The Full-Scale Mock-Up System (FSMS) is designed to provide operator training and proof of principle testing of the following AWR systems: Silos Waste Retrieval System (SWRS),Transfer

Tank Area(TTA), and TTA Waste Retrieval System(TWRS). 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 basis for the amount of surrogate required for the FSMS is equivalent to the amount of waste material to be removed from Silos 1 and 2 in one 8-hour shift. This corresponds to 44 gallons per minute (21,120 gallons per eight-hour shift) or a total of 2813 cubic feet of surrogate material. To more closely simulate the waste material depth in Silos 1 and 2, a tank located inside Silo 4 allowing for a surrogate material depth of 3.8 feet is used. The tank footprint covers three manways into Silo 4. The tank is 8 feet wide and 6 feet high with a 48 feet, 3¾ inch long straight section starting 5 feet behind the sluicing nozzle manway and going toward the center of the tank. The overall length of the tank is 70 feet, ¾ inch long. The tank expands on a 78° angle from the center of the central manway and extends to the Silo 4 wall. The expanded section allows slurry to collect and be transferred by the retrieval slurry pump. The wall of the inner tank that connects the angular section is curved to allow demonstration of the cleaning of silo walls and floor. Four-foot-high, plywood splashguards are installed on top of the tank to contain the surrogate during sluicing. A process schematic of the FSMS and its sequence of operation is shown in Exhibit 7-1.

The FSMS is comprised of the following major features:

- FSMS Surrogate Tank,
- RCS Blower Skid (simulating Phase II RCS),
- High-Pressure Pump Skid,
- Equipment Deck,
- Equipment Deck Enclosure,
- Transfer Piping,
- Diverter Valves,
- Phase Separators,
- Sluicers,
- Sluicer Enclosure,
- Slurry Pump,
- Slurry Pump Enclosure,
- EMMA™,
- EMMA™ Enclosure,
- Conditioning and Transfer System (CATS),

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- High-Pressure Pump Skid,
- Silo Retrieval End-Effector (SREE), and
- Silo Debris Retrieval System (SDRS).

The FSMS communicates directly with the following systems:

- TTA Waste Retrieval System (TWRS),
- Transfer Tank Area System (TTA),
- Sampling System,
- Ultra-Filtration System.

The FSMS is used to validate and optimize equipment integration for all AWR system operations using the following process sequence (numbers correspond to numbers on Exhibit 7-1):

1. Surrogate representative of the K-65 material and BentoGrout™ and the prescribed debris is placed in the surrogate tank inside Silo 4 to achieve sufficient depth of surrogate material to test all aspects of the system (1 day's production).

2. The fan system simulating the RCS Phase II system is calibrated to match air flows and negative gas pressures in the silo headspace and the effects of equipment ingress and egress.

3. Using the sluicing nozzle and the slurry transfer pump suspended from the Silo 4 Support Structure and water staged in one of the TTA Storage Tanks, the AWR surrogate is sluiced to the designated TTA receiving tank.

4. Required archive samples are drawn from the slurry as it is transported to the TTA receiving tank.

5. Decant water from the TTA Water Supply Tank is used to test and verify operation of the Ultra Filtration System. Decant water is transferred to the Filter Process Tank for feed to the filter. After passing through the ultra-filter, the clean water is supplied to the High-Pressure Pump Skid by the Filtrate Tank and the solids containing water is returned to the Filter Process Tank.

6. After the bulk removal of the AWR surrogate, the sluicing nozzle and slurry transport pump are replaced with the debris retrieval system and the CATS. The EMMA™ maneuvers the SREE to remove the surrogate simulated waste heel in the tank. CATS further dilutes the waste stream and pumps it to the TTA receiving tank. The shape of the Silo 4 inner surrogate tank provides a simulation of all areas of the tank from the center to the walls. The removed surrogate is allowed to settle in the TTA receiving tank.

7. Discrete objects in the surrogate tank will be reduced in size as necessary using the SDRS cutter and shall be removed using EMMA™ and the Debris Removal System basket.

8. EMMA™ will demonstrate its ability to wash down and decontaminate the silo dome and walls and to spray a fixative using arm-mounted nozzles.

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9. Contamination of the SWRS is simulated to demonstrate effectiveness of the installed decontamination equipment (EMMA™ and the decontamination spray rings).

10. 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 Phase Separators for slurry dewatering. After the surrogate material dewatering requirements have been satisfied, the material is radiologically surveyed to determine disposition. If the material meets free release criteria, it is disposed of in the landfill. If the surrogate material is contaminated, FDF designates a disposal location. The separated water is discharged to ground drainage

11. Steps 2 through 10 are repeated as required for SOT.

12. The FSMS is available for additional testing and training.

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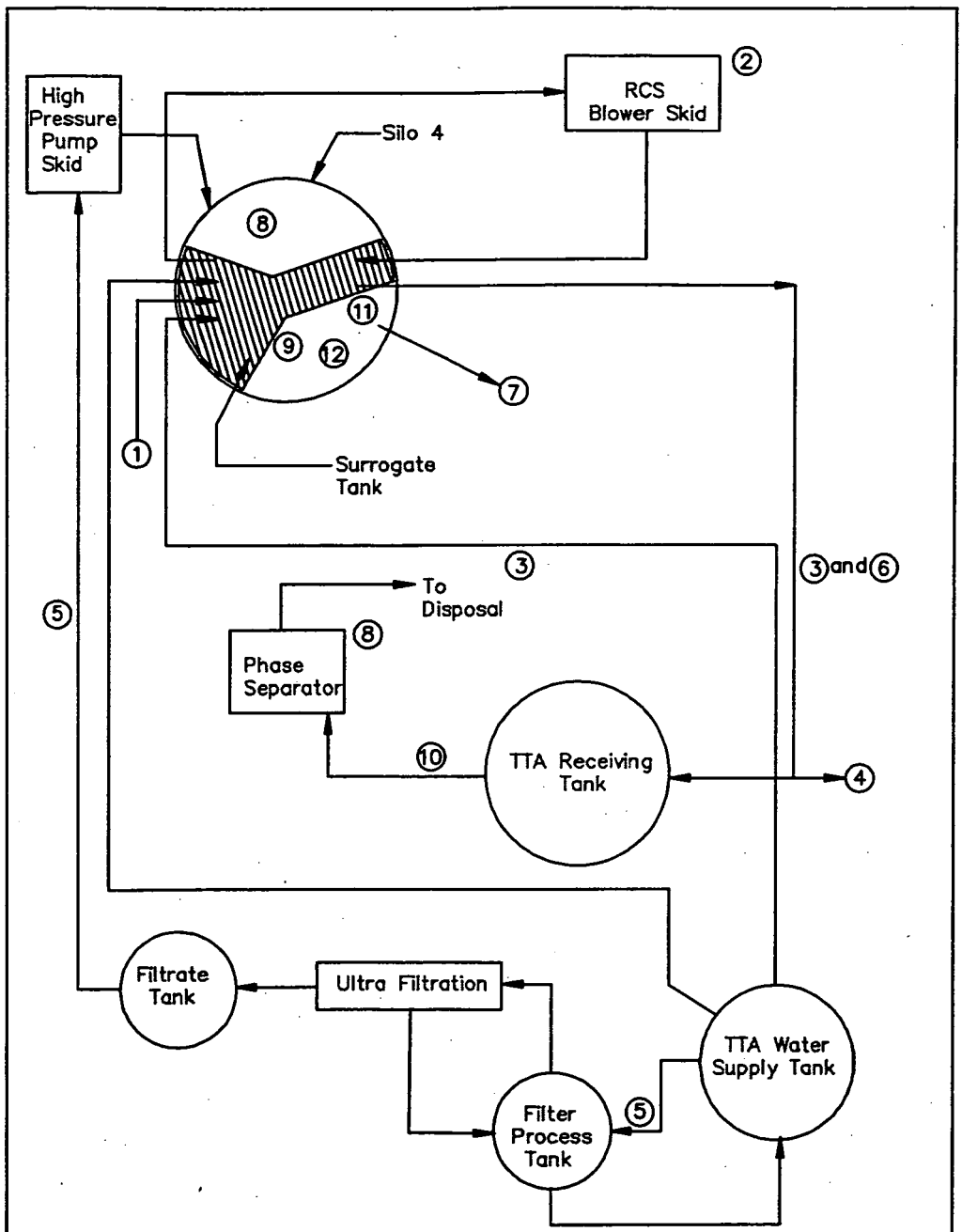

Exhibit 7–1:
FULL SCALE MOCKUP SYSTEM (FSMS)

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5.0 AWR PROJECT SUPPORT SYSTEMS AND COMPONENTS

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5.1 Distributed Control System

5.1.1 Introduction

The AWR control system is an integrated system that allows both local control at the equipment site and remote control at the central control trailer station. The AWR control system supports operations during FSMS testing and SWRS, DWRS, FDS, and TWRS waste removal operations.

5.1.1.1 System Concept

The AWR control system is a PLC-based system with distributive input/output (I/O) data collection and control nodes. The PLCs and redundant operator HMI stations are located in the control trailer. The data collection and control nodes are currently located at the Silo Bridge, high-pressure pumps, and the TTA building. The distributive I/O data collection and control nodes are connected to the PLCs by a fiber optic network. The individual equipment items located at the I/O nodes are connected to the nearest I/O node with field wiring. Both the RCS and the TTA Sampling System are equipped with self-contained PLC controllers.

5.1.1.2 Installation

The AWR control system is modular in design. Most of the AWR control system is installed on the mechanical equipment. The control system components required for the TTA are designed for field installation at the Fernald site.

To ensure the control system works with the TTA equipment upon installation in the TTA building, proper interface documentation control is required. The interface documentation control is required to ensure the PLC and HMI programming agrees with the I/O connections and operating expectations of the TTA equipment when the TTA equipment is connected to the TTA I/O node.

5.1.1.3 Utilities

Electrical Power—Uninterruptible Power Supply (UPS) 120-volt AC, single-phase power is provided to the FSMS and Silo 1 and 2 control trailers. Uninterruptible Power Supply (UPS) 120-volt AC, single-phase power is provided to each I/O data collection and control node. 120-volt AC power, single-phase is provided to the FSMS and Silo 1 and 2 control trailers.

Fiber Optic—Fiber optic cables are installed to the required I/O nodes located throughout the site. The fiber optic cables can support three ring networks. Spare feeds of fiber optic lines are provided.

Interfaces—Interfaces to equipment systems include the EMMA™ System and the Gripping End-Effector, the RCS, the Sampling System, SWRS, TWRS, SREE, and SDRS.

Maintenance—The required maintenance on the AWR control system is low. Low maintenance is the result of using quality components and a modular design within the AWR control system.

5.1.2 FSMS And AWR Control System General Description

The AWR control system is designed incorporating the following general requirements in addition to the 29 functions and requirements stated in Design Criteria Package.

- Safely control the equipment,
- Protect the operator,
- Allow remote operation of the equipment,
- Easy to learn and operate, and
- Reduced maintenance.

The following information is the description of the control system from the conceptual review session. As the design is finalized, the control system will be modified as required to support any changed requirements.

5.1.2.1 Control Trailer

Two control trailers are used at for the AWR Project. One control trailer is used to support the FSMS testing, training, and operations. The second control trailer is used to support Silo 1 and 2 waste removal operations.

Each control trailer has an operator's station for the control of the waste removal support equipment. This operator station does not include the EMMA™ controls, as EMMA™ has a separate and adjacent operator station. The control trailers have wiring distribution for field 120-volt AC power and UPS 120-volt AC power.

5.1.2.2 FSMS Operations

FSMS test operations are performed first. The FSMS testing provides a means to test the equipment, train operators in equipment use, conduct a training session in waste removal from Silo 4, and perform the FSM ICAT and SOT.

5.1.2.3 Operator's Station

The operator station in the control trailer (either FSMS or Silo) provides a central location for controlling and monitoring the equipment at the Silo Bridge and the TTA building. The selected PLC system is based on the Siemens's central processor unit (CPU) Simatic S7-414-2DP. The CPU directly supports the Profibus (Process Field Bus) network standard. The CPU supports 32768 channels of digital I/O and 2048 channels of analog I/O. The CPU has 384K bytes RAM program statements. The CPU memory has battery backup to prevent loss of the operating program and data. The CPU is equipped with a real-time clock.

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The PLC and the data/control I/O modules are networked on the Profibus. The Profibus network allows the data collection and equipment control to occur remotely in the field and away from the PLC. The Profibus network greatly reduces the amount of I/O field cabling required to support the PLC operations.

Each CPU will have its own 10 amp, 24-volt DC power supply. The UPS power supplies electrical power to the CPU power supply. The CPUs and its power supply are mounted on a Deutsches Institut Normung (DIN) rail inside a cabinet to minimize dust accumulation.

The programming of PLC and I/O interface development is performed with the Siemens STEP 7 Development System. The STEP 7 has user-friendly functions for all phases of an automation project including: configuration and parameterization of hardware, definition of communication, programming, testing, starting up, servicing, documentation, archiving, operation, and diagnostics functions. STEP 7 supports ladder diagramming, function block diagramming, and statement lists programming methods.

Other software used in the development of the PLC controller include Continuous Function Chart (CFC) and Sequence Function Chart (SFC). The CFC software supports hardware devices (i.e., variable frequency motor drive) that directly connect to the Profibus. The SFC supports graphic creation of sequence control and operation of equipment. Other Siemens software may become required as the needs of the operating equipment become more defined.

The STEP 7 software operates on the PC-based programming computer. The programming computer is located in the control trailer near the CPU. The connection from the PC to the CPU is by way of the Profibus network connection on the CPU. The PC computer may be identical to the computers used for the HMI's.

Installed Spares—The PLC system has 25% installed spare for memory and digital and analog I/O channel count. The I/O modules that are mounted within the field I/O nodes use no more than 75% capacity of the module to provide for the 25% installed spare I/O channels.

EMMA™ Interface—The requirement for the field PLC to monitor and record alarms from the EMMA™ system requires a connection from the field PLC to the EMMA™ controller. The EMMA™ controller consists of three Siemens PLCs. Because only one PLC can be the master on the Profibus network, the EMMA™ controller cannot be on the same Profibus network as the field PLC. The connection between the EMMA™ PLC master and the field PLC is performed using six digital outputs to EMMA™ PLC and six digital inputs from EMMA™ PLC. The EMMA™ PLC archives its own operating information.

Operator Station's I/O—An I/O node is required to support the operator devices at the operator station. The I/O node consists of SM 421 digital input module and SM 422 digital output module connected to the back plane of the S7-414-2DP CPU.

Field termination blocks are used to connect the field wiring to the modules. The wiring from the field termination block to an module is equipped with a connector to the module. The connector is keyed to prevent terminating the connector into the wrong module. If an module needs to be replaced, the operator removes this connector instead of disconnecting the entire field wiring from the module.

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The selected digital I/O modules (with reservations to change) have 32 digital inputs and 32 digital outputs. The inputs and outputs are rated for 24-volts DC. The modules are used to support the emergency stop (E-stop) control (described later), the water sluicing nozzle joystick and vertical position control, water sluicing nozzle selection, and Master Equipment Enable Switch (MEES) key (described later).

Joystick—The sluicing nozzle position is controlled in the pitch and the yaw direction. A two-degree-of-freedom joystick is used for controlling the pitch and yaw of the sluicing nozzle. The joystick is mounted at the operator's control station. The joystick is equipped with a deadman switch that allows the joystick to only become active when the operator grasps the it.

The sluicing nozzle vertical position is controlled with a hoist located inside the sluicing nozzle enclosure. The command signals for the hoist are governed by a three-position (up-stop-down) joystick, equipped with a deadman. The hoist joystick is located near the pitch/yaw joystick. This gives the sluicing operator direct physical devices with that to control the sluicing nozzle.

During the FSMS there could be up to three sluicing nozzles in operation. During SWRS operations only one sluicing nozzle operates and during TWRS operations, two sluicing nozzles operate. A single joystick will be installed at the operating station to operate all sluicing nozzles. A three-way selector switch determines which sluicing nozzle will be controlled by the joystick. During SWRS, the silo sluicing nozzle position will be selected. During TWRS, the switch will be used to select one of the two sluicing nozzles installed in a TTA tank.

5.1.2.4 Human-Machine Interface (HMI).

The operator's HMI station consists of two PC-type computers operating graphic screens depicting equipment layout and operating status. From the HMI screens, the operators issue commands to control the equipment and view operating status of the equipment. Equipment operating parameters are set and changed from the HMI screens.

The two HMIs operate in a redundant mode. The redundant mode allows either HMI computer to perform display and control operations for the PLC system. When both HMI computers are operating, the operator uses either or both HMI computers to view operating status and control the field equipment. The two HMI computers are connected directly to the Profibus.

The Siemens WinCC Software Development System is applied to create the display and control screens for the two HMI computers. WinCC supports data trending and archiving with time-controlled and event-driven project reporting and documentation. WinCC supports alarm logging acquisition and archiving. Password protection is supported for limiting operator access for operating control limits. Each HMI computer requires a full software license for WinCC and the redundant support software license.

The PC computers for the HMIs must operate the Microsoft NT operating system. For this reason, the computer is equipped with one of the fastest processor available when the computers are purchased. A hard disk greater than 10 gigabytes and with a minimum of 64K of RAM is installed. The computers are Ethernet ready for networking to a printer. The computers are equipped with a read/write CDROM disk drive for archiving data. A Profibus connection card (CP5412) is installed in each HMI computer to allow the computer to connect and have access to the Profibus. The color display screen is 19 inches or larger for HMI display. The computer is equipped with a keyboard and mouse pointer device. All HMI computers are powered from the UPS power within the control trailer.

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RCS HMI—The RCS PLC is mounted on the RCS skid and the PLC is equipped with its own local HMI. A separate HMI for the RCS is located at the operator's station. Communications between the RCS HMI and the PLC is with the Profibus network. If the RCS PLC is set up as a master, the HMI needs a separate Profibus network from the field Profibus.

Sampling System—The sampling system is located near the TTA building. The sampling system is equipped with its own PLC. The PLC runs its own program to automatically collect and log the samples from the waste flow from the Silos 1 and 2 to the TTA. The sampling system PLC needs to be in the slave mode to allow operation on the Profibus network the field PLC's are using. The field HMI displays and controls the operation of the sampling system.

General HMI Display Screen Layout—The top display screen shows the overall layout of the fielded equipment. This layout includes the equipment on the silo bridge, the high-pressure pumps, TTA equipment, and Sampling System. The screen shows the general operating condition of the equipment; especially the pumps and motor-operated valve positions. Some information about tank levels and water pressures and flows are displayed.

The operator clicks on a screen icon to pop up another screen to display detailed information about the equipment device(s). The information shown depends on the device(s). For example, clicking on the slurry pump will pop up a screen about all the devices within the slurry pump enclosure including the motor-operated valves (MOV).

This pop-up screen allows the operator to start a motor or change a valve postion.

Operating parameters are also changed within the device pop up display screen. Password protection is an option. Operating motors and pumps are displayed in green and the off condition is represented by red. Open valves are displayed in the green and closed valves in red. Alarms and warning messages are displayed on any screen displayed on the HMI computer.

5.1.2.5 Profibus Network Communication

The current network requires three separate Profibus networks. The first Profibus network is for the field PLC, the second Profibus network is to support the EMMA™ controller, and the third Profibus network is to support the RCS PLC. Fiber optics are used to connect the widely separated equipment I/O data nodes.

The three Profibus networks are configured for the ring topology. The ring topology imposes a redundant data path over the Profibus network. If a fiber optic cable is broken, there still is a fiber optic path on the network for data travel.

Every data I/O node requires the OLM/S4 copper-to-fiber converter. There are two ports for the fiber optic fiber and two copper ports to the I/O node equipment. The OLM/S4 supports the redundant ring topology.

The fiber optic cabling consists of two 62.5/125 glass fibers within the cable. The cable requires at least six fibers. The unused optic fibers become installed spares. The optic fibers are terminated with ST connectors to connect directly into the OLM/S4 modules.

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5.1.2.6 Master Equipment Enable Switch

The master equipment enable switch (MEES) is a PLC hardware protection system. The MEES has a key switch at the operator station in the control trailer that prevents equipment startup and operation unless the key is in the Operate position. When the key is in the Operate position, the PLC allows the HMI's or local control panels to control the equipment.

After an E-stop condition forces the equipment to stop operating and the E-stop switches are returned to the run position, the MEES must be turned to the Off position and then back to the Operate position to allow the field equipment to operate by way of the PLC and HMI. This prevents an operator in the field from clearing an E-stop switch and accidentally starting equipment before conditions are ready for equipment startup.

5.1.2.7 Emergency Soft Stop

The soft stop control allows the operator to rapidly shutdown all operating equipment (i.e., motor-driven equipment) at the silo bridge or the TTA. The soft stop commands are produced by the PLC, operators in the control trailer, or operators in the field. The PLC monitors the soft stop signals and upon detection of an soft stop command, the PLC will issue shutdown commands to the equipment.

The soft stop is intended to rapidly stop motor-driven equipment. If desired, the soft stop signal can be used to position equipment (i.e., motor-operated valves) to a safe or known position. The PLC monitors and responds to an E-stop command.

5.1.2.8 Hardware Interface Connections

Wire termination is accomplished with Phoenix Contact products or similar products. Field wiring to the I/O modules connects to terminal interfaces and not directly to the I/O module. Phoenix Contact provides products for DIN rail wire termination, fuse holders, relays and relay holders, and other DIN rail products.

5.1.2.9 Local Control

The PCL directs the local control of the field equipment. This method allows greater control of the equipment than that provided by hand switches and relays at the equipment locations.

Control commands are provided with hand switches located on the local control panels.

The Hand-Off-Remote switch position Off will command the PLC not to start or operate the equipment from any command source. In the Remote position, the PLC will take commands from the HMI. In either case, Off or Hand, an HMI alarm event is recorded.

5.1.3 I/O Nodes

The Sluicer, Slurry, Decant, and High Pressure Pump I/O Nodes are the data collection and control point for the equipment devices. The I/O node requires an ET200M station with an IM153 module and standard S7-300 I/O modules. This forms a distributive I/O data collection and control node. The ET200M station can support a total of eight S7-300 type I/O modules. An I/O module is replaced within the station without removing power or affecting the operating status of the other I/O modules in the station. The type and number of I/O modules are

determined as the piping and instrumentation diagram (P&ID) documents for equipment located on the silo bridge platform are finalized.

If the I/O requirements for the bridge I/O is more than what one ET200M station can support, then a second ET200M station with I/O modules is added. The I/O requirements include the 25% installed I/O spare channel requirement.

Generally, there are requirements for both digital and analog I/O modules. The digital I/O modules may include both DC and AC voltage I/O modules. The choices of digital I/O modules include SM321, SM322, and SM323 modules. There are also different models within each type of module. The choices of analog I/O modules include SM331, SM332, and SM334 modules. There are also different models within each type of analog module. The I/O modules are rated for a temperature range of 0°C to 60°C.

The ET200M station is not weather resistance. The station is housed in a heated NEMA 4 enclosure. The enclosure may require air conditioning to keep the internal enclosure temperature below 60°C (140°F).

5.1.3.1 Profibus

The fiber optic link from the control trailer to the bridge I/O node terminates in the I/O node enclosure. At this location, the Profibus is converted back to a copper link using the OLM/S4 converter. Another fiber optic link links the bridge I/O node to the high-pressure pump I/O node. The Siemens IM153 module is required for the ET200M station to use the Profibus.

5.1.3.2 Power Supply

The ET200M station requires 24-volt DC for operation. The select power supply is Siemens PS307 module and mounts on the DIN rail with the IM 153 module. The power supply requires 115-volt AC power from the UPS. The power supply output is rated for 5 amps. The power supply supplies power to a limited amount of sensors and actuators. Additional power supplies are required for sensor and actuator requirements.

5.1.3.3 Power

The I/O node enclosure requires 115-volt AC, single-phase, for enclosure heating, ventilating, and air conditioning (HVAC) and MOV power. Others supply all power to the I/O node enclosure.

5.1.3.4 Enclosure

The instrument node enclosure has an environmental rating of NEMA 4 or better. Because of the heat-producing devices inside the cabinet, the cabinet may require air conditioning. The enclosure is equipped with a sun shield to reduce the sun heat load during the summer conditions. The enclosure has an internal heater to maintain warm internal cabinet temperature in cold weather conditions. The cabinet size will be as minimal as possible. The enclosure is equipped with a thermocouple to provide warning of excess high temperature inside the enclosure.

5.1.3.5 Hardware Interface Connections

Wire termination is accomplished with Phoenix Contact products or similar products. Field wiring to the I/O modules connects to terminal interfaces and not directly to the I/O module. Phoenix Contact provides products for DIN rail wire termination, fuse holders, relays and relay holders, and other DIN rail products.

5.1.4 Sluicing Nozzle System

The sluicing nozzle system is designed to spray high-pressure water into the silo material to form a slurry mixture. The sluicing nozzle system consists of a pitch and yaw-positioning device on the nozzle. A hoist is used to lower and raise the nozzle into and out of the tank. The sluicing nozzle system has MOVs within the enclosure.

5.1.4.1 Sluicing Nozzle Pitch and Yaw Positioning

The sluicing water jet nozzle requires pitch and yaw position control. The Siemens IM 178-4 position controller module is a two-channel positioning interface module. Two absolute encoders, mounted on the sluicing nozzle, provide the nozzle's pitch and yaw position inputs to the interface module. The SM 338 reads the actual position values cyclically from the absolute encoders to pass the values onto the PLC by way of the Profibus.

The PLC receives the current pitch and yaw nozzle positions from the interface module over Profibus and the joystick positions at the operator station. The PLC finds a new commanded position (encoder position) for the nozzle and sends the commanded positions to the analog output module over Profibus. The analog output module generates an analog command to the motor drive amplifier.

The pitch and yaw motors and motor drive amplifiers are Electro-Craft devices or similar equipment. The final torque output of the motor gearbox may be as high as 400 foot-pound. The nozzle requires a positioning velocity of 0 to 10 degrees per second. The final motor and motor amplifier selection coincides with the mechanical design progression.

The absolute encoders are Siemens devices equipped with synchro-serial interface (SSI). The positioning resolution is 0.09 degree. The encoders will connect directly to the SM 338 module.

5.1.4.2 Sluicing Nozzle Vertical Positioning

A commercial two-speed winch is used to control the vertical height of the sluicing nozzle. In local operation, the hoist has two speeds. In remote operation (i.e., HMI operation), the hoist will be limited to the slow speed. An analog positioning sensor measures the vertical position of the nozzle mast. The sensor output is measured in the Bridge I/O node.

5.1.4.3 Motor Operated Valves (MOV)

The MOV located inside the sluicing enclosure are controlled by the Sluicer I/O node. Limit switches mounted on the valve determine the valve's position. The valve motor actuator and the limit switches require 120-volt AC power.

Output modules (installed in the Bridge I/O node) control MOVs, support small ac drive motor loads, and input modules that monitor ac sensor values. The motor drive power that is supplied

by the AC output module is fuse protected. The fuses are located in the Sluicer I/O node enclosure.

5.1.4.4 Motor Starter

To allow the PLC to remove AC power from the pitch and yaw motor drive amplifiers and from the hoist, a motor starter is used to supply power to the amplifiers and hoist. The motor starter provides a method to remove power from the motors for normal shutdown or soft stop shutdown. The motor drive amplifiers and the hoist are fuse protected. There is a lockable disconnect switch in-line between the motor starter and the 480-volt AC, three-phase power supplied by others.

5.1.4.5 Control Enclosure

A NEMA 4 or better enclosure is required to house the disconnect switch, motor starter, pitch and yaw motor drive amplifiers, hoist motor controller, land interface circuits. The enclosure requires both heat and air conditioning to maintain proper operating temperature inside the enclosure. The control enclosure is mounted to the outside on the sluicing enclosure.

5.1.4.6 Cable Handling Inside the Enclosure

The cables that pass from the control enclosure to the Sluicing Enclosure will pass through sealed bulkhead fittings. The cables from the control enclosure to the hoist and MOVs travel direct to their devices. The cables (motor and encoder) for the sluicing nozzle are stored on a cable reel. The cables are pulled off the cable reel as required when new mast sections are installed to lengthen the sluicing nozzle mast. After the new length of cable from the cable reel are attached to the new mast section, the cable connectors on the cable reel end are reconnected to the cable connectors from the control enclosure.

5.1.4.7 Local Control

A Hand-Off-Remote switch is located on the control enclosure. In Remote position, the control of the equipment within the sluicing nozzle enclosure is controlled by the HMI. In the Off position, the PLC does not accept any commands to operate equipment within the sluicing nozzle enclosure. In the Hand position, the PLC accepts commands from the local I/O node control panel. In the Hand position, all equipment within the sluicing nozzle enclosure is placed into local control. The equipment includes the pitch and yaw nozzle motors, the nozzle hoist, and MOVs.

5.1.4.8 Hardware Interface Connections

Wire termination is accomplished with Phoenix Contact products or similar products. Field wiring to the I/O modules connects to terminal interfaces and not directly to the I/O module. Phoenix Contact provides products for DIN rail wire termination, fuse holders, relays and relay holders, and other DIN rail products.

5.1.5 Bulk Waste Retrieval/CATS System

The bulk waste retrieval/CATS system is the equipment used to pump the material out of the silos and to the TTA tanks.

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5.1.5.1 Slurry Pump

The slurry pump is required to operate at different speeds to control the amount of slurry that is pumped out of the silo. A variable-speed motor driving through a gear reducer governs the slurry pump. A variable-speed motor drive powers the motor. The operator in the control trailer controls the speed of the pump by adjusting the speed of the pump motor.

The current selected variable-speed motor drive is a Siemens MidiMaster Vector drive with the Profibus connection. The motor drive is controlled directly by the PLC over the Profibus network. This variable-speed motor drive is sensorless. These features make this motor drive attractive.

Currently, the slurry pump motor is rated at 50 horsepower. The motor drive requires 480-volt AC, three-phase power. Local control of the pump motor is provided by the front panel controls located on the motor drive amplifier.

An ultrasonic level sensor is mounted above the slurry pump intake to determine the level of slurry present at the pump intake. If the slurry amount or level is low, the sensor will detect the low-level and turn the slurry pump off.

The slurry pump vertical height is controlled by a motor-driven elevator platform. The elevator platform vertical height is positioned by a single-speed motor driving lead screws in each of the corners of the elevator platform. The elevator platform height can be controlled either from the HMI or locally. The position of the elevator platform is measured and displayed on the HMI. A bi-directional motor starter controls the elevator motor. The motor requires three-phase, 480-volt AC power.

5.1.5.2 Motor Operated Valves

The three MOVs located inside the slurry pump enclosure are controlled by the Slurry I/O node. Limit switches mounted on the valves determine the valve's position. The valve motor actuator and the limit switches are 120-volt AC power.

5.1.5.3 Motor Starter

To allow the PLC to remove AC power from the slurry pump motor drive and from the elevator platform, a motor starter is used to provide power to the motor drive and elevator platform motor. The motor starter provides a method to remove power from the motors for normal shutdown or soft stop shutdown.

There is a lockable disconnect switch in-line between the slurry pump motor drive and the 480-volt AC, three-phase power.

5.1.5.4 Control Enclosure

A NEMA 4 or better enclosure is required to house a disconnect switch, motor starter, elevator motor controller, and interface circuits. The enclosure requires both heat and air conditioning to maintain proper operating temperature inside the enclosure. The control enclosure is mounted to the outside on the slurry pump enclosure.

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5.1.5.5 Cable Handling Inside the Enclosure

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The cables that pass from the control enclosure to the Slurry Pump Enclosure pass through sealed bulkhead fittings. The cables from the control travel directly to their devices.

5.1.5.6 Local Control

A Hand-Off-Remote switch is located on the control enclosure. In Remote position, the control of the equipment within the slurry enclosure is controlled by the HMI. In the Off position, the PLC does not accept any commands to operate any equipment within the slurry pump enclosure. In the Hand position, the PLC accepts commands from the local I/O node control panel.

In the Hand position, all equipment within the Slurry pump enclosure is placed into local control. The equipment includes the slurry pump motor, the elevator, and MOVs.

5.1.5.7 Profibus Equipment

A slurry flow meter sensor is installed in the slurry pump enclosure. The flow sensor connects directly to the Profibus network, which provides to the HMI all information generated by the flow sensor.

5.1.5.8 Hardware Interface Connections

Wire termination is accomplished with Phoenix Contact products or similar products. Field wiring to the I/O modules connects to terminal interfaces and not directly to the I/O module. Phoenix Contact provides products for DIN rail wire termination, fuse holders, relays and relay holders, and other DIN rail products.

5.1.5.9 Team-Supplied Equipment

Six radiation detectors are supplied for use on two silo risers. The radiation detectors are stand alone and provide their own input device and monitor in the control trailer.

5.1.6 High-Pressure Pump I/O Node

The High-Pressure Pump I/O Node or I/O Node 2 is the data collection and control point for the equipment devices located on or near the high-pressure pumps. The I/O node requires an ET200M station with an IM153 module and standard S7-300 I/O modules. This forms a distributive I/O data collection and control node. The ET200M station supports a total of eight S7-300 type I/O modules. An I/O module is replaced within the station without removing power or affecting the operating status of the other I/O modules in the station.

A second ET200M station with I/O modules is added If the I/O requirements for the bridge I/O is more than what one ET200M station can support. The I/O requirements include the 25% installed I/O spare points requirement.

Generally, there are requirements for both digital and analog I/O modules. The digital I/O modules may include both DC and AC voltage I/O modules. The choices of digital I/O modules include SM321, SM322, and SM323 modules. There are also different models within each type of module. The choices of analog I/O modules include SM331, SM332, and SM334 modules.

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There are also different models within each type of analog module. The I/O modules are rated for a temperature range of 0°C to 60°C.

The ET200M station is not weather resistance. The station is housed in a heated NEMA 4 enclosure. The internal enclosure temperature may require air conditioning to keep the temperature below 60°C (140°F).

5.1.6.1 Profibus

The fiber optic link from the bridge I/O node terminates in the high-pressure I/O node enclosure. At this location, the Profibus is converted back to a copper link using the OLM/S4 converter. Another fiber optic link links the high-pressure pump skid I/O node to the TTA I/O node. The Siemens IM153 module is required for the ET200M station to use the Profibus.

5.1.6.2 Power Supply

The ET200M station requires 24-volt DC for operation. The selected power supply is Siemens PS307 module and mounts on the DIN rail with the IM 153 module. The power supply requires 115-volt AC power from the Uninterruptible Power Supply. The power supply output is rated for 5 amps. The power supply provides power to sensors and actuators. Additional power supplies may be required for sensor and actuator requirements.

5.1.6.3 Power

The I/O node enclosure requires 115-volt AC, single-phase power for enclosure HVAC and MOV power.

5.1.6.4 Emergency Soft Stop

The soft stop cable is intended to rapidly stop motor-driven equipment.

5.1.6.5 Enclosure

The I/O node enclosure has an environmental rating of NEMA 4 or better. The enclosure is equipped with a sun shield to reduce the sun heat load during the summer conditions. The enclosure has a heater to maintain warm internal cabinet temperature in cold weather conditions.

The I/O node enclosure is mounted to the outside of the high-pressure pump skid cover. The enclosure is equipped with high temperature switch to provide warning of excess high temperature inside the enclosure.

5.1.6.6 Hardware Interface Connections

Wire termination will be accomplished with Phoenix Contact products or similar products. Field wiring to the I/O modules connects to terminal interfaces and not directly to the I/O module. Phoenix Contact provides products for DIN rail wire termination, fuse holders, relays and relay holders, and other DIN rail products.

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5.1.6.7 High-Pressure Water Pumps

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The three water pressure pumps can be started and stopped from the HMI. The pump discharge flow is dumped or directed to the using device. The pump discharge pressure to the using device is controllable. The pumps' operating information and discharge water pressure is displayed on the HMI. The water pressure pumps supply water to the SREE cutting jets, to the jet pump, and to the riser decontamination spray rings.

5.1.6.8 Hydraulic Pressure Pumps

The hydraulic pump supplies hydraulic operating pressure to the SREE rotation motor and the debris cutting shear. From the HMI, the pump can be started and stopped. Operating conditions are monitored.

5.1.6.9 Motor Starter

Each motor has its own motor starter allowing the PLC to control the starting and stopping of the high-pressure pump motors. The motor starter is controlled from the high-pressure I/O node. There is a lockable disconnect switch in-line between the motor starter and the 480-volt AC, three-phase power.

5.1.6.10 Control Enclosure

A NEMA 4 or better enclosure is required to house the disconnect switch and the pump motor starter. Each motor has its own enclosure near the motor the enclosure is controlling. The enclosures do not require heat or air conditioning.

5.1.6.11 Local Control

A Hand-Off-Remote switch for each pump is located on the high-pressure I/O node enclosure. In the Remote position, the control of that high-pressure pump and associated control equipment is controlled by the HMI. In the Off position, the PLC does not accept any commands to operate equipment associated with that pump. In the Hand position, the PLC accepts commands from the local control panel.

In the Hand position, all equipment associated with the high-pressure pump is placed into local control. The equipment includes the starting and stopping of the pump, position of the dump valve, pressure adjustment, and pressure reading. The control commands are performed at the hand-held local controller.

5.1.6.12 Hardware Interface Connections

Wire termination is accomplished with Phoenix Contact products or similar products. Field wiring to the I/O modules connects to terminal interfaces and not directly to the I/O module. Phoenix Contact provides products for DIN rail wire termination, fuse holders, relays and relay holders, and other DIN rail products.

5.1.7 TTA I/O Node

There are up to 14 I/O nodes with in the TTA for data collection and control point for the equipment devices located in or near the TTA building. Each I/O node requires an ET200M

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station with an IM153 module and standard S7-300 I/O modules. This forms a distributive I/O data collection and control node. The ET200M station supports a total of eight S7-300 type I/O modules. An I/O module is replaced within the station without removing power or affecting the operating status of the other I/O modules in the station.

Generally, there are requirements for both digital and analog I/O modules. The digital I/O modules include both DC and AC voltage I/O modules. The choices of digital I/O modules include SM321, SM322, and SM323 modules. There are also different models within each type of module. The choices of analog I/O modules include SM331, SM332, and SM334 modules. There are also different models within each type of analog module.

The I/O modules are rated for a temperature range of 0°C to 60°C. The ET200M station is not weather resistant. The station is housed in a NEMA 4 enclosure.

5.1.7.1 Profibus

The fiber optic link terminates at the Sample Valve Box node enclosure. At this location, the Profibus is converted back to a copper link using the OLM/S4 converter. Another fiber optic link links the FSM Diverter Equipment Box node back to the Operator Station I/O node. The Siemens IM153 module is required for the ET200M station to use the Profibus.

5.1.7.2 Power Supply

The ET200M station requires 24-volt DC for operation. The selected power supply is Siemens PS307 module and mounts on the DIN rail with the IM 153 module. The power supply requires 115-volt AC power from the Uninterruptible Power Supply. The power supply output is rated for 5 amps. The power supply provides power to a limited amount of sensors and actuators. Sensor and actuator requirements may demand additional power supplies.

5.1.7.3 Power

The I/O node enclosure require 115-volt AC, single-phase power for enclosure HVAC and MOV power.

5.1.7.4 Emergency Soft Stop

The Decant, Sluicer, and Slurry control nodes are equipped with soft stop controls.

5.1.7.5 Enclosure

The instrument node enclosure has an environmental rating of NEMA 4 or better.

5.1.7.6 Hardware Interface Connections

Wire termination is accomplished with Phoenix Contact products or similar products. Field wiring to the I/O modules connects to terminal interfaces and not directly to the I/O module. Phoenix Contact provides products for DIN rail wire termination, fuse holders, relays and relay holders, and other DIN rail products.

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5.1.8 Decant Pumps

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The decant pump is a single-speed pump and is used to pump tank liquid from the TTA waste storage tank to the silo sluicing nozzle. The pump floats on the water surface of a TTA waste storage tank when the pump is operating. There are two independent decant pump systems.

One decant pump is in Tank A and the other decant pump is in Tank B during SWRS operations. When the second silo SWRS operations are ready to begin, the decant pumps move to the second set of A and B tanks in the TTA building. Currently, the decant pump motor is rated at 60 horsepower. The motor requires 480-volt AC, three-phase power.

The decant pump lowers into the waste TTA storage tank using two hoists located on the ceiling of the decant pump enclosure.

5.1.8.1 TTA I/O Node Control Motor Operated Valves

The motor-operated valves (MOV) located inside the decant pump enclosure have limit switches mounted on the valves determined the valve's position. The valve motor actuator and the limit switches may be 120-volt AC power.

5.1.8.2 Motor Starter

The decant pump motor has a motor starter in a control enclosure mounted to the decant pump enclosure. The motor starter is controlled by the PLC. The motor starter also provides a method to remove power from the motors for normal shutdown or soft stop shutdown. There is a lockable disconnect switch in-line between the motor starter and the 480-volt AC, three-phase power.

5.1.8.3 Control Enclosure

A NEMA 4 or better enclosure is required to house the disconnect switch and motor starter. The enclosure does not require heat or air conditioning. The control enclosure is mounted to the outside on the decant pump enclosure.

5.1.8.4 Cable Handling Inside the Enclosure

The cables that pass from the control enclosure to the Slurry Pump Enclosure pass through sealed bulkhead fittings. The cables from the control enclosure to the MOVs travel direct to their devices. The cables for the decant motor are stored on a cable reel quipped with a slip ring.

5.1.8.5 Local Control

A Hand-Off-Remote switch is located on the control enclosure. In Remote position, the control of the equipment within the decant enclosure is controlled by the HMI. In the Off position, the PLC does not accept any commands to operate equipment within the decant pump enclosure. In the Hand position, the PLC accepts commands from the local hand-held control panel.

In the Hand position, all equipment within the decant pump enclosure is placed into local control. The equipment includes the decant pump motor and MOVs located inside the decant pump enclosure.

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5.1.8.6 Hardware Interface Connections

Wire termination is accomplished with Phoenix Contact products or similar products. Field wiring to the I/O modules connects to terminal interfaces and not directly to the I/O module. Phoenix Contact provides products for DIN rail wire termination, fuse holders, relays and relay holders, and other DIN rail products.

5.1.9 TTA Sluicing Nozzle System

The sluicing nozzle system is designed to spray high-pressure water into the TTA waste storage tank material to form a slurry mixture. The sluicing nozzle system is identical to the sluicing nozzle system used on the silos.

The sluicing nozzle system supports the TWRS operations. During TWRS operations, two sluicing nozzle systems are installed into one TTA waste storage tank. The sluicing nozzle system's controls are identical to the sluicing nozzles used in the silos.

5.1.10 TTA Bulk Waste Retrieval

The TTA bulk waste retrieval system is the equipment used to pump the waste material out of the TTA tanks and to the processing treatment facility. The TTA bulk waste retrieval system control is identical to the Silo bulk waste retrieval system.

5.1.11 TTA Building Equipment

The TTA building equipment that is controlled by the TTA I/O node includes the three-way and two-way MOVs and liquid transfer pumps. The TTA I/O node also monitors the pressure and flow sensors within the TTA system. The complete P&ID documents identify all TTA I/O node inputs and outputs for the TTA.

5.1.11.1 Motor Starters within the MCC

Presently, there are three MCCs located near the TTA building. TTA I/O node controls the motor starters using the Actuator Sensor Interface (ASI) network or a new I/O node outside the TTA building.

5.1.11.2 Local Equipment Control

Each motor in the TTA has its own Hand-Off-Remote switch located on the TTA I/O node enclosure. Each MOV is controlled by its own Hand-Off-Remote/Position switch.

5.1.11.3 Hardware Interface Connections

Wire termination is accomplished with Phoenix Contact products or similar products. Field wiring to the I/O modules connects to terminal interfaces and not directly to the I/O module. Phoenix Contact provides products for DIN rail wire termination, fuse holders, relays and relay holders, and other DIN rail products.

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5.1.12 Radon Control System (RCS).

The RCS has its own redundant PLC for control. This PLC is located at the RCS building and is equipped with a Profibus communication interface communicating on Fiber Optic Ring 3. The local RCS HMI communicates with the RCS PLC and provides both monitoring and control operations for the RCS. A different Profibus network for the RCS PLC is set for communication with the RCS HMI located in the control trailer. The BOP PLC will provide HVAC data from modules to the RCS PLC system through this Profibus network as well as changes in setpoints from the RCS HMI in the control trailer. For FSMS testing, an RCS simulator PLC will control and test the airflow from silo 4 to demonstrate controlling silo pressure.

5.1.13 Sample Collection System

The sample collection system is controlled by a small, independent PLC for its own monitoring and equipment control. The PLC is located on the sampling skid. This PLC is equipped with a Profibus communication interface and may communicate on Fiber Optic Ring 1. The sampling system PLC is set as a slave device on the Profibus network, and share Profibus Network 1.

5.2 System Components

5.2.1 Decant Pump System

The decant pump system is used to supply water to the silo sluicer water cannon. The pump system enclosure is mounted on the TTA equipment deck directly over the 48-inch riser centrally located on each storage tank. Two pump systems are provided. After the two pumps remove the supernate from two tanks, they are moved to the two remaining tanks, and remove the supernate from them. The decant pump system contains all the equipment needed to operate the pump, and interfaces with the TTA.

5.2.1.1 Supernate Pump Assembly

The pump assembly consists of one 60 horsepower centrifugal pump mounted on a float. The float has two pontoons, 22-inches diameter by 60-inches long, connected by a spring loaded folding frame 48-inches long when opened. The pump suction strainer will extend about 1 foot below the water level in the storage tank.

5.2.1.2 Enclosure

The enclosure is built with a structural steel tubing frame, and steel sheet metal welded to the frame. It has one airtight access door, one equipment pass through, and sufficient glove ports and windows to allow equipment maintenance.

The enclosure contains the equipment needed to allow the supernate pump to function. This includes two 1-ton hoists to install and remove the pump from the tanks, one hose reel to hold the pump discharge hose, one cable reel to hold the pump motor wiring, and two 3-way ball valves and piping to direct the supernate and slurry flow. The enclosure also contains a spray ring to decontaminate the pump assembly when it is removed from the tank. The local control box for the electric components and motors is located on the outside wall of the enclosure.

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5.2.1.3 Installation

The enclosure is pre-assembled at the time of delivery to the site. It is moved to the proper location on the equipment deck using air bearings. The riser connection on the bottom is attached to the 48-inch riser boot by a band clamp, and the enclosure is leveled and bolted to the floor. The utility interfaces are connected and tested.

5.2.1.4 Deployment

The pump assembly is hoisted into the tank using the two hoists located in the top of the enclosure. The assembly is installed in two parts, the float assembly, and the pump and mounting plate assembly. The float assembly is folded to pass through the 48-inch-diameter riser on the top of the storage tank. Once the float is in the water, the spring force will unfold it. The pump and mounting plate are then lowered into the tank and placed on the float. The guide pins on the float properly position the pump.

5.2.1.5 Operation

The pump is operated as needed to supply water to the sluicer water cannon. During normal operation, the pump is remotely controlled from the TTA control room. The valves in the enclosure allow the operator to flush out the slurry piping as needed. As the tank fills with settled solids, the cable and hose are decontaminated and retracted onto their respective reels. The pump is raised up to the riser when slurry is being pumped to the tank.

5.2.1.6 Retraction

The system disassembles in reverse order from the way it is assembled, with the exception of the pump and float assemblies are decontaminated by the spray ring before they are removed from the riser.

5.2.1.7 Control Approach

The pump operates either remotely or locally. The remote control console is located in the TTA control room. The operator controls the pump, hoists, and the valves from there. The operator receives feedback from the system by way of the sensor/transmitters on the pump, valves, and the E-stop switch. The system is locally controlled from a local control panel that contains pump and valve switches, and the E-stop switch. The hoists, and any other powered equipment are operated locally.

Controls determine the level of the pump based on the supernate level in the tank. The level indicator determines both the surface and residue interface. Low-level shutoff of the pump is approximately 3 feet above that interface. The amount of water is calculated to ensure sufficient water is available to operate a day's sluicing.

5.2.2 High-Pressure Pump Skids

Three high-pressure pumps are provided to generate pressurized water for decontamination water to the decontamination spray rings, motive water to the jet pumps and cutting water to the SREE. All three pumps are mounted on one skid and enclosed. A local control panel is located on the outside of the enclosure. Quick disconnects for the high-pressure water supply lines are

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mounted at the enclosure interface. The enclosure has a footprint of 15 feet long × 7 feet wide × 1 foot high with an approximate weight of 15,000 pounds.

The equipment provided with the system consists of three high-pressure pumps: the decontamination water, jet pump motive water and SREE cutting water supply pumps. These pumps are housed in a heated and ventilated enclosure that includes the following: (1) three high-pressure pumps, (2) a lube water system collection pan, (3) a sump pump located in the sump, (4) process valves, piping and hoses, (5) a fresh air vent, (6) an exhaust fan, and (7) an enclosure heater to prevent freezing.

5.2.2.1 Equipment Description

The enclosure is constructed of insulated fiberglass walls and roof attached to a floor/support frame structure. The floor/support is fabricated of welded and painted carbon steel. Forklift points as well as a grounding lug are integrated in the support frame. Any liquid leaks inside the enclosure are contained and collected in a sump located in the floor of the enclosure. A sump pump will be provided that will transfer any liquid to the water supply tank. The sump pump is an air-operated, double-diaphragm pump.

The high-pressure pump for the decontamination water supply is the Butterworth Liqua Blaster, Model 103ET. This pump has the capability to supply up to 40 gallons per minute at 3000 pounds per square inch discharge pressure. This pump is a three-piston, positive-displacement pump constructed of stainless steel, carbon steel, and cast iron. A 480-volt, 3-phase, 75-horsepower, totally enclosed, fan-cooled (TEFC) electric motor drives the pump.

The cutting water and motive water pumps are identical systems. Both of these pumps are the Butterworth Liqua Blaster Model 110ET. Each has the capability to pump up to 10 gallons per minute at 10,000 pounds per square inch discharge pressure. These pumps are three-piston, positive-displacement pumps constructed of stainless steel, carbon steel, and cast iron. A 480-volt, 3-phase, 75-horsepower, TEFC electric motor drives each pump.

The lube water from each pump drains into a common collection tank supplied with an air-operated, double-diaphragm sump pump to transfer the liquid to the process water tank.

The fresh air vent and the exhaust fan provide air circulation inside the enclosure. Louvers with a replaceable steel mesh screen over an opening in the enclosure wall will from the fresh air vent. The exhaust fan is powered by a 110-volt motor. It is equipped with movable louvers to prevent heat loss during cold weather. A thermostat-controlled, 1500-watt heater powered by 110 volts prevents system freezing during cold weather .

5.2.2.2 Operational Description

All equipment inside the enclosure is installed before delivery to the site. A forklift positions the system on leveled and compacted gravel or a concrete pad located on the ground. Three-phase, 460-Volt AC and 110-Volt AC electrical service will be connected at the disconnect switch, that also contains the power distribution panel. The process water supply and return lines and the high-pressure supply lines connect at their respective quick-disconnects.

Process water is supplied to the high-pressure water supply system at 40 gallons per minute and 50 pounds per square inch. The water supply line enters the enclosure and divides into three separate supply lines to each pump. Each line has a hand operated valve to manually

shut off the water. The pump supply lines also have local flow and pressure instrumentation. The low-level pressure switch interlocks with the power to the pump, turning off the pump when the pressure of the incoming supply water drops below the predetermined level.

Each pump has a pressure-relief valve to protect the pump from over pressurization. The crankcase lube gauge on the pump has a low-level switch that shuts off power to the pump. The lube water gravity drains to a common lube water collection tank where a sump pump returns the liquid to the water supply tank. This return line from the collection tank has backflow preventers.

The discharge line from each pump has an air-operated dump valve that—when closed—diverts the water supply to the return line. The return line from the dump valve has flow instrumentation and back flow preventers. The differential of this return flow and the inlet flow indicates the high-pressure water supply flow. This flow rate is monitored remotely.

The pressure is controlled remotely with the air-operated control valve or locally with the manually operated control valve. When the pumps are started up, the dump valve returns the water to the supply tank, the manual valve is closed and the remote valve is opened. When high-pressure water is needed, the dump valve opens, allowing the water to pass through the remote pressure control valve. As this valve closes, the water is forced down the supply hose. The pressure is monitored remotely.

For manual operation of the pumps, the manual control valve is opened and the remote control valve is closed upon start up. As the dump valves open, the water passes through the manual valve. Local instrumentation allows operations to monitor the pressure as they close the manual valve.

5.2.2.3 Controls

The pumps operate either locally or remotely. The local control panel mounts on the exterior of the enclosure and has pump status lights, start/stop buttons, dump supply/auto switch, dump valve status lights, and an E-stop button. In local operation, pressure is controlled with the manual pressure-controlling valve. The local pressure indicator provides feedback to the operator to monitor discharge pressure. In remote operation, the manual pressure control valve is fully closed. The pressure is controlled from the remote graphical control console by inputting the desired discharge pressure and using the pressure transmitter and pressure controller for closed loop control. The remote console displays discharge pressure and dump valve status.

System interlocks shut down the pumps in the event of low inlet pressure, high discharge pressure, low crankcase lube level, high discharge flow, or high liquid-level in the sump. Enclosure temperature control (i.e., heater and exhaust fan) is provided by thermostats located in the enclosure and is not integrated with the local control panel or remote console. A lockable electrical disconnect switch will be mounted at the local control panel.

5.2.3 TTA Decontamination Pump Skid

One high-pressure decontamination pump provides support to the decontamination spray ring operation in the TTA. The pump will be mounted on a skid weighing up to 5,000 pounds and having a 4-foot × 6-foot footprint. All nonskid mounted piping, hoses, valves, fittings, and instrumentation are included as part of the TTA decontamination pump skid system.

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5.2.3.1 Pump

The single decontamination pump for service in the TTA is a positive-displacement, piston-type pump with water lubrication. The pump provides 3000 pounds per square inch and 40 gallons per minute at the pump discharge. This pump uses a 75-horsepower motor requiring 460-Volt, three-phase power. The high-pressure pump is skid mounted and capable of local operation from the local panel or remote operation from the central control console (HMI). The pump has a pressure-relief valve, pressure indicator, pressure transmitter, pressure controller (for remote operation), and a manual pressure control valve (for local operation). The pump is mounted to a painted, carbon steel skid without any leak collection or detection capabilities. It operates indoors without any freeze protection provisions. The pump meets seismic, floor loading, and building ventilation requirements. Inlet piping (<200 pounds per square inch) meets the requirements of ASME B31.3 and outlet piping meets the requirements of ASME B31.3 or the Water Jet Technology Association.

5.2.3.2 Controls

The pump is operated locally or remotely. The local control panel, mounted to the skid, has pump start and stop buttons, dump/supply/auto switch, dump valve status indicator lights, and E-stop. In local operation, pressure is controlled with the manual pressure-controlling valve. The local pressure indicator provides feedback to the operator to monitor discharge pressure. In remote operation, the manual pressure control valve is fully closed. The pressure is controlled from the central control console by inputting the desired discharge pressure and using the pressure transmitter and pressure controller for closed loop control. The remote console displays discharge pressure and dump valve status.

5.2.4 Sluicer System

The sluicer directs a concentrated stream of decant fluid to the waste surface and "pushes" a pumpable slurry toward the bulk waste removal pump. The sluicer deploys through one of the risers located 25 feet from the center of the silo. Using decant water supplied by the sluice water supply pump, the sluicer directs a concentrated water stream to the waste surface and provides a slurry to the retrieval pump. The sluicer system has three degrees of freedom: mast elevation, sluicing nozzle pan, and sluicing nozzle tilt. The sluicer system weighs approximately 15,000 pounds.

The sluicer system consists of the sluicer, its controls, and the enclosure. Sluicer components include the mast sections, mast hoist, mast support table, and sluicing nozzle assembly. The sluicer is controlled from either a local control panel or remotely from a graphical control console. The enclosure includes a small double-door pass through port (approximately 2-feet × 2-feet × 2-feet deep), a large double-door access hatch (approximately 3-feet × 3-feet × 11-feet high), a mast handling trolley, and numerous glove ports.

5.2.4.1 Equipment Description

Mast and mast hoist—The mast serves a dual purpose: supply feed water and power/signals to the sluicing nozzle and its controls, and support to the nozzle (and its reaction forces). To deploy the sluicing nozzle fully into the silo (41 feet from the bottom of the bridge to the silo bottom), the mast has four 9-foot-long modular extensions in addition to the pan/tilt module. As the level in the silo decreases, extensions are added to increase the mast length. A hoist at the top of the sluicer housing remotely or locally controls mast elevation.

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A roof-mounted trolley running from inside the double-door hatch and along the perimeter of the sluicer enclosure moves mast modules into and out of the enclosure. Spare modules will be stored at the end of the trolley run and suspended from the trolley. As extra modules are required to extend the mast reach, a module is rolled on the trolley to near the mast hoist and handed off to the mast hoist. The in-silo portion of the mast is locked to and suspended from the mast support table during the process of adding mast modules.

The mast is made of rectangular structural tubing. The mast module joints are self-aligning joints using high-strength fasteners to hold the joints in place. The mating edges of each mast section are machined to ensure a snug fit. A removable flange-type attachment is connected to the top of the deployed mast to prevent the mast from falling into the silo in the event of a catastrophic hoist or cable failure.

The sluicer fluid-supply hose is routed through the inside of the mast. The hose has quick-connect fittings at the mast joints for ease of connection. Power and signal cabling for the sluicer joint motors and encoders are routed outside of and attached to the mast sections. All these cables are bundled together. Extra cable is stored on a manually controlled motor operated cable reel. As a new mast section is added, the cable reel pigtail is disconnected and enough cable is deployed from the reel to attach to the new mast section. The bundle is clamped to each mast section approximately every 3 feet. There is a section of hose and cable bundle suspended between the top mast section and the inlet piping inside the enclosure. This suspended section has enough slack to allow full mast elevation travel without binding the hose or cable bundle. When sufficient cable is deployed and attached, the cable reel is locked and the pigtail connected.

Mast Support Table—The mast support table guides the mast radially during sluicing operations. Cam rollers are mounted to the table to guide the mast and support the reaction forces from the sluicing nozzle. While adding or removing mast extensions, the support table will support the in-silo portion of the mast and nozzle assembly.

Sluicing Nozzle Assembly—The sluicing nozzle assembly consists of the nozzle and the pan and tilt mechanisms. The nozzle is sized to optimize the sluicing stream delivered at the waste surface given the supplied flow conditions (nominally 300 gallons per minute at 150 pounds per square inch less line losses from the pump). The pan and tilt mechanisms are electrically driven with position feedback to the remote control console. The nozzle is capable of directing flow from the horizontal position to approximately +/- 90°. The pan mechanism is capable of rotating the nozzle approximately +/- 170°.

Enclosure—The enclosure has a footprint of approximately 6 feet by 10 feet and is constructed of structural tubing with a sheet metal skin. Glove ports are located strategically at various points on the enclosure including near the mast support table, the small pass through port, and the hose and cable connection locations as a minimum. A double-door access hatch allows large items to be moved into or out of the enclosure without breaking containment. The outside door is a single door. The inner door is a double door (French doors) to minimize the space required to open the doors. A trolley rail runs inside the large pass through area. A second trolley rail runs in the main enclosure and around the periphery of the main enclosure. The trolleys are used to move mast extensions into and out of the enclosure and for mast extension storage. A hose and cable interface box attaches to the enclosure. Hoses and cables inside the enclosure terminate at the interface box with bulkhead connectors and quick-connects. A

small double-door pass through port is provided to move smaller items into and out of the enclosure without breaking containment.

5.2.4.2 Operational Description

The initial condition of the sluicer system before beginning operations is with all hoses and control and power cables connected internally and externally. One mast module is mounted to the sluicing assembly and supported by the mast hoist. The sluicing nozzle is aligned with the mast to allow the assembly to pass through the silo riser into the silo. The other three mast extensions are stored in a corner of the enclosure hanging from the trolley. All doors and hatches are closed and latched. Mast position limits are set by the operator. The local/off/remote switch at the local control panel is set to "remote". From the remote console, the sluicer operator lowers the mast into the silo until the nozzle is at the desired operating position. The nozzle is directed to the desired location using the joystick controls at the remote console. The sluicer is ready for operation in this condition.

During sluicing, the sluicer operator continues to move the sluicing nozzle with the joystick controller to "push" slurry toward the bulk waste removal pump. The operator adjusts the nozzle elevation as required by lowering or raising the mast. When the lower limit of mast travel is reached, operations must cease to allow addition of another mast extension.

A locking support bracket is installed at the top of the in-silo mast extension to allow the mast to rest on the support table. The mast is lowered until it rests on the support table. The mast hoist is disconnected from the top of the mast and raised. A second mast extension is rolled on the trolley to near the mast hoist. The mast hoist is connected to the top of the second mast extension and the mast extension is released from the trolley. The second mast extension is lowered into place on top of the in-silo mast and fastened. Hose connections are made at both ends of the second extension and the cable bundle is extended and clamped to the outside of the second extension. The position limits are adjusted as necessary. Operations continue as previously described.

Retraction of the mast is a reverse process of the actions described above. The sluicing nozzle is aligned with the mast to allow it to pass up through the silo riser. Hoses and cables are disconnected. The mast is raised and mast extensions are removed and stowed on the trolley one at a time.

5.2.4.3 Control Approach (local/remote controls, interlocks, instrumentation).

The sluicer operates remotely with local control available for the mast hoist. The hoist operates on three-phase, 480-Volt AC power supplied to a local panel. Remote operations are from a control console inside the control room. A local control panel is provided at the sluicer enclosure. The local panel has a mast hoist up/off/down switch, sluicer control valve open/close switch, cable reel out/off/in switch, sluicer module local/off/remote switch, and E-stop button. Motor starter/contactors/amplifiers, control power supplies, digital I/O cards, E-stop, and relays are mounted in the local cabinet. Lockable power disconnect switches ares provided at the local panel. The remote control console uses multi-screen, graphical user interface, PLC-based control. The graphical sluicer screen shows sluice water pressure and flow, sluicer angles, and E-stop status. Specific interlock requirements are programmed. After acceptance testing, software control is offered. This same console supports remote control of all equipment provided.

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The sluicer pan and tilt joints are driven with servomotors with encoders for position feedback to the remote console and closed loop control system. The pan joint 0-degree position directs the nozzle approximately toward the center of the silo. It is capable of rotation up to ± 170 degrees. The tilt joint 0-degree position directs the nozzle toward the bottom of the silo. It is capable of rotation up to at least +100 degrees and –5 degrees. Each of the joints is capable of velocities from 0.1 to 5 degrees per second in either the positive or negative direction. The sluicer joints are controlled from the remote console only (i.e., there is no local control for the joints) by a joystick controller. The sluicer operator inputs the desired joint velocity on the graphical control console and then uses the joystick to direct the nozzle spray. The graphical control console displays joint positions and position limit alerts.

Each of the joints has software-controlled position limits. These limits are set to prevent the operator from moving the joints outside the desired limits of operation and to protect the equipment. The software limits are controlled by the sluicer operator and accessed through the graphical control console by inputting a password.

The mast hoist is controlled either locally or from the remote console. A "local/off/remote" switch located at the local control panel selects the point of control. With the switch in the "local" position, the hoist is operated locally. An "up/off/down" switch on the local panel controls the hoist. With the local switch in the "up" position, the hoist moves up and in the "down" position, the hoist moves down. This is a "dead man" type switch so that if it is released, the switch returns to the "off" position. With the local switch in the "remote" position, the hoist operates remotely from the graphical control console. From the console, the operator selects the mast hoist and either lowers or raises the mast by selecting and holding the up or down arrow. The mast hoist has an adjustable limit switch to control the upper and lower bounds for mast hoist operation.

5.2.5 Slurry (Bulk Waste Retrieval) Pump/CATS

The slurry (bulk waste retrieval) pump/CATS system is incorporated into one system and consists of a single enclosure housing all equipment associated with the bulk waste retrieval and CATS system. The enclosure and equipment are mounted on the silo bridge structure. Also associated with the system but located on the bridge outside the enclosure is a local control panel for the system equipment. The bulk waste retrieval slurry pump is deployed vertically through the silo riser and is driven from a variable-speed drive motor coupled directly to the slurry pump. The pump and drive is supported from up to two 12-foot-long mast sections. The mast sections include hose jumpers providing slurry discharge, slurry recycle/flush water, SREE hydraulic water supply/return, SREE cutting jet High-Pressure Water (HPW), and heels removal jet pump motive high-pressure wand (HPW). The overall weight of the slurry pump/CATS system and support equipment is estimated at approximately 18000 pounds. The space requirement for the slurry pump and deployment/operational equipment is an approximate 9-foot × 18-foot footprint × 20-feet high.

The bulk waste retrieval and CATS system include the following equipment: (1) a progressive cavity (Seepex) pump; (2) a deployment mast assembly with external hoses and piping; (3) a vertical positioning table for vertically changing pump elevations; (4) variable-speed control pump drive motor and gear box, (5) a mast section stowage trolley, (6) a spray ring for decontamination of equipment; (7) process valves, piping, and hoses; (8) provisions for stowage and deployment of the SREE hose bundle; and (9) heel waste surge tank for collection and transfer of heel waste.

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5.2.5.1 Equipment Description

Pump—The slurry pump is a progressive cavity pump. The pump is a Seepex, Model 130-12BN. It has the capacity to pump up to 500-gallons per minute water at 100 pounds per square inch discharge pressure. The pump normally operates at approximately 300 revolutions per minute at 350 gallons per minute. The pump and gear motor are approximately 130 inches long. The pump assembly weighs approximately 2300 pounds. The pump assembly is mounted from one or two 12-foot-long mast sections in a vertical orientation. A strainer basket/can assembly is mounted on the suction end of the pump with the strainer being approximately 24 inches in diameter. A carbon steel pump housing, Buna-n stator, and hard coated stainless steel rotor are necessary for this application. The system design is periodically evaluated for other materials that might better suit the slurry properties.

Pump Support Mast—The pump is supported from the motor end in a vertical-mounting configuration because of the size restrictions of the silo riser vertical access. The mast is in two 12-foot-long sections constructed of 10-inch pipe. The sections are fabricated out of thick section material and have machined connection flanges with locating dowel pins to maximize alignment and minimize vibration. Each shaft section includes: (1) two 3-inch hose jumpers, one for the slurry discharge and one for sluice/slurry water recycle; (2) two high-pressure (10000 pounds per square inch), ½-inch ID hoses for the SREE cutting jets and the jet pump motive water; and (3) two hydraulic hoses for the SREE drive motor. The uppermost shaft section is attached to a vertical positioning table with a travel of approximately 2 feet more than the shaft section length. A variable-speed drive motor coupled to a gearbox is mounted to the slurry pump and drives the slurry pump. The motor is approximately 50 horsepower and operates in a range of 0 to 300 revolutions per minute.

Elevation Table—The elevation table is constructed of a flat plate on that the slurry pump mast assembly mounts. The plate is fitted with four direct couple ACME screw linear actuators driven by an open loop, remotely controlled, single-speed AC drive motor. A level instrument/encoder remotely displays the table elevation. Limits for the top and bottom of the table travel are maintained by software interlocks on the basis of the table level signal. The gear boxes, drive shafts and couplings, and drive motor are mounted to the structural steel frame members of the enclosure.

Mast Section Trolley—The mast section stowage trolley is mounted on the side of the enclosure and is of dual crane rail type construction. It has the capacity to store all mast sections. The trolleys are free rolling, non motorized, and fitted with attachments for hanging the mast sections vertically. The trolley assembly of the monorail has a rotating boom section on the end that can extend under the elevation table and transfer the mast sections from the elevation table to the trolley. The trolley has travel stops at both ends.

Enclosure—The equipment enclosure is constructed of welded and painted carbon steel. It generally uses a structural tube exterior frame with a carbon steel sheet metal skin welded to the structural frame members. The frame includes anchor points, lifting eyes, and grounding lugs. Because of the excessive time and cost required for full personal protective equipment (PPE) dress out activities inside the enclosure, glove ports and viewing windows are located in areas where routine work is required. Routine activities include adding or removing mast sections, routine maintenance of valves and instruments, passing small items (less than 1 cubic foot and 50 pounds) into the enclosure, and performing decontamination with the hand-held spray wand. A large, controlled ventilation vestibule is provided for personnel access to the

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inside of the enclosure or insertion/removal of large equipment. A supplied air connection is provided for the enclosure as well. All glove ports and windows are capable of attaching steel cover panels to them if required for missile protection. The enclosures include piping penetrations for attachment of inlet ventilation, decontamination water, and other utilities such as compressed air. Electrical services are attached by waterproof, bulkhead-type electrical connectors. Each enclosure includes a spool piece on the bottom for attachment to the silo/tank risers. A spray ring is located near the bottom of the enclosure as a part of this spool piece. The floor of the enclosure is designed to drain decontamination water into the risers.

Hose Bundle—A hose bundle approximately 75-feet long supplies utilities to the SREE and heel waste jet pump. The SREE utilities (water hydraulics and high-pressure cutting water) are attached to the SREE at one end of the hose bundle. The other end of the hose bundle attaches to the pump mast at the heel waste surge tank section, that connects to the bottom of the pump. The hose bundle includes a waste conveyance hose with the jet pump incorporated in-line. The waste conveyance hose is 2-inches ID on the suction and discharge of the jet pump. The SREE hydraulic supply hose is ½-inch ID and the return hose will be ¾-inch ID. The SREE and jet pump high-pressure water hoses will both be ½-inch ID. An abrasion sleeve surrounds all the hoses in the hose bundle. The enclosure incorporates a hose bundle reel capable of deploying and retracting the hose bundle. When the hose bundle is stowed on the reel, the jet pump is removed and replaced by a flexible jumper of the same length. As the bundle is deployed, the jet pump is installed in line as that section of bundle is unspooled.

5.2.5.2 Operational Description

5.2.5.2.1 Bulk Waste Retrieval Mode

Installation—The bulk waste retrieval equipment is located within a single enclosure. Equipment inside the enclosure, including wiring, instrumentation, and piping and the decontamination spray ring are positioned and installed before delivery. After rotating the bridge in place over the silo, the enclosure is coupled to the silo riser opening by removing the blind flange on the flexible boot below the spray ring and bolting the flange to the flange on the silo riser. Blind flanges are removed from the double-walled process piping interface point and the secondary containment for the piping is attached to the mating flange on the enclosure. Using the glove access at the process piping connection point, blind flanges are removed from a flexible jumper on the process piping in the enclosure and the jumper is bolted to the bridge mounted secondarily contained process piping. Single-walled piping is attached with mating quick connects, and/or flanges, and/or screwed piping connections

Deployment—The enclosure is delivered with the slurry pump suction strainer coupled to the elevation table. The elevation table is positioned at the upper end of its travel. At the start of deployment, the pump is lowered into the silo riser by lowering the elevation table to its lower position. The pump suction is still several feet above the waste in the silo at this point. A support slides into place around the upper end of the pump at this point. The support is capable of supporting the weight of the pump and all mast sections combined. Once the upper end of the pump assembly is secured, it unbolts from the elevation table assembly and the elevation table raises to the upper end of its travel. A mast section, suspended from the mast section trolley at the top of enclosure, rolls into place under the elevation table assembly. The table lowers until the top of the mast section can be coupled and bolted to the table. The table then lowers again until the lower end of the mast section is bolted to the pump assembly. The slide is then released from the pump and retracted from over the riser opening. The pump

lowers further into the silo adding additional mast sections until the pump suction encounters the waste determined by visual observation using the in-tank cameras. The 3-inch process hoses (slurry and flush/recycle) connect to the mast.

Operations—The slurry pump is lowered approximately 1-inch above the BentoGrout™ layer and its elevation noted by the slurry pump operator. Lowering and raising the pump occurs by remotely operating the elevation table from the control station located in the control room. The slurry pump suction rises approximately 2 feet above the level of the top of the BentoGrout™ layer. The sluice water is directed though the sluicer under the slurry pump suction and will sluice in an area approximately 6 feet in diameter. The slurry pump is lowered until the solids level switch is triggered. The pump is then started. The slurry pump is started remotely and its speed remotely controlled to regulate the discharge flow rate or pressure. As the slurry pool level decreases, the pump is slowed, or stopped to maintain suction. If the pump is slowed to a point that there is risk of settling in the pipe, the pump stops and the transfer line is flushed. Valving inside the enclosure allows the slurry transfer line to be flushed by diverting sluice water through the slurry transfer line. The valve and piping selection is such that the transfer line can be either forward or back flushed (depending upon valve line-up) using sluice water supplied from the decant pump system in the TTA. As sluicing proceeds, the solids level under the pump suction lowers as indicated by the solids level switch. The operator continues to lower the pump remotely until solids are encountered and the switch is made again. The solids content in the transfer line is remotely monitored during slurry transfer operations. The solids content is adjusted by adding sluice water to the slurry transfer line. The sluice water used to adjust the solids content is injected into the line by a 1-inch control valve located in the enclosure. The operator is required to closely monitor the discharge pressure of the slurry pump for indications of cavitation during operations. If cavitation is detected, signaled by erratic pressure fluctuations, the operator shuts the pump down and flushes the pump and transfer line.

The most likely place for solids plugging to occur is at the pump suction. Pump suction plugs are cleared by running the pump in reverse, or by blasting the suction strainer with the high-pressure spray ring mounted to it. Solids plugging occurring in the waste transfer piping is detected by increase in pump discharge pressure with no increase in pump speed or no significant change in solids content. In the event of a partial or total plug in the slurry transfer line, the valving in the enclosure diverts the pump discharge back through the mast to the silo while sluice water is used to clear the plug. Once the plug is cleared, the slurry is diverted back into the transfer line to resume normal operations.

Retraction—Retraction of the bulk waste removal pump fundamentally operates in reverse order of deployment except that the decontamination spray ring is activated during retraction of mast sections to ensure contamination inside the enclosures is kept as low as reasonably achievable (ALARA).

5.2.5.2.2CATS Mode

Installation—The heel waste retrieval (CATS) mode associated equipment uses the same equipment described above (e.g., enclosure, slurry transfer pump, elevation table, process piping and valving, overhead trolleys), but also uses the following additional equipment: (1) an in-silo heel waste surge tank; (2) a hose bundle to provide high-pressure water (HPW) and hydraulic drive supply utilities to the jet pump and SREE; (3) hose bundle handling equipment to aid in the deployment and retraction of the SREE/jet pump/hose bundle assembly, and (4) hose bundle support hoists located in the EMMA™ and sluicer enclosures to reduce hose bundle

loading on the EMMA™. These items are installed in the enclosures after bulk waste retrieval is completed and the slurry pump is retracted and roughly decontaminated.

Deployment— Installation of this equipment into the silo is performed by personnel working inside the enclosure. The SREE, attached to the end of the hose bundle, lowers through the riser while unspooling the hose bundle from its reel until the first hoist line attachment collar on the hose bundle is within reach of the EMMA™. While paying out hoist line from the hose bundle lift hoist located in the sluicer enclosure, the EMMA™ carries the hoist line hook to the collar and attaches it to the collar. The hoist then takes up cable as the remainder of the hose bundle is lowered into the tank. When only 10-feet of bundle remains on the reel, the end of the bundle is manually taken off the reel and attached to the couplings on the pump mast. The surge tank, slurry pump assembly, and mast sections are deployed into the silo in the same manner as used in bulk retreival mode.

Operations—The waste heel removal begins in the area near the sluicer riser. At the start of heel removal, the sluice water decants from the TTA and diverts through the 3-inch flush/recycle line routed along the mast and into the surge tank in the silo. The slurry pump starts and its speed is adjusted to maintain the liquid-level in the surge tank. The high-pressure pump supplying the SREE is remotely started and the pressure adjusts to between 500 pounds per square inch and 5000 pounds per square inch. The SREE rotation starts and adjusts to between 200 revolutions per minute and 500 revolutions per minute. The hose bundle hoist in the sluicer enclosure is remotely operated to raise the hose bundle out of the waste to allow the EMMA™ to move the SREE in the silo without dragging the hose bundle through the waste. The EMMA™ positions the bottom of the SREE at the waste surface and creates a slurry pool approximately 6 feet in diameter. Once the solids content of the slurry pool appears appropriate (10% to 50% solids), the high-pressure pump supplying the jet pump motive water is remotely started and the water pressure adjusted to between 6000 pounds per square inch and 10000 pounds per square inch creating suction through the waste hose in the hose bundle. The EMMA™ then lowers the SREE into the slurry pool and pumps the slurry though the jet pump to the heel waste surge tank. The slurry pump speed is adjusted to account for the additional flow into the hopper. The EMMA™ continuously moves the SREE through the pool, expanding the pool depth and diameter until the hose bundle requires moving to another area of the silo. This operation continues until an area approximately 20 to 25 feet in radius from the sluicer riser is cleaned. When heel removal is complete in this region of the silo, the SREE is lifted into the air with the jet pump operating to clear the waste hose of most of its water. The EMMA™ places the SREE on the floor of the tank in a cradle and detaches the hose bundle hoist cable extending through the sluicer riser. The sluicer-deployed hose bundle hoist cable is retracted and the EMMA™ grasps the hose bundle at one of the gripper collars located every 20 feet along the length of the hose bundle. The EMMA™ picks up a portion of the hose bundle and moves it to the edge of the uncleaned portion of the tank. The hose bundle hoist cable in the EMMA™ enclosure is deployed into the silo where the EMMA™ attaches it to the hoist attachment collar. The remainder of the heel waste is removed using the same method as described above.

Retraction—Retraction of the CATS equipment occurs in reverse order of the deployment while using the decontamination spray ring to perform gross decontamination of equipment before entering the enclosure.

Controls—The slurry pump is capable of being operated remotely or locally. The pump drive motor-operates on three-phase, 480-Volt AC power supplied to a local panel. A variable-speed

motor controller is supplied with the pump motor and allows the pump motor to be operated at 1700 to 0 revolutions per minute. The elevation table is controlled both locally and remotely. It will be interlocked with the limit switch mounted on the pump suction, that detects suction screen contact with the solid waste in the tank. The elevation table operation also interlocks with the upper and lower-travel-limits. The hose bundle reel operates locally. The process valves (slurry, flush, recycle, and solids control) operate locally or remotely. Interlocks for these are to be provided. Remote operations are from the central control console inside the control room. A local control panel is located at the silo bridge. The local panel provides a master on/off/auto switch, valve position switches, elevation table run switch, elevation table position display, hose bundle reel motor start/stop switch and a master E-stop button. Motor starter/contactors, control power supplies, digital I/O cards, E-stop, relays, and status lights are mounted in the local cabinet. A lockable power disconnect switch is positioned at the local panel.

5.2.6 Oil Hydraulic Power Supply

The hydraulic power supply system provides the hydraulic power needed by the SREE. The hydraulic portion of the system is based on a recirculating hydraulic system that runs on Shell Tullus hydraulic oil. A local control panel is located on the outside of the enclosure. Self-checking quick disconnects for the supply and return lines are mounted at the enclosure interface. The enclosure (that houses the 3000 pounds per square inch, 5 gallons per minute hydraulic pressure unit) has a footprint of approximately 4-feet × 4-feet and an estimated weight of 1000 pounds.

The system consists of a weather enclosure with the following equipment located inside it: (1) a hydraulic pump; (2) a water reservoir; (3) an oil cooler; (4) a filtering system; (5) process valves, piping, and hoses; (6) a fresh air vent; (7) an exhaust fan; and (8) an oil resevior heater to prevent freezing.

5.2.6.1 Equipment Description

The enclosure is constructed of fiberglass or sheet metal walls and roof attached to a floor/support frame structure. A door is provided in one wall for operator access to perform operational checks and maintenance. The floor-support frame structure is fabricated of welded and painted carbon steel. Forklift points, as well as a grounding lug are integrated in the support frame. The space requirement for the enclosure is approximately 4 × 4 × 5 feet high. The estimated weight is 5000 pounds.

A 460-volt, three-phase, 10-horsepower, 1725 revolutions per minute electric motor drives the pump. The pump/motor unit is capable of 3000 pounds per square inch at 5 gallons per minute. The reservoir is a steel tank with a total capacity of 25 gallons. A tank mounted unit contains monitors for temperature and level. The oil level can also be checked visually by a sight glass. The oil cooler will be an electric refrigeration unit. The filtering system is located in the return loop and includes a 10-micron cartridge filter. A pressure-relief valve vents the pressure back to the reservoir should over-pressurization occur.

The fresh air vent and the exhaust fan provide air circulation inside the enclosure. Louvers with a replaceable steel mesh screen over an opening in the enclosure wall from the fresh air vent. The exhaust fan is powered by a 110-volt motor. It is located in an adjoining wall to the fresh air vent, and is equipped with movable louvers to prevent heat loss during cold weather. A

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thermostat controlled oil reservior heater to prevent system freezing during cold weather is also powered by 110 volts.

5.2.6.2 Operational Description

Installation—All equipment inside the enclosure is installed before delivery to the Fernald site. A forklift positions the system on leveled and compacted gravel or a concrete pad located on the ground near the silo. Three-phase, 460-Volt AC and 110-Volt AC electrical service is connected at the disconnect switch, that also contains the power distribution panel. Hydraulic hoses and a water supply line are connected at their respective quick-disconnects. As dependent systems connect to this system and the hydraulic lines are purged of air, the reservoir level is monitored to avoid a low-level shutdown.

Operation—The system will control hydraulic pressure from 500 pounds per square inch to 3000 pounds per square inch. The system may operate in local mode or remotely. The system will be configured to control flow rate of oil to the SREE. Interlocked flow switches will automatically shut down the pump upon any hose break. A low level switch on the reservior will also be interlocked with pump operation.

5.2.6.3 Controls

The system operates either locally or remotely. The local control panel mounted on the exterior of the enclosure has pump status lights, a manual/off/auto selector switch, and a flow control adjustment switch. Also included in this panel are a motor starter/contactor, an E-stop, digital I/O cards, relays, and control power supplies. Power and signal cables external to the enclosure are provided. Remote operation is controlled by input from the central control system multi-screen, graphical user interface (HMI) that is PLC based. The Hydraulics screen offers system remote/local status, pump start/stop and run status, E-stop status, and flow rate control. Low-pressure, flow-achieved indications and reservoir temperature readout are also on this screen. This console provides remote control of all equipment.

System interlocks are provided to shut down the pump in the event of low reservoir level or high oil temperature. Enclosure temperature control (exhaust fan) is provided by thermostats located in the enclosure and is not integrated with the local control panel or remote console. A lockable electrical disconnect switch is mounted at the local control panel.

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Process Flow Diagrams

2753

FOSTER WHEELER

FOSTER WHEELER ENVIRONMENTAL CORPORATION

PROCESS FLOW DIAGRAMS FOR ALL SYSTEMS

DOCUMENT NO.
624-P622-05, Rev. 1

FOR THE

SILOS 1 AND 2 ACCELERATED WASTE RETRIEVAL (AWR) PROJECT

SUBMITTED TO:
FLUOR DANIEL FERNALD (FDF)
CONTRACT NO. FSC 624

January 7, 2000

000192

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FOSTER WHEELER ENVIRONMENTAL CORPORATION

Process Flow Diagrams for All System

Revision 1

Recommended by:

John Lawson

Foster Wheeler Engineering Manager

1/7/00

Date

Approved by:

Ed S Nelson

Foster Wheeler Project Manager

1-7-00

Date

000193

Process Flow Diagrams for All Systems

2753

DOCUMENT NO. 624-P622-05

DRAWING NUMBER	DRAWING TITLE	REVISION
10FMD001	FULL-SCALE MOCKUP SYSTEM PROCESS FLOW DIAGRAM MASS BALANCE – RADON CONTROL	1
10FMD002	FULL-SCALE MOCKUP SYSTEM PROCESS FLOW DIAGRAM RADON CONTROL SYSTEM	1
10FMD003	FULL-SCALE MOCKUP SYSTEM PROCESS FLOW DIAGRAM RADON CONTROL SYSTEM	1
10FMD006	FULL-SCALE MOCKUP SYSTEM PROCESS FLOW DIAGRAM MASS BALANCE TABLE	1
10FMD007	FULL-SCALE MOCKUP SYSTEM PROCESS FLOW DIAGRAM SILO 4 - SWRS MODE	1
10FMD008	FULL-SCALE MOCKUP SYSTEM PROCESS FLOW DIAGRAM SLURRY & WATER PIPING TIE-IN	1
10FMD009	FULL-SCALE MOCKUP SYSTEM PROCESS FLOW DIAGRAM PHASE SEPARATORS	1
10FMD010	FULL-SCALE MOCKUP SYSTEM PROCESS FLOW DIAGRAM HP PUMP SKID SKD-11-250	1

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Process Flow Diagrams for All Systems

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DOCUMENT NO. 624-P622-05

DRAWING NUMBER	DRAWING TITLE	REVISION
10FMD011	FULL-SCALE MOCKUP SYSTEM PROCESS FLOW DIAGRAM SILO 4 – CATS MODE	1
11FMD001	SILO WASTE RETRIEVAL SYSTEM PROCESS FLOW DIAGRAM MASS BALANCE TABLE - SHT 1	1
11FMD002	SILO WASTE RETRIEVAL SYSTEM PROCESS FLOW DIAGRAM MASS BALANCE TABLE - SHT 2	1
11FMD003	SILO WASTE RETRIEVAL SYSTEM PROCESS FLOW DIAGRAM SILO 2 – SWRS MODE	1
11FMD004	SILO WASTE RETRIEVAL SYSTEM PROCESS FLOW DIAGRAM DIVERTER BOX ENC-11-001	1
11FMD005	SILO WASTE RETRIEVAL SYSTEM PROCESS FLOW DIAGRAM SLURRY LINE CLEANOUTS	1
11FMD006	SILO WASTE RETRIEVAL SYSTEM PROCESS FLOW DIAGRAM HP PUMP SKID SKD-11-251	1
11FMD007	SILO WASTE RETRIEVAL SYSTEM PROCESS FLOW DIAGRAM SAMPLE VALVE ENCLOSURE	1

000195

Process Flow Diagrams for All Systems 2753

DOCUMENT NO. 624-P622-05

DRAWING NUMBER	DRAWING TITLE	REVISION
11FMD008	SILO WASTE RETRIEVAL SYSTEM PROCESS FLOW DIAGRAM SAMPLE SYSTEM	1
11FMD009	SILO WASTE RETRIEVAL SYSTEM PROCESS FLOW DIAGRAM SILO 1 – CATS MODE	1
12FMD001	TRANSFER TANK SYSTEM PROCESS FLOW DIAGRAM DISTRIBUTION ENC-12-001	1
12FMD002	TRANSFER TANK SYSTEM PROCESS FLOW DIAGRAM STORAGE TANK TNK-12-001A	1
12FMD003	TRANSFER TANK SYSTEM PROCESS FLOW DIAGRAM STORAGE TANK TNK-12-001B	1
12FMD004	TRANSFER TANK SYSTEM PROCESS FLOW DIAGRAM STORAGE TANK TNK-12-002A	1
12FMD005	TRANSFER TANK SYSTEM PROCESS FLOW DIAGRAM STORAGE TANK TNK-12-002B	1
12FMD006	TRANSFER TANK SYSTEM PROCESS FLOW DIAGRAM BUILDING SUMP SMP-12-003	1

000196

Process Flow Diagrams for All Systems 2753

DOCUMENT NO. 624-P622-05

DRAWING NUMBER	DRAWING TITLE	REVISION
12FMD007	TRANSFER TANK SYSTEM PROCESS FLOW DIAGRAM ULTRA FILTRATION SKD-12-001	1
12FMD008	TRANSFER TANK SYSTEM PROCESS FLOW DIAGRAM FILTRATE SYSTEM	1
13FMD001	TRANSFER TANK WASTE RETRIEVAL PROCESS FLOW DIAGRAM MASS BALANCE TABLE	1
13FMD002	TRANSFER TANK WASTE RETRIEVAL PROCESS FLOW DIAGRAM STORAGE TANK TNK-12-002A	1
13FMD003	TRANSFER TANK WASTE RETRIEVAL PROCESS FLOW DIAGRAM SAMPLE VALVE ENCLOSURE	1
13FMD004	TRANSFER TANK WASTE RETRIEVAL PROCESS FLOW DIAGRAM FUTURE REMEDIATION FACILITY	1
14FMD001	DECANT SUMP RETRIEVAL SYSTEM PROCESS FLOW DIAGRAM MASS BALANCE TABLE	1
14FMD002	DECANT SUMP RETRIEVAL SYSTEM PROCESS FLOW DIAGRAM DECANT SUMP RETRIEVAL	1

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Process Flow Diagrams for All Systems

2753

DOCUMENT NO. 624-P622-05

DRAWING NUMBER	DRAWING TITLE	REVISION
20FMD001	RADON CONTROL SYSTEM PROCESS FLOW DIAGRAM MASS BALANCE TABLES – SHT 1	1
20FMD002	RADON CONTROL SYSTEM PROCESS FLOW DIAGRAM MASS BALANCE TABLES – SHT 2	1
20FMD003	RADON CONTROL SYSTEM PROCESS FLOW DIAGRAM SILO 2	1
20FMD004	RADON CONTROL SYSTEM PROCESS FLOW DIAGRAM SILO 1	1
20FMD005	RADON CONTROL SYSTEM PROCESS FLOW DIAGRAM FILTER & FILTRATE STORAGE TANKS	1
20FMD006	RADON CONTROL SYSTEM PROCESS FLOW DIAGRAM TTA STORAGE TANKS	1
20FMD007	RADON CONTROL SYSTEM PROCESS FLOW DIAGRAM CARBON BEDS	1
20FMD008	RADON CONTROL SYSTEM PROCESS FLOW DIAGRAM AIR HANDLING & CONDENSATE	1

000198

Process Flow Diagrams for All Systems

2753

DOCUMENT NO. 624-P622-05

DRAWING NUMBER	DRAWING TITLE	REVISION
20FMD009	RADON CONTROL SYSTEM PROCESS FLOW DIAGRAM SAMPLE TANKS	1
20FMD010	RADON CONTROL SYSTEM PROCESS FLOW DIAGRAM EXHAUST & RECIRC FAN	1
20FMD011	RADON CONTROL SYSTEM PROCESS FLOW DIAGRAM DECANT WASTE RETRIEVAL	1
51FMD001	POTABLE/DOMESTIC WATER SYS PROCESS FLOW DIAGRAM MAKE-UP WATER	1

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F-2753

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.

000200

UNDER TEMPORARY AUTHORIZATION (BASED ON APPLICATION TO REGISTER BY COMDTY 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
1	01/07/00	BJD	RAR	KDR	CERTIFIED FOR CONSTRUCTION
0	11/01/99	BJD	RAR		PRELIMINARY DESIGN SUBMITTAL

KENNETH D. RICKETT PROFESSIONAL ENGINEER REGISTRATION NO. 100742 STATE OF TENNESSEE 01/07/00

		DATE
DRAWN BY	BJDuncan	01/07/00
DESIGNED BY	BJDuncan	01/07/00
CHECKED BY	R.R. Hunt	01/07/00
APPROVED BY	Kenneth D. Rickett	01/07/00
APPROVED BY	[illegible]	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	1

FILENAME: 10FMD001.DWG

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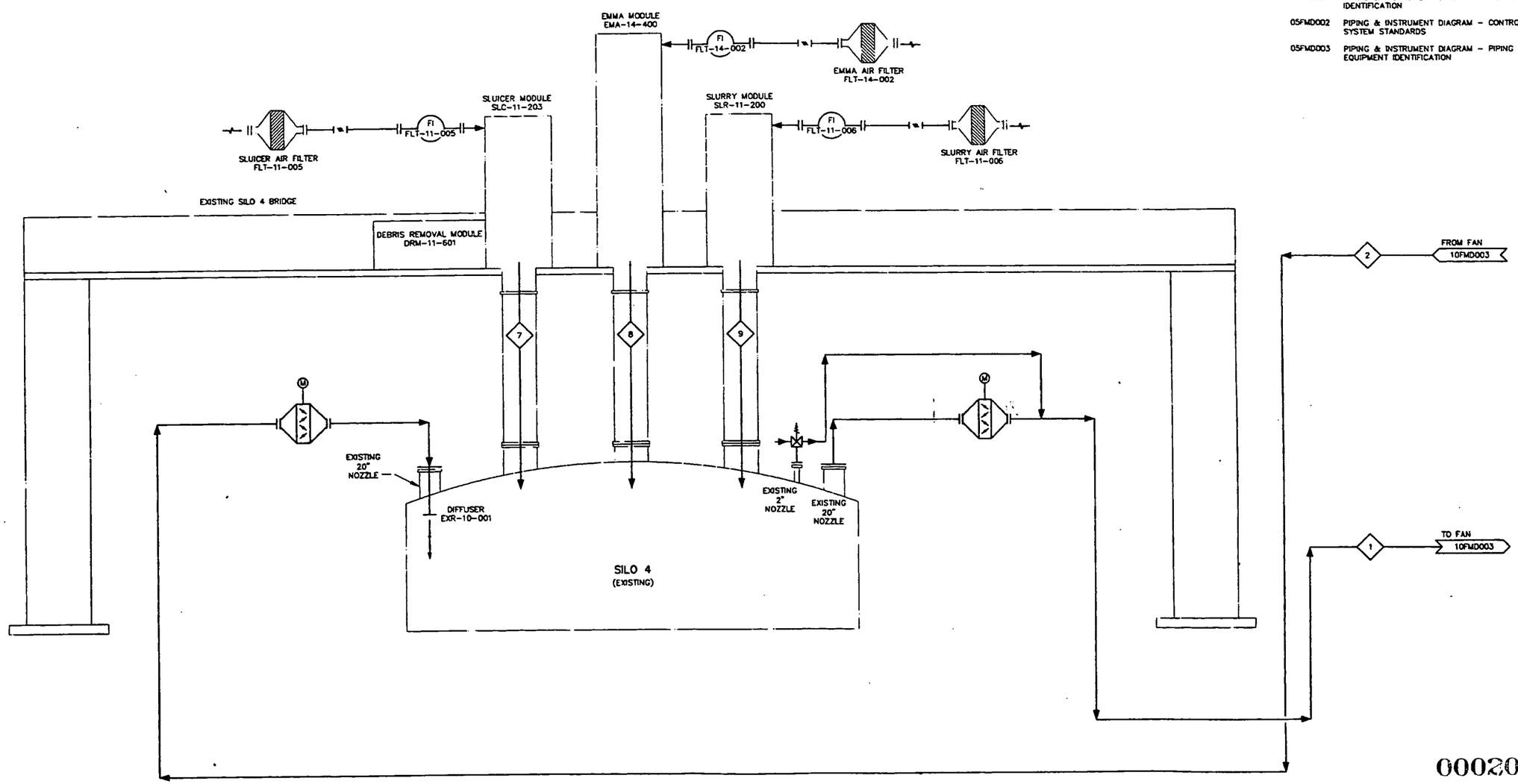
NOTES:

1. FOR GENERAL NOTES SEE DRAWING 05FMD004.
2. FOR MASS BALANCE TABLES SEE DRAWING 10FMD001.

REFERENCE DRAWINGS:

05FMD001	PIPING & INSTRUMENT DIAGRAM – INSTRUMENT IDENTIFICATION
05FMD002	PIPING & INSTRUMENT DIAGRAM – CONTROL SYSTEM STANDARDS
05FMD003	PIPING & INSTRUMENT DIAGRAM – PIPING & EQUIPMENT IDENTIFICATION



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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
1	01/07/00	BJD		KDR	CERTIFIED FOR CONSTRUCTION
0	11/03/99	BJD	RAR		PRELIMINARY DESIGN SUBMITTAL

KENNETH D. RICKETT PROFESSIONAL ENGINEER REGISTERED ENGINEER NO. 105742 STATE OF TENNESSEE 01/07/00

DRAWN BY B.J. Davis DATE 01/07/00
DESIGNED BY B.J. Davis DATE 01/07/00
CHECKED BY DATE 01/07/00
APPROVED BY Kenneth Rickett DATE 01/07/00
APPROVED BY 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	SCALE:	DWG. NO.	REV
D	NONE	10FMD002	1

FILENAME: 10FMD002.DWG

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NOTES:

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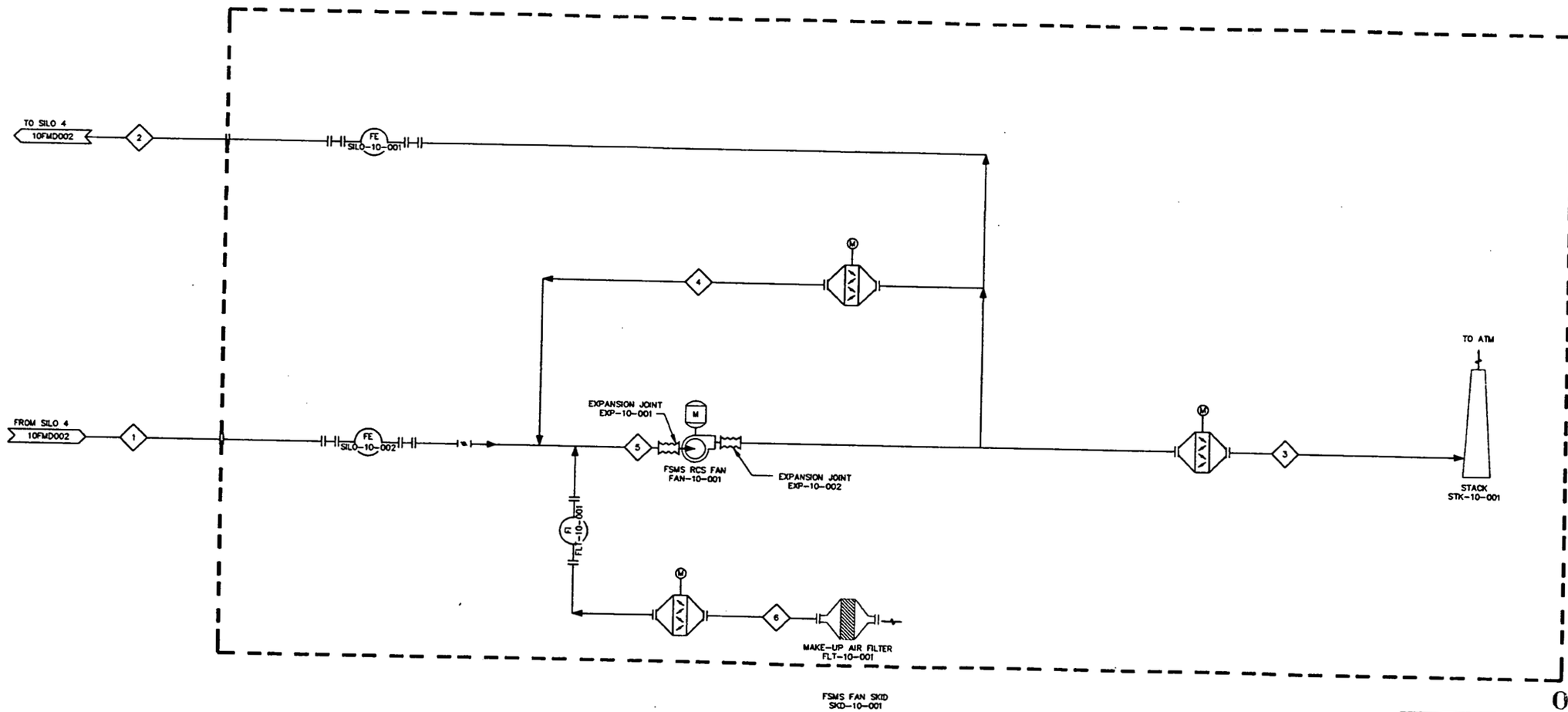
1. FOR GENERAL NOTES SEE DRAWING 05FMD004.
2. FOR MASS BALANCE TABLES SEE DRAWING 10FMD001.

REFERENCE DRAWINGS:

05FMD001	PIPING & INSTRUMENT DIAGRAM – INSTRUMENT IDENTIFICATION
05FMD002	PIPING & INSTRUMENT DIAGRAM – CONTROL SYSTEM STANDARDS
05FMD003	PIPING & INSTRUMENT DIAGRAM – PIPING & EQUIPMENT IDENTIFICATION



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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
1	01/07/00	RGD	JHH	KDR	CERTIFIED FOR CONSTRUCTION
0	11/09/99	BJD	RAR		PRELIMINARY DESIGN SUBMITTAL

KENNETH D. RICKETT PROFESSIONAL ENGINEER REGISTERED NO. 103724 STATE OF TENNESSEE

		DATE
DRAWN BY	B J Davis	01/07/01
DESIGNED BY	B J Davis	01/07/01
CHECKED BY	J H Hunt	01/07/01
APPROVED BY	Kenneth D Rickett	01/07/00
APPROVED BY	John Swann	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	SCALE:	DWG. NO.	REV
D	NONE	10FMD003	1

FILENAME: 10FMD003.DWG

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FULL-SCALE MOCKUP MASS BALANCE TABLE

FSMS INVENTORY		STREAM NUMBER	37	1	1	2	3	4	30	5	6	7	7	7	21	22	8	28	29	9
		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	SAMPLE TANK DECANT	SAMPLE TANK FLUSH	SLURRY DISCHARGE (BULK RETRIEVAL)	SLURRY DISCHARGE RETRIEVED WASTE (BULK RETRIEVAL)	SLURRY DISCHARGE (CATS WITH DILUTION WATER)	SLURRY DISCHARGE (FROM SREE TO SLURRY PUMP)	SAMPLE STORAGE	SLURRY LINE FROM UF SYSTEM	UF SUPPLY FROM PROCESS TANK	UF RETURN TO PROCESS TANK	SLURRY SAMPLE LINE
TOTAL SOLIDS (LB)	184,751		NOTE 3					NOTE 3	NOTE 3	NOTE 3	NOTE 3		NOTE 2			NOTE 3	NOTE 3	NOTE 3	NOTE 3	NOTE 3
BENTOGROUT (LB)	3,791	FLOW (GPM)	320	300	300	50	300	320	20	10	10	355	355	325	25	9	300	300	100	0.355
FIU SIMULANT (LB)	180,960	% SOLIDS (WT)	0	0	0	0	0	0	0	4.5	0	15.0	15.0	3.0	32	55.0	0	0	0	15.0
VOLUME BENTOGROUT (GAL) IN-SITU	1,575	SOLIDS PER GAL (LB)	0	0	0	0	0	0	0	0.378	0	1.334	1.334	0.247	3.183	6.387	0	0	0	1.334
VOLUME FIU (GAL) IN-SITU	20,886	SOLIDS PER DAY (LB)	0	0	0	0	0	0	0	54	0	227,424	227,424	38,603	38,811	172	0	0	0	227
WATER (LB)	94,886	MINUTES PER DAY OPERATION (MIN)	480	480	480	60	60	24	375	14.3	15	480	480	480	480	3	25	375	375	480
TOTAL MASS (LB)	279,637	TOTAL VOLUME PER DAY (GALLONS)	153,600	144,000	144,000	3,000	18,000	7,520	7,500	143	150	170,487	170,487	156,192	12,192	27	7,500	112,500	37,500	170
VOLUME WATER (GALLONS)	11,861	DAYS OF OPERATION	1.01	0.76	0.25	0	0	1.01	1.01	1.01	1.01	0.76	0.76	0.25	0.25	1.01	1.01	1.01	1.01	1.01
TOTAL VOLUME (GALLONS)	22,461	TOTAL VOLUME (GALLONS)	155,136	109,440	36,000	0	0	7,595	7,575	144	152	129,570	129,570	39,048	3,048	27	7,575	113,625	37,875	172
		TOTAL MASS SOLIDS (LB)	0	0	0	0	0	0	0	55	0	172,842	172,842	9,651	9,703	174	0	0	0	230
		SOLIDS PER HOUR (LB/HR)	0	0	0	0	0	0	0	227	0	28,428	28,428	4,825	4,851	3,449	0	0	0	28

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 3	NOTE 3	NOTE 3	NOTE 3
BENTOGROUT (LB)	3,791	FLOW (GPM)	6	40	180	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	5,400	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	7.50	1.00
TOTAL VOLUME (GALLONS)	22,461	TOTAL VOLUME (GALLONS)	360	12,000	1,350	1,200	303	7,575	135,000	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

NOTES:

1. MASS BALANCE TABLES TO BE USED IN CONJUNCTION WITH 10FMD007, 10FMD008, 10FMD009, 10FMD010 & 10FMD011.
2. STREAM OF APPROXIMATE WASTE RETRIEVED (SLURRY SOLIDS 15% – DECANT SOLIDS 2 %).
3. 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.

STREAM NUMBER	DRAWING
37	12FMD001 12FMD002 12FMD003 12FMD004 12FMD005
4	12FMD001 12FMD008
30	12FMD001
5	11FMD007 11FMD008
6	11FMD007
22	11FMD008
8	12FMD001 12FMD007
28	12FMD007 12FMD008
29	12FMD007 12FMD008
9	12FMD007 12FMD008
14	11FMD007
15	12FMD007 12FMD008
18	12FMD001
19	12FMD008

000203

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
1	01/07/00	BJD	JW	KDR	CERTIFIED FOR CONSTRUCTION
0	01/01/00	BJD	SWH		PRELIMINARY DESIGN SUBMITTAL

RPE KENNETH D. RICKETT PROFESSIONAL ENGINEER No. 103742 STATE OF TENNESSEE 01/07/00

		DATE
DRAWN BY	B.J. Davis	01/07/00
DESIGNED BY	B.J. Davis	01/07/00
CHECKED BY	J.W. Hunter	01/07/00
APPROVED BY	Kenneth Rickett	01/07/00
APPROVED BY	John Emerson	01/07/00

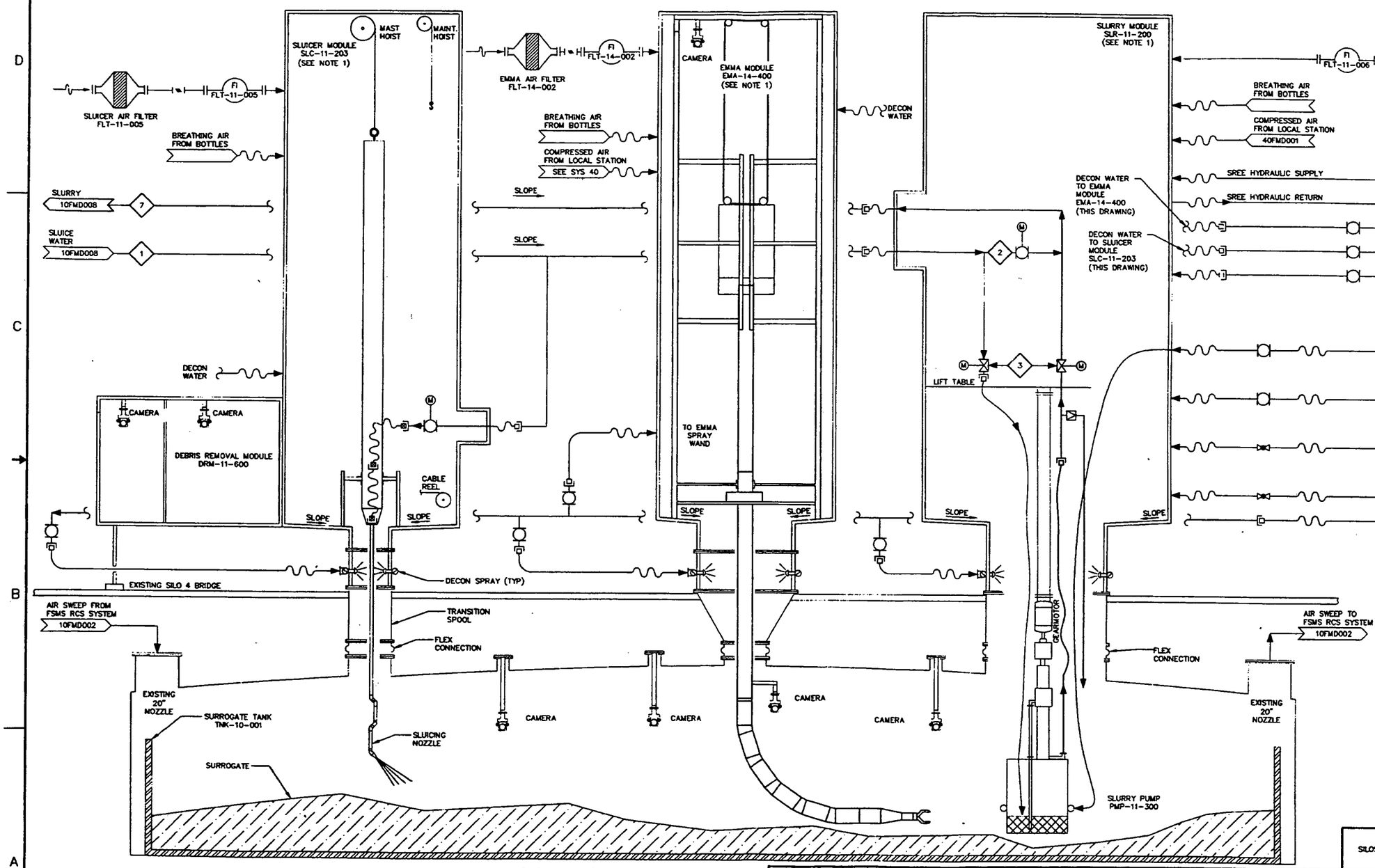
DEPARTMENT OF ENERGY
FERNALD ENVIRONMENTAL MANAGEMENT PROJECT
SILOS 1 AND 2 ACCELERATED WASTE RETRIEVAL PROJECT
FERNALD, OHIO
FDF CONTRACT NO. FSC 624

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	1

FILENAME: 10FMD006.DWG



SILO 4 – SWRS MODE

000204

NOTES:

1. FOR GENERAL NOTES SEE DRAWING 05FMD004.
2. FOR MASS BALANCE TABLES SEE DRAWING 10FMD006.

REFERENCE DRAWINGS:

05FMD001	PIPING & INSTRUMENT DIAGRAM – INSTRUMENT IDENTIFICATION
05FMD002	PIPING & INSTRUMENT DIAGRAM – CONTROL SYSTEM STANDARDS
05FMD003	PIPING & INSTRUMENT DIAGRAM – PIPING & EQUIPMENT IDENTIFICATION

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
1	01/07/00	BJD			CERTIFIED FOR CONSTRUCTION
0	01/01/99	BJD	RAR		PRELIMINARY DESIGN SUBMITTAL

KENNETH D. RICKETT PROFESSIONAL ENGINEER REGISTRATION No. 103742 STATE OF TENNESSEE

DRAWN BY	DATE 01/07/00
DESIGNED BY	DATE 01/07/00
CHECKED BY	DATE 01/07/00
APPROVED BY	DATE 01/07/00
APPROVED BY	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

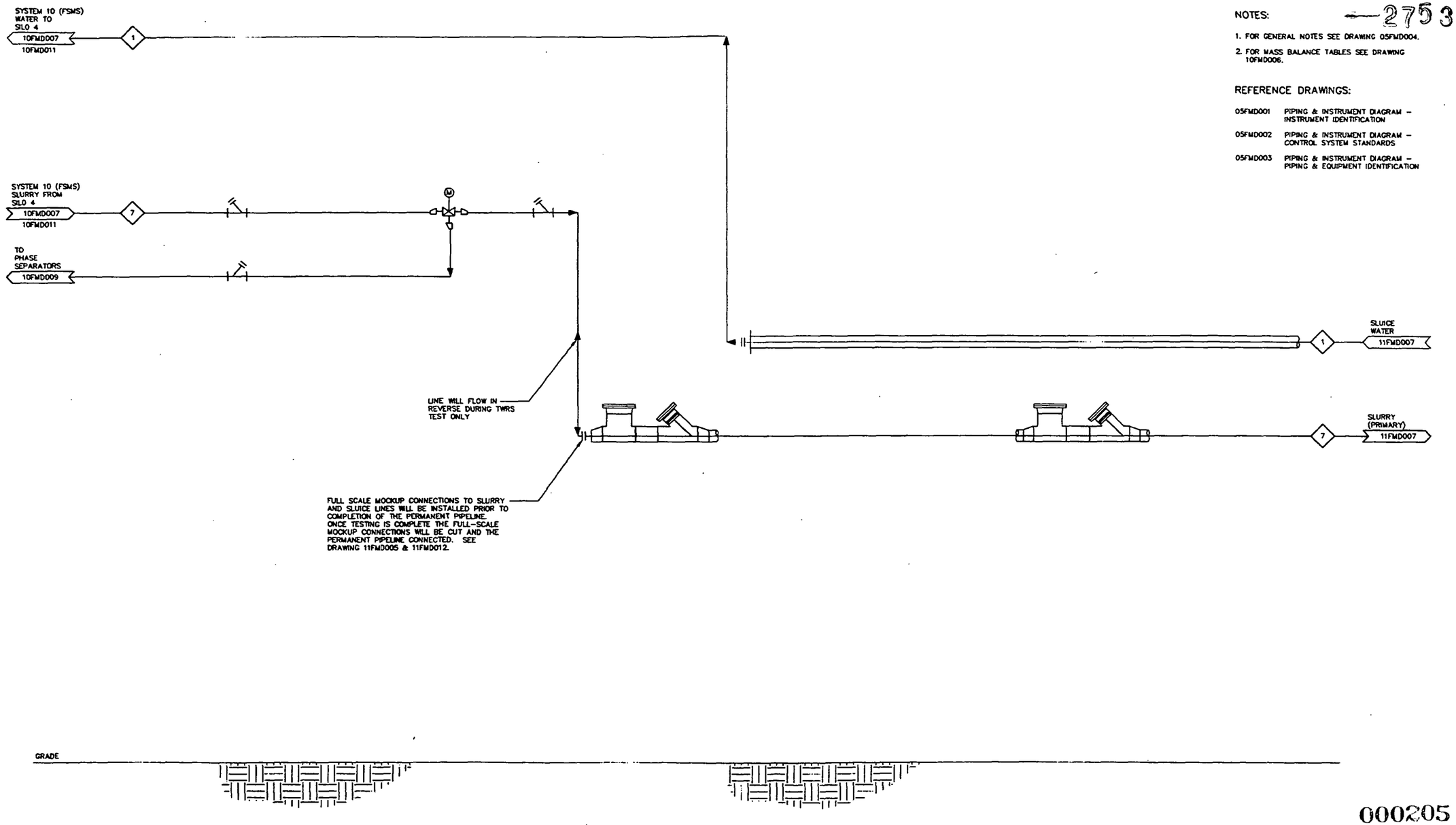
FOSTER WHEELER
FOSTER WHEELER ENVIRONMENTAL CORPORATION

TITLE
FULL-SCALE MOCKUP SYSTEM
PROCESS FLOW DIAGRAM
SILO 4 – SWRS MODE

SIZE	SCALE:	DWG. NO.	REV
D	NONE	10FMD007	1

FILENAME: 10FMD007.DWG

G:\CLEARE\FWSILOS\MCS\SYS10\10fmd007.dwg Thu Jan 06 12:26:51 2000



NOTES:

1. FOR GENERAL NOTES SEE DRAWING 05FMD004.
2. FOR MASS BALANCE TABLES SEE DRAWING 10FMD006.

REFERENCE DRAWINGS:

05FMD001	PIPING & INSTRUMENT DIAGRAM – INSTRUMENT IDENTIFICATION
05FMD002	PIPING & INSTRUMENT DIAGRAM – CONTROL SYSTEM STANDARDS
05FMD003	PIPING & INSTRUMENT DIAGRAM – PIPING & EQUIPMENT IDENTIFICATION

2753

000205

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
1	01/07/00	BJD	RAR	KDR	CERTIFIED FOR CONSTRUCTION
0	11/01/99	BJD	RAR		PRELIMINARY DESIGN SUBMITTAL

REG. KENNETH D. RICKETT PROFESSIONAL ENGINEER REGISTRATION NO. 103745 STATE OF TENNESSEE 01/07/00

		DATE
DRAWN BY	B.J. Davis	01/07/00
DESIGNED BY	B.J. Davis	01/07/00
CHECKED BY	[illegible]	01/07/00
APPROVED BY	Kenneth Rickett	01/07/00
APPROVED BY	[illegible]	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
SLURRY & WATER PIPING TIE-IN

SIZE	SCALE:	DWG. NO.	REV
D	NONE	10FMD008	1

FILENAME: 10FMD008.DWG

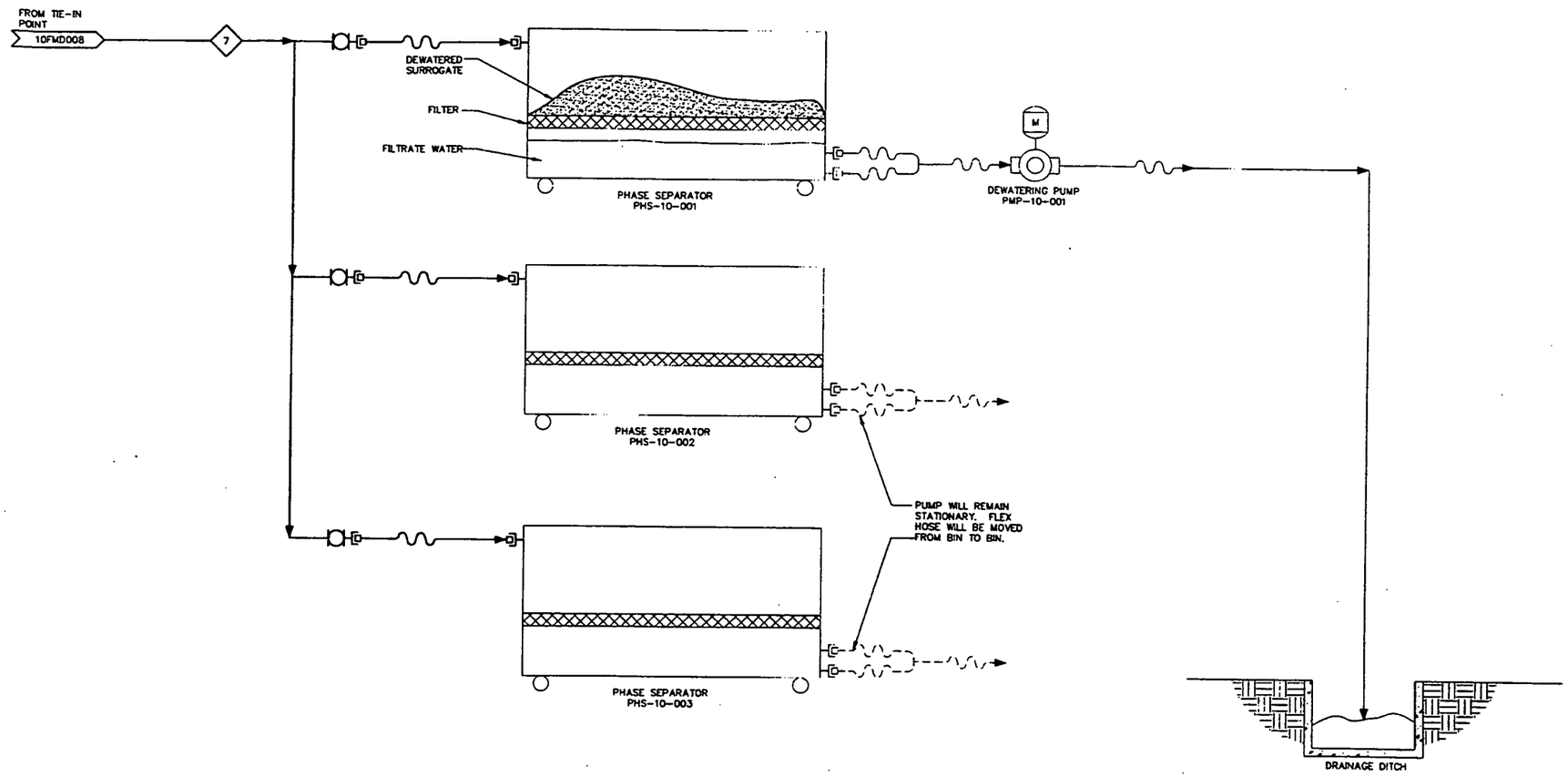
G:\CHAPE\FSILOS\WEG\SYS10\10fm008.dwg Thu Jan 06 18:27:48 2000

NOTES:

1. FOR GENERAL NOTES SEE DRAWING 05FMD004.
2. FOR MASS BALANCE TABLES SEE DRAWING 10FMD006.

REFERENCE DRAWINGS:

05FMD001	PIPING & INSTRUMENT DIAGRAM – INSTRUMENT IDENTIFICATION
05FMD002	PIPING & INSTRUMENT DIAGRAM – CONTROL SYSTEM STANDARDS
05FMD003	PIPING & INSTRUMENT DIAGRAM – PIPING & EQUIPMENT IDENTIFICATION



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
1	01/07/00	BJD	JHT	KDR	CERTIFIED FOR CONSTRUCTION
0	01/03/99	BJD	RAR		PRELIMINARY DESIGN SUBMITTAL

KENNETH D. RICKETT PROFESSIONAL ENGINEER REGISTERED No. 103749 STATE OF TENNESSEE

DRAWN BY: B.J. Davis DATE: 01/07/00
DESIGNED BY: B.J. Davis DATE: 01/07/00
CHECKED BY: J.W. Hunt DATE: 01/07/00
APPROVED BY: Kenneth Rickett DATE: 01/07/00
APPROVED BY: John Swanson 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 PHASE SEPARATORS

SIZE: D | SCALE: NONE | DWG. NO. 10FMD009 | REV 1

FILENAME: 10FMD009.DWG

000206

2753

NOTES:

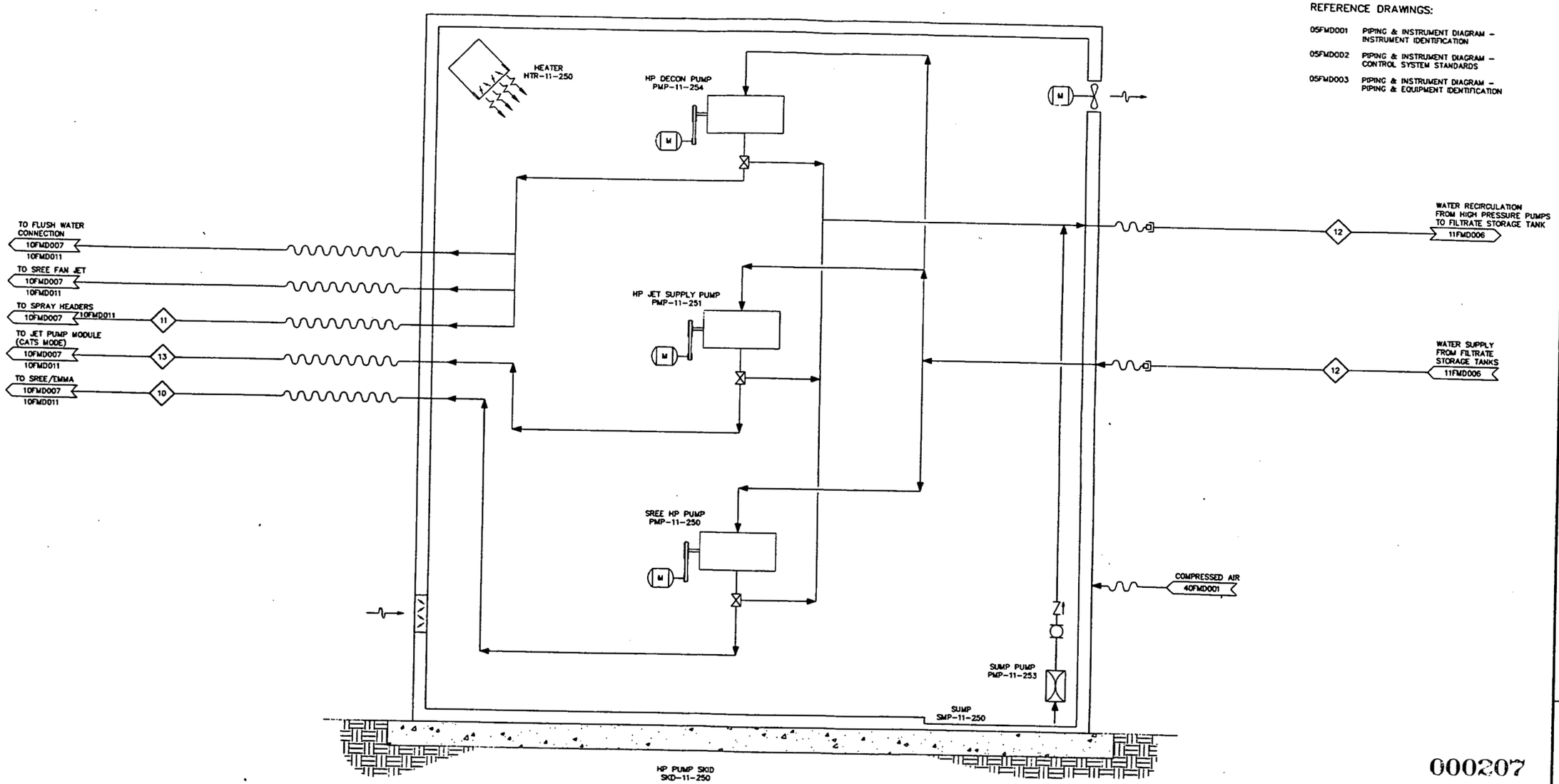
1. FOR GENERAL NOTES SEE DRAWING 05FMD004.
2. FOR MASS BALANCE TABLES SEE DRAWING 10FMD006.

REFERENCE DRAWINGS:

05FMD001 PIPING & INSTRUMENT DIAGRAM – INSTRUMENT IDENTIFICATION

05FMD002 PIPING & INSTRUMENT DIAGRAM – CONTROL SYSTEM STANDARDS

05FMD003 PIPING & INSTRUMENT DIAGRAM – PIPING & EQUIPMENT IDENTIFICATION



000207

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
1	01/07/00	BJD	RAR	KDR	CERTIFIED FOR CONSTRUCTION
0	01/01/99	BJD	RAR		PRELIMINARY DESIGN SUBMITTAL

KENNETH D. RICKS, PROFESSIONAL ENGINEER, LICENSE NO. 103172, STATE OF TENNESSEE

		DATE
DRAWN BY	BJD	01/07/00
DESIGNED BY	BJD	01/07/00
CHECKED BY		01/01/00
APPROVED BY		01/07/00
APPROVED BY		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
D	NONE	10FMD010	1

FILENAME: 10FMD010.DWG

G:\DWGS\FDF81LGS\MEC\SYS10\10fmd010.dwg Thu Jan 06 18:32:15 2000

2753

SLUICER AIR FILTER FLT-11-005
FI FLT-11-005
BREATHING AIR FROM BOTTLES
SLUICER MODULE SLC-11-203 (SEE NOTE 1)
MAST HOIST
MAINT. HOIST
EMMA AIR FILTER FLT-14-002
FI FLT-14-002
CAMERA
EMMA MODULE EMA-14-400 (SEE NOTE 1)
DECON WATER
SLURRY MODULE SLR-11-200 (SEE NOTE 1)
FI FLT-11-006
SLURRY AIR FILTER FLT-11-006
BREATHING AIR FROM BOTTLES
COMPRESSED AIR FROM LOCAL STATION
40FMD001
SLURRY
10FMD008
SLUICE WATER
10FMD008
BREATHING AIR FROM BOTTLES
COMPRESSED AIR FROM LOCAL STATION
SEE SYS 40
SLOPE
SLOPE
DECON WATER TO EMMA MODULE EMA-14-400 (THIS DRAWING)
SREE HYDRAULIC SUPPLY
SREE HYDRAULIC RETURN
HYDRAULIC SKID SKD-11-253
DECON WATER TO SLUICER MODULE SLC-11-203 (THIS DRAWING)
DECON WATER
51FMD003
DECON WATER
CAMERA
CAMERA
DEBRIS REMOVAL MODULE DRM-11-600
TO EMMA SPRAY WAND
LIFT TABLE
FLUSH WATER FROM HP DECON PUMP
10FMD010
SREE FAN JET WATER FROM HP DECON PUMP
10FMD010
WATER FROM SREE HP SUPPLY PUMP (CATS MODE)
10FMD010
WATER FROM HP JET SUPPLY PUMP (CATS MODE)
10FMD010
FROM HP DECON PUMP
10FMD010
CABLE REEL
SLOPE
SLOPE
SLOPE
SLOPE
SLOPE
SLOPE
EXISTING SILO 4 BRIDGE
DECON SPRAY (TYP)
AIR SWEEP FROM FSMS RCS SYSTEM
10FMD002
TRANSITION SPOOL
FLEX CONNECTION
GEARMOTOR
AIR SWEEP TO FSMS RCS SYSTEM
10FMD002
FLEX CONNECTION
EXISTING 20" NOZZLE
SURROGATE TANK TNK-10-001
SLUICING NOZZLE
SURROGATE
CAMERA
CAMERA
CAMERA
CAMERA
EXISTING 20" NOZZLE
SREE
JET PUMP
SLURRY PUMP PMP-11-300

SILO 4 – CATS MODE

NOTES:

1. FOR GENERAL NOTES SEE DRAWING 05FMD004.
2. FOR MASS BALANCE TABLES SEE DRAWING 10FMD006.

REFERENCE DRAWINGS:

05FMD001 PIPING & INSTRUMENT DIAGRAM – INSTRUMENT IDENTIFICATION
05FMD002 PIPING & INSTRUMENT DIAGRAM – CONTROL SYSTEM STANDARDS
05FMD003 PIPING & INSTRUMENT DIAGRAM – PIPING & EQUIPMENT IDENTIFICATION

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
1	01/07/00	BJD	JWH	MRL	CERTIFIED FOR CONSTRUCTION
0	01/01/99	BJD	RAR		PRELIMINARY DESIGN SUBMITTAL

RPE KENNETH D. RICKETT PROFESSIONAL ENGINEER REG. 10371 STATE OF TENNESSEE

		DATE
DRAWN BY	BJ Davis	01/07/00
DESIGNED BY	BJ Davis	01/07/00
CHECKED BY	J.W. Hooper	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	SCALE:	DWG. NO.	REV
D	NONE	10FMD011	1

FILENAME: 10FMD011.DWG

G:\DRAGE\FDF\SILOS\MEC\SYS10\10fmd011.dwg Fri Jan 07 19:05:26 2000

000208

2753

SILO 2 – 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	SAMPLE ACCUMULATION TANK DECANT	SAMPLE ACCUMULATION TANK FLUSH	SLURRY DISCHARGE (BULK RETRIEVAL)	SLURRY DISCHARGE RETRIEVED WASTE (BULK RETRIEVAL)	SLURRY DISCHARGE (CATS WITH DILUTION WATER)	SLURRY DISCHARGE (FROM SREE TO SLURRY PUMP)	SAMPLE TO STORAGE DRUM	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)	320	300	300	50	300	320	20	10	10	330.8	330.8	321	21	9	300	300	280
BENTOGROUT (LB)	187,369	% SOLIDS (WT)	2.0	2.0	2.0	2.0	2.0	2.0	2.0	4.0	0	15.0	13.38	4.18	31.0	58.0	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	0.336	0	1.315	1.164	0.351	2.983	6.926	0.336	0.167	0.179
VOLUME BENTOGROUT (GALLONS) IN-SITU	83,011	SOLIDS PER DAY (LB)	25,654	24,050	24,050	501	3,006	1,256	1,253	51	0	208,762	184,751	54,118	30,071	187	2,519	18,789	18,770
VOLUME K-65 (GALLONS) IN-SITU	751,141	MINUTES PER DAY OPERATION (MIN)	480	480	480	60	60	24	375	15.3	15	480	480	480	480	3	25	375	375
WATER (LB)	3,911,803	TOTAL VOLUME PER DAY (GALLONS)	153,600	144,000	144,000	3,000	18,000	7,520	7,500	153	150	158,777	158,777	154,080	10,080	27	7,500	112,500	105,000
TOTAL MASS (LB)	13,042,768	DAYS OF OPERATION	62.13	46.95	15.18	0.00	0.00	64.63	64.63	50.75	50.75	46.95	46.95	15.18	15.18	50.75	64.63	64.63	64.63
VOLUME WATER (GALLONS)	468,749	TOTAL VOLUME (GALLONS)	9,543,792	6,761,069	2,186,236	0	0	486,048	484,755	7,764	7,612	7,454,874	7,454,874	2,339,272	153,037	1,370	484,755	7,271,332	6,786,577
TOTAL VOLUME (GALLONS)	834,152	TOTAL MASS SOLIDS (LB)	1,593,969	1,129,209	365,137	0	0	81,178	80,962	2,608	0	9,801,761	8,674,417	821,626	456,548	9,490	162,841	1,214,431	1,213,150
CURIES	9,682	SOLIDS PER HOUR (LB/HR)	3,207	3,006	3,006	501	3,006	3,207	200	202	0	26,095	23,094	6,765	3,759	3,740	6,047	3,006	3,003
		CURIES	1,690	1,197	387	0	0	86	86	3	0	10,393	9,198	871	484	10	173	1,288	1,286

SILO 2 – 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	SLURRY SAMPLE LINE	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)	0.375	6	40	150	10	150	20	40	5	200	200	50	0	0	0	0	50
BENTOGROUT (LB)	187,369	% SOLIDS (WT)	15.0	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)	1.315	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)	237	0	0	0	0	0	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	480	60	480	480	2	375	20	0	90	30	60	0	0	0	0	0
WATER (LB)	3,911,803	TOTAL VOLUME PER DAY (GALLONS)	180	2,880	2,400	72,000	4,800	300	7,500	800	0	18,000	6,000	3,000	0	0	0	0	0
TOTAL MASS (LB)	13,042,768	DAYS OF OPERATION	62.13	15.18	5.00	15.18	15.18	62.13	64.63	0.00	0.00	21.00	21.00	4.00	0	0	0	0	0
VOLUME WATER (GALLONS)	468,749	TOTAL VOLUME (GALLONS)	11,184	43,725	12,000	1,093,118	72,875	18,640	484,755	0	0	378,000	126,000	12,000	0	0	0	0	0
TOTAL VOLUME (GALLONS)	834,152	TOTAL MASS SOLIDS (LB)	14,705	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
CURIES	9,682	SOLIDS PER HOUR (LB/HR)	30	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		CURIES	18	0	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.
2. STREAM OF APPROXIMATE WASTE RETRIEVED (SLURRY SOILDS 15% – DECANT SOLIDS 2%).
3. TTA TANK FOUNDATION DRAIN.

000209

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
1	01/07/00	BJD	JLH	RJK	CERTIFIED FOR CONSTRUCTION
0	11/17/99	BJD	SWH		PRELIMINARY DESIGN SUBMITTAL

REGISTERED PROFESSIONAL ENGINEER KENNETH D. RICKETTS No. 103742 STATE OF TENNESSEE 01/07/00

DRAWN BY B.J. Dai DATE 01/07/00
DESIGNED BY B.J. Dai DATE 01/07/00
CHECKED BY J.H. Hunt DATE 01/07/00
APPROVED BY Kenneth D. Ricketts DATE 01/07/00
APPROVED BY John Swan 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 1

SIZE D | SCALE: NONE | DWG. NO. 11FMD001 | REV 1

FILENAME: 11FMD001.DWG

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2753

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	SAMPLE ACCUMULATION TANK DECANT	SAMPLE ACCUMULATION TANK FLUSH	SLURRY DISCHARGE (BULK RETRIEVAL)	SLURRY DISCHARGE RETRIEVED WASTE (BULK RETRIEVAL)	SLURRY DISCHARGE (CATS WITH DILUTION WATER)	SLURRY DISCHARGE (FROM SREE TO SLURRY PUMP)	SAMPLE TO STORAGE DRUM	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	10	10	330.8	330.8	321	21	9	300	300	280
BENTOGROUT (LB)	214,613	% SOLIDS (WT)	2.0	2.0	2.0	2.0	2.0	2.0	2.0	4.0	0	15.0	13.38	4.18	31.0	58.0	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	0.336	0	1.315	1.164	0.351	2.983	6.926	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	51	0	208,762	184,751	54,118	30,071	187	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	15.3	15	480	480	480	480	3	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	153	150	158,777	158,777	154,080	10,080	27	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	58.37	58.37	54.57	54.57	15.21	15.21	58.37	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	8,931	8,756	8,664,415	8,664,415	2,343,650	153,323	1,576	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	3,000	0	11,392,080	10,081,826	823,163	457,403	10,916	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	202	0	26,095	23,094	6,765	3,759	3,740	6,047	3,006	3,003
		CURIES	2,949	2,162	603	0	0	150	149	5	0	18,768	16,609	1,356	754	18	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	SLURRY SAMPLE LINE	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)	10,539,229	FLOW (GPM)	0.375	6	40	150	10	150	20	40	5	200	200	50	0	0	0	0	50
BENTOGROUT (LB)	214,613	% SOLIDS (WT)	15.0	0	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)	1.315	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	95,130	SOLIDS PER DAY (LB)	237	0	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	480	60	480	480	2	375	20	480	90	30	60	0	0	0	0	0
WATER (LB)	4,510,370	TOTAL VOLUME PER DAY (GALLONS)	180	2,880	2,400	72,000	4,800	300	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	69.78	15.21	5.00	15.21	15.21	69.78	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)	12,560	43,807	12,000	1,095,163	73,011	20,934	542,103	0	0	397,800	124,200	15,000	0	0	0	0	0
TOTAL VOLUME (GALLONS)	962,204	TOTAL MASS SOLIDS (LB)	16,515	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
CURIES	17,363	SOLIDS PER HOUR (LB/HR)	30	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		CURIES	27	0	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 SOLIDS 15% ~ DECANT SOLIDS 2%).
3. TTA TANK FOUNDATION DRAIN.

000210

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
1	01/07/00	BJD	SWH	[illegible]	CERTIFIED FOR CONSTRUCTION
0	11/01/99	BJD	SWH		PRELIMINARY DESIGN SUBMITTAL

KENNETH D. RICKETT PROFESSIONAL ENGINEER REGISTRATION NO. 105742 STATE OF TENNESSEE

DRAWN BY BJD DATE 01/07/00
DESIGNED BY BJD DATE 01/07/00
CHECKED BY SWH DATE 01/07/00
APPROVED BY Kenneth Rickett DATE 01/07/00
APPROVED BY [illegible] 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 D | SCALE: NONE | DWG. NO. 11FMD002 | REV 1

FILENAME: 11FMD002.DWG

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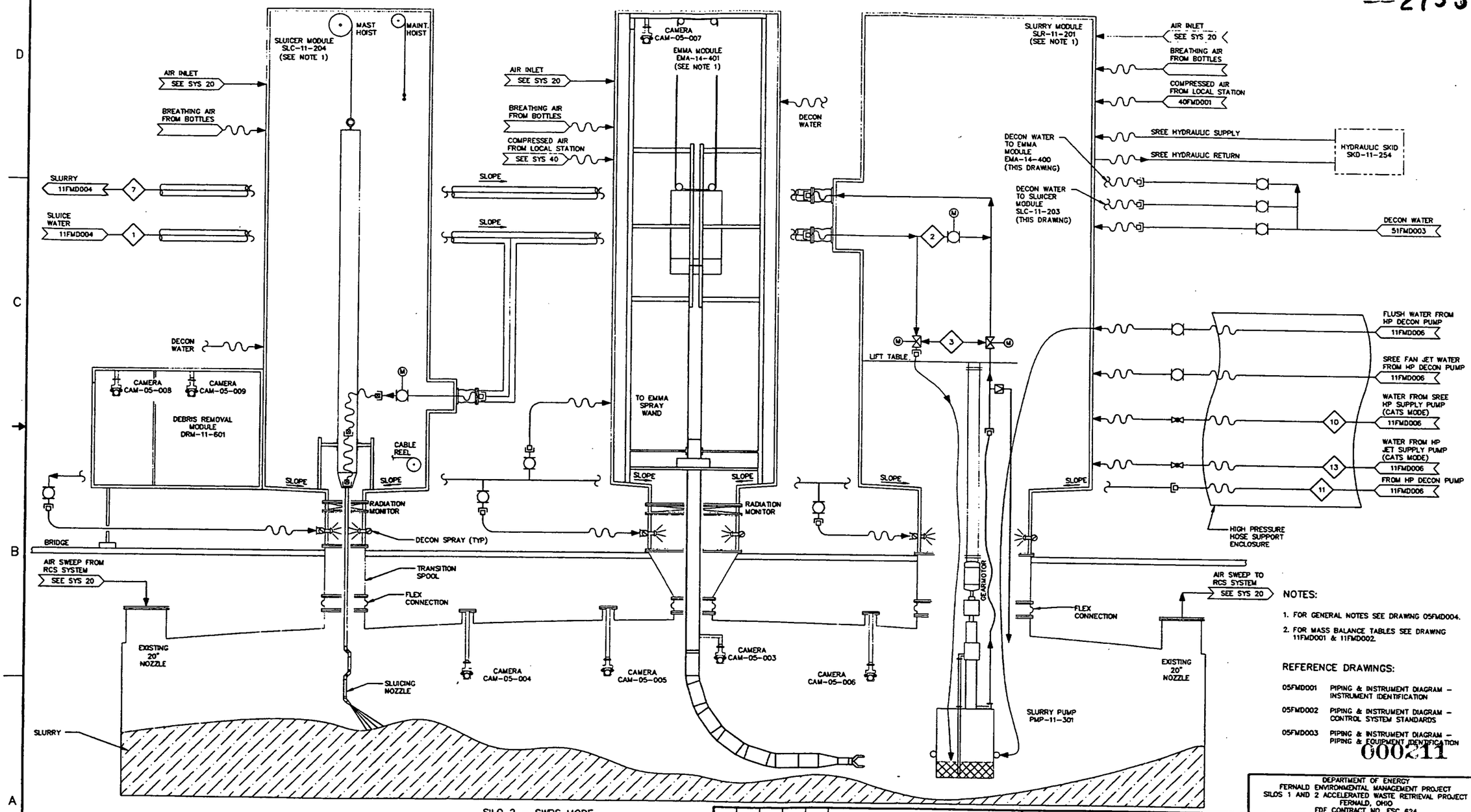
—2753



SILO 2 – SWRS MODE

NOTES:

1. FOR GENERAL NOTES SEE DRAWING 05FMD004.
2. FOR MASS BALANCE TABLES SEE DRAWING 11FMD001 & 11FMD002.

REFERENCE DRAWINGS:

05FMD001 PIPING & INSTRUMENT DIAGRAM – INSTRUMENT IDENTIFICATION

05FMD002 PIPING & INSTRUMENT DIAGRAM – CONTROL SYSTEM STANDARDS

05FMD003 PIPING & INSTRUMENT DIAGRAM – PIPING & EQUIPMENT IDENTIFICATION

000211

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	APRV'D	DESCRIPTION/ISSUE
1	01/07/00	BJD		KMR	CERTIFIED FOR CONSTRUCTION
0	11/01/99	BJD	SWH		PRELIMINARY DESIGN SUBMITTAL

KENNETH D. RICKETT PROFESSIONAL ENGINEER 01/07/00 STATE OF TENNESSEE

DRAWN BY B.J. Davis DATE 01/07/00
DESIGNED BY B.J. Davis DATE 01/07/00
CHECKED BY S.W. Hamrick 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 1

FILENAME: 11FMD003.DWG

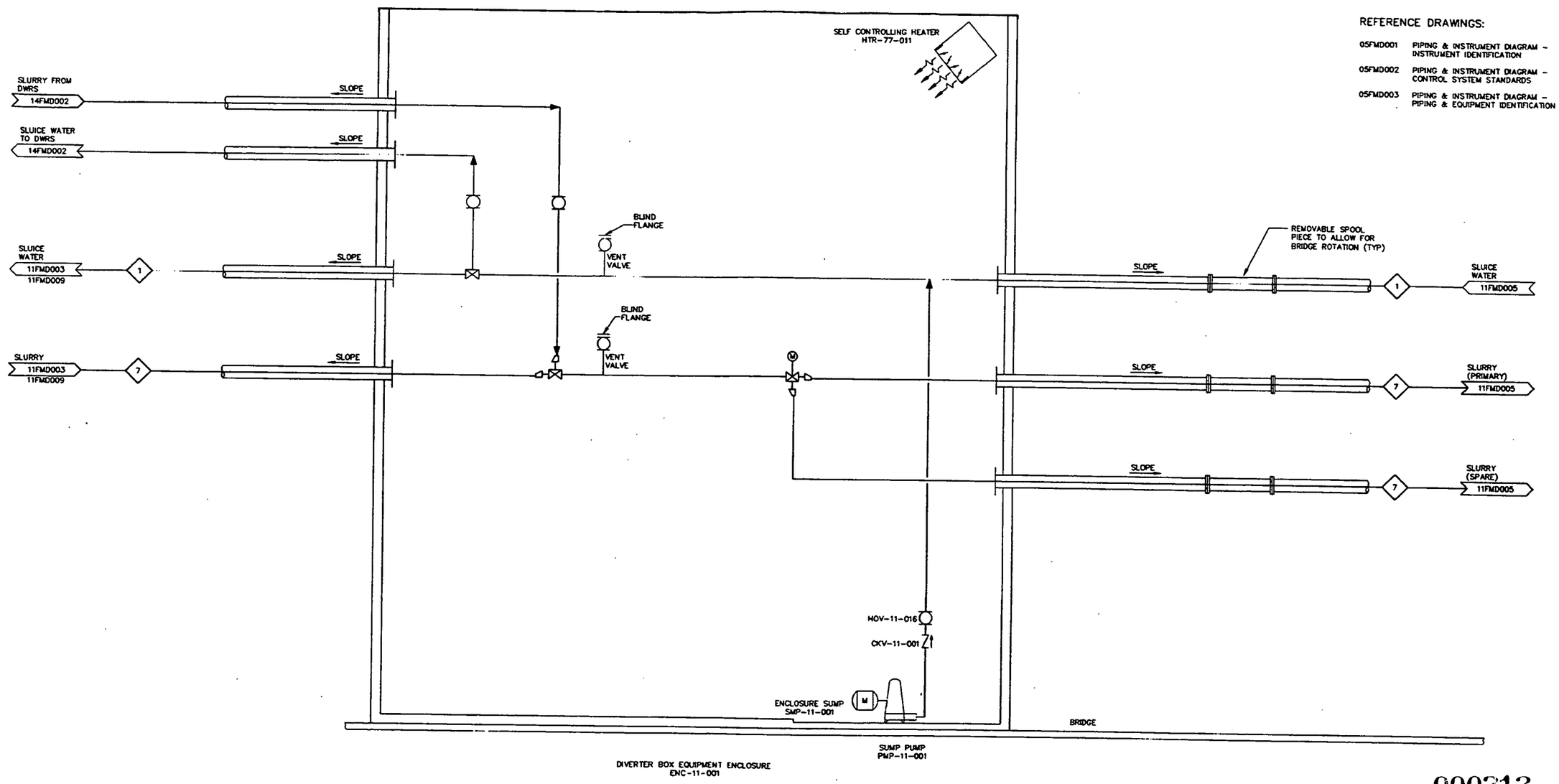
G:\CHARGE\FDF\SILOS\MEC\STS\11\11fmd003.dwg Thu Jan 06 12:30:38 2000

NOTES:

1. FOR GENERAL NOTES SEE DRAWING 05FMD004.
2. FOR MASS BALANCE TABLES SEE DRAWING 11FMD001 & 11FMD002.

REFERENCE DRAWINGS:

05FMD001	PIPING & INSTRUMENT DIAGRAM - INSTRUMENT IDENTIFICATION
05FMD002	PIPING & INSTRUMENT DIAGRAM - CONTROL SYSTEM STANDARDS
05FMD003	PIPING & INSTRUMENT DIAGRAM - PIPING & EQUIPMENT IDENTIFICATION



000212

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
1	[illegible]	[illegible]	[illegible]	[illegible]	CERTIFIED FOR CONSTRUCTION
0	11/01/99	BJD	SWH		PRELIMINARY DESIGN SUBMITTAL

RPE: KENNETH D. RICKETT, PROFESSIONAL ENGINEER, NO. 105742, STATE OF TENNESSEE

		DATE
DRAWN BY	B.J. Dan	01/07/00
DESIGNED BY	B.J. Dan	01/07/00
CHECKED BY	N.V. Hunt	01/07/00
APPROVED BY	Kenneth D. Rickett	01/07/00
APPROVED BY	[illegible]	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	1

FILENAME: 11FMD004.DWG

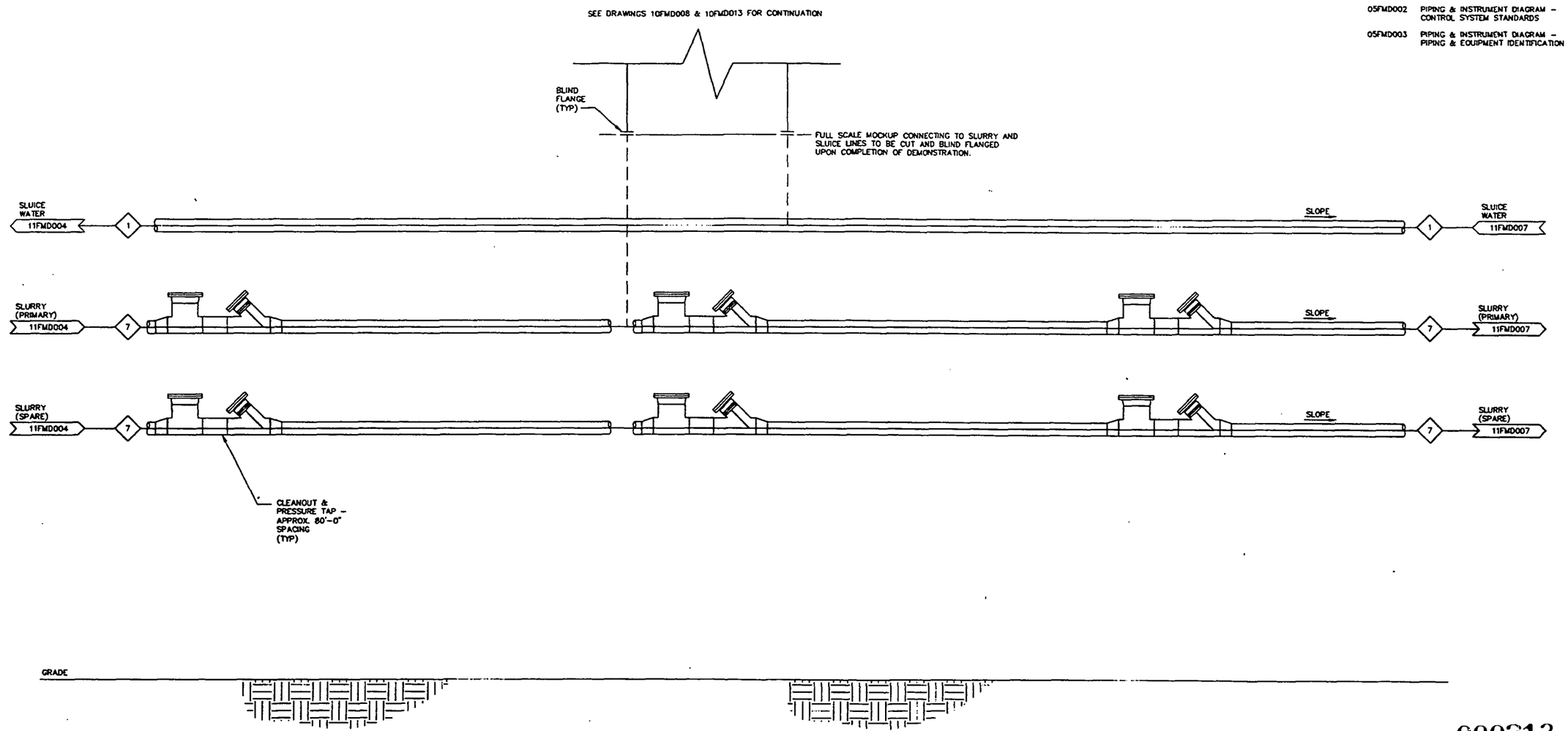
O:\CADRES\FSILOS\WASTE\11FMD004.dwg Thu Jan 06 12:25 2000

NOTES: —2753

1. FOR GENERAL NOTES SEE DRAWING 05FMD004.
2. FOR MASS BALANCE TABLES SEE DRAWING 11FMD001 & 11FMD002.

REFERENCE DRAWINGS:

05FMD001	PIPING & INSTRUMENT DIAGRAM – INSTRUMENT IDENTIFICATION
05FMD002	PIPING & INSTRUMENT DIAGRAM – CONTROL SYSTEM STANDARDS
05FMD003	PIPING & INSTRUMENT DIAGRAM – PIPING & EQUIPMENT IDENTIFICATION



000213

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
1	[illegible]	[illegible]	[illegible]	KDR	CERTIFIED FOR CONSTRUCTION
0	11/01/99	BJD	SWH		PRELIMINARY DESIGN SUBMITTAL

KENNETH D. RICKETT — REGISTERED ENGINEER — NO. 109745 — STATE OF TENNESSEE

DRAWN BY: B J Davis	DATE: 01/07/00
DESIGNED BY: B J Davis	DATE: 01/07/00
CHECKED BY: [illegible]	DATE: 01/07/00
APPROVED BY: Kenneth Rickett	DATE: 01/07/00
APPROVED BY: John Swan	DATE: 01/9/00

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 SLURRY LINE CLEANOUTS

SIZE	SCALE:	DWG. NO.	REV
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FILENAME: 11FMD005.DWG

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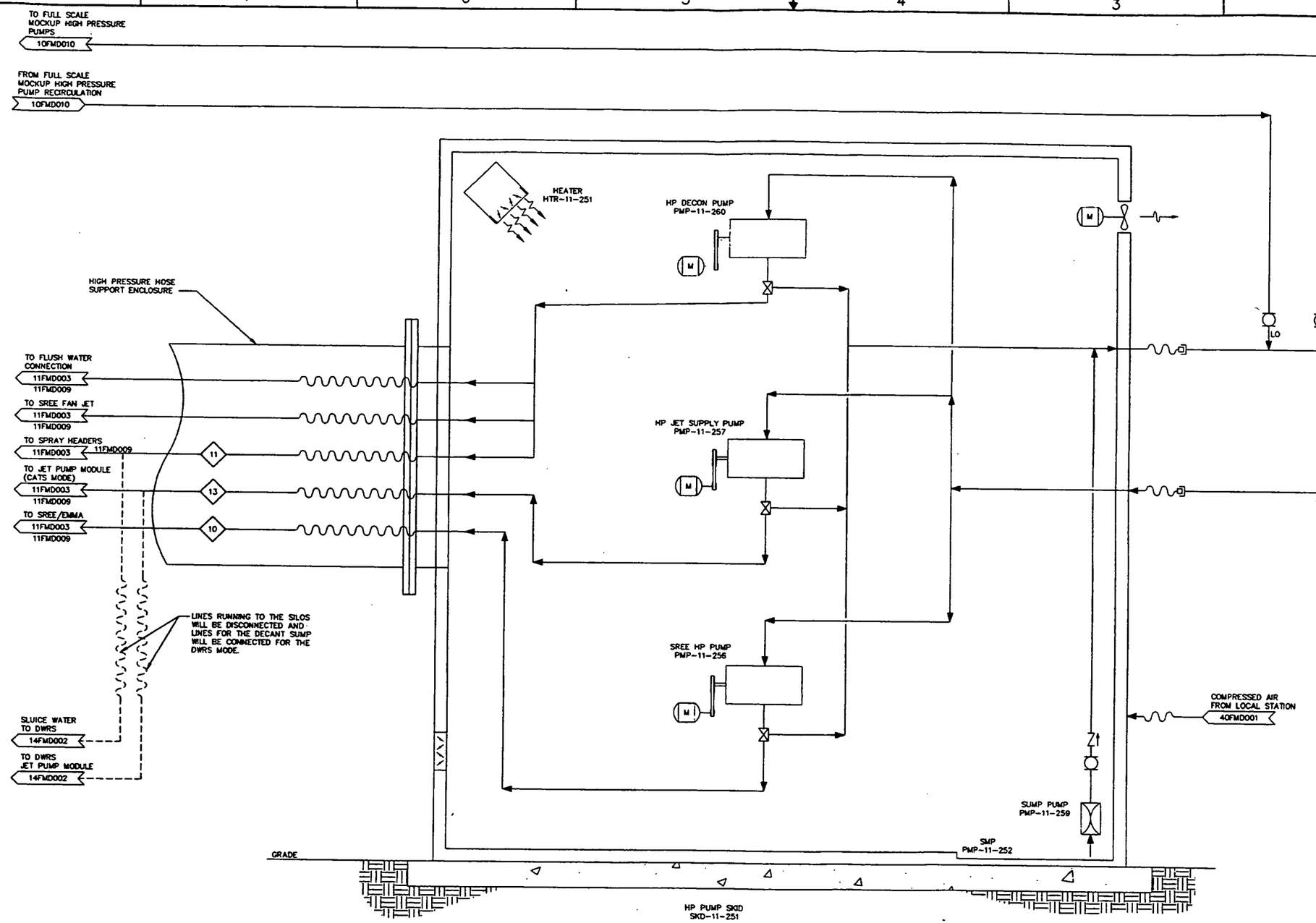

NOTES:

1. FOR GENERAL NOTES SEE DRAWING 05FMD004.
2. FOR MASS BALANCE TABLES SEE DRAWING 11FMD001 & 11FMD002.

REFERENCE DRAWINGS:

05FMD001	PIPING & INSTRUMENT DIAGRAM – INSTRUMENT IDENTIFICATION
05FMD002	PIPING & INSTRUMENT DIAGRAM – CONTROL SYSTEM STANDARDS
05FMD003	PIPING & INSTRUMENT DIAGRAM – PIPING & EQUIPMENT IDENTIFICATION

2753

000214

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
1	01/07/00	BJD	SWH	KDR	CERTIFIED FOR CONSTRUCTION
0	11/01/99	BJD	SWH		PRELIMINARY DESIGN SUBMITTAL

KENNETH D. RICKETT PE, PROFESSIONAL ENGINEER, REGISTRATION NO. 103142, STATE OF TENNESSEE

		DATE
DRAWN BY	B. J. Davis	01/07/00
DESIGNED BY	R. J. Davis	01/07/00
CHECKED BY	S. W. Hewitt	01/07/00
APPROVED BY	Kenneth D. Rickett	01/07/00
APPROVED BY	John Simmons	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	SCALE:	DWG. NO.	REV
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FILENAME: 11FMD006.DWG

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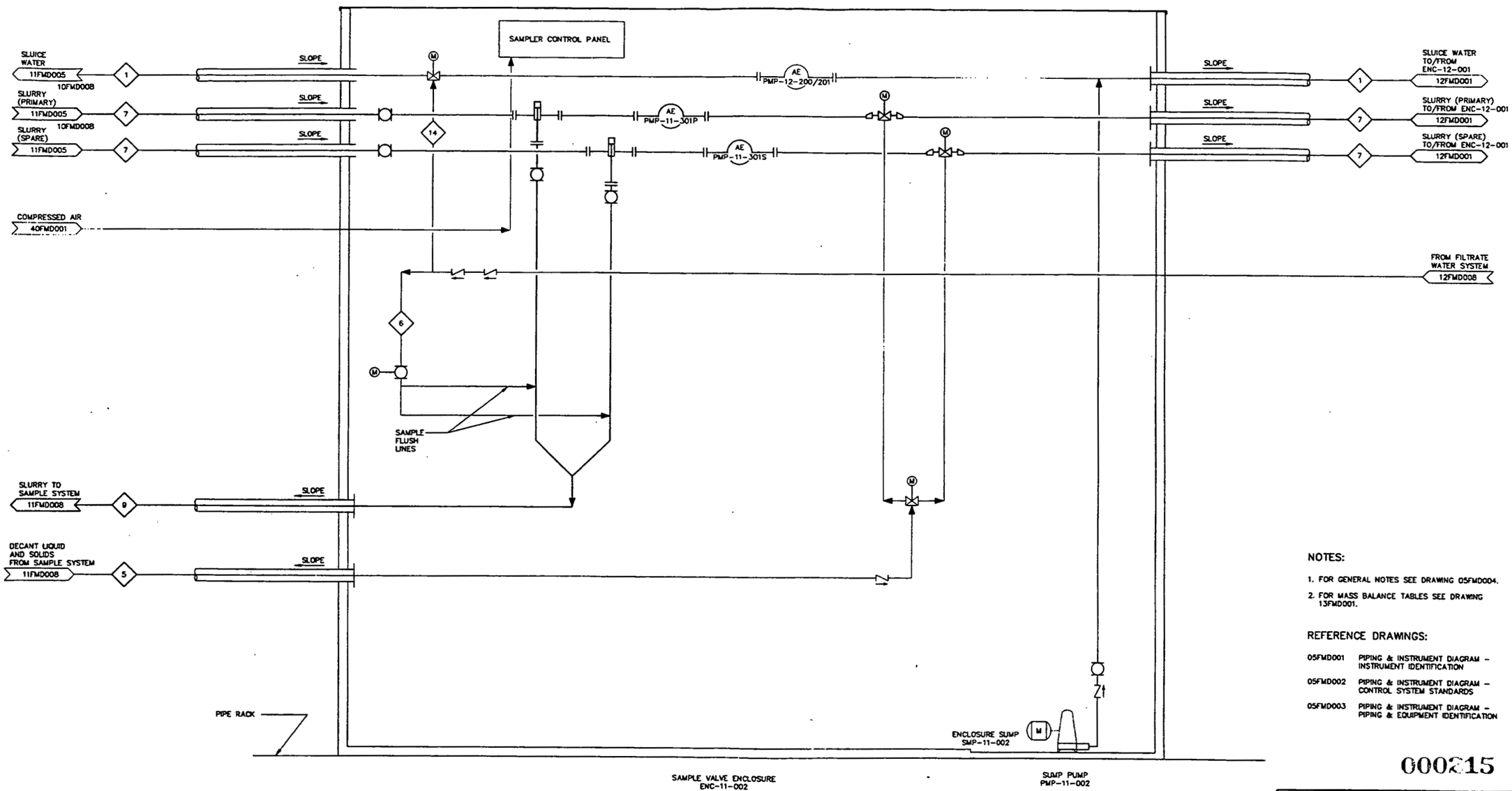
2753



NOTES:

1. FOR GENERAL NOTES SEE DRAWING 05FMD004.
2. FOR MASS BALANCE TABLES SEE DRAWING 13FMD001.

REFERENCE DRAWINGS:

05FMD001 PIPING & INSTRUMENT DIAGRAM – INSTRUMENT IDENTIFICATION

05FMD002 PIPING & INSTRUMENT DIAGRAM – CONTROL SYSTEM STANDARDS

05FMD003 PIPING & INSTRUMENT DIAGRAM – PIPING & EQUIPMENT IDENTIFICATION

000215

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
1	01/07/00	BJD	ALN	KDR	CERTIFIED FOR CONSTRUCTION
0	11/09/99	BJD	SWH		PRELIMINARY DESIGN SUBMITTAL

KENNETH D. RICHARDS, REGISTERED PROFESSIONAL ENGINEER, NO. 102742, STATE OF TENNESSEE

DRAWN BY B.J. Davis DATE 01/07/00
DESIGNED BY B.J. Davis DATE 01/07/00
CHECKED BY A.N. Haught DATE 01/07/00
APPROVED BY Kenneth Richards DATE 01/07/00
APPROVED BY John Lawson DATE 01/07/00

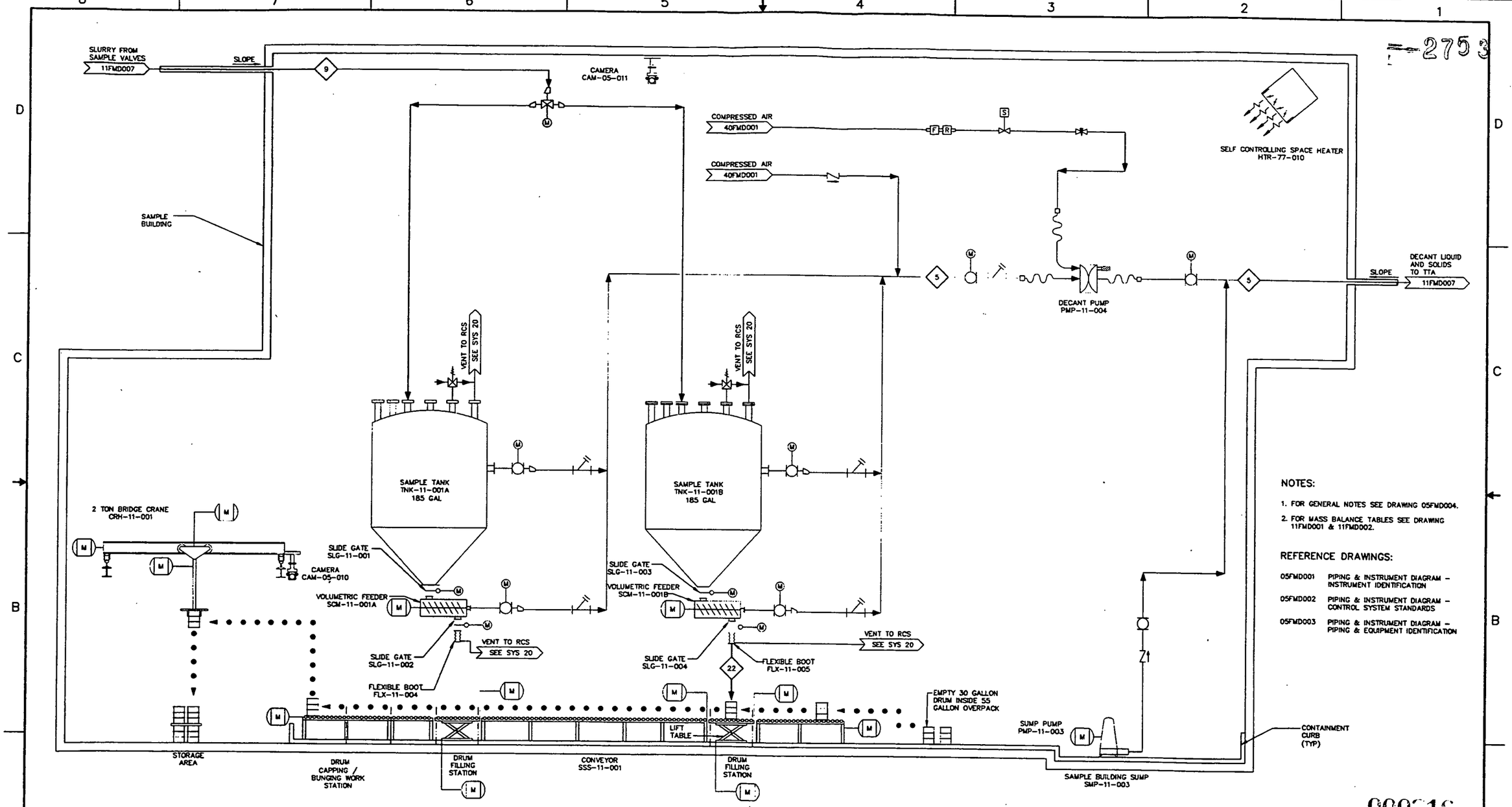
DEPARTMENT OF ENERGY
FERNALD ENVIRONMENTAL MANAGEMENT PROJECT
SILOS 1 AND 2 ACCELERATED WASTE RETRIEVAL PROJECT
FERNALD, OHIO
FDF CONTRACT NO. FSC 624

FOSTER WHEELER
FOSTER WHEELER ENVIRONMENTAL CORPORATION

TITLE
SILO WASTE RETRIEVAL SYSTEM
PROCESS FLOW DIAGRAM
SAMPLE VALVE ENCLOSURE

SIZE D | SCALE: NONE | DWG. NO. 11FMD007 | REV 1

FILENAME: 11FMD007.DWG



SAMPLE SYSTEM

NOTES:

1. FOR GENERAL NOTES SEE DRAWING 05FMD004.
2. FOR MASS BALANCE TABLES SEE DRAWING 11FMD001 & 11FMD002.

REFERENCE DRAWINGS:

05FMD001	PIPING & INSTRUMENT DIAGRAM – INSTRUMENT IDENTIFICATION
05FMD002	PIPING & INSTRUMENT DIAGRAM – CONTROL SYSTEM STANDARDS
05FMD003	PIPING & INSTRUMENT DIAGRAM – PIPING & EQUIPMENT IDENTIFICATION

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
1	[illegible]	[illegible]	[illegible]	[illegible]	CERTIFIED FOR CONSTRUCTION
0	11/01/99	BJD	SWH		PRELIMINARY DESIGN SUBMITTAL

KENNETH D. RICHARDS — PROFESSIONAL ENGINEER — NO. 103744 — STATE OF TENNESSEE

		DATE
DRAWN BY	B.J. Davis	01/07/00
DESIGNED BY	B.J. Davis	01/07/00
CHECKED BY	J.J. Hurst	01/07/00
APPROVED BY	Kenneth Richards	01/07/00
APPROVED BY	[illegible]	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
SAMPLE SYSTEM

SIZE D | SCALE: NONE | DWG. NO. 11FMD008 | REV 1

FILENAME: 11FMD008.DWG

000216

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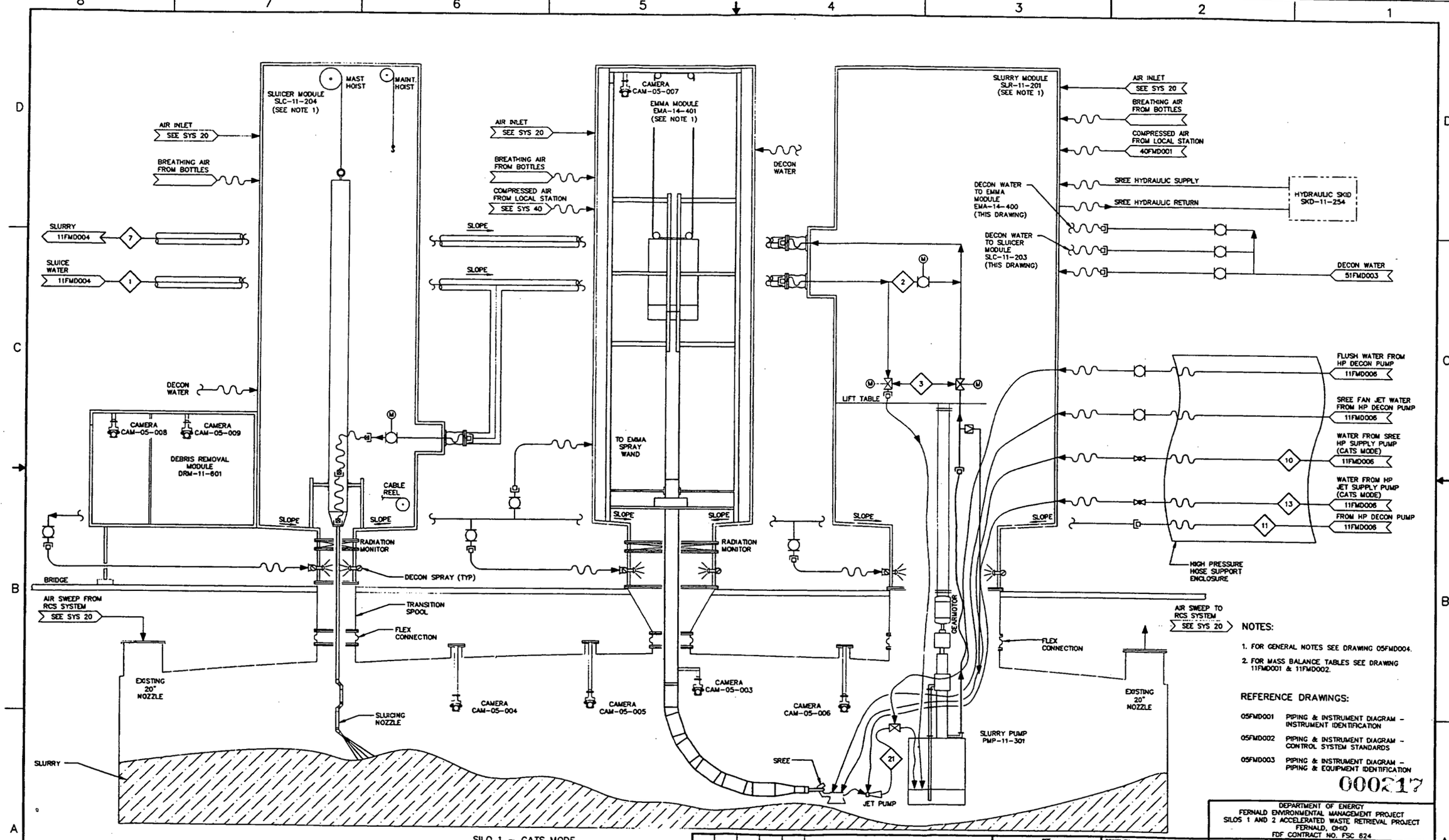

SILO 1 – CATS MODE

NOTES:

1. FOR GENERAL NOTES SEE DRAWING 05FMD004.
2. FOR MASS BALANCE TABLES SEE DRAWING 11FMD001 & 11FMD002.

REFERENCE DRAWINGS:

05FMD001 PIPING & INSTRUMENT DIAGRAM – INSTRUMENT IDENTIFICATION

05FMD002 PIPING & INSTRUMENT DIAGRAM – CONTROL SYSTEM STANDARDS

05FMD003 PIPING & INSTRUMENT DIAGRAM – PIPING & EQUIPMENT IDENTIFICATION

000217

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
1	01/07/00	BJD	DLK	KDR	CERTIFIED FOR CONSTRUCTION
0	11/09/99	BJD	SWH		PRELIMINARY DESIGN SUBMITTAL

KENNETH D. RICHARDS PROFESSIONAL ENGINEER No. 10372 STATE OF TENNESSEE 01/07/00

DRAWN BY B.J. Davis DATE 01/07/00
DESIGNED BY B.J. Davis DATE 01/07/00
CHECKED BY S.W. Hoot DATE 01/07/00
APPROVED BY Kenneth D. Richards DATE 01/07/00
APPROVED BY Cynthia Sanderson 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
SILO WASTE RETRIEVAL SYSTEM
PROCESS FLOW DIAGRAM
SILO 1 – CATS MODE

SIZE	SCALE	DWG. NO.	REV
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FILENAME: 11FMD009.DWG

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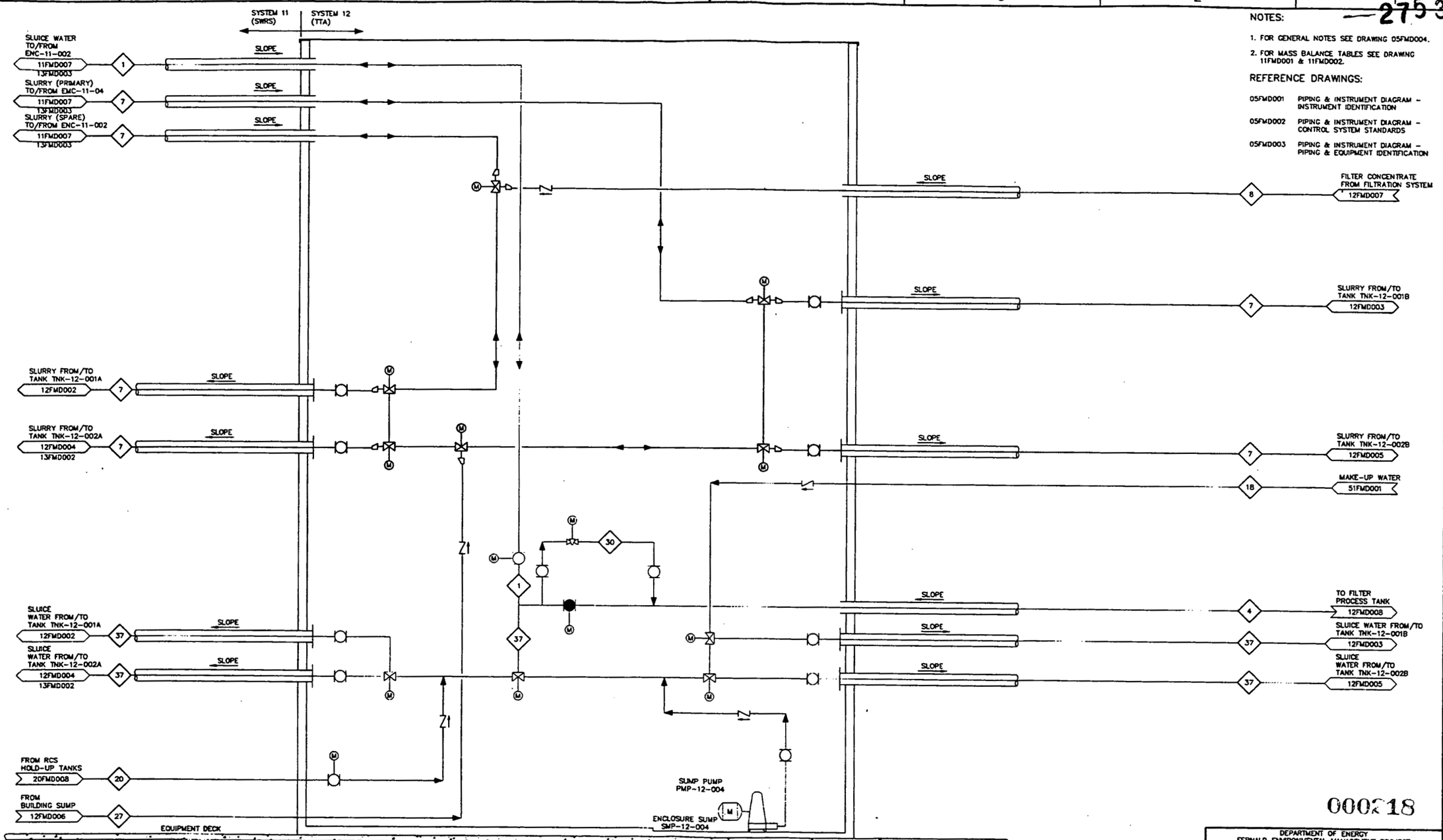

NOTES:

1. FOR GENERAL NOTES SEE DRAWING 05FMD004.
2. FOR MASS BALANCE TABLES SEE DRAWING 11FMD001 & 11FMD002.

REFERENCE DRAWINGS:

05FMD001	PIPING & INSTRUMENT DIAGRAM – INSTRUMENT IDENTIFICATION
05FMD002	PIPING & INSTRUMENT DIAGRAM – CONTROL SYSTEM STANDARDS
05FMD003	PIPING & INSTRUMENT DIAGRAM – PIPING & EQUIPMENT IDENTIFICATION

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
1	01/07/00	BJD	SWH	KDR	CERTIFIED FOR CONSTRUCTION
0	11/01/99	BJD	SWH		PRELIMINARY DESIGN SUBMITTAL

KENNETH D. RICKETT PROFESSIONAL ENGINEER STATE OF TENNESSEE

		DATE
DRAWN BY	B.J. Davis	01/07/00
DESIGNED BY	B.J. Davis	01/07/00
CHECKED BY	S.W. Wright	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
DISTRIBUTION ENC-12-001

SIZE	SCALE:	DWG. NO.	REV
D	NONE	12FMD001	1

FILENAME: 12FMD001.DWG

000218

2753

G:\DRAGE\ENC\SYS12\12fmd001.dwg Thu Jan 06 20:22:39 2000

275.3

SELF CONTROLLING SPACE HEATER HTR-77-001

SELF CONTROLLING SPACE HEATER HTR-77-002

SELF CONTROLLING SPACE HEATER HTR-77-003

SELF CONTROLLING SPACE HEATER HTR-77-004

SLURRY TO/FROM ENC-12-001 — 12FMD001 — 7

SLOPE

BLIND FLANGE (USED FOR SLURRY CONNECTION TO SLR-11-202 OR DEC-12-200)

FLANGED CONNECTION (USED FOR SLUICE WATER CONNECTION TO SLR-11-202 OR DEC-12-200)

SLUICE WATER TO/FROM ENC-12-001 — 12FMD001 — 37

SLOPE

FLEXIBLE MAKE-UP WATER CONNECTION

BLIND FLANGE (USED FOR SLUICE WATER CONNECTION SLC-12-205)

BLIND FLANGE (USED FOR SLUICE WATER CONNECTION SLC-11-204)

BLIND FLANGE FITTED WITH QUICK DISCONNECT (SLURRY FILL NOZZLE USED FOR CONNECTION TO DEC-12-200)

HP DECON WATER HEADER CONTINUED TO TNK-12-001B — 12FMD003

HP DECON PUMP WATER HEADER IN TTA — 16 — 12FMD008

CONNECTION FOR FLUSH WATER IN SLURRY MODULE SLR-11-202

CONNECTION FOR DECON SPRAY RINGS IN SLC-11-204

CONNECTION FOR DECON SPRAY RINGS IN SLR-11-202 OR DECANT MODULE DEC-12-200

CONNECTION FOR LEVEL INST. DECON WATER

CONNECTOR DECON SPRAY RINGS IN SLC-11-205

DECON WATER HEADER CONTINUED TO TNK-12-002A — 12FMD004

AIR SWEEP FROM RCS SYSTEM — SEE SYS 20

EQUIPMENT DECK

CAMERA VIEWPORT / SPARE

CAMERA VIEWPORT / SPARE

CAMERA VIEWPORT / SPARE

CAMERA VIEWPORT / SPARE

CAMERA VIEWPORT / SPARE

CAMERA VIEWPORT / SPARE

AIR SWEEP TO RCS SYSTEM — SEE SYS 20

OVERFLOW TO/ FROM TANK TNK-12-001B — 12FMD003

TRANSFER STORAGE TANK TNK-12-001A

SHOWN IN SWRS MODE FROM SILO 2

TO BUILDING SUMP — 12FMD006

CONTAINMENT BUILDING

TANK FOUNDATION

SLOPE

TANK SUMP SMP-12-001A

000219

NOTES:

1. FOR GENERAL NOTES SEE DRAWING 05FMD004.
2. FOR MASS BALANCE TABLES SEE DRAWING 11FMD001 & 11FMD002.

REFERENCE DRAWINGS:

05FMD001	PIPING & INSTRUMENT DIAGRAM – INSTRUMENT IDENTIFICATION
05FMD002	PIPING & INSTRUMENT DIAGRAM – CONTROL SYSTEM STANDARDS
05FMD003	PIPING & INSTRUMENT DIAGRAM – PIPING & EQUIPMENT IDENTIFICATION

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
1	01/07/00	BJD	SWH	KDR	CERTIFIED FOR CONSTRUCTION
D	11/01/99	BJD	SWH		PRELIMINARY DESIGN SUBMITTAL

KENNETH D. RICKETT — PROFESSIONAL ENGINEER — REGISTRATION NO. 102742 — STATE OF TENNESSEE

DRAWN BY — DATE 01/07/00
DESIGNED BY — DATE 01/07/00
CHECKED BY — DATE 01/07/00
APPROVED BY — DATE 01/07/00
APPROVED BY — DATE 01/08/00

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-12-001A

SIZE: D — SCALE: NONE — DWG. NO. 12FMD002 — REV 1

FILENAME: 12FMD002.DWG

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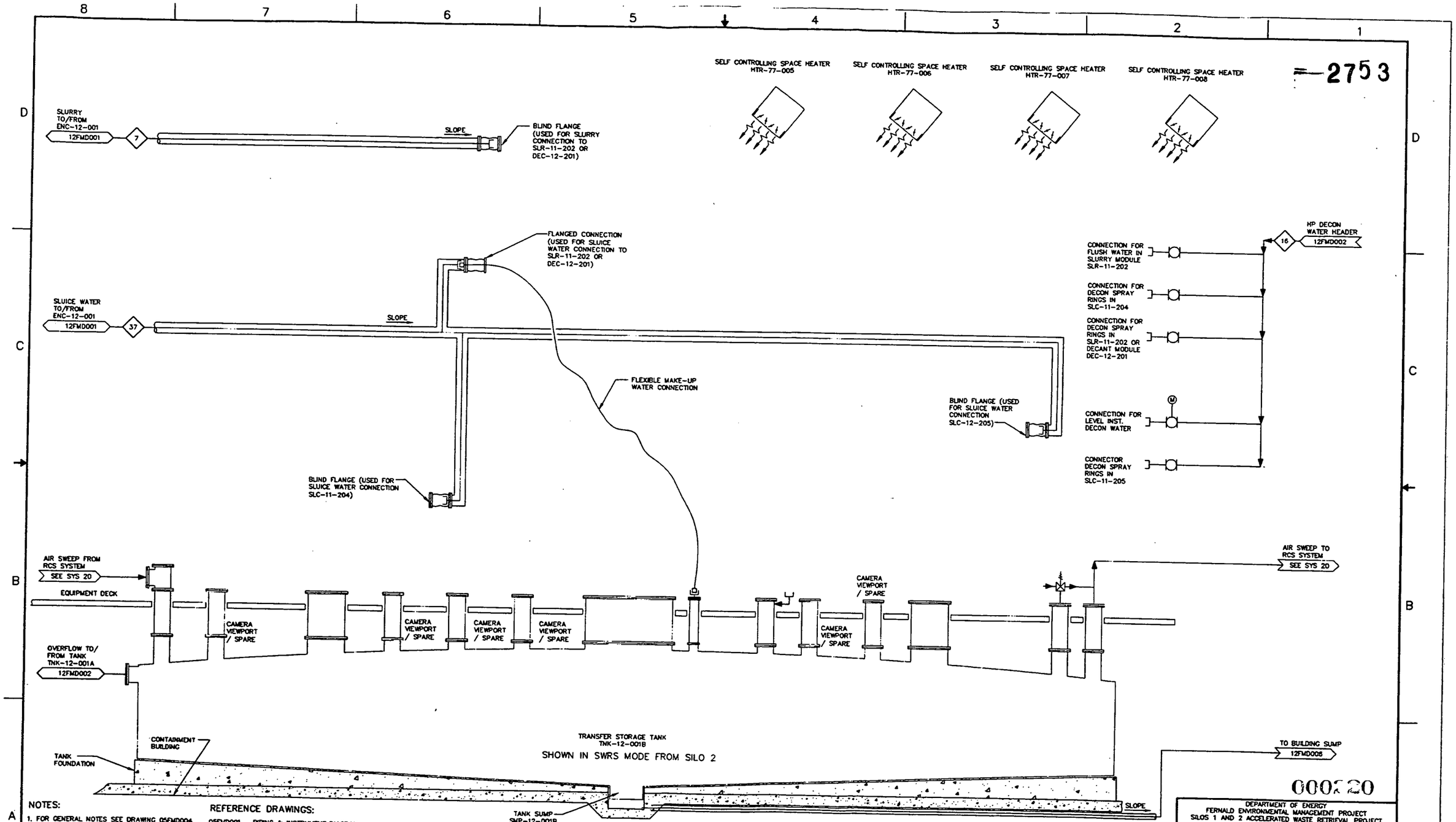

000220

NOTES:

1. FOR GENERAL NOTES SEE DRAWING 05FMD004.
2. FOR MASS BALANCE TABLES SEE DRAWING 11FMD001 & 11FMD002.

REFERENCE DRAWINGS:

05FMD001 PIPING & INSTRUMENT DIAGRAM – INSTRUMENT IDENTIFICATION

05FMD002 PIPING & INSTRUMENT DIAGRAM – CONTROL SYSTEM STANDARDS

PIPING & INSTRUMENT DIAGRAM – PIPING & EQUIPMENT IDENTIFICATION

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
1	01/06/00	BJD	SWH		CERTIFIED FOR CONSTRUCTION
0	01/01/99	BJD	SWH		PRELIMINARY DESIGN SUBMITTAL

KENNETH D. RICHARDS — PROFESSIONAL ENGINEER — REGISTERED — STATE OF TENNESSEE — 01/07/00

		DATE
DRAWN BY	B.J. Davis	01/07/00
DESIGNED BY	B.J. Davis	01/07/00
CHECKED BY	J.W. Hunt	01/07/00
APPROVED BY	Kenneth Richards	01/07/00
APPROVED BY	John Swanson	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-12-001B

SIZE	SCALE	DWG. NO.	REV
D	NONE	12FMD003	1

FILENAME: 12FMD003.DWG

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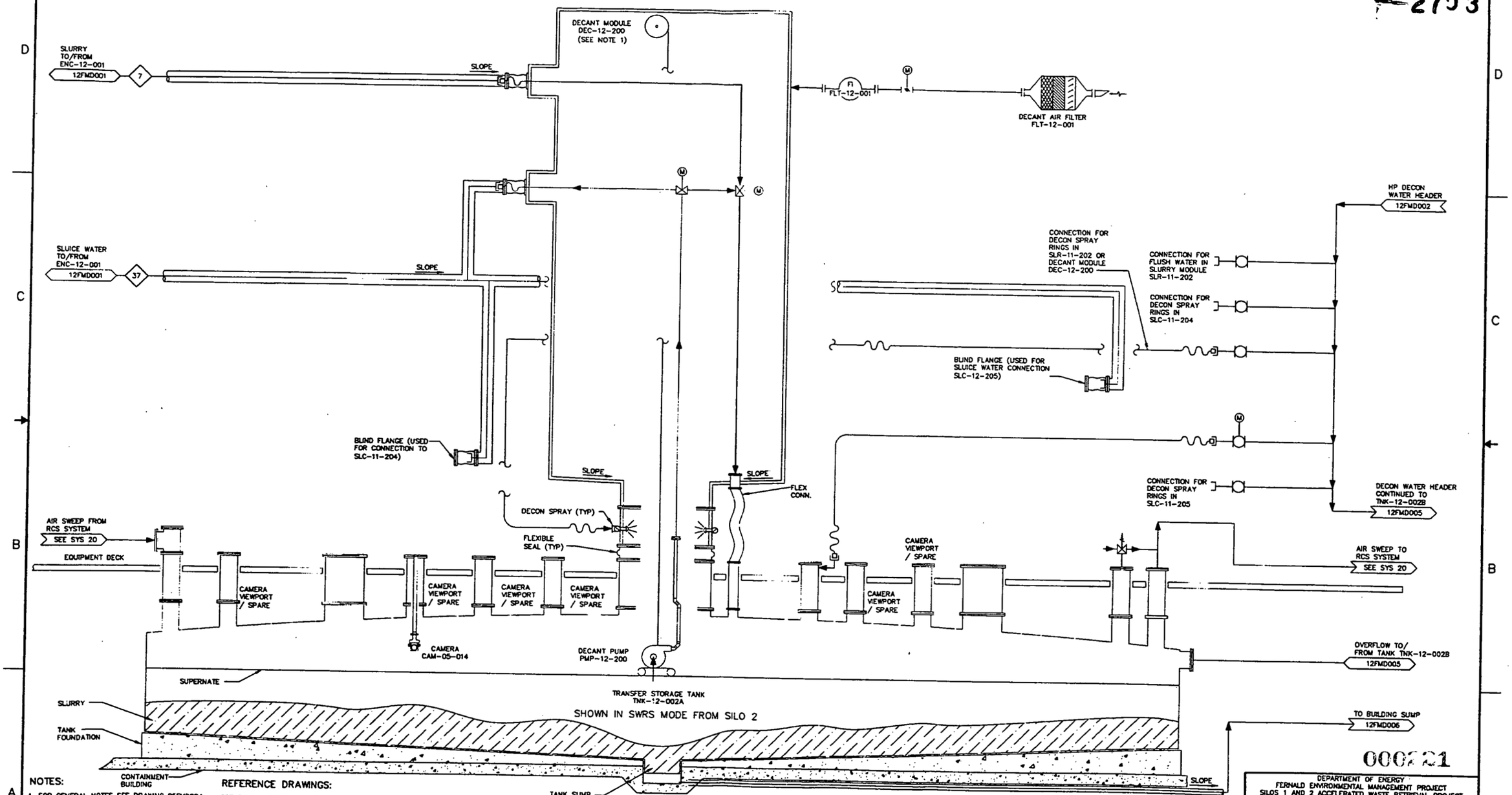
2753



000221

NOTES:

1. FOR GENERAL NOTES SEE DRAWING 05FMD004.
2. FOR MASS BALANCE TABLES SEE DRAWING 11FMD001 & 11FMD002.

REFERENCE DRAWINGS:

05FMD001 PIPING & INSTRUMENT DIAGRAM – INSTRUMENT IDENTIFICATION
05FMD002 PIPING & INSTRUMENT DIAGRAM – CONTROL SYSTEM STANDARDS
05FMD003 PIPING & INSTRUMENT DIAGRAM – PIPING & EQUIPMENT IDENTIFICATION

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
1	01/01/00	RAD	JLH	TDR	CERTIFIED FOR CONSTRUCTION
0	07/01/99	BJD	SWH		PRELIMINARY DESIGN SUBMITTAL

KENNETH D. RICKETT PROFESSIONAL ENGINEER STATE OF TENNESSEE

DRAWN BY		DATE 01/07/00
DESIGNED BY		DATE 01/07/00
CHECKED BY		DATE 01/07/00
APPROVED BY		DATE 01/07/00
APPROVED BY		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

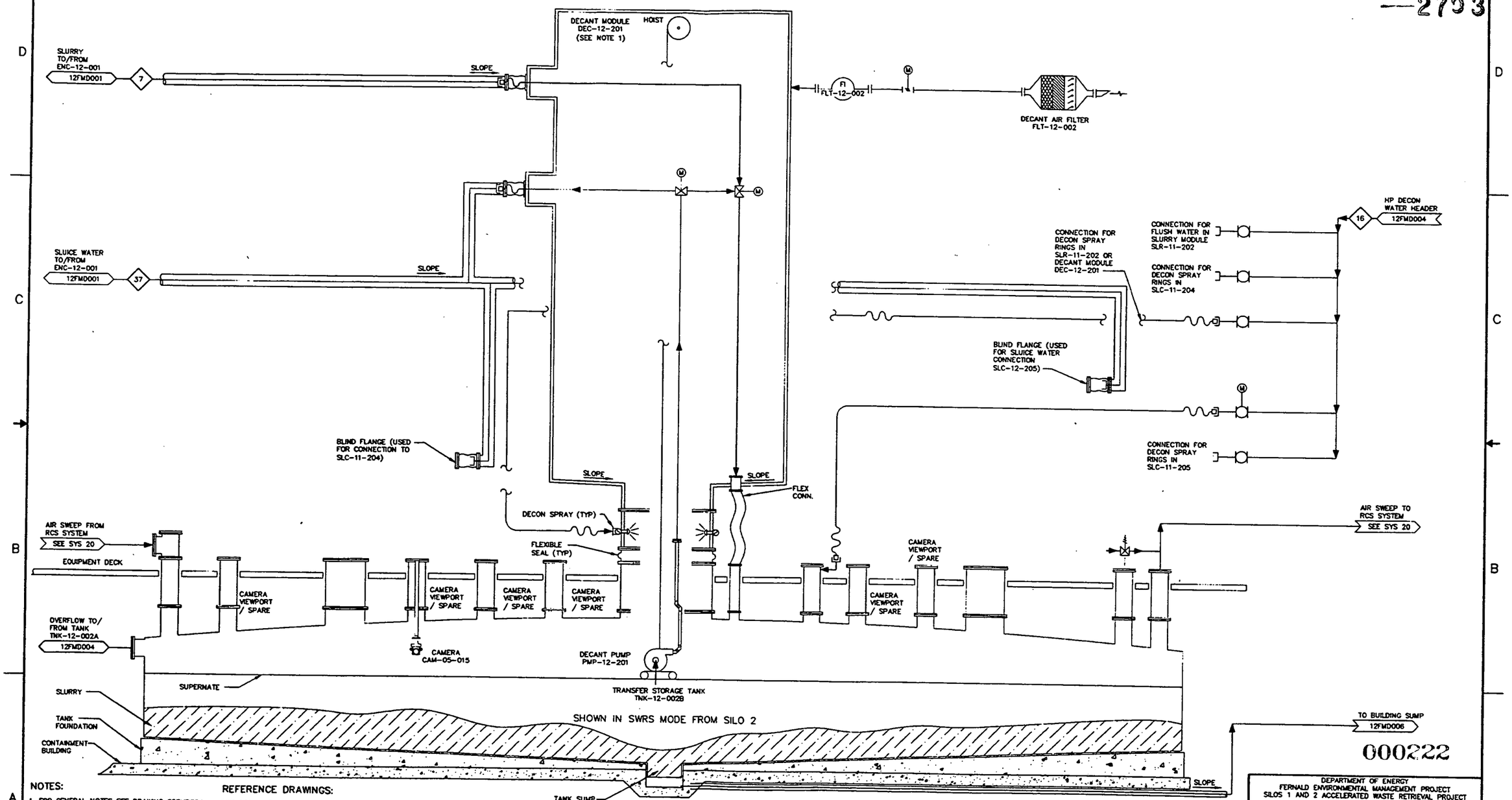
TITLE
TRANSFER TANK SYSTEM
PROCESS FLOW DIAGRAM
STORAGE TANK TNK-12-002A

SIZE	SCALE	DWG. NO.	REV
D	NONE	12FMD004	1

FILENAME: 12FMD004.DWG

Z:\DWGREV\CS\5121\12\fd004.dwg Thu Jan 06 21:44:20 2000

—2753



000222

NOTES:

1. FOR GENERAL NOTES SEE DRAWING 05FMD004.
2. FOR MASS BALANCE TABLES SEE DRAWING 11FMD001 & 11FMD002.

REFERENCE DRAWINGS:

05FMD001 PIPING & INSTRUMENT DIAGRAM – INSTRUMENT IDENTIFICATION

05FMD002 PIPING & INSTRUMENT DIAGRAM – CONTROL SYSTEM STANDARDS

PIPING & INSTRUMENT DIAGRAM – PIPING & EQUIPMENT IDENTIFICATION

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
1	01/07/00	MJD	DLA	KDR	CERTIFIED FOR CONSTRUCTION
0	11/03/99	BJD	SWH		PRELIMINARY DESIGN SUBMITTAL

KENNETH D. RICKETT REGISTERED PROFESSIONAL ENGINEER No. 105724 STATE OF TENNESSEE

DRAWN BY B.J. Davis DATE 01/07/00
DESIGNED BY B.J. Davis DATE 01/07/00
CHECKED BY D.H. 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
STORAGE TANK TNK-12-002B

SIZE D | SCALE: NONE | DWG. NO. 12FMD005 | REV 1

FILENAME: 12FMD005.DWG

G:\DRAFT\FSILOS\WEC\SYS12\12FMD005.dwg Thu Jan 06 12:44:46 2000

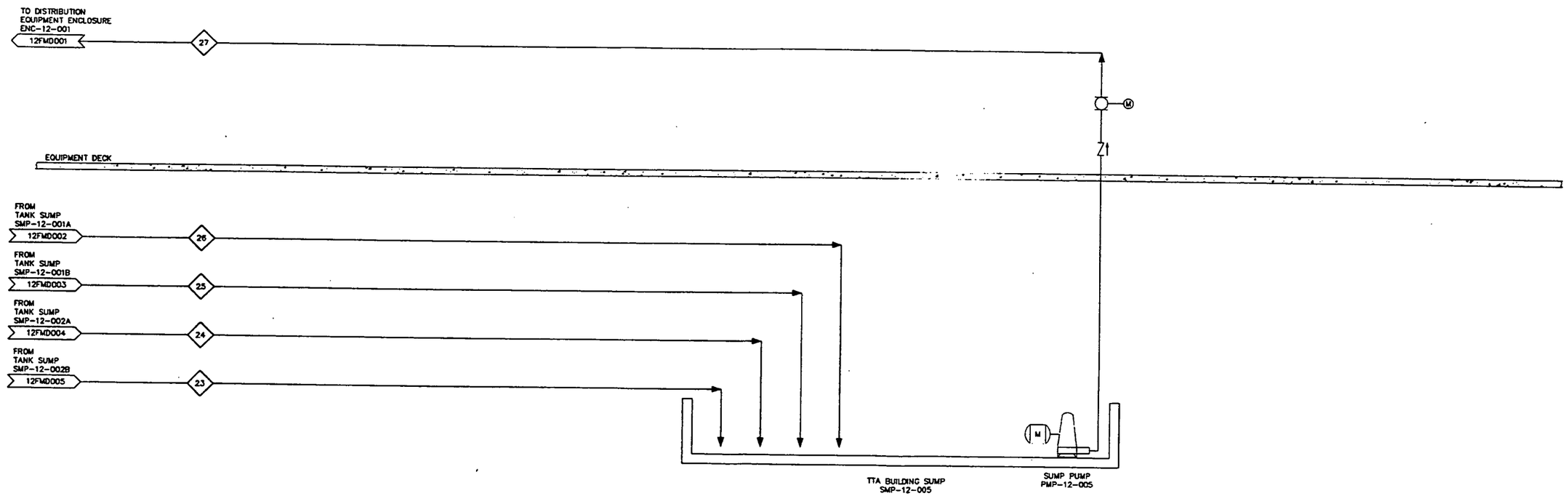
2153

NOTES:

1. FOR GENERAL NOTES SEE DRAWING 05FMD004.
2. FOR MASS BALANCE TABLES SEE DRAWING 11FMD001 & 11FMD002.

REFERENCE DRAWINGS:

05FMD001	PIPING & INSTRUMENT DIAGRAM – INSTRUMENT IDENTIFICATION
05FMD002	PIPING & INSTRUMENT DIAGRAM – CONTROL SYSTEM STANDARDS
05FMD003	PIPING & INSTRUMENT DIAGRAM – PIPING & EQUIPMENT IDENTIFICATION



000223

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	APRV'D	DESCRIPTION/ISSUE
1	01/07/00	BJD	SWH	KDR	CERTIFIED FOR CONSTRUCTION
0	11/01/99	BJD	SWH		PRELIMINARY DESIGN SUBMITTAL

KENNETH D. RIGGS, PROFESSIONAL ENGINEER, REGISTERED, STATE OF TENNESSEE, 01/07/00

		DATE
DRAWN BY	B.J. Davis	01/07/00
DESIGNED BY	B.J. Davis	01/07/00
CHECKED BY	J.W. Hurst	01/07/00
APPROVED BY	Kenneth D. Riggs	01/07/00
APPROVED BY	John Kinsman	01/09/00

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

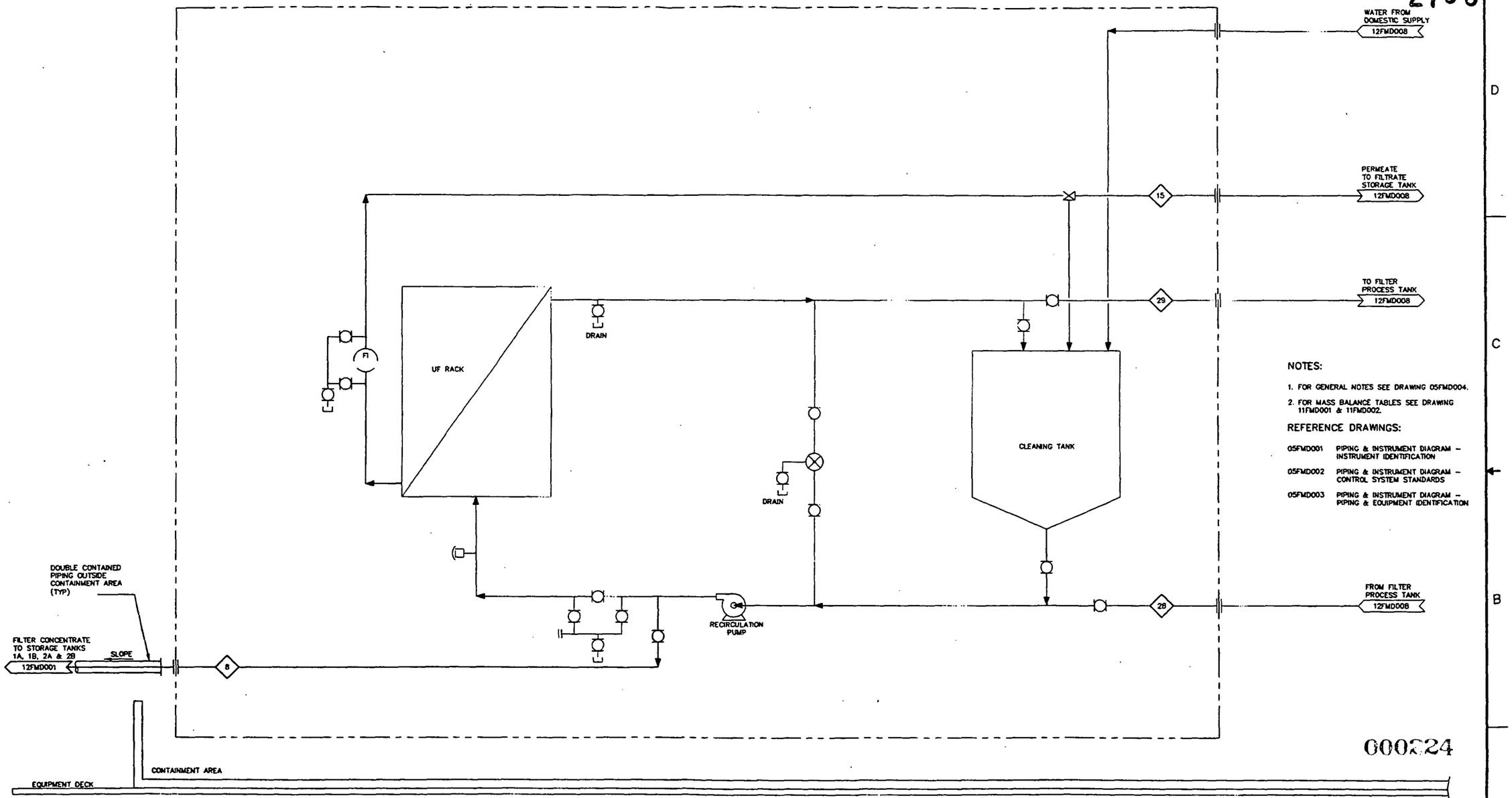
TITLE
TRANSFER TANK SYSTEM
PROCESS FLOW DIAGRAM
BUILDING SUMP SMP-12-005

SIZE	SCALE:	DWG. NO.	REV
D	NONE	12FMD006	1

FILENAME: 12FMD006.DWG

G:\CAD\12FMD006.dwg Wed Jan 05 22:22:40 2000

2753



000224

ULTRA FILTRATION SKID
SKD-12-001

NOTES:

1. FOR GENERAL NOTES SEE DRAWING 05FMD004.
2. FOR MASS BALANCE TABLES SEE DRAWING 11FMD001 & 11FMD002.

REFERENCE DRAWINGS:

05FMD001	PIPING & INSTRUMENT DIAGRAM – INSTRUMENT IDENTIFICATION
05FMD002	PIPING & INSTRUMENT DIAGRAM – CONTROL SYSTEM STANDARDS
05FMD003	PIPING & INSTRUMENT DIAGRAM – PIPING & EQUIPMENT IDENTIFICATION

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	APRV'D	DESCRIPTION/ISSUE
1	01/06/00	BJD	SWH	KDR	CERTIFIED FOR CONSTRUCTION
0	11/01/99	BJD	SWH		PRELIMINARY DESIGN SUBMITTAL

KENNETH D. RICKETT PROFESSIONAL ENGINEER No. 105242 STATE OF TENNESSEE 01/07/00

		DATE
DRAWN BY	B.J. Davis	01/07/00
DESIGNED BY	B.J. Davis	01/07/00
CHECKED BY	S.W. Hoyt	01/07/00
APPROVED BY	Kenneth Rickett	01/07/00
APPROVED BY	John Simon	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	SCALE:	DWG. NO.	REV
D	NONE	12FMD007	1

FILENAME: 12FMD007.DWG

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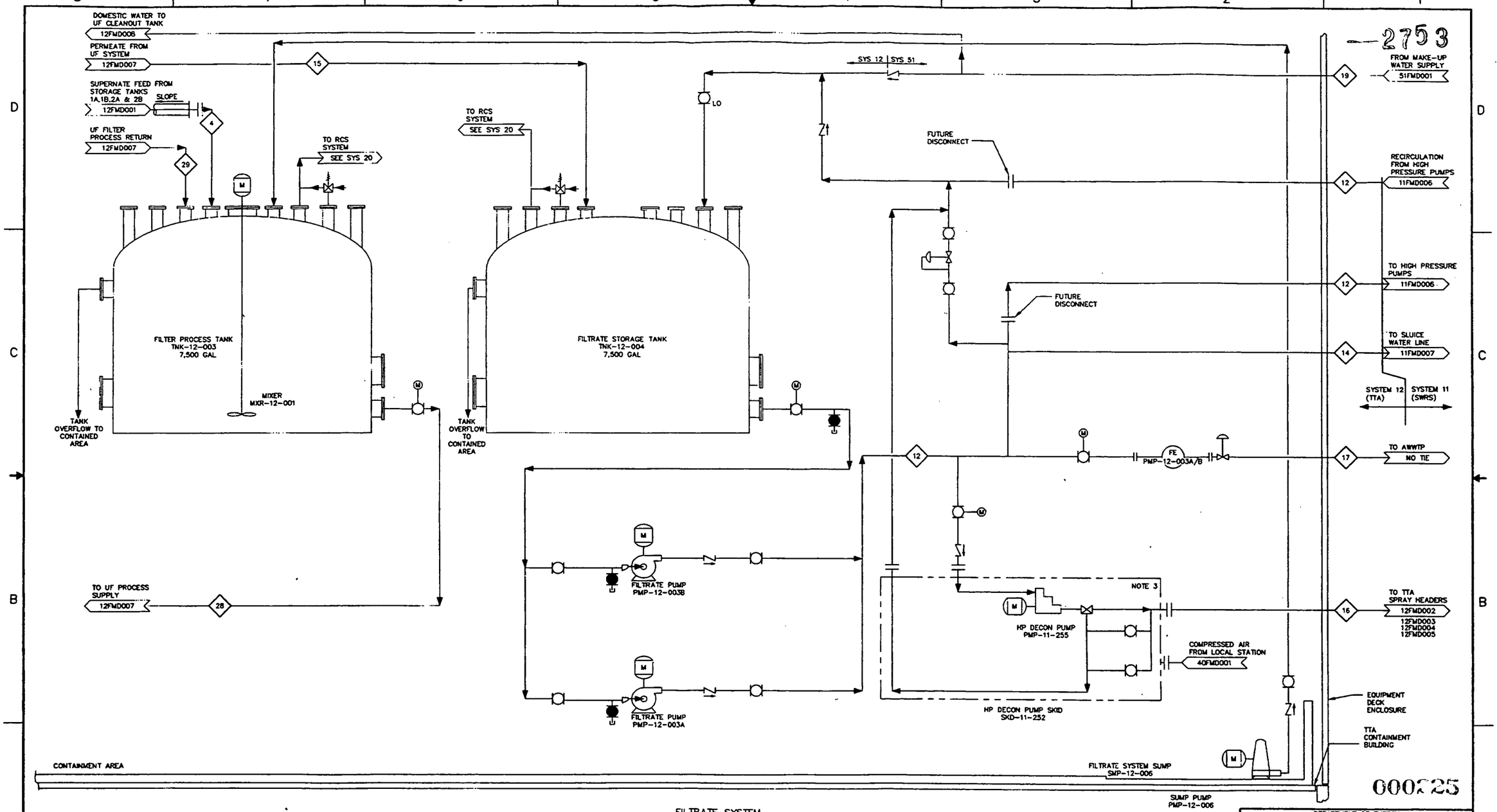

FILTRATE SYSTEM

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 PIPING & INSTRUMENT DIAGRAM – INSTRUMENT IDENTIFICATION

05FMD002 PIPING & INSTRUMENT DIAGRAM – CONTROL SYSTEM STANDARDS

PIPING & INSTRUMENT DIAGRAM – PIPING & EQUIPMENT IDENTIFICATION

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
1	1/6/00	BJD	SWH	KDR	CERTIFIED FOR CONSTRUCTION
0	11/01/99	BJD	SWH		PRELIMINARY DESIGN SUBMITTAL

KENNETH D. RIOKEN — PROFESSIONAL ENGINEER — REGISTRATION No. 105743 — STATE OF TENNESSEE — 01/19/00

		DATE
DRAWN BY	B.J. Davis	01/07/00
DESIGNED BY	B.J. Davis	01/07/00
CHECKED BY	J.N. Hampton	01/07/00
APPROVED BY	Kenneth D. Rioken	01/07/00
APPROVED BY	John Swanson	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

SIZE	SCALE	DWG. NO.	REV
D	NONE	12FMD008	1

FILENAME: 12FMD008.DWG

G:\DWGS\FDF3\LOS\MCS\SYS\F1\12fmd008.dwg Thu Jan 06 20:05:51 2000

2753

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

TYPICAL 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	338	338	40	0	0	0	0	50
K-65 (LB)	5,160,000	% SOLIDS (WT)	2.0	2.0	2.0	15.0	13.0	0	20.0	20.0	20.0	20.0	20.0
WATER (LB)	3,870,000	SOLIDS PER GAL (LB)	0.167	0.167	0.167	1.315	1.129	0	1.798	1.798	1.798	1.798	1.798
TOTAL MASS (LB)	9,140,000	SOLIDS PER DAY (LB)	24,050	501	3,006	213,218	183,097	0	0	0	0	0	0
VOLUME WATER (GALLONS)	464,000	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	162,166	162,166	800	0	0	0	0	0
TOTAL SOLIDS (GALLONS)	211,000	DAYS OF OPERATION	29	0	0	29	29	5	0	0	0	0	0
CURIES	8,680	TOTAL VOLUME (GALLONS)	4,140,000	0	0	4,670,000	4,670,000	4,000	0	0	0	0	0
		TOTAL MASS SOLIDS (LB)	629,000	0	0	6,140,000	5,270,000	0	0	0	0	0	0
		SOLIDS PER HOUR (LB/HR)	3,010	501	3,010	26,700	22,900	0	0	0	0	0	0
		CURIES	1,140	0	0	10,100	8,680	--	--	--	--	--	--

000226

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	APRV'D	DESCRIPTION/ISSUE
1	01/07/00	BJD	SWH	KDR	CERTIFIED FOR CONSTRUCTION
0	11/01/99	BJD	SWH		PRELIMINARY DESIGN SUBMITTAL

KENNETH D. RICKETTS REGISTERED PROFESSIONAL ENGINEER No. 103742 STATE OF TENNESSEE

DRAWN BY B.J. Davis DATE 01/07/00
DESIGNED BY B.J. Davis DATE 01/07/00
CHECKED BY S.W. Hancock DATE 01/07/00
APPROVED BY Kenneth Rickett DATE 01/07/00
APPROVED BY John Hanson 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 D | SCALE: NONE | DWG. NO. 13FMD001 | REV 1

FILENAME: 13FMD001.DWG

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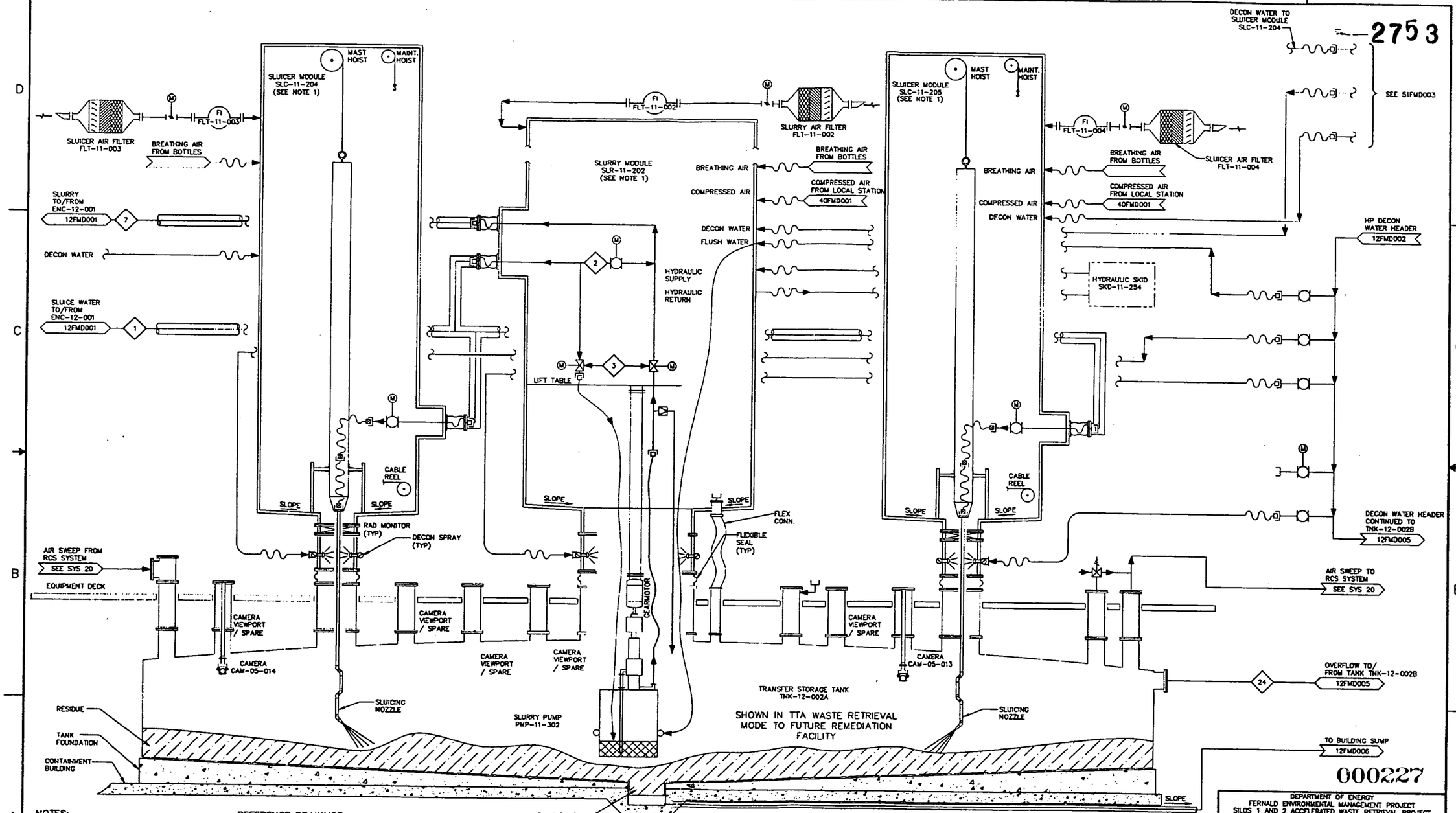
2753



000227

NOTES:
1. FOR GENERAL NOTES SEE DRAWING 05FMD004.
2. FOR MASS BALANCE TABLES SEE DRAWING 13FMD001.

REFERENCE DRAWINGS:
05FMD001 PIPING & INSTRUMENT DIAGRAM – INSTRUMENT IDENTIFICATION
05FMD002 PIPING & INSTRUMENT DIAGRAM – CONTROL SYSTEM STANDARDS
05FMD003 PIPING & INSTRUMENT DIAGRAM – PIPING & EQUIPMENT IDENTIFICATION

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	APRV'D	DESCRIPTION/ISSUE
1	01/07/00	BJD	JLH	KRR	CERTIFIED FOR CONSTRUCTION
0	01/01/99	BJD	SWH		PRELIMINARY DESIGN SUBMITTAL

KENNETH R. RICHETT REGISTERED PROFESSIONAL ENGINEER NO. 1027142 STATE OF TENNESSEE 01/07/00

DRAWN BY B.J. Davis DATE 01/01/00
DESIGNED BY B.J. Davis DATE 01/07/00
CHECKED BY J.L. Hampton DATE 01/07/00
APPROVED BY Kenneth R. Richett DATE 01/07/00
APPROVED BY Gordon 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-12-002A

SIZE D | SCALE: NONE | DWG. NO. 13FMD002 | REV 1

FILENAME: 13FMD002.DWG

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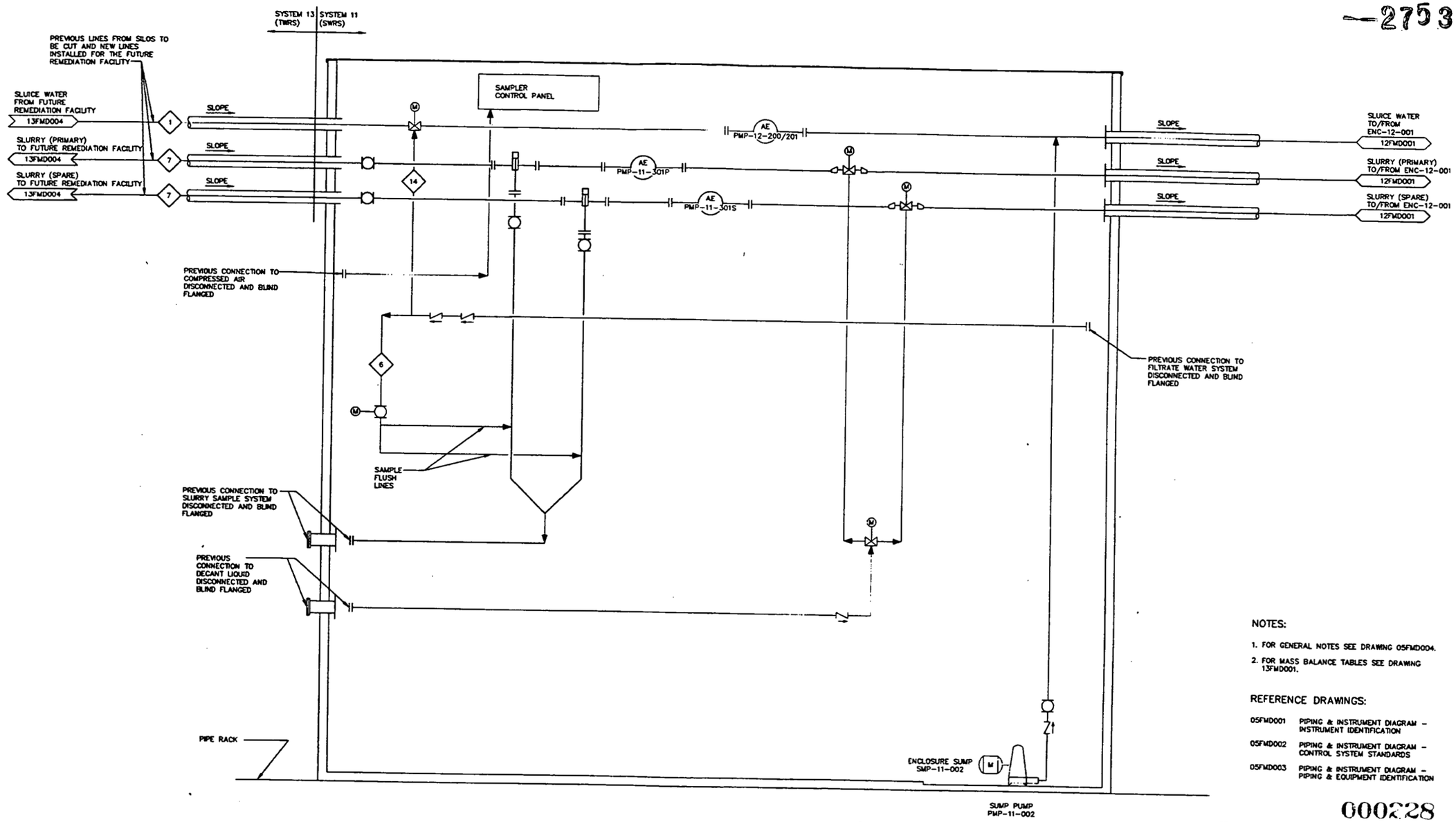

NOTES:

1. FOR GENERAL NOTES SEE DRAWING 05FMD004.
2. FOR MASS BALANCE TABLES SEE DRAWING 13FMD001.

REFERENCE DRAWINGS:

05FMD001	PIPING & INSTRUMENT DIAGRAM – INSTRUMENT IDENTIFICATION
05FMD002	PIPING & INSTRUMENT DIAGRAM – CONTROL SYSTEM STANDARDS
05FMD003	PIPING & INSTRUMENT DIAGRAM – PIPING & EQUIPMENT IDENTIFICATION

000228

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	APRV'D	DESCRIPTION/ISSUE
1	01/07/00	BJD	SWH	KDR	CERTIFIED FOR CONSTRUCTION
0	11/03/99	BJD	SWH		PRELIMINARY DESIGN SUBMITTAL

KENNETH D. RICHARDS REGISTERED PROFESSIONAL ENGINEER No. 103722 STATE OF TENNESSEE 01/07/00

DRAWN BY	DATE 01/07/00
DESIGNED BY	DATE 01/07/00
CHECKED BY	DATE 01/07/00
APPROVED BY	DATE 01/07/00
APPROVED BY	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 SAMPLE VALVE ENCLOSURE

SIZE	SCALE	DWG. NO.	REV
D	NONE	13FMD003	1

FILENAME: 13FMD003.DWG

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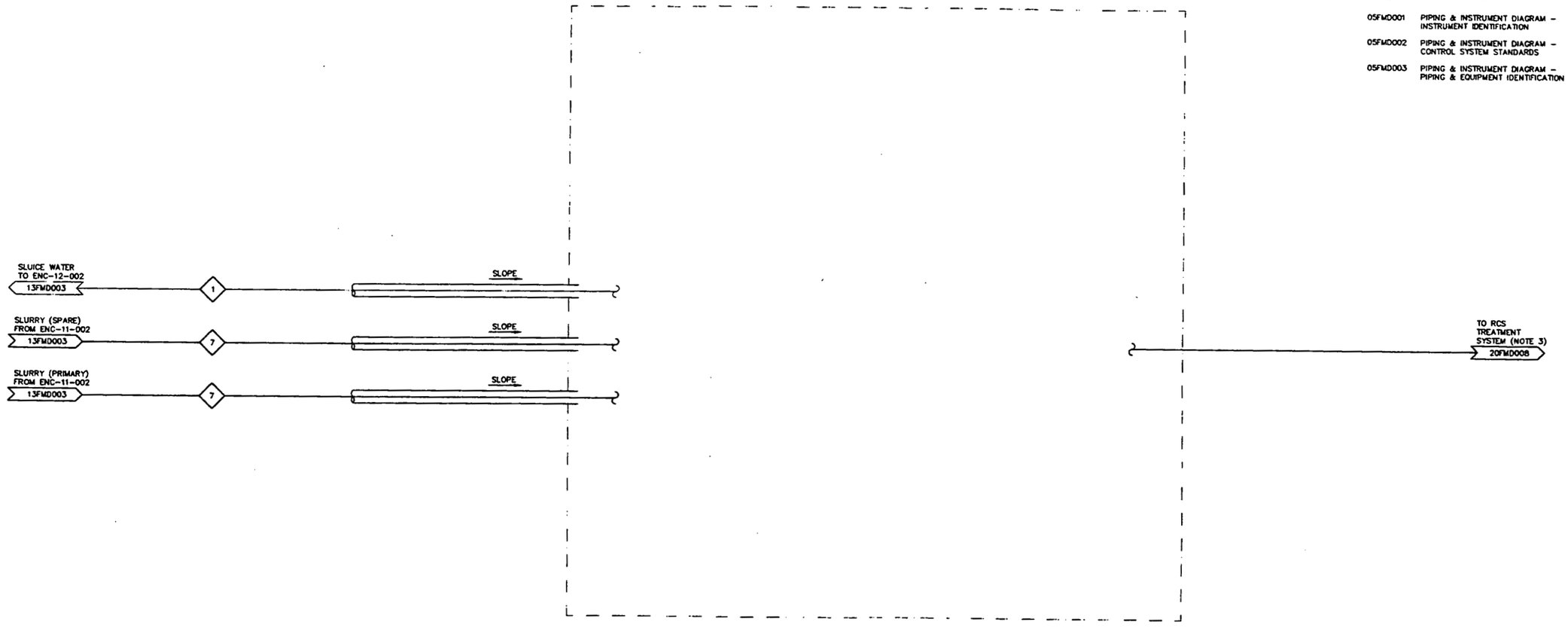
NOTES: 2753

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	PIPING & INSTRUMENT DIAGRAM - INSTRUMENT IDENTIFICATION
05FMD002	PIPING & INSTRUMENT DIAGRAM - CONTROL SYSTEM STANDARDS
05FMD003	PIPING & INSTRUMENT DIAGRAM - PIPING & EQUIPMENT IDENTIFICATION



000229

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
1	[illegible]	[illegible]	[illegible]	[illegible]	CERTIFIED FOR CONSTRUCTION
0	11/01/99	BJD	SWH		PRELIMINARY DESIGN SUBMITTAL

KENNETH R. RICKETT — REGISTERED PROFESSIONAL ENGINEER — No. 103742 — STATE OF TENNESSEE

		DATE
DRAWN BY	[illegible]	01/07/00
DESIGNED BY	[illegible]	01/07/00
CHECKED BY	[illegible]	01/07/00
APPROVED BY	[illegible]	01/07/00
APPROVED BY	[illegible]	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
FUTURE REMEDIATION FACILITY

SIZE	SCALE:	DWG. NO.	REV
D	NONE	13FMD004	1

FILENAME: 13FMD004.DWG

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2753

DECANT SUMP RETRIEVAL – AWRS MASS BALANCE TABLE

INVENTORY		STREAM NUMBER	37	1	33	4	30	5	6	34	34	35	35	22	8	28	29	9	32
		STREAM DESCRIPTION	DECANT FROM TTA TO UF MAKE-UP CONNECTION	DECANT FROM UF CONNECTION TO HOLD-UP TANK	DECANT INTO HOLD-UP TANK	DECANT WATER TO BE FILTERED	DECANT MAKE-UP TO FILTER PROCESS TANK	SAMPLE ACCUMULATION TANK DECANT	SAMPLE ACCUMULATION TANK FLUSH	SLURRY DISCHARGE FROM HOLD-UP TANK (LIQUID RECOVERY)	SLURRY DISCHARGE FROM HOLD-UP TANK (SOLIDS RECOVERY)	SLURRY DISCHARGE TO HOLD-UP TANK (LIQUID RECOVERY)	SLURRY DISCHARGE TO HOLD-UP TANK (SOLIDS RECOVERY)	SAMPLE STORAGE	SLURRY LINE FROM UF SYSTEM	UF DECANT SUPPLY FROM PROCESS TANK	UF DECANT RETURN TO PROCESS TANK	SLURRY SAMPLE LINE	HP DECON WATER FOR SLUICE WATER
		FLOW (GPM)	320	300	300	320	20	10	10	358	353	58	52.55	9	300	300	280	0.38	40
K-65 (LB)	11,995	% SOLIDS (WT)	2.0	2.0	2.0	2.0	2.0	1.5	0	1.94	2.78	1.65	7.15	10.0	4.0	2.0	2.14	2.8	0
LIQUID (LB)	44,135	SOLIDS PER GAL (LB)	0.167	0.167	0.167	0.167	0.167	0.121	0	0.162	0.233	0.138	0.607	0.858	0.336	0.167	0.179	0.233	0
TOTAL MASS (LB)	56,130	SOLIDS PER DAY (LB)	25,654	24,050	24,050	1,256	1,253	18	0	27,864	39,351	3,833	15,302	23	2,519	18,789	18,770	42	0
K-65 (GALLONS) IN-SITU	1,008	MINUTES PER DAY OPERATION (MIN)	480	480	480	24	375	15	15	480	480	480	480	3	25	375	375	480	120
LIQUID (GALLONS) IN-SITU	5,292	TOTAL VOLUME PER DAY (GALLONS)	153,600	144,000	144,000	7,520	7,500	153	150	171,840	169,224	27,840	25,224	27	7,500	112,500	105,000	180	4,800
TOTAL VOLUME (GALLONS)	6,300	DAYS OF OPERATION	2.03	2.03	2.03	2.03	2.03	1.57	1.57	0.46	1.57	0.46	1.57	1.57	2.03	2.03	2.03	1.57	1.57
CURIES	94	TOTAL VOLUME (GALLONS)	311,367	291,906	291,906	15,244	15,203	240	253	78,939	265,301	12,789	39,545	42	15,203	228,052	212,848	282	7,525
		TOTAL MASS SOLIDS (LB)	52,003	48,753	48,753	2,546	2,539	29	0	12,800	61,692	1,761	23,990	36	5,107	38,088	38,048	66	0
		SOLIDS PER HOUR (LB/HR)	3,207	3,006	3,006	3,207	200	73	0	3,483	4,919	479	1,913	463	6,047	3,006	3,003	5	0
		CURIES	409.40	383.81	383.81	20.04	19.99	0.23	0.00	100.77	485.68	13.86	188.87	0.29	40.21	299.85	299.54	0.52	0

DECANT SUMP RETRIEVAL – AWRS MASS BALANCE TABLE – CONT.

INVENTORY		STREAM NUMBER	31	12	15
		STREAM DESCRIPTION	JET PUMP WATER	FILTRATE RECIRCULATION LOOP (FILTERED WATER)	FROM UF TO FW TANK (FILTERED WATER)
		FLOW (GPM)	10	180	20
K-65 (LB)	11,995	% SOLIDS (WT)	0	0	0
LIQUID (LB)	44,135	SOLIDS PER GAL (LB)	0	0	0
TOTAL MASS (LB)	56,130	SOLIDS PER DAY (LB)	0	0	0
K-65 (GALLONS) IN-SITU	1,008	MINUTES PER DAY OPERATION (MIN)	480	480	375
LIQUID (GALLONS) IN-SITU	5,292	TOTAL VOLUME PER DAY (GALLONS)	4,800	86,400	7,500
TOTAL VOLUME (GALLONS)	6,300	DAYS OF OPERATION	2.03	2.03	2.03
CURIES	94	TOTAL VOLUME (GALLONS)	9,730	175,144	15,203
		TOTAL MASS SOLIDS (LB)	0	0	0
		SOLIDS PER HOUR (LB/HR)	0	0	0
		CURIES	0	0	0

NOTES:

1. MASS BALANCE TABLE TO BE USED IN CONJUNCTION WITH DRAWING 14FMD002.

000230

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
1	06/01/00	MSP	JLH	KDR	CERTIFIED FOR CONSTRUCTION
0	01/07/98	BJD	SWH		PRELIMINARY DESIGN SUBMITTAL

KENNETH D. RICKETT, JR. REGISTERED PROFESSIONAL ENGINEER NO. 103143 STATE OF TENNESSEE 06/01/00

DRAWN BY B.J. Davis DATE 01/07/00
DESIGNED BY B.J. Davis DATE 01/07/00
CHECKED BY J.N. Hewitt 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
MASS BALANCE TABLE

SIZE D | SCALE: NONE | DWG. NO. 14FMD001 | REV 1

FILENAME: 14FMD001.DWG

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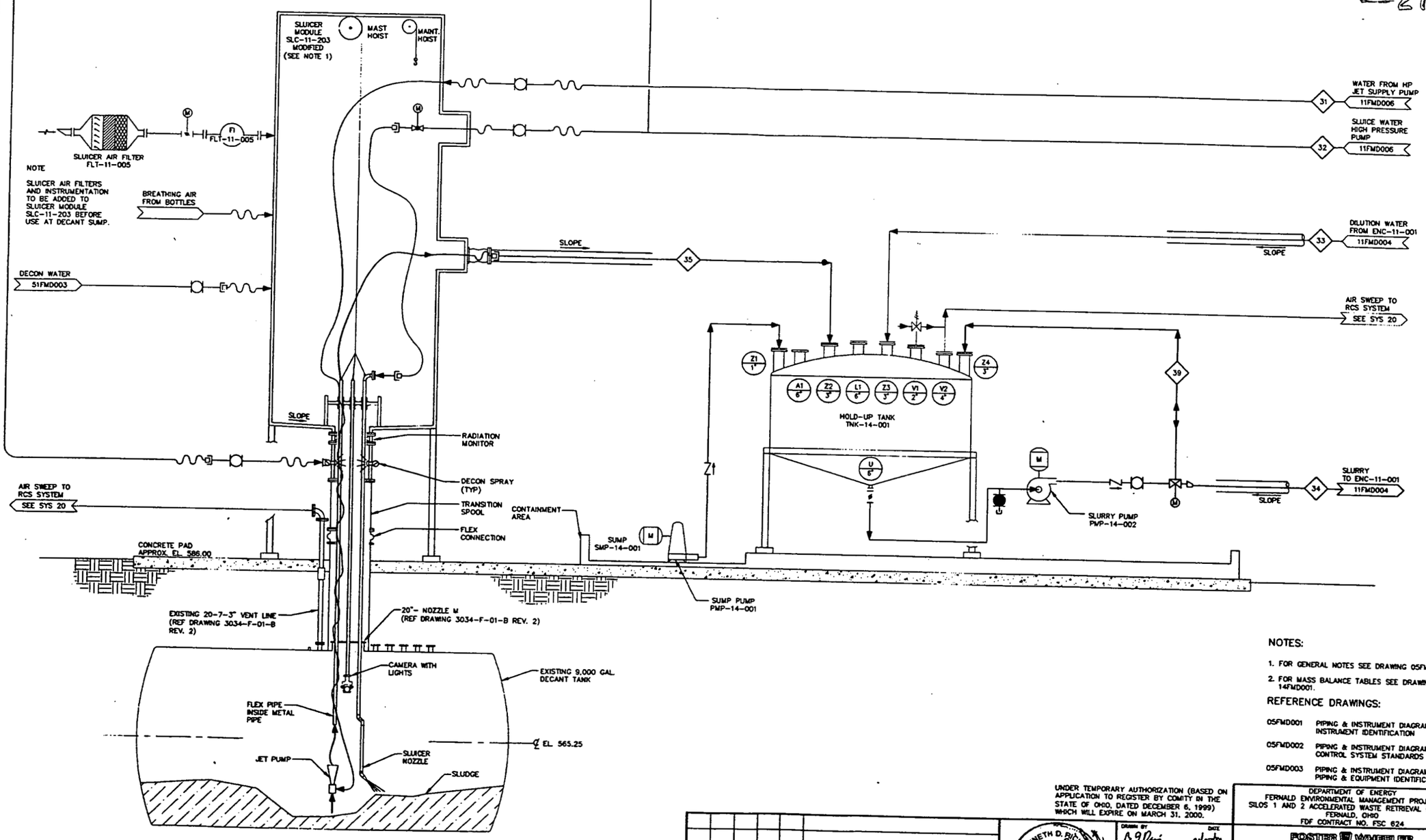

NOTES:

1. FOR GENERAL NOTES SEE DRAWING 05FMD004.
2. FOR MASS BALANCE TABLES SEE DRAWING 14FMD001.

REFERENCE DRAWINGS:

05FMD001	PIPING & INSTRUMENT DIAGRAM – INSTRUMENT IDENTIFICATION
05FMD002	PIPING & INSTRUMENT DIAGRAM – CONTROL SYSTEM STANDARDS
05FMD003	PIPING & INSTRUMENT DIAGRAM – PIPING & EQUIPMENT IDENTIFICATION

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
1	[illegible]	[illegible]	[illegible]	[illegible]	CERTIFIED FOR CONSTRUCTION
0	11/01/99	BJD	SWH		PRELIMINARY DESIGN SUBMITTAL

KENNETH D. PICKETT PROFESSIONAL ENGINEER No. 102743 STATE OF TENNESSEE

DRAWN BY B.J. Davis DATE 01/07/00
DESIGNED BY B.J. Davis DATE 01/07/00
CHECKED BY S.W. Hunt DATE 01/07/00
APPROVED BY Kenneth D. Pickett DATE 01/07/00
APPROVED BY [illegible] 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 1

FILENAME: 14FMD002.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
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
AIR (LBS/HR)	1080.37	1080.37	--	2160.73	2160.73	2160.73	3152.55	1010.72	1010.72	--	--
WATER (LBS/HR)	20.34	20.34	--	40.68	1.66	1.66	7.88	2.48	2.48	--	--
TOTAL, (LBS/HR)	1100.71	1100.71	--	2201.41	2162.39	2162.39	3160.43	1013.20	1013.20	--	--
FLOW (CFM)	250.00	250.00	--	500.00	454.00	454.00	678.00	227.00	227.00	--	--
FLOW (GPM)	--	--	--	--	--	--	--	--	--	--	--
RADON (PICOCURIES/L)	252195	249620	--	250907	276250	27	24	24	24	--	--
RADON (CURIES/HR)	1.07E-01	1.06E-01	--	2.13E-01	2.13E-01	2.08E-05	2.78E-05	9.29E-06	9.29E-06	--	--
TEMPERATURE (DEG F)	75	75	--	75	40	40	51	73	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 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			TTA NOT FUNCTIONAL IN PHASE 1	TTA NOT FUNCTIONAL IN PHASE 1

STREAM NUMBER	10	11	12	13	14	15	16	17	18	19	20
COMPONENT	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)	--	--	222.56	39422	39644.56	760.61	231.21	--	--	--	--
WATER (LBS/HR)	39.02	--	0.55	737	737.55	1.87	4.35	25037.46	--	--	--
TOTAL, (LBS/HR)	39.02	--	223.11	40159	40382.11	762.47	235.56	25037.46	--	--	--
FLOW (CFM)	--	--	50.00	9100.00	9150.00	171.00	54.00	--	--	--	--
FLOW (GPM)	0.08	--	--	--	--	--	--	50.00	--	--	--
RADON (PICOCURIES/L)	138043	--	24	0	0	24	0	2443	--	--	--
RADON (CURIES/HR)	2.44E-06	--	2.05E-06	0.00E+00	2.05E-06	6.99E-06	0.00E+00	2.08E-05	--	--	--
TEMPERATURE (DEG F)	40	--	73	75	75	73	75	--	--	--	--
PRESSURE (INCHES WC)	--	--	--	--	--	--	--	--	--	--	--
NOTES		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 2 RETRIEVAL, SILO 1 HEADSPACE REDUCTION, TTA VENTILATION

STREAM NUMBER	1	2	3	4	5	6	6A	7	8	9	9A
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
AIR (LBS/HR)	1080.37	1080.37	1080.37	3241.10	3241.10	3241.10	4666.95	--	1015.52	1080.37	--
WATER (LBS/HR)	20.34	20.34	20.34	61.03	2.49	2.49	3.44	--	0.68	20.34	--
TOTAL, (LBS/HR)	1100.71	1100.71	1100.71	3302.12	3243.59	3243.59	4670.40	--	1016.20	1100.71	--
FLOW (CFM)	250.00	250.00	250.00	750.00	681.00	681.00	1000.00	--	227.00	250.00	--
FLOW (GPM)	--	--	--	--	--	--	--	--	--	--	--
RADON (PICOCURIES/L)	1665166	251837	272500	729768	803478	1701	1701	--	1701	0	--
RADON (CURIES/HR)	0.707	0.107	0.116	9.30E-01	9.30E-01	1.97E-03	2.89E-03	--	6.56E-04	0.00E+00	--
TEMPERATURE (DEG F)	75	75	75	75	40	40	51	--	73	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 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 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

STREAM NUMBER	10	11	12	13	14	15	16	17	18	19	20
COMPONENT	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)	--	--	2031.06	39422	41453.06	1425.84	0.00	--	360.12	360.12	360.12
WATER (LBS/HR)	58.54	--	1.36	737	738.36	0.95	0.00	25037.46	6.78	6.78	6.78
TOTAL, (LBS/HR)	58.54	--	2032.41	40159	42191.11	1426.79	0.00	25037.46	366.90	366.90	366.90
FLOW (CFM)	--	--	454.00	9100.00	9554.00	319.00	0.00	--	83.00	83.00	83.00
FLOW (GPM)	0.12	--	--	--	--	--	--	50.00	--	--	--
RADON (PICOCURIES/L)	401500	--	1701	0	90	1701	0	7106	0	.0	0
RADON (CURIES/HR)	1.07E-05	--	1.31E-03	0.00E+00	1.31E-03	9.21E-04	0.00E+00	8.07E-05	0.00E+00	0.00E+00	0.00E+00
TEMPERATURE (DEG F)	40	--	73	75	75	73	75	--	75	75	75
PRESSURE (INCHES WC)	--	--	--	--	--	--	--	--	--	--	--
NOTES		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
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
AIR (LBS/HR)	--	1080.37	2160.73	3241.10	3241.10	3241.10	4666.95	--	--	2160.73	--
WATER (LBS/HR)	--	20.34	40.68	61.03	2.49	2.49	3.44	--	--	40.68	--
TOTAL, (LBS/HR)	--	1100.71	2201.41	3302.12	3243.59	3243.59	4670.40	--	--	2201.41	--
FLOW (CFM)	--	250.00	500.00	750.00	681.00	681.00	1000.00	--	--	500.00	--
FLOW (GPM)	--	--	--	--	--	--	--	--	--	--	--
RADON (PICOCURIES/L)	--	912497	211373	445081	490036	1038	1038	--	--	0	--
RADON (CURIES/HR)	--	3.88E-01	1.80E-01	5.67E-01	5.67E-01	1.20E-03	1.76E-03	--	--	0.00E+00	--
TEMPERATURE (DEG F)	--	75	75	75	40	40	51	--	--	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 BED 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

STREAM NUMBER	10	11	12	13	14	15	16	17	18	19	20
COMPONENT	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)	--	--	3046.56	39422	42469.56	1425.85	0.00	--	360.12	360.12	360.12
WATER (LBS/HR)	58.54	--	2.04	737	739.04	0.95	0.00	25037.46	6.78	6.78	6.78
TOTAL, (LBS/HR)	58.54	--	3048.60	40159	43207.60	1426.80	0.00	25037.46	366.90	366.90	366.90
FLOW (CFM)	--	--	681.00	9100	9781.00	319.00	0.00	--	83.00	83.00	83.00
FLOW (GPM)	0.12	--	--	--	--	--	--	50.00	--	--	--
RADON (PICOCURIES/L)	244872	--	1038	0	81	1038	0	4334	0	0	0
RADON (CURIES/HR)	6.50E-06	--	1.20E-03	0.00E+00	1.20E-03	5.62E-04	0.00E+00	4.92E-05	0.00E+00	0.00E+00	0.00E+00
TEMPERATURE (DEG F)	40	--	73	75	75	73	75	--	75	75	75
PRESSURE (INCHES WC)	--	--	--	--	--	--	--	--	--	--	--
NOTES		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, 20FMD004, & 20FMD005.
2. STREAM 13 FLOW FROM 77FMD002.

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	APRV'D	DESCRIPTION/ISSUE
1	[illegible]				CERTIFIED FOR CONSTRUCTION
0	11/01/99	BJD	KR		PRELIMINARY DESIGN SUBMITTAL

KENNETH D. RICKETTS — STATE OF TENNESSEE — No. 103742

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

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 1

FILENAME: 20FMD001.DWG

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)	--	--	2160.73	2160.73	2160.73	2160.73	3146.67	--	--	2160.73	--	--	--	2027.15	39422	41449.15	985.92	0.00	--	--	--	--	360.12
WATER (LBS/HR)	--	--	40.68	40.68	1.66	1.66	2.35	--	--	40.68	--	39.02	--	1.41	737	738.41	0.69	0.00	25037.46	--	--	--	6.78
TOTAL, (LBS/HR)	--	--	2201.41	2201.41	2162.39	2162.39	3149.02	--	--	2201.41	--	39.02	--	2028.56	40159	42187	986.61	0.00	25037.46	--	--	--	366.90
FLOW (CFM)	--	--	500.00	500.00	454.00	454.00	675.00	--	--	500.00	--	--	--	454.00	9100.00	9554.00	221.00	0.00	--	--	--	--	83.00
FLOW (GPM)	--	--	--	--	--	--	--	--	--	--	--	0.08	--	--	--	--	--	--	50.00	--	--	--	--
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	2.60E-05	--	--	0.00E+00	--	2.06E-06	--	1.75E-05	0.00E+00	1.75E-05	8.51E-06	0.00E+00	1.75E-05	--	--	--	--
TEMPERATURE (DEG F)	--	--	75	75	40	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

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)	--	--	2160.73	4321.46	4321.46	4321.46	4321.46	--	--	2160.73	--	--	2160.73	4139.64	39422	43561.64	0.00	0.00	--	--	--	--
WATER (LBS/HR)	--	--	40.68	81.37	3.32	3.32	3.32	--	--	40.68	--	78.05	40.68	2.95	737	739.95	0.00	0.00	25037.46	--	--	--
TOTAL, (LBS/HR)	--	--	2201.41	4402.83	4324.78	4324.78	4324.78	--	--	2201.41	--	78.05	2201.41	4142.58	40159	44301.58	0.00	0.00	25037.46	--	--	--
FLOW (CFM)	--	--	500.00	1000.00	908.00	908.00	908.00	--	--	500.00	--	--	500.00	908.00	9100.00	10008.00	0.00	0.00	--	--	--	--
FLOW (GPM)	--	--	--	--	--	--	--	--	--	--	--	0.16	--	--	--	--	--	--	50.00	--	--	--
RADON (PICOCURIES/L)	--	--	710019	565009	622078	6140	6140	--	--	0	--	310854	420000	6140	0	619	0	0	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	9.47E-03	0.00E+00	9.47E-03	0.00E+00	0.00E+00	8.25E-05	--	--	--
TEMPERATURE (DEG F)	--	--	75	75	40	40	40	--	--	75	--	40	75	62	75	75	62	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 RECIRUCLATION 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 FHASE 3			EQUIPMENT ENCLOSURES NOT INSTALLED IN PHASE 3	EQUIPMENT ENCLOSURES NOT INSTALLED IN PHASE 3	EQUIPMENT ENCLOSURES NOT INSTALLED IN PHASE 3

NOTES:

1. FOR FLOW DIAGRAMS SEE DRAWINGS 50FMD003, 50FMD004, & 50FMD005.
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.

REV	DATE	BY	CHK'D	APR'VD	DESCRIPTION/ISSUE
1	01/07/00	BJD	KR		CERTIFIED FOR CONSTRUCTION
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.

KENNETH D. PRICKETT REGISTERED PROFESSIONAL ENGINEER NO. 103742 STATE OF TENNESSEE

		DATE
DRAWN BY	BJDavis	01/07/01
DESIGNED BY	BJDavis	01/07/00
CHECKED BY	[illegible]	01/07/00
APPROVED BY	Kenneth Prickett	01/07/00
APPROVED BY	[illegible]	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 2

SIZE	SCALE	DWG. NO.	REV
D	NONE	20FMD002	1

FILENAME: 20FMD002.DWG

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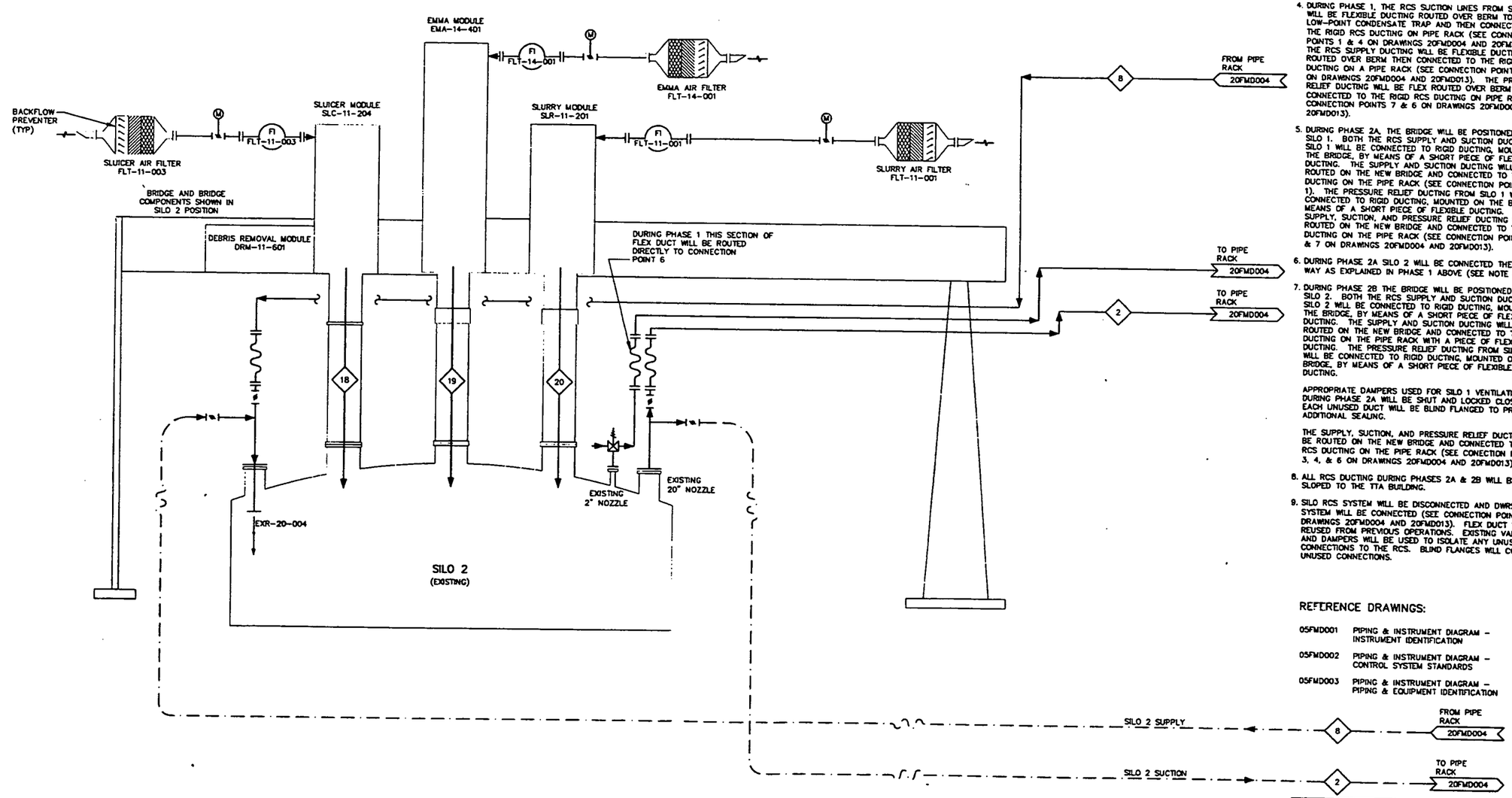

NOTES:

1. FOR GENERAL NOTES SEE DRAWING 05FMD004.
2. FOR MASS BALANCE TABLES SEE DRAWINGS 20FMD001 & 20FMD002.
3. THE SEQUENCE OF OPERATION OF SILOS IS DIVIDED INTO PHASE 1, PHASE 2A, & PHASE 2B.
4. DURING PHASE 1, THE RCS SUCTION LINES FROM SILO 1 & 2 WILL BE FLEXIBLE DUCTING ROUTED OVER BERM TO A LOW-POINT CONDENSATE TRAP AND THEN CONNECTED TO THE RIGID RCS DUCTING ON PIPE RACK (SEE CONNECTION POINTS 1 & 4 ON DRAWINGS 20FMD004 AND 20FMD013). THE RCS SUPPLY DUCTING WILL BE FLEXIBLE DUCTING ROUTED OVER BERM THEN CONNECTED TO THE RIGID RCS DUCTING ON A PIPE RACK (SEE CONNECTION POINTS 2 & 3 ON DRAWINGS 20FMD004 AND 20FMD013). THE PRESSURE RELIEF DUCTING WILL BE FLEX ROUTED OVER BERM THEN CONNECTED TO THE RIGID RCS DUCTING ON PIPE RACK (SEE CONNECTION POINTS 7 & 6 ON DRAWINGS 20FMD004 AND 20FMD013).
5. DURING PHASE 2A, THE BRIDGE WILL BE POSITIONED OVER SILO 1. BOTH THE RCS SUPPLY AND SUCTION DUCTS FROM SILO 1 WILL BE CONNECTED TO RIGID DUCTING, MOUNTED ON THE BRIDGE, BY MEANS OF A SHORT PIECE OF FLEXIBLE DUCTING. THE SUPPLY AND SUCTION DUCTING WILL BE ROUTED ON THE NEW BRIDGE AND CONNECTED TO THE RCS DUCTING ON THE PIPE RACK (SEE CONNECTION POINTS 2 & 1). THE PRESSURE RELIEF DUCTING FROM SILO 1 WILL BE CONNECTED TO RIGID DUCTING, MOUNTED ON THE BRIDGE BY MEANS OF A SHORT PIECE OF FLEXIBLE DUCTING. THE SUPPLY, SUCTION, AND PRESSURE RELIEF DUCTING WILL BE ROUTED ON THE NEW BRIDGE AND CONNECTED TO THE RCS DUCTING ON THE PIPE RACK (SEE CONNECTION POINTS 2, 1 & 7 ON DRAWINGS 20FMD004 AND 20FMD013).
6. DURING PHASE 2A SILO 2 WILL BE CONNECTED THE SAME WAY AS EXPLAINED IN PHASE 1 ABOVE (SEE NOTE 4).
7. DURING PHASE 2B THE BRIDGE WILL BE POSITIONED OVER SILO 2. BOTH THE RCS SUPPLY AND SUCTION DUCTS FROM SILO 2 WILL BE CONNECTED TO RIGID DUCTING, MOUNTED ON THE BRIDGE, BY MEANS OF A SHORT PIECE OF FLEXIBLE DUCTING. THE SUPPLY AND SUCTION DUCTING WILL BE ROUTED ON THE NEW BRIDGE AND CONNECTED TO THE RCS DUCTING ON THE PIPE RACK WITH A PIECE OF FLEXIBLE DUCTING. THE PRESSURE RELIEF DUCTING FROM SILO 2 WILL BE CONNECTED TO RIGID DUCTING, MOUNTED ON THE BRIDGE, BY MEANS OF A SHORT PIECE OF FLEXIBLE DUCTING.

   APPROPRIATE DAMPERS USED FOR SILO 1 VENTILATION DURING PHASE 2A WILL BE SHUT AND LOCKED CLOSED. EACH UNUSED DUCT WILL BE BLIND FLANGED TO PROVIDE ADDITIONAL SEALING.

   THE SUPPLY, SUCTION, AND PRESSURE RELIEF DUCTING WILL BE ROUTED ON THE NEW BRIDGE AND CONNECTED TO THE RCS DUCTING ON THE PIPE RACK (SEE CONECTION POINTS 3, 4, & 6 ON DRAWINGS 20FMD004 AND 20FMD013).
8. ALL RCS DUCTING DURING PHASES 2A & 2B WILL BE SLOPED TO THE TTA BUILDING.
9. SILO RCS SYSTEM WILL BE DISCONNECTED AND DWRS SYSTEM WILL BE CONNECTED (SEE CONNECTION POINT 5 ON DRAWINGS 20FMD004 AND 20FMD013). FLEX DUCT WILL BE REUSED FROM PREVIOUS OPERATIONS. EXISTING VALVES AND DAMPERS WILL BE USED TO ISOLATE ANY UNUSED CONNECTIONS TO THE RCS. BLIND FLANGES WILL COVER UNUSED CONNECTIONS.

REFERENCE DRAWINGS:

05FMD001	PIPING & INSTRUMENT DIAGRAM – INSTRUMENT IDENTIFICATION
05FMD002	PIPING & INSTRUMENT DIAGRAM – CONTROL SYSTEM STANDARDS
05FMD003	PIPING & INSTRUMENT DIAGRAM – PIPING & EQUIPMENT IDENTIFICATION

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	APRV'D	DESCRIPTION/ISSUE
1	01/01/00	BJD	JLH	DSF	CERTIFIED FOR CONSTRUCTION
0	11/01/99	BJD	KR		PRELIMINARY DESIGN SUBMITTAL

KENNETH D. RICKETT REGISTERED PROFESSIONAL ENGINEER NO. 103748 STATE OF TENNESSEE 01/07/00

		DATE
DRAWN BY	B.J. Davis	01/07/00
DESIGNED BY	B.J. Davis	01/07/00
CHECKED BY	J.L. Hunt	01/07/00
APPROVED BY	Kenneth Rickett	01/07/00
APPROVED BY	Don Dawson	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	1

000234

FILENAME: 20FMD003.DWG

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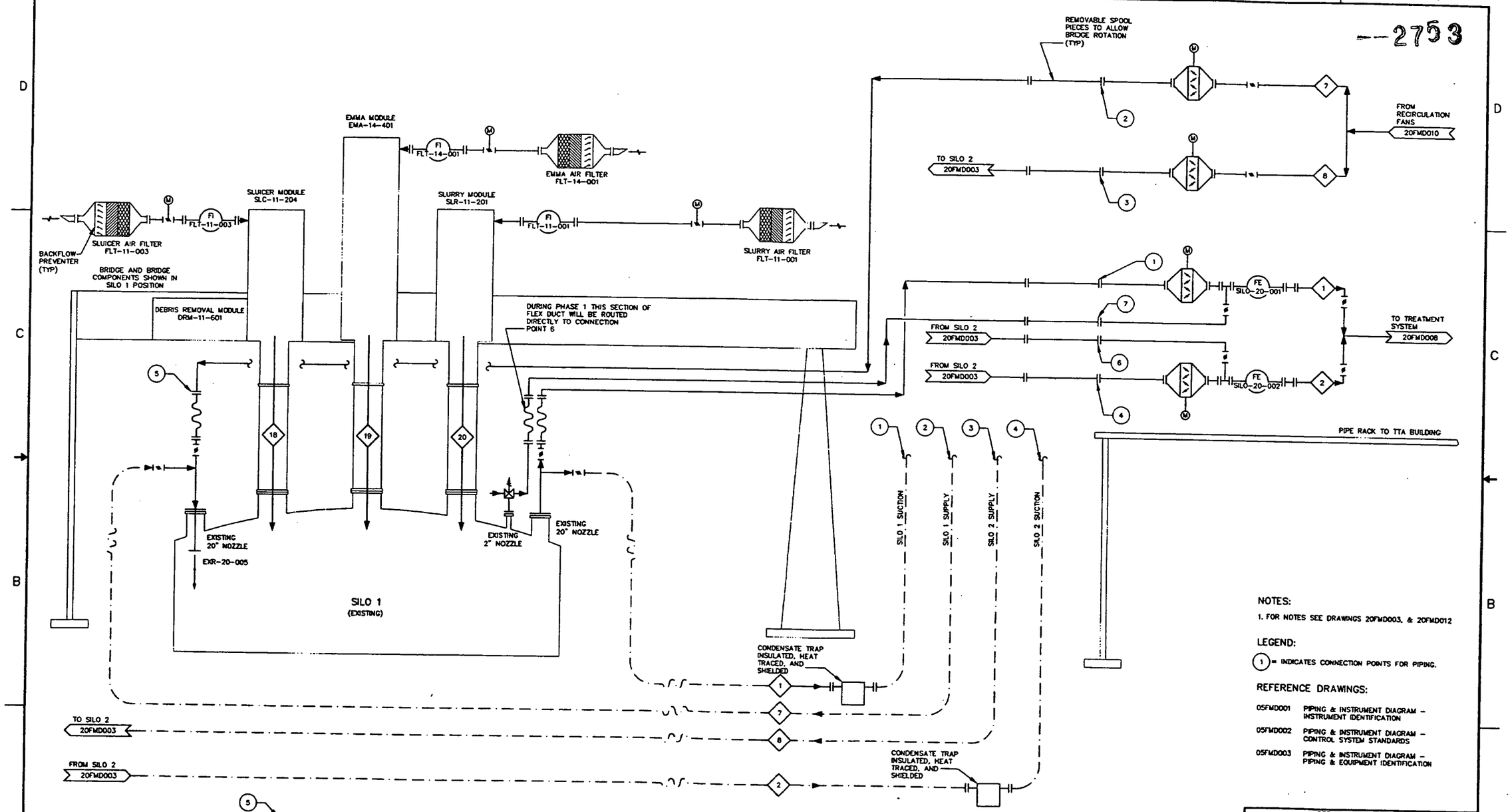

2753

NOTES:

1. FOR NOTES SEE DRAWINGS 20FMD003, & 20FMD012

LEGEND:

(1) = INDICATES CONNECTION POINTS FOR PIPING.

REFERENCE DRAWINGS:

05FMD001 PIPING & INSTRUMENT DIAGRAM – INSTRUMENT IDENTIFICATION

05FMD002 PIPING & INSTRUMENT DIAGRAM – CONTROL SYSTEM STANDARDS

05FMD003 PIPING & INSTRUMENT DIAGRAM – PIPING & EQUIPMENT IDENTIFICATION

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
1	01/07/00	BJD	KR	KDR	CERTIFIED FOR CONSTRUCTION
0	11/01/99	BJD	KR		PRELIMINARY DESIGN SUBMITTAL

KENNETH D. RICHARDS REGISTERED PROFESSIONAL ENGINEER AMERICAN TRUST NO. 103742 STATE OF TENNESSEE

		DATE
DRAWN BY	B.D. Davis	01/07/00
DESIGNED BY	B.D. Davis	01/07/00
CHECKED BY	S.W. Hunter	01/07/00
APPROVED BY	Kenneth D. Richards	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
SILO 1

SIZE	SCALE:	DWG. NO.	REV
D	NONE	20FMD004	1

000235

FILENAME: 20FMD004.DWG

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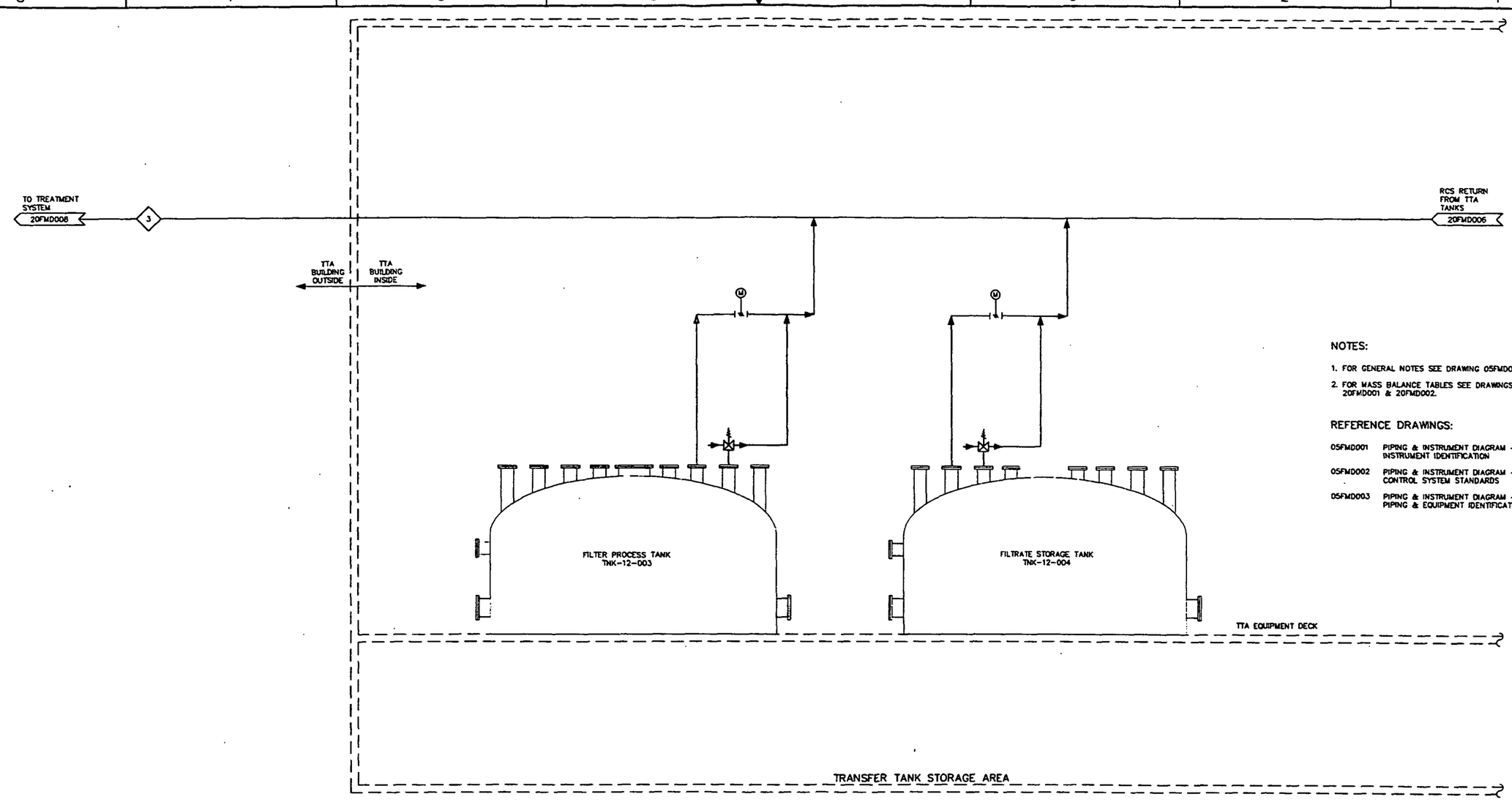

NOTES:

1. FOR GENERAL NOTES SEE DRAWING 05FMD004.
2. FOR MASS BALANCE TABLES SEE DRAWINGS 20FMD001 & 20FMD002.

REFERENCE DRAWINGS:

05FMD001 PIPING & INSTRUMENT DIAGRAM – INSTRUMENT IDENTIFICATION

05FMD002 PIPING & INSTRUMENT DIAGRAM – CONTROL SYSTEM STANDARDS

05FMD003 PIPING & INSTRUMENT DIAGRAM – PIPING & EQUIPMENT IDENTIFICATION

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
1	[illegible]	BJD	JLH	KRR	CERTIFIED FOR CONSTRUCTION
0	11/01/99	BJD	KR		PRELIMINARY DESIGN SUBMITTAL

KENNETH D. RICKETTS PROFESSIONAL ENGINEER No. 105742 STATE OF TENNESSEE

		DATE
DRAWN BY	B.J. Davis	01/07/00
DESIGNED BY	B.J. Davis	01/07/00
CHECKED BY	J.L. Hemphill	01/07/00
APPROVED BY	Kenneth Ricketts	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
FILTER & FILTRATE STORAGE TNKS

SIZE	SCALE:	DWG. NO.	REV
D	NONE	20FMD005	1

FILENAME: 20FMD005.DWG

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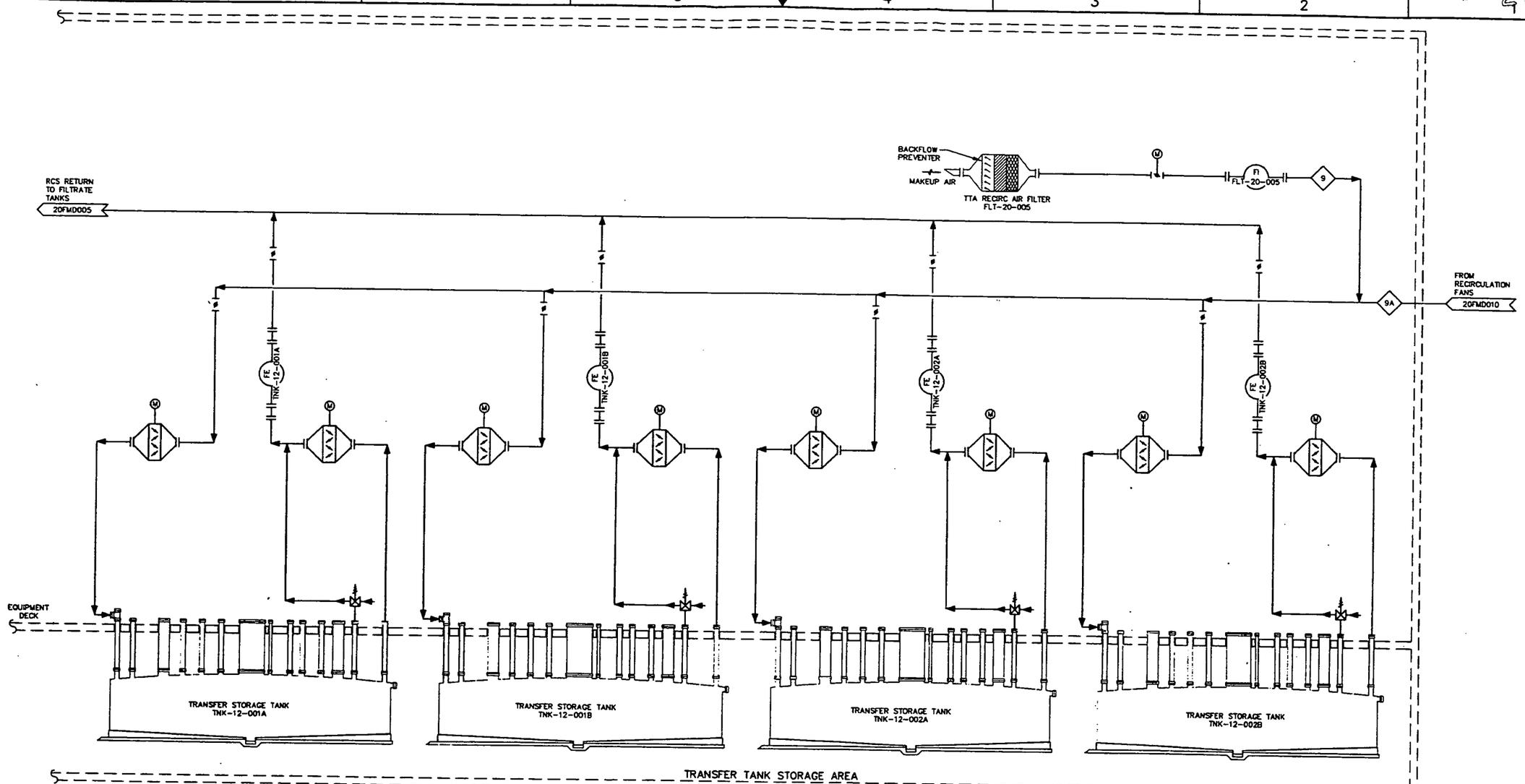

NOTES:

1. FOR GENERAL NOTES SEE DRAWING 05FMD004.
2. FOR MASS BALANCE TABLES SEE DRAWINGS 20FMD001 & 20FMD002.

REFERENCE DRAWINGS:

05FMD001 PIPING & INSTRUMENT DIAGRAM – INSTRUMENT IDENTIFICATION

05FMD002 PIPING & INSTRUMENT DIAGRAM – CONTROL SYSTEM STANDARDS

05FMD003 PIPING & INSTRUMENT DIAGRAM – PIPING & EQUIPMENT IDENTIFICATION

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
1	[illegible]	[illegible]	[illegible]	[illegible]	CERTIFIED FOR CONSTRUCTION
0	11/01/99	BJD	KR		PRELIMINARY DESIGN SUBMITTAL

KENNETH D. RICKETTS PROFESSIONAL ENGINEER REGISTERED ENVIRONMENTAL PROFESSIONAL NO. 103742 STATE OF TENNESSEE 01/07/00

DRAWN BY [illegible] DATE 01/07/00
DESIGNED BY [illegible] DATE 01/07/00
CHECKED BY [illegible] DATE 01/07/00
APPROVED BY [illegible] DATE 01/07/00
APPROVED BY [illegible] 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
TTA STORAGE TANKS

SIZE D | SCALE: NONE | DWG. NO. 20FMD006 | REV 1

FILENAME: 20FMD006.DWG

000237

2753

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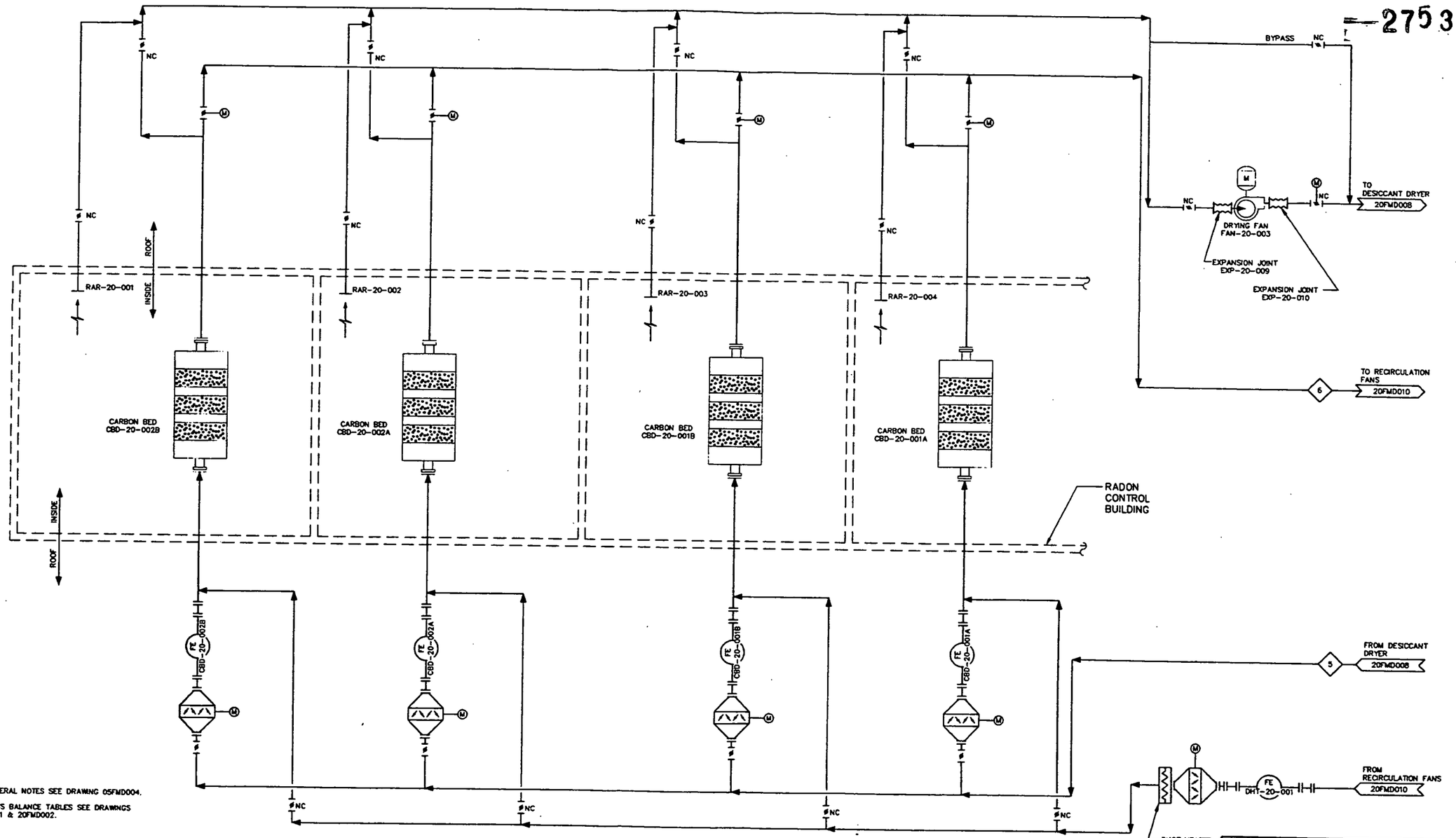

NOTES:

1. FOR GENERAL NOTES SEE DRAWING 05FMD004.
2. FOR MASS BALANCE TABLES SEE DRAWINGS 20FMD001 & 20FMD002.

REFERENCE DRAWINGS:

05FMD001 PIPING & INSTRUMENT DIAGRAM – INSTRUMENT IDENTIFICATION

05FMD002 PIPING & INSTRUMENT DIAGRAM – CONTROL SYSTEM STANDARDS

05FMD003 PIPING & INSTRUMENT DIAGRAM – PIPING & EQUIPMENT IDENTIFICATION

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
1	01/07/00	BJD	JLH	KDR	CERTIFIED FOR CONSTRUCTION
0	11/01/99	BJD	KR		PRELIMINARY DESIGN SUBMITTAL

KENNETH D. RICHARDS, REGISTERED PROFESSIONAL ENGINEER, No. 103745, STATE OF TENNESSEE

		DATE
DRAWN BY		01/07/00
DESIGNED BY		01/07/00
CHECKED BY		01/07/00
APPROVED BY		01/07/00
APPROVED BY		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	1

FILENAME: 20FMD007.DWG

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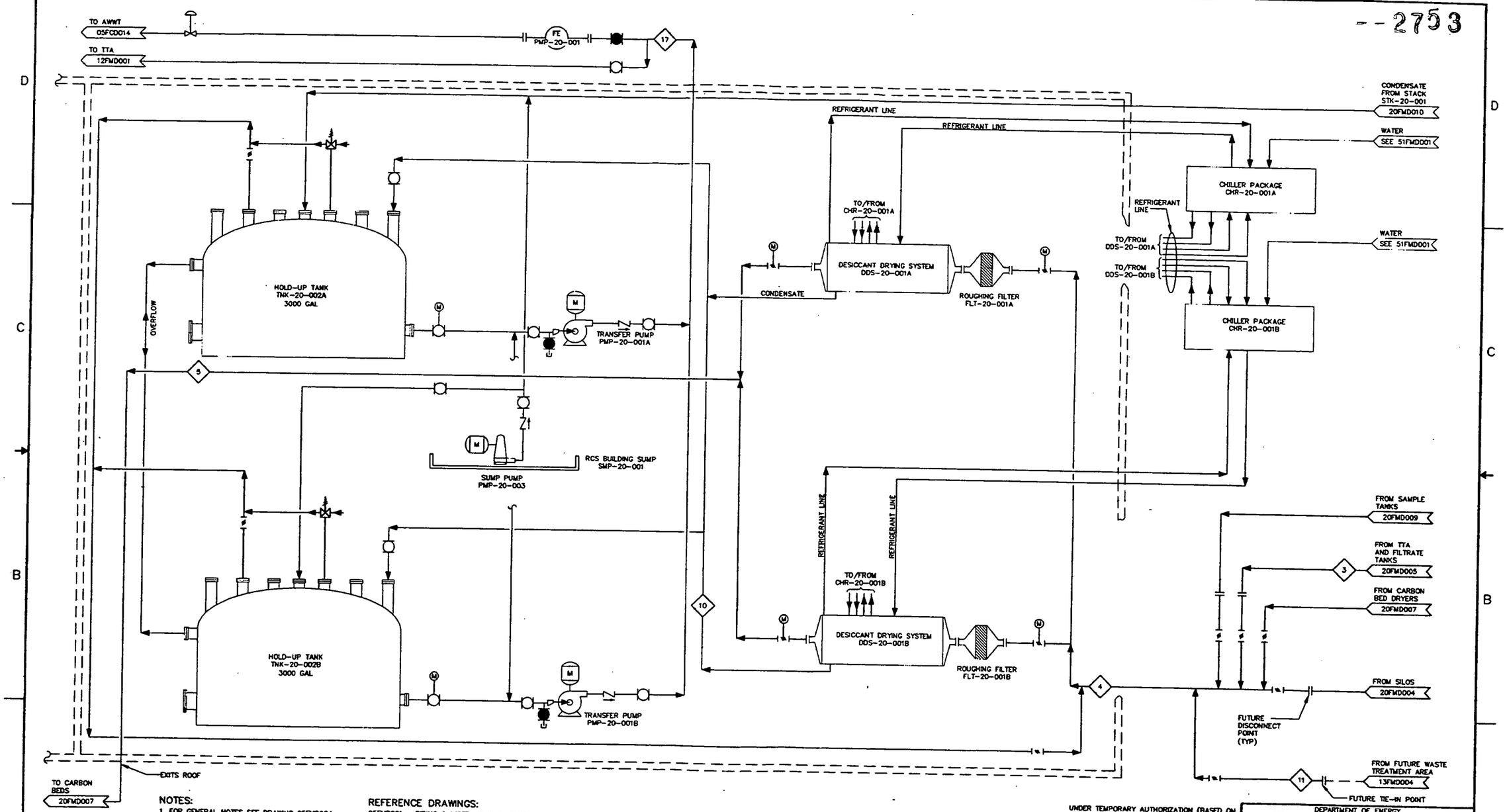
000238



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 PIPING & INSTRUMENT DIAGRAM – INSTRUMENT IDENTIFICATION

05FMD002 PIPING & INSTRUMENT DIAGRAM – CONTROL SYSTEM STANDARDS

05FMD003 PIPING & INSTRUMENT DIAGRAM – PIPING & EQUIPMENT IDENTIFICATION

REV	DATE	BY	CHK'D	APRV'D	DESCRIPTION/ISSUE
1	01/07/00	MJP	JWA	KJR	CERTIFIED FOR CONSTRUCTION
0	11/09/99	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.

KENNETH D. RIOPELLE PROFESSIONAL ENGINEER REGISTRATION NO. 107242 STATE OF TENNESSEE

DRAWN BY 01/07/00
DESIGNED BY 01/07/00
CHECKED BY 01/07/00
APPROVED BY 01/07/00
APPROVED BY 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
AIR HANDLING & CONDENSATE

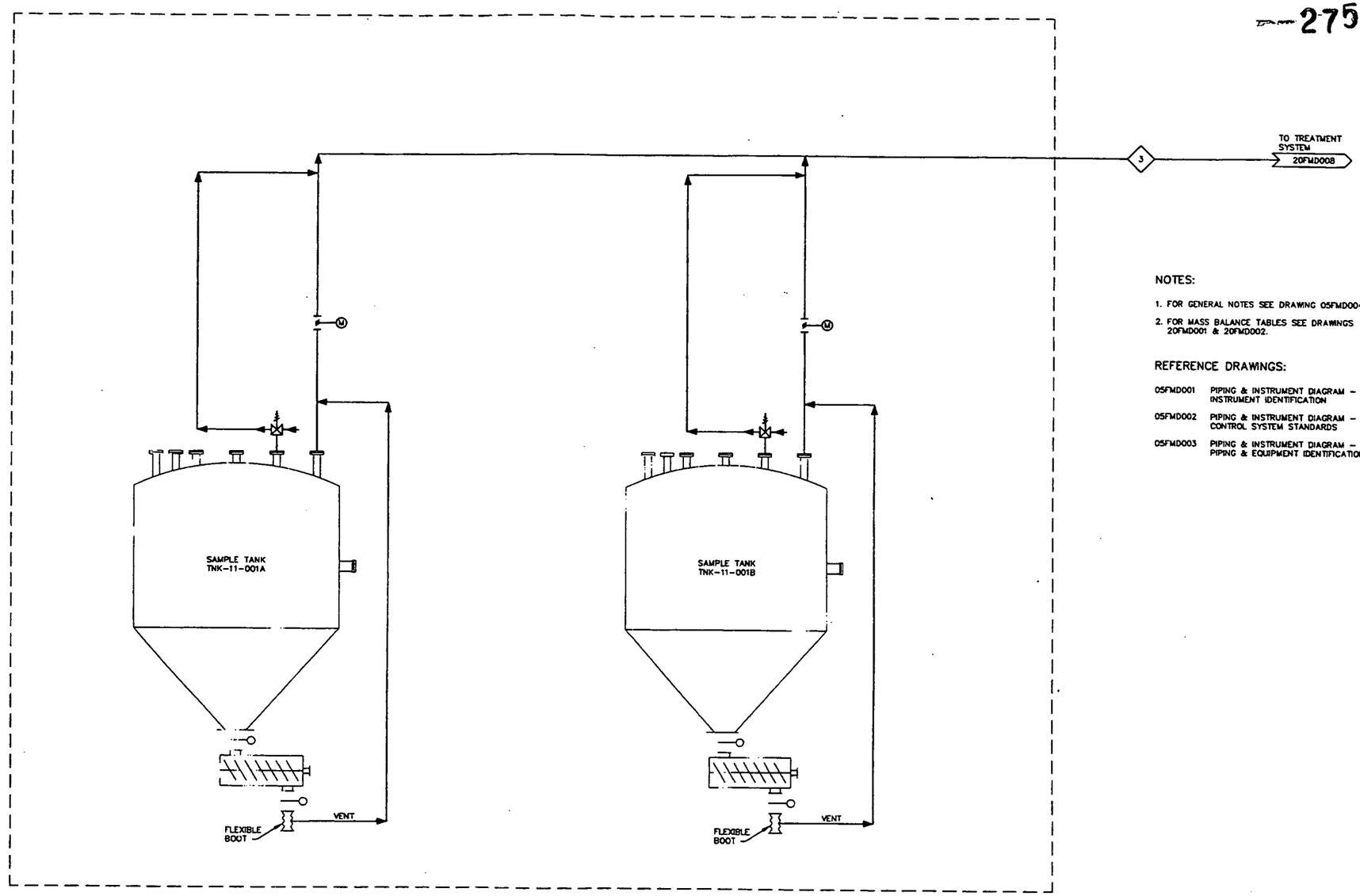
SIZE D | SCALE: NONE | DWG. NO. 20FMD008 | REV 1

FILENAME: 20FMD008.DWG

000239

G:\DRAFTING\FILES\SILOS\20FMD008.dwg Thu Jan 06 21:02:38 2000

2753



SAMPLE PREPARATION & STORAGE AREA

NOTES:

1. FOR GENERAL NOTES SEE DRAWING 05FMD004.
2. FOR MASS BALANCE TABLES SEE DRAWINGS 20FMD001 & 20FMD002.

REFERENCE DRAWINGS:

05FMD001	PIPING & INSTRUMENT DIAGRAM – INSTRUMENT IDENTIFICATION
05FMD002	PIPING & INSTRUMENT DIAGRAM – CONTROL SYSTEM STANDARDS
05FMD003	PIPING & INSTRUMENT DIAGRAM – PIPING & EQUIPMENT IDENTIFICATION

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	APRV'D	DESCRIPTION/ISSUE
1	01/07/00	BJD	KR		CERTIFIED FOR CONSTRUCTION
0	11/01/99	BJD	KR		PRELIMINARY DESIGN SUBMITTAL

KENNETH D. RICKS — PROFESSIONAL ENGINEER — REGISTERED — No. 102742 — STATE OF TENNESSEE

DRAWN BY	B.J. Davis	DATE 01/07/00
DESIGNED BY	B.J. Davis	DATE 01/07/00
CHECKED BY	[illegible]	DATE 01/07/00
APPROVED BY	Kenneth Ricks	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
SAMPLE TANKS

SIZE	SCALE:	DWG. NO.	REV
D	NONE	20FMD009	1

000240 1 FILENAME: 20FMD009.DWG

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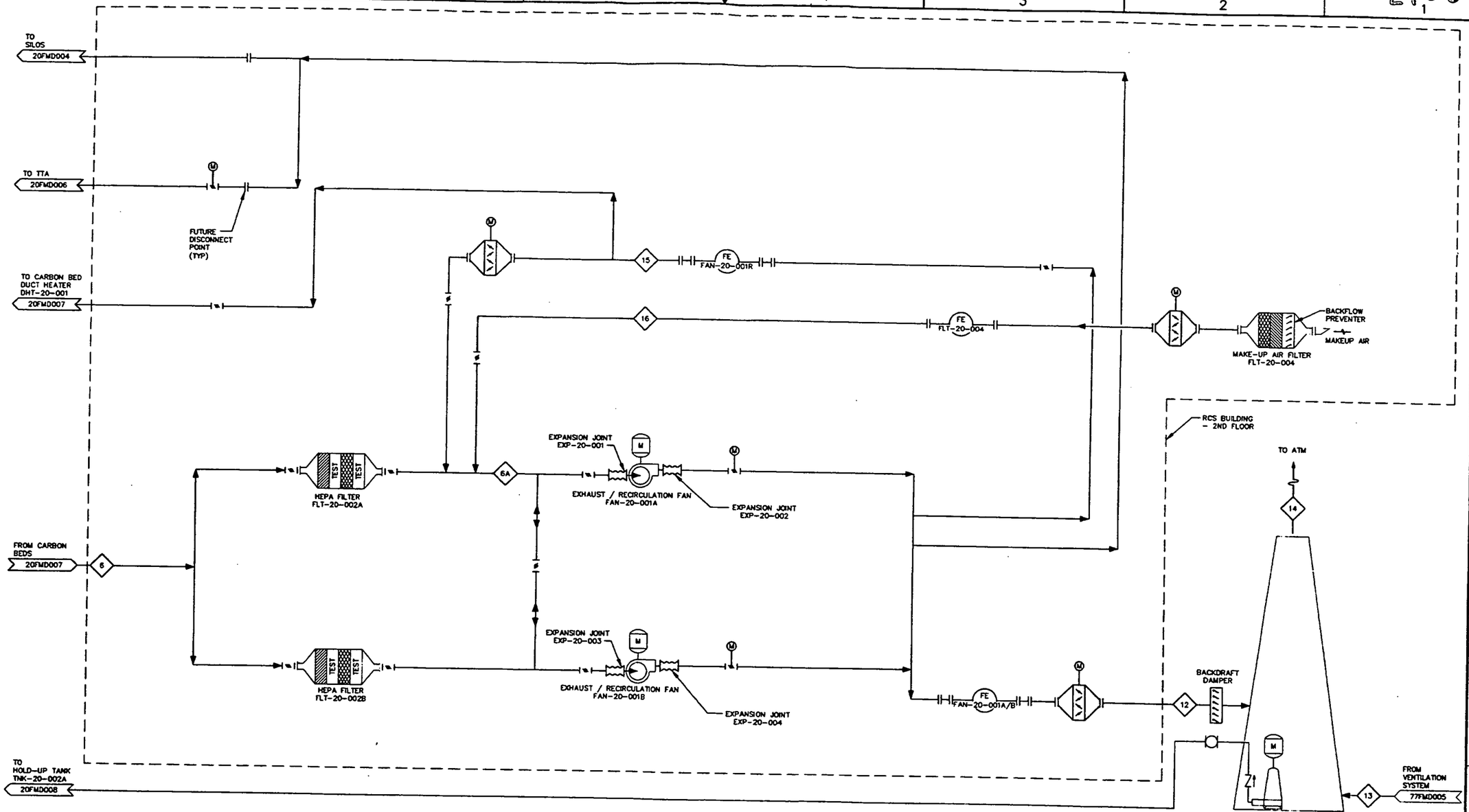


NOTES:

1. FOR GENERAL NOTES SEE DRAWING 05FMD004.
2. FOR MASS BALANCE TABLES SEE DRAWINGS 20FMD001 & 20FMD002.

REFERENCE DRAWINGS:

05FMD001	PIPING & INSTRUMENT DIAGRAM – INSTRUMENT IDENTIFICATION
05FMD002	PIPING & INSTRUMENT DIAGRAM – CONTROL SYSTEM STANDARDS
05FMD003	PIPING & INSTRUMENT DIAGRAM – PIPING & EQUIPMENT IDENTIFICATION

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
1	[illegible]	[illegible]	[illegible]	KR	CERTIFIED FOR CONSTRUCTION
0	11/01/99	BJD	KR		PRELIMINARY DESIGN SUBMITTAL

KENNETH D. PROSSITT — REGISTERED ENGINEER — STATE OF TENNESSEE

DRAWN BY	01/07/00
DESIGNED BY	01/07/00
CHECKED BY	01/07/00
APPROVED BY	01/07/00
APPROVED BY	01/07/00

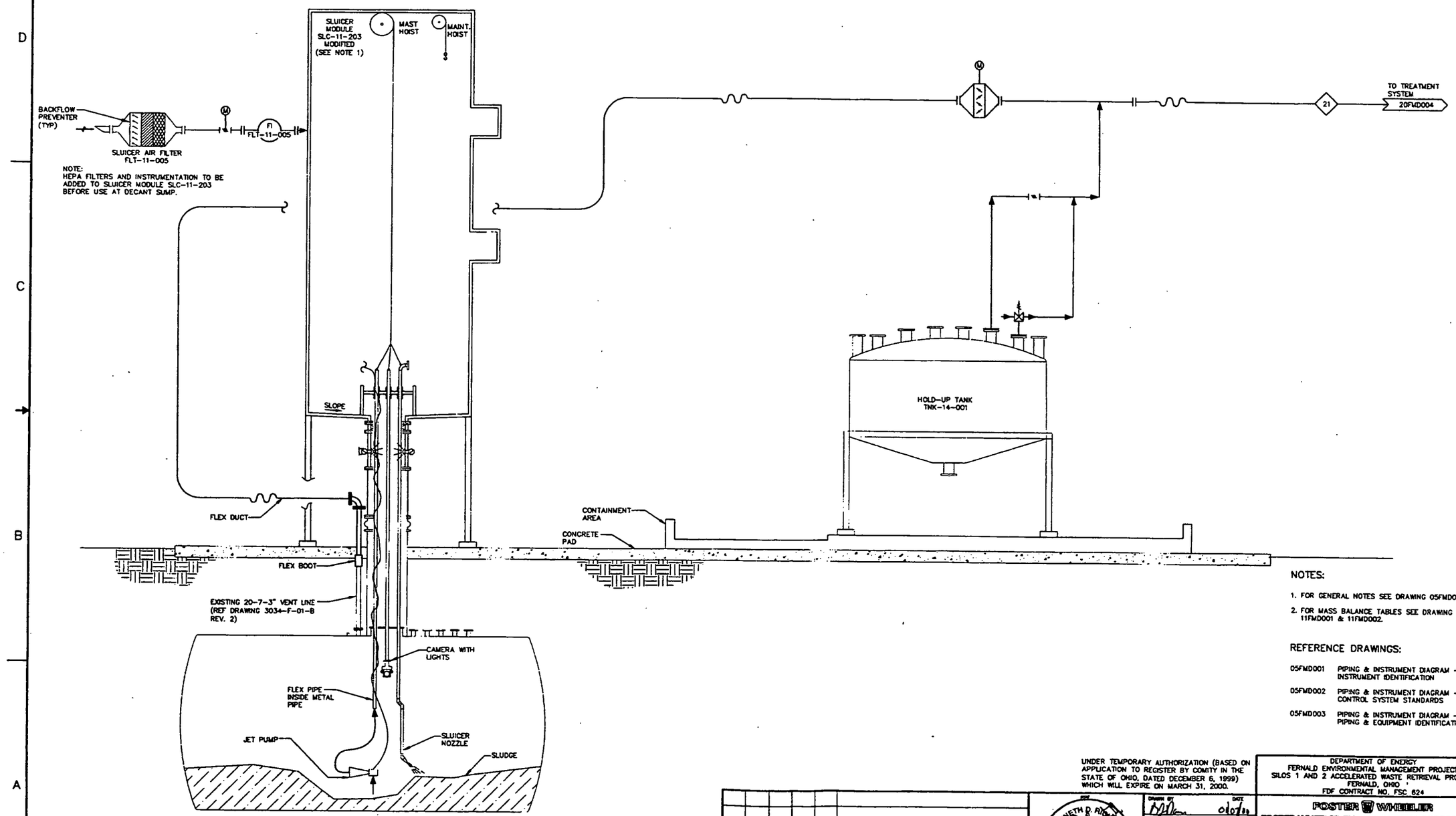
DEPARTMENT OF ENERGY
FERNALD ENVIRONMENTAL MANAGEMENT PROJECT
SILOS 1 AND 2 ACCELERATED WASTE RETRIEVAL PROJECT
FERNALD, OHIO
FDF CONTRACT NO. FSC 624

FOSTER WHEELER
FOSTER WHEELER ENVIRONMENTAL CORPORATION

TITLE
RADON CONTROL SYSTEM
PROCESS FLOW DIAGRAM
EXHAUST & RECIRC FANS

SIZE	SCALE:	DWG. NO.	REV
D	NONE	20FMD010	1

G:\DRAFE\FDFS\LOS\WES\STS20\20fmd010.dwg Thu Jan 06 21:06:01 2000



NOTES:

1. FOR GENERAL NOTES SEE DRAWING 05FMD004.
2. FOR MASS BALANCE TABLES SEE DRAWING 11FMD001 & 11FMD002.

REFERENCE DRAWINGS:

05FMD001	PIPING & INSTRUMENT DIAGRAM – INSTRUMENT IDENTIFICATION
05FMD002	PIPING & INSTRUMENT DIAGRAM – CONTROL SYSTEM STANDARDS
05FMD003	PIPING & INSTRUMENT DIAGRAM – PIPING & EQUIPMENT IDENTIFICATION

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
1	01/07/00	MJ	KR	KDR	CERTIFIED FOR CONSTRUCTION
0	11/01/99	BJD	KR		PRELIMINARY DESIGN SUBMITTAL

KENNETH D. RIGGETTO — REGISTERED PROFESSIONAL ENGINEER — STATE OF TENNESSEE — No. 103743

DRAWN BY	DATE 01/07/00
DESIGNED BY	DATE 01/07/00
CHECKED BY	DATE 01/07/00
APPROVED BY	DATE 01/07/00
APPROVED BY	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	SCALE:	DWG. NO.	REV
D	NONE	20FMD011	1

000242

FILENAME: 20FMD011.DWG

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2703

NOTES:

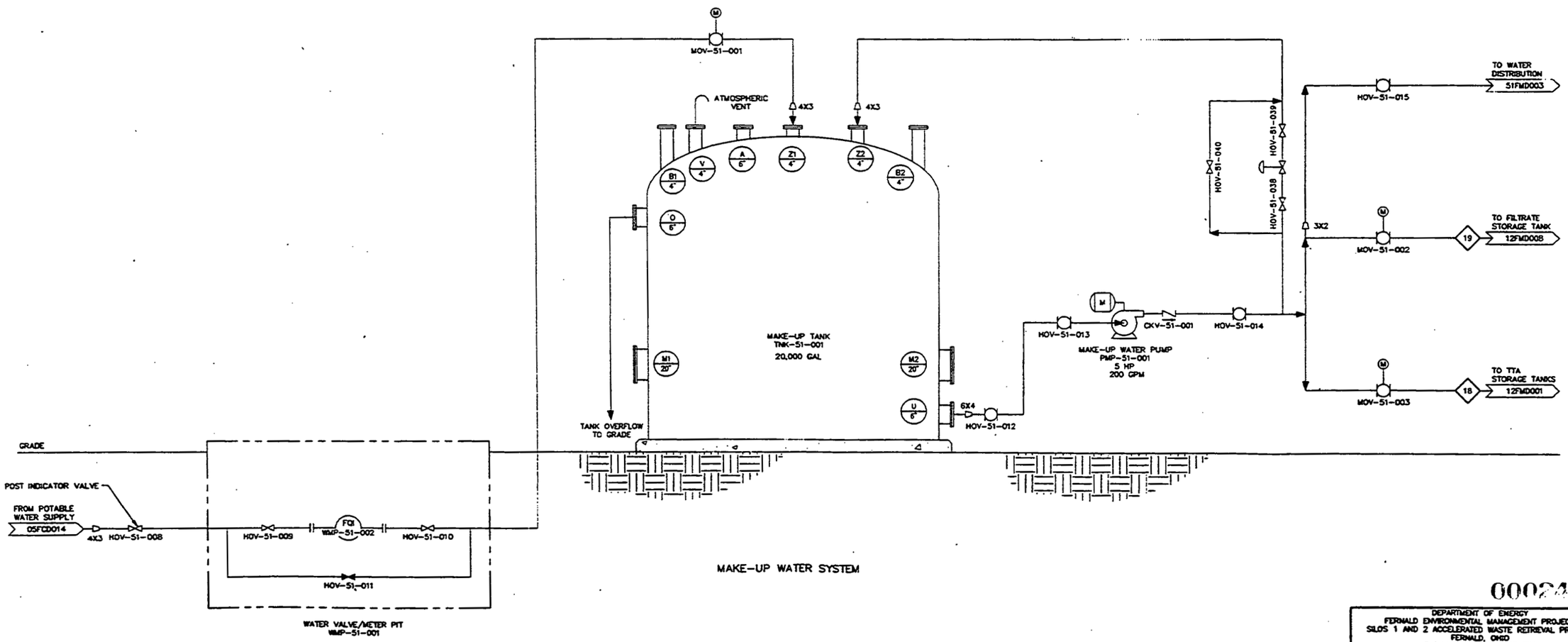
1. FOR GENERAL NOTES SEE DRAWING 05FMD004.
2. FOR MASS BALANCE TABLES SEE DRAWING 11FMD001 & 11FMD002.

REFERENCE DRAWINGS:

05FMD001 PIPING & INSTRUMENT DIAGRAM – INSTRUMENT IDENTIFICATION

05FMD002 PIPING & INSTRUMENT DIAGRAM – CONTROL SYSTEM STANDARDS

05FMD003 PIPING & INSTRUMENT DIAGRAM – PIPING & EQUIPMENT IDENTIFICATION



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PRELIMINARY
NOT FOR CONSTRUCTION

REV	DATE	BY	CHK'D	APR'VD	DESCRIPTION/ISSUE
0	11/1/99	BPD			PRELIMINARY DESIGN PACKAGE

BPC

DRAWN BY BPDan DATE 11/01/99
DESIGNED BY BPDan DATE 11/01/99
CHECKED BY DATE 11/1/99
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
POTABLE/DOMESTIC WATER SYS
PROCESS FLOW DIAGRAM
MAKE-UP WATER

SIZE D | SCALE: NONE | DWG. NO. 51FMD001 | REV 0

FILENAME: 51FMD001.DWG

G:\DWGS\FDF511\51FMD001.dwg Tue Oct 26 23:30:23 1999

Heat and Material Balances

—2753

FOSTER WHEELER

FOSTER WHEELER ENVIRONMENTAL CORPORATION

HEAT AND MATERIAL BALANCES FOR ALL SYSTEMS

DOCUMENT NO.
624-P622-06, Rev. 1

FOR THE

SILOS 1 AND 2 ACCELERATED WASTE RETRIEVAL (AWR) PROJECT

SUBMITTED TO:
FLUOR DANIEL FERNALD (FDF)
CONTRACT NO. FSC 624

January 7, 2000

000244

FOSTER WHEELER ENVIRONMENTAL CORPORATION

Heat and Material Balances for All Systems

Revision 1

Recommended by:

John Lawson
Foster Wheeler Engineering Manager

1/7/00
Date

Approved by:

Ed S
Foster Wheeler Project Manager

1-7-00
Date

000245

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	1
10FMD006	FULL-SCALE MOCKUP SYSTEM PROCESS FLOW DIAGRAM MASS BALANCE TABLE	1
11FMD001	SILO WASTE RETRIEVAL SYSTEM PROCESS FLOW DIAGRAM MASS BALANCE TABLE - SHT 1	1
11FMD002	SILO WASTE RETRIEVAL SYSTEM PROCESS FLOW DIAGRAM MASS BALANCE TABLE - SHT 2	1
13FMD001	TRANSFER TANK WASTE RETRIEVAL PROCESS FLOW DIAGRAM MASS BALANCE TABLE	1
14FMD001	DECANT SUMP RETRIEVAL SYSTEM PROCESS FLOW DIAGRAM MASS BALANCE TABLE	1
20FMD001	RADON CONTROL SYSTEM PROCESS FLOW DIAGRAM MASS BALANCE TABLES – SHT 1	1
20FMD002	RADON CONTROL SYSTEM PROCESS FLOW DIAGRAM MASS BALANCE TABLES – SHT 2	1

"Drawings are duplicates of previous section: "PROCESS FLOW DIAGRAMS."

000246

—2753

General Arrangement Drawings

—2753

FOSTER WHEELER

FOSTER WHEELER ENVIRONMENTAL CORPORATION

GENERAL ARRANGEMENT DRAWINGS

DOCUMENT NO.
624-P622-12, Rev. 2

FOR THE

SILOS 1 AND 2 ACCELERATED WASTE RETRIEVAL (AWR) PROJECT

SUBMITTED TO:
FLUOR DANIEL FERNALD (FDF)
CONTRACT NO. FSC 624

January 7, 2000

000247

FOSTER WHEELER ENVIRONMENTAL CORPORATION

GENERAL ARRANGEMENT DRAWINGS

Revision 2

Recommended by:

John Lawson

Foster Wheeler Engineering Manager

1/7/00

Date

Approved by:

Foster Wheeler Project Manager

1-7-00

Date

000248

GENERAL ARRANGEMENT DRAWINGS—2753

DOCUMENT NO. 624-P622-12

For information regarding General Arrangement Drawings, please see the following drawings:

DRAWING NUMBER	DRAWING TITLE	REVISION
05FMD010	MISC. FACILITIES GENERAL ARRANGEMENT KEY PLAN	2
10FMD017	FULL-SCALE MOCKUP SYSTEM GENERAL ARRANGEMENT SHEET 1 OF 2	2
10FMD018	FULL-SCALE MOCKUP SYSTEM SECTION SHEET 2 OF 2	2
11FMD019	SILO WASTE RETRIEVAL SYSTEM GENERAL ARRANGEMENT SILO 1 & 2 BRIDGE	2
11FMD020	SILO WASTE RETRIEVAL SYSTEM GENERAL ARRANGEMENT SILO 1 & 2 BRIDGE	2
11FMD025	SILO WASTE RETRIEVAL SYSTEM GENERAL ARRANGEMENT SAMPLE BUILDING	1
11FMD026	SILO WASTE RETRIEVAL SYSTEM SECTIONS & DETAILS SAMPLE BUILDING	1

Rev. 2

000249

GENERAL ARRANGEMENT DRAWINGS 2753

DOCUMENT NO. 624-P622-12

DRAWING NUMBER	DRAWING TITLE	REVISION
12FMD021	TRANSFER TANK SYSTEM GENERAL ARRANGEMENT SHEET 1 OF 6	1
12FMD022	TRANSFER TANK SYSTEM GENERAL ARRANGEMENT SHEET 2 OF 6	1
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	1
14FMD006	DECANT WASTE RETRIEVAL SYSTEM GENERAL ARRANGEMENT SHEET 1 0F 2	2
14FMD007	DECANT WASTE RETRIEVAL SYSTEM GENERAL ARRANGEMENT SHEET 2 0F 2	2

Rev. 2

000250

GENERAL ARRANGEMENT DRAWINGS

2753

DOCUMENT NO. 624-P622-12

DRAWING NUMBER	DRAWING TITLE	REVISION
20FMD027	RADON CONTROL SYSTEM GENERAL ARRANGEMENT 1st FLOOR	1
20FMD028	RADON CONTROL SYSTEM GENERAL ARRANGEMENT 2ND FLOOR	1
20FMD029	RADON CONTROL SYSTEM GENERAL ARRANGEMENT SECTIONS & DETAILS	1

Rev. 2

000251

F-2753

STATE OF OHIO NORTH (NAD 83)

N 481000

N 480800

N 480600

N 480400

N 480200

E 1346900

E 1347000

E 1347200

E 1347400

E 1347600

E 1347800

2ND STREET

PIPE RACK

SEE DRAWING 10FMD017 FULL-SCALE MOCKUP SYSTEM GENERAL ARRANGEMENT

SEE DRAWING 11FMD019 SILO WASTE RETRIEVAL SYSTEM GENERAL ARRANGEMENT

STORAGE TRAILER T-412

STORAGE TRAILER T-411

CONTROL TRAILER T-410

EXIST. PUMP PIT

AIR COMPRESSOR

MAKEUP WATER STORAGE TANK & PUMP

ELECTRICAL EQUIPMENT BUILDING 94G

SEE DRAWING 14FMD006 DECANT WASTE RETRIEVAL SYSTEM GENERAL ARRANGEMENT

EXIST. DECANT TANK

EMPTY DRUM STAGING AREA SEE DRAWING 12FMD021 TRANSFER TANK AREA SYSTEM GENERAL ARRANGEMENT

SAMPLE PREP & STORAGE BUILDING 94F SEE DRAWING 11FMD025 SILO WASTE RETRIEVAL SYSTEM GENERAL ARRANGEMENT

RADON CONTROL SYSTEM AIR HANDLING BUILDING 94E SEE DRAWING 20FMD027 RADON CONTROL SYSTEM GENERAL ARRANGEMENT

TRANSFER TANK AREA BUILDING 94C SEE DRAWING 12FMD021 TRANSFER TANK AREA SYSTEM GENERAL ARRANGEMENT

RADON CONTROL SYSTEM CARBON BED BUILDING 94D SEE DRAWING 20FMD027 RADON CONTROL SYSTEM GENERAL ARRANGEMENT

000252

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
2	01/07/00	WCB	SWH		CERTIFIED FOR CONSTRUCTION
1	12/01/99	WCB	SWH		REVISED FOR NOZZLE LOCATIONS
0	11/99	WCB	SWH		PRELIMINARY DESIGN SUBMITTAL

KENNETH D. RICKETT PROFESSIONAL ENGINEER REGISTRATION NO. 103744 STATE OF TENNESSEE

DRAWN BY: WC Blair DATE: 01/07/00
DESIGNED BY: WC Blair DATE: 01/07/00
CHECKED BY: SW Hunt DATE: 01/07/00
APPROVED BY: Kenneth D. Rickett DATE: 01/07/00
APPROVED BY: John Swanson 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: MISC FACILITIES GENERAL ARRANGEMENT KEY PLAN

SIZE: D | SCALE: 1"=60'-0" | DWG. NO. 05FMD010 | REV 2

FILENAME: 05FMD010.DWG

2ND DRAWING: 00-05-FOP.DWG 05FMD010

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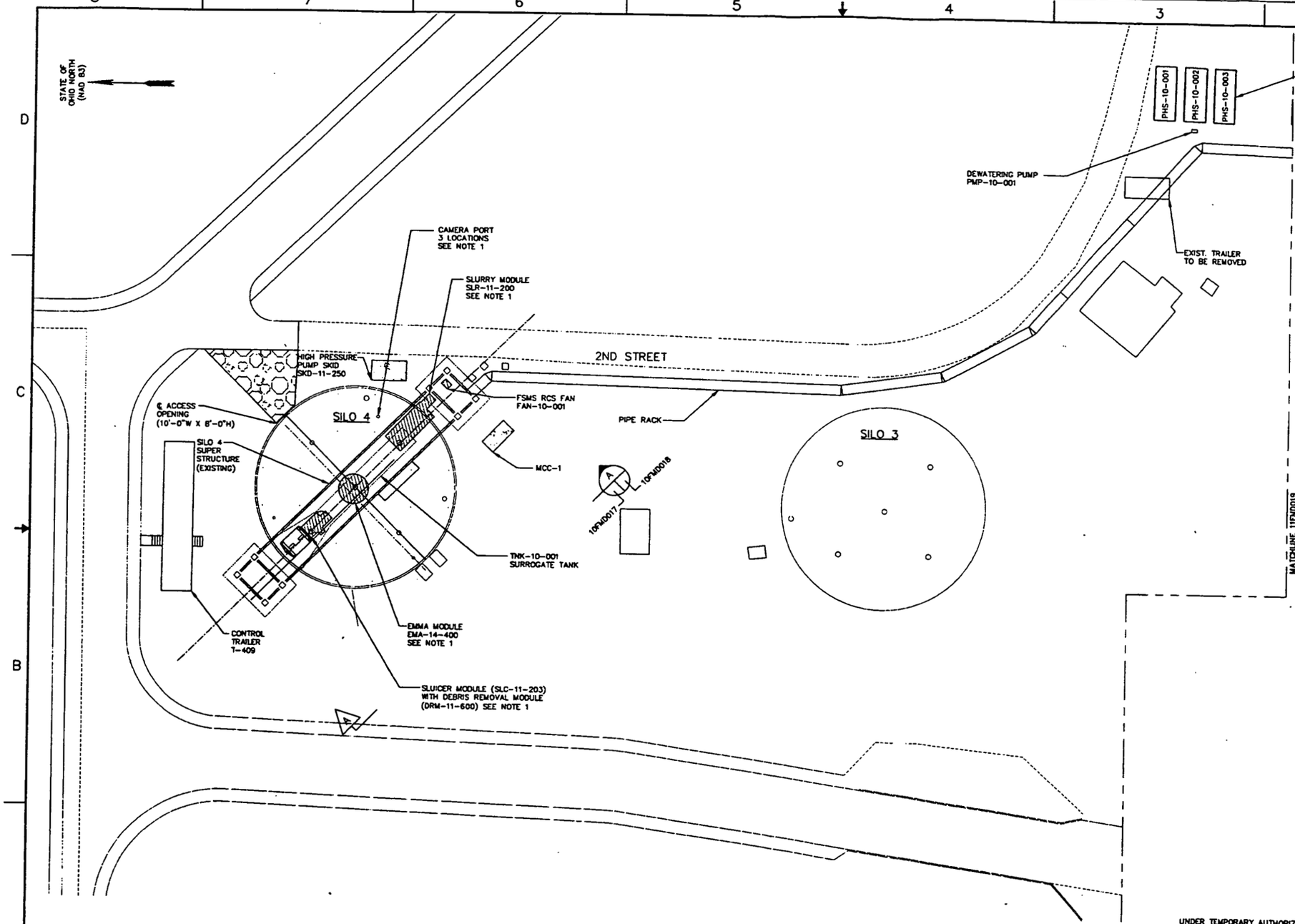

-2703

NOTES:

1. FOR RISER DETAILS, SEE SILO PENETRATION AND RISER INSTALLATION PLAN, DOCUMENT NO. 624-P622-63

REFERENCE DRAWINGS:

05FMD010 GENERAL ARRANGEMENT KEY PLAN

000253

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

REV	DATE	BY	CHK'D	APR'VD	DESCRIPTION/ISSUE
2	01/07/00				CERTIFIED FOR CONSTRUCTION
1	12/01/99	WCB	SWH		REVISED FOR NOZZLE LOCATIONS
0	11/99	WCB	RAR		PRELIMINARY DESIGN SUBMITTAL

KENNETH D. RICHARDS, REGISTERED PROFESSIONAL ENGINEER, NO. 103744, STATE OF TENNESSEE

DRAWN BY: 01/07/00
DESIGNED BY: 01/07/00
CHECKED BY: 01/07/00
APPROVED BY: 01/07/00
APPROVED BY: 01/07/00

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

FOSTER WHEELER
FOSTER WHEELER ENVIRONMENTAL CORPORATION

TITLE
FULL-SCALE MOCKUP SYSTEM
GENERAL ARRANGEMENT
SHEET 1 OF 2

SIZE: D | SCALE: 1"=20'-0" | DWG. NO. 10FMD017 | REV 2

FILENAME: 10FMD017.DWG

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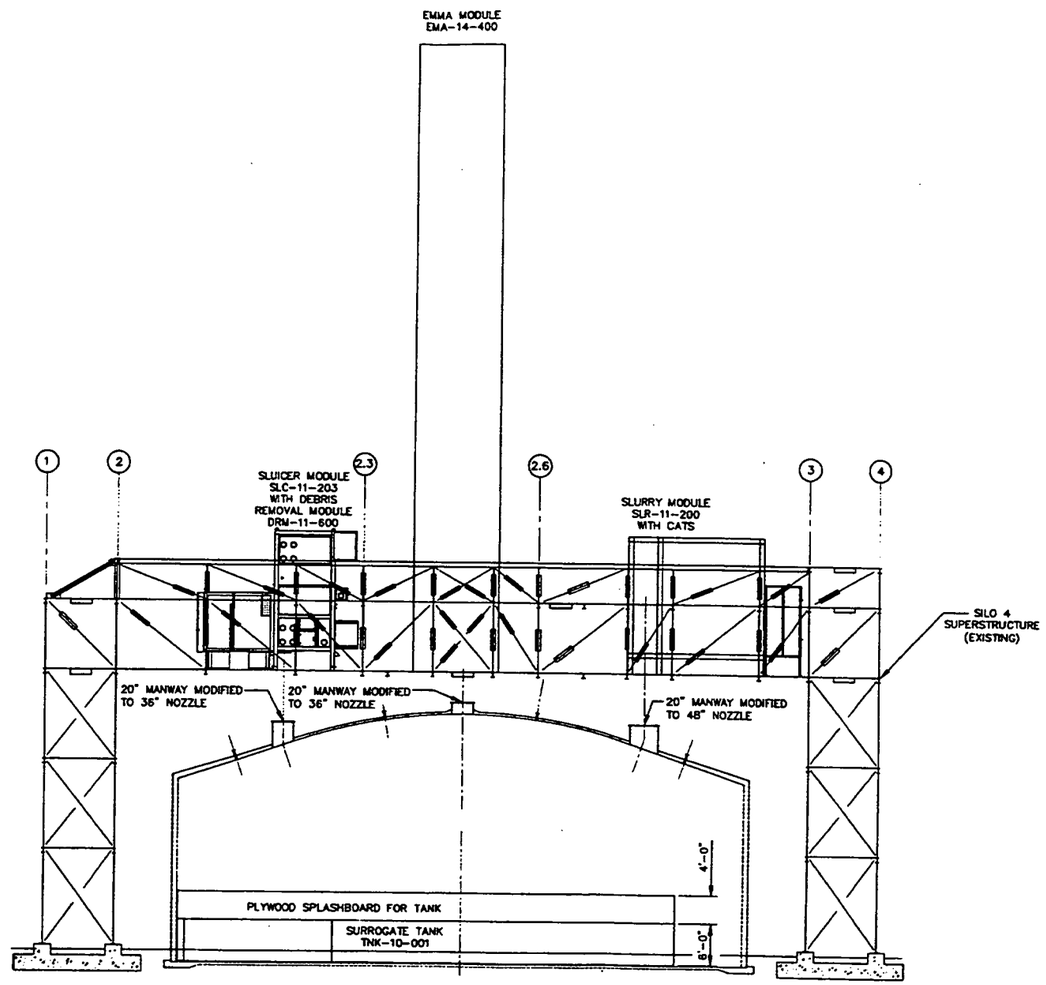
XREF DRAWINGS: 05FMD010 05FMD020 05FMD030

--2753



A SECTION
SCALE: 1"=10'-0"
10FMD017 — 10FMD018

000254

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

REV	DATE	BY	CHK'D	APR'VD	DESCRIPTION/ISSUE
2	01/07/00	[illegible]	[illegible]	[illegible]	CERTIFIED FOR CONSTRUCTION
1	12/01/99	WCB	SWH		REVISED FOR NOZZLE LOCATIONS
0	11/99	WCB	RAR		PRELIMINARY DESIGN SUBMITTAL

KENNETH D. RICKETT, PE, PROFESSIONAL ENGINEER, REGISTERED, No. 103743, STATE OF TENNESSEE

		DATE
DRAWN BY	[illegible]	01/07/00
DESIGNED BY	[illegible]	01/07/00
CHECKED BY	J.N. Wright	01/07/00
APPROVED BY	Kenneth D. Rickett	01/07/00
APPROVED BY	Clifton Sawyer	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

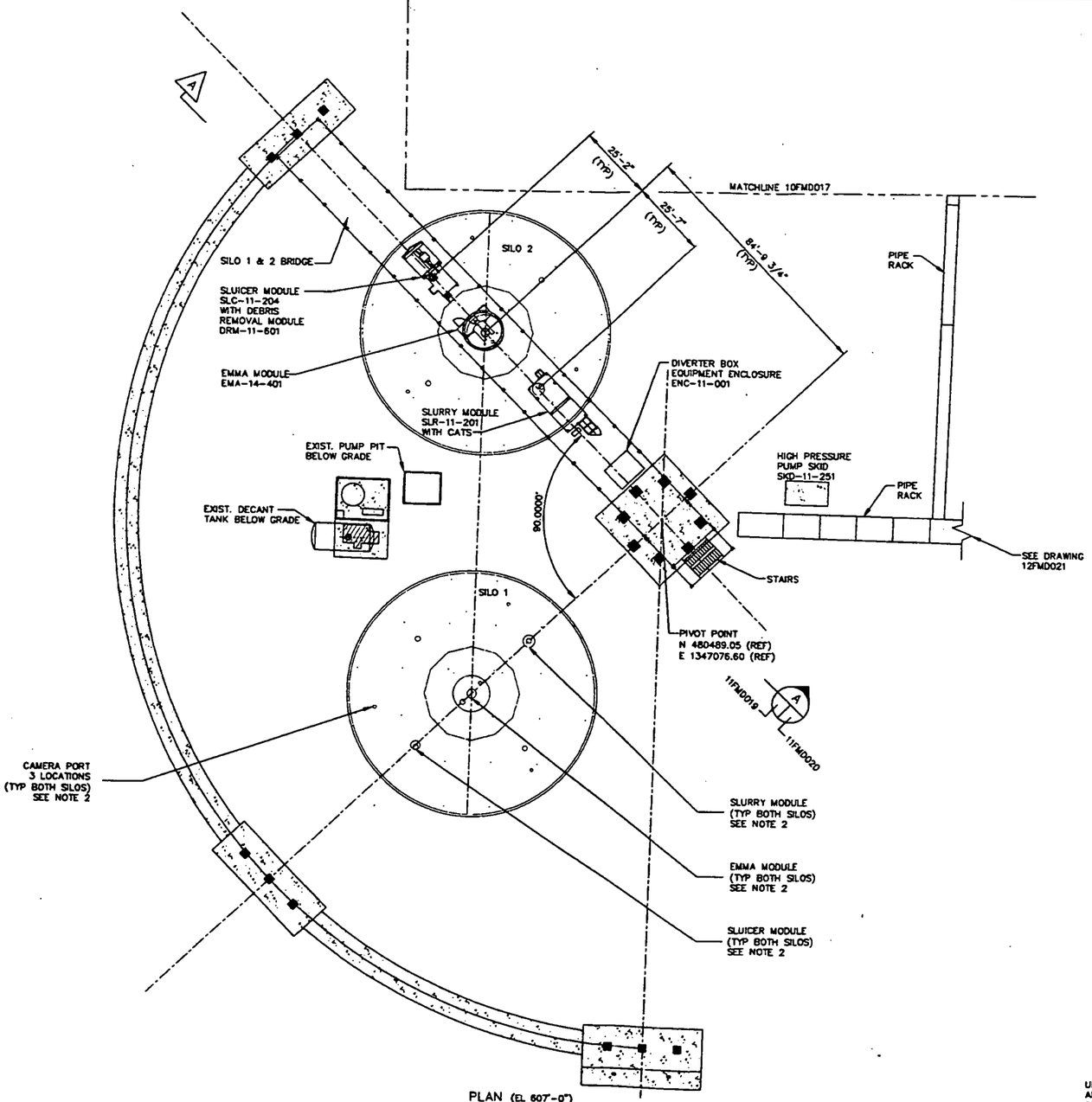
FOSTER WHEELER
FOSTER WHEELER ENVIRONMENTAL CORPORATION

TITLE
FULL-SCALE MOCKUP SYSTEM
SECTION
SHEET 2 OF 2

SIZE	SCALE:	DWG. NO.	REV
D	1"=10'-0"	10FMD018	2

FILENAME: 10FMD018.DWG

G:\CHARGE\FD-SILOS\MEC\SYS\0101\m0018.dwg Fri Jan 07 11:32:50 2000



PLAN (EL 607'-0")
SCALE: 1"=20'-0"

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. 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

REFERENCE DRAWINGS:

05FMD010 GENERAL ARRANGEMENT KEY PLAN

000255

UNDER TEMPORARY AUTHORIZATION (BASED ON APPLICATION TO REGISTER BY COMOTY 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
2	01/01/00	WCB	SWH		CERTIFIED FOR CONSTRUCTION
1	12/01/99	WCB	SWH		REVISED FOR NOZZLE LOCATIONS
0	11/99	WCB	SWH		PRELIMINARY DESIGN SUBMITTAL

DRAWN BY 01/01/00
DESIGNED BY 01/01/00
CHECKED BY 01/01/00
APPROVED BY 01/01/00
APPROVED BY 01/01/00

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.DWG

XREF DRAWINGS: 10FMD010.DWG 60-PROP.DWG 60-EXST.DWG

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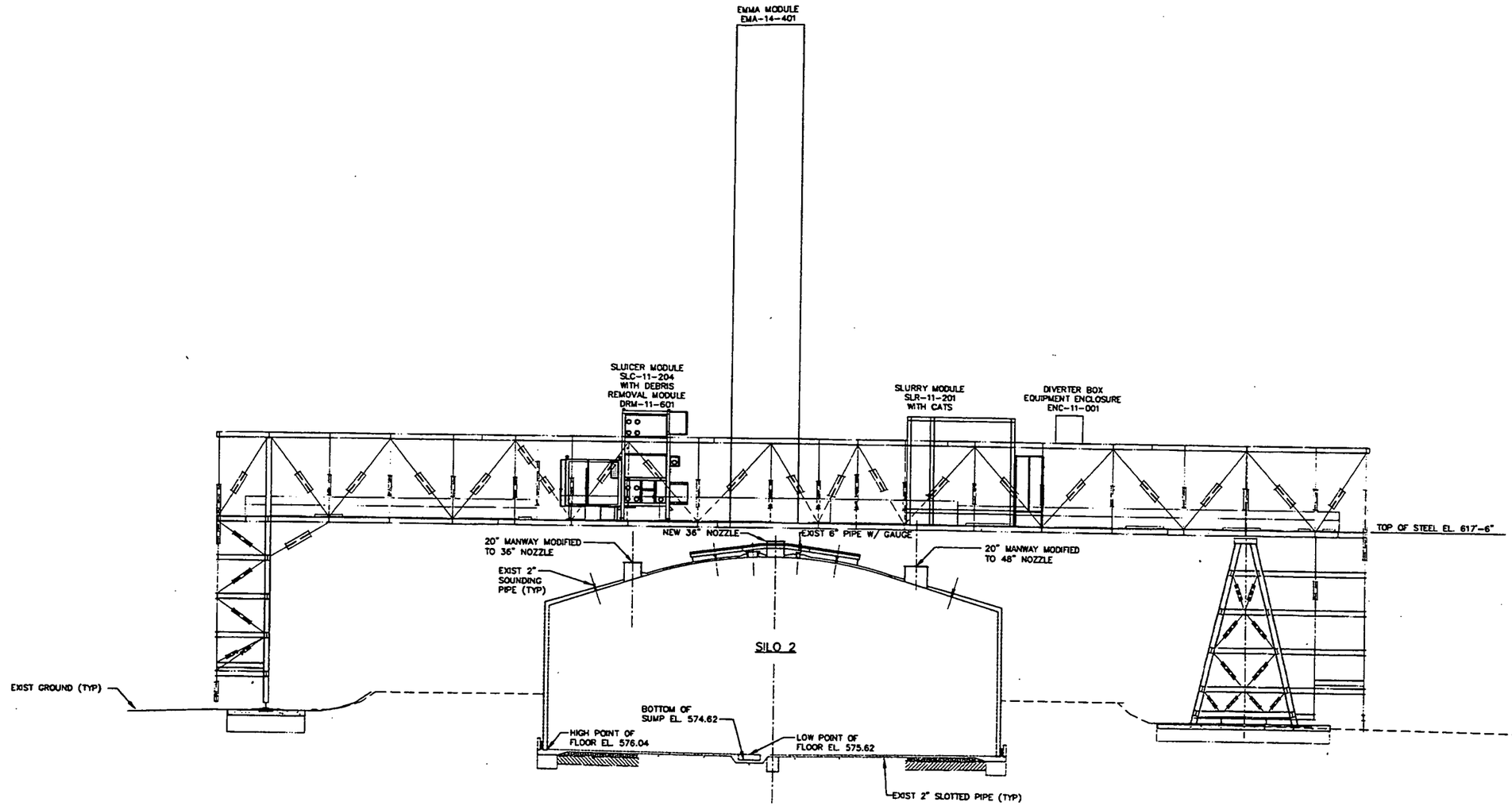
2753



A SECTION
SCALE: 1"=10'-0"
11FMD019 — 11FMD020

000256

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

REV	DATE	BY	CHK'D	APRV'D	DESCRIPTION/ISSUE
2	01/07/00		JLN	KSR	CERTIFIED FOR CONSTRUCTION
1	12/08/99	WCB	SWH		REVISED FOR NOZZLE LOCATIONS
0	11/99	WCB	SWH		PRELIMINARY DESIGN SUBMITTAL

KENNETH D. RIGGS, PROFESSIONAL ENGINEER, No. 103743, STATE OF TENNESSEE

		DATE
DRAWN BY:		01/07/00
DESIGNED BY:		01/07/00
CHECKED BY:		01/07/00
APPROVED BY:		01/07/00
APPROVED BY:		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

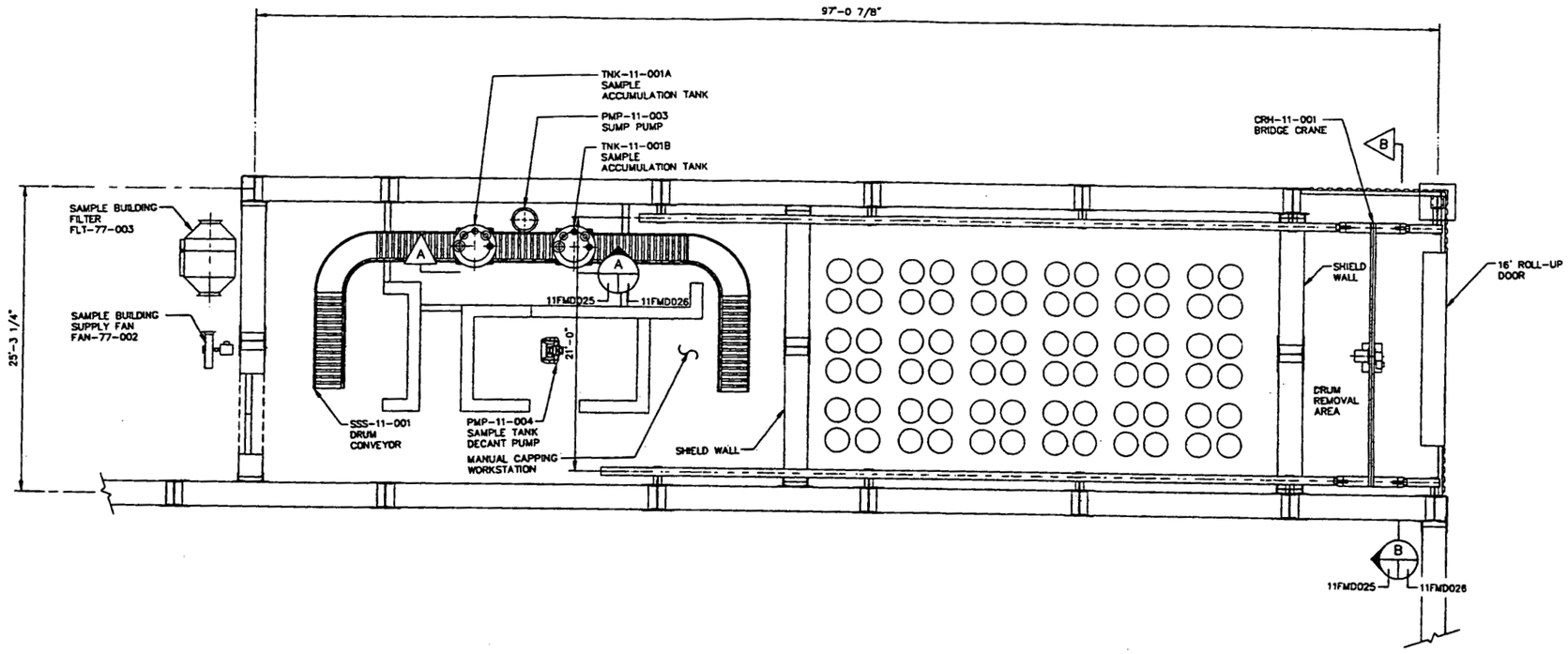
SIZE: D | SCALE: 1"=10'-0" | DWG. NO. 11FMD020 | REV 2

FILENAME: 11FMD020.DWG

G:\DRAWINGS\SILOS\WCS\SYS11\11fmd020.dwg Fri Jan 07 11:14:42 2000

2753

STATE OF OHIO NORTH (NAD 83)



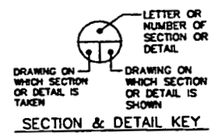
PLAN VIEW
SCALE: 3/16"=1'-0"

REFERENCE DRAWINGS:

05FMD010 GENERAL ARRANGEMENT KEY PLAN

000257

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.



SECTION & DETAIL KEY

REV	DATE	BY	CHK'D	APR'VD	DESCRIPTION/ISSUE
1	01/07/00	WCB	JWB	KDR	CERTIFIED FOR CONSTRUCTION
0	11/01/99	WCB	SWH		PRELIMINARY DESIGN SUBMITTAL

RPC KENNETH D. RICHARDS PROFESSIONAL ENGINEER REG. 19072E STATE OF TENNESSEE 01/07/00

		DATE
DRAWN BY	WCB	01/07/00
DESIGNED BY	WCB	01/07/00
CHECKED BY	JWB	01/07/00
APPROVED BY	Kenneth Richards	01/07/00
APPROVED BY	Jeff Swanson	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

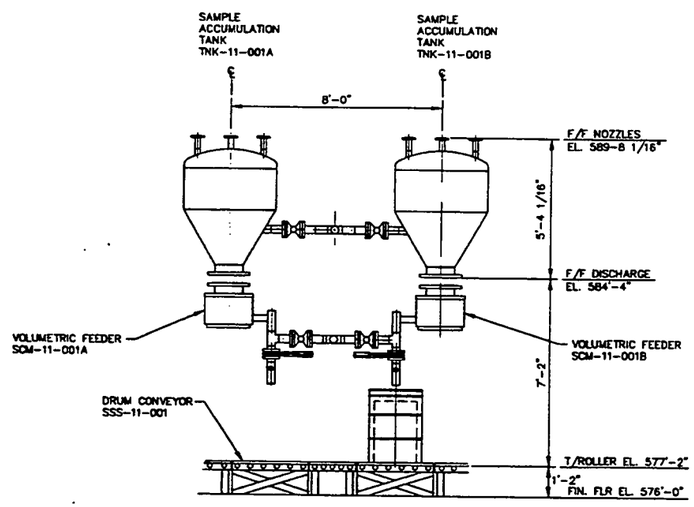
TITLE
SILO WASTE RETRIEVAL SYSTEM
GENERAL ARRANGEMENT
SAMPLE BUILDING

SIZE	SCALE:	DWG. NO.	REV
D	3/16" = 1'-0"	11FMD025	1

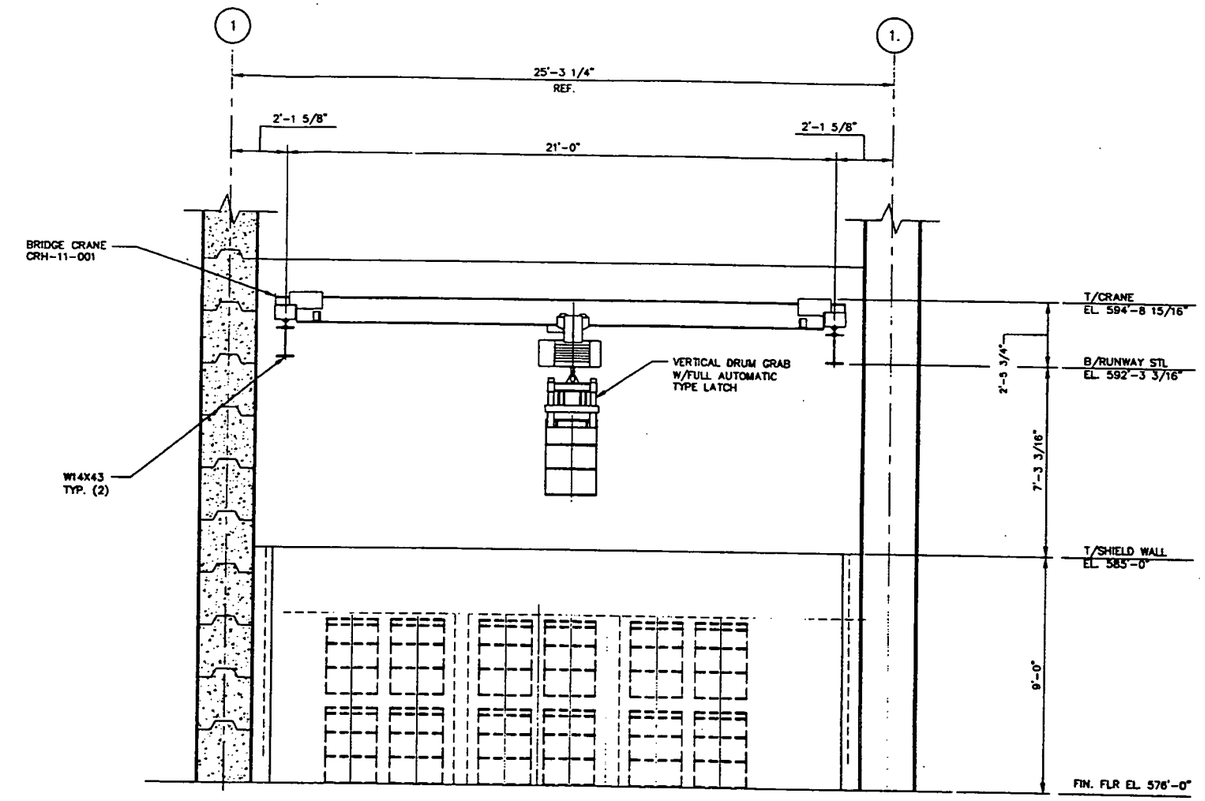
FILENAME: 11FMD025

H:\DWARE\FDF3.DGS\DECS\FS11\11fmd025.dwg Fri Jan 07 10:07:47 2000

2753



A SECTION
SCALE: 3/8" = 1'-0"
11FMD025 — 11FMD026



B SECTION
SCALE: 3/8" = 1'-0"
11FMD025 — 11FMD026

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				CERTIFIED FOR CONSTRUCTION
0	11/01/99	WCB	SWH		PRELIMINARY DESIGN SUBMITTAL

KENNETH D. RICHARDS PROFESSIONAL ENGINEER No. 103742 STATE OF TENNESSEE

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.

000258

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

DRAWN BY — DATE 01/07/00
DESIGNED BY — DATE 01/07/00
CHECKED BY — DATE 01/07/00
APPROVED BY — DATE 01/07/00
APPROVED BY — DATE 01/07/00

TITLE
SILO WASTE RETRIEVAL SYSTEM
SECTIONS & DETAILS
SAMPLE BUILDING

SIZE D | SCALE: 3/8" = 1'-0" | DWG. NO. 11FMD026 | REV 1

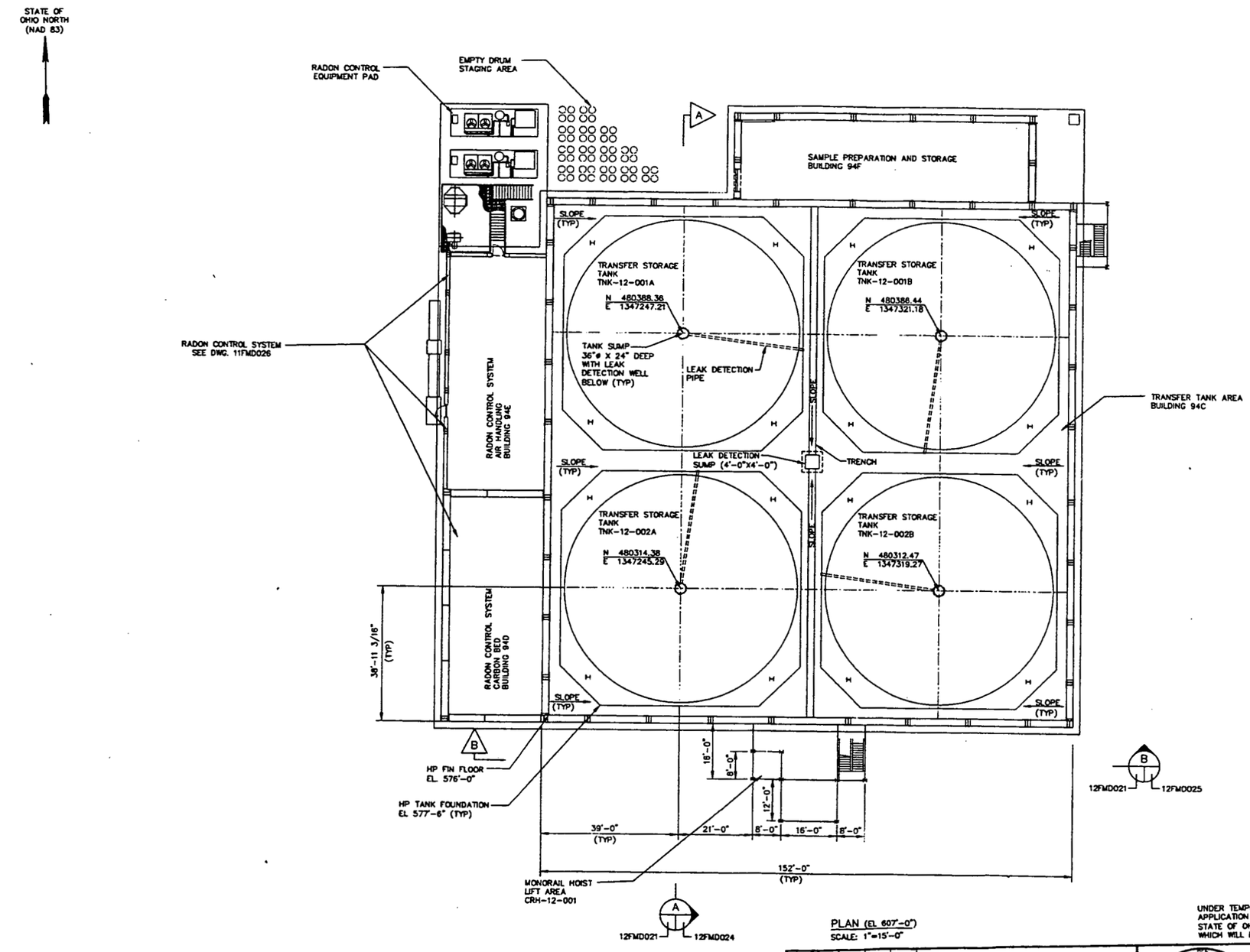
FILENAME: 11FMD026

G:\DWGS\VD\...\11fmd026.dwg Fri Jan 07 11:49:37 2000

2753

NOTES:

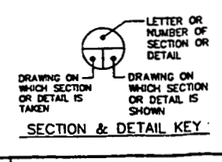
1. RATE OF FLOOR SLOPE IS 1"/8'-0" UNLESS NOTED OTHERWISE.



PLAN (EL 607'-0")
SCALE: 1"=15'-0"

REFERENCE DRAWINGS:

05FMD010 GENERAL ARRANGEMENT KEYPLAN



SECTION & DETAIL KEY

REV	DATE	BY	CHK'D	APR'VD	DESCRIPTION/ISSUE
1	01/07/00	WCB	SWH	KDB	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.

KENNETH D. ALBRIGHT REGISTERED PROFESSIONAL ENGINEER LICENSE NO. 108742 STATE OF TENNESSEE

DRAWN BY 01/07/00 DATE
DESIGNED BY 01/07/00 DATE
CHECKED BY 01/07/00 DATE
APPROVED BY 01/07/00 DATE
APPROVED BY 01/07/00 DATE

000259

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 1

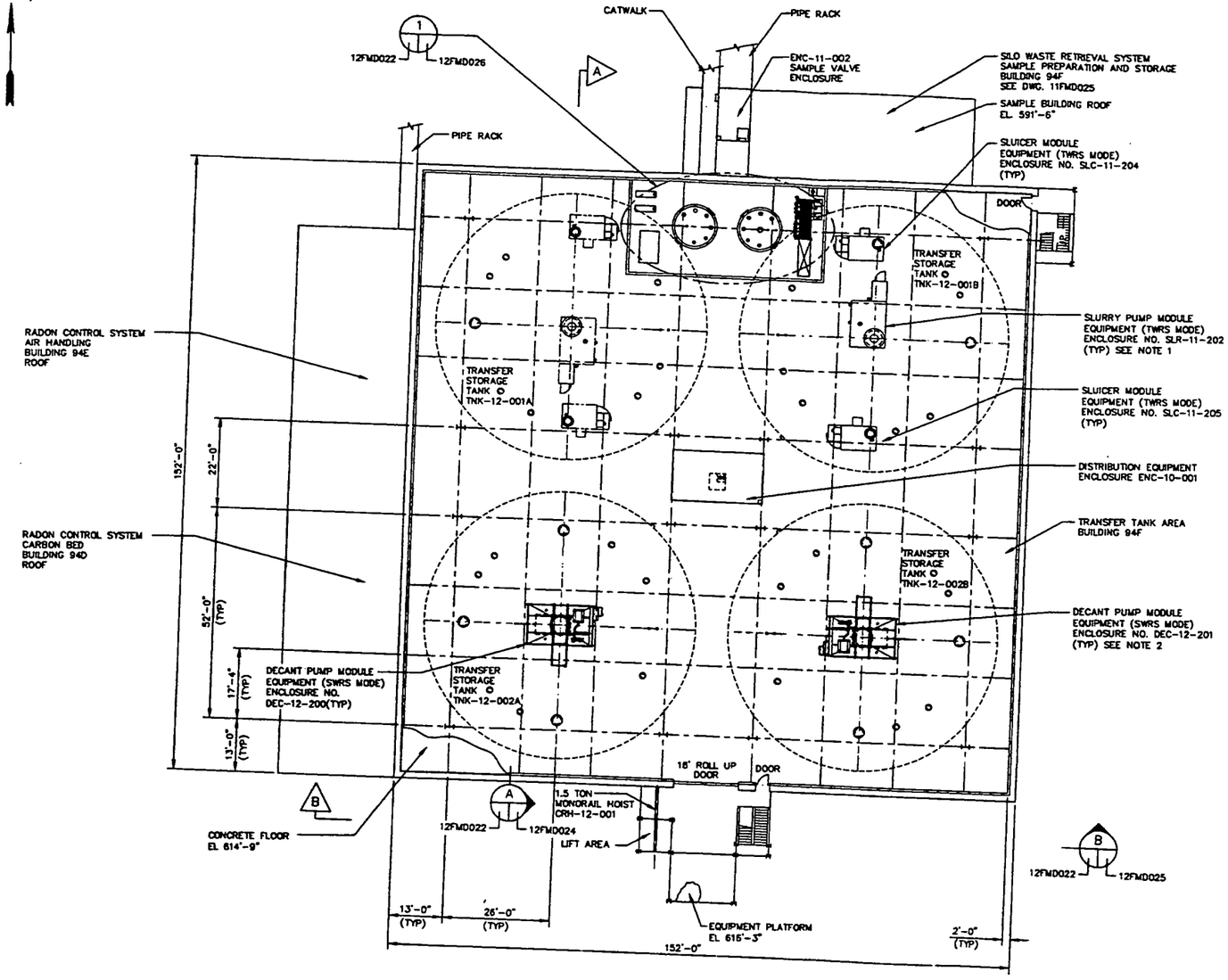
FILENAME: 12FMD021.DWG

3GRREVIUFS1L25\WES\STS12\12fmd021.dwg Fri Jan 07 15:27:31 2000

DATE:01/07/2000 USER:WCB

2753

STATE OF OHIO NORTH (NAD 83)



PLAN (EL 636'-0")
SCALE: 1"=15'-0"

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.

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

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	APRV'D	DESCRIPTION/ISSUE
1	01/07/00	WCB	JJ	KDR	CERTIFIED FOR CONSTRUCTION
0	11/01/99	WCB	SWH		PRELIMINARY DESIGN SUBMITTAL

KENNETH D. RICKETT PROFESSIONAL ENGINEER LICENSE NO. 103745 STATE OF TENNESSEE 01/07/00

000260

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

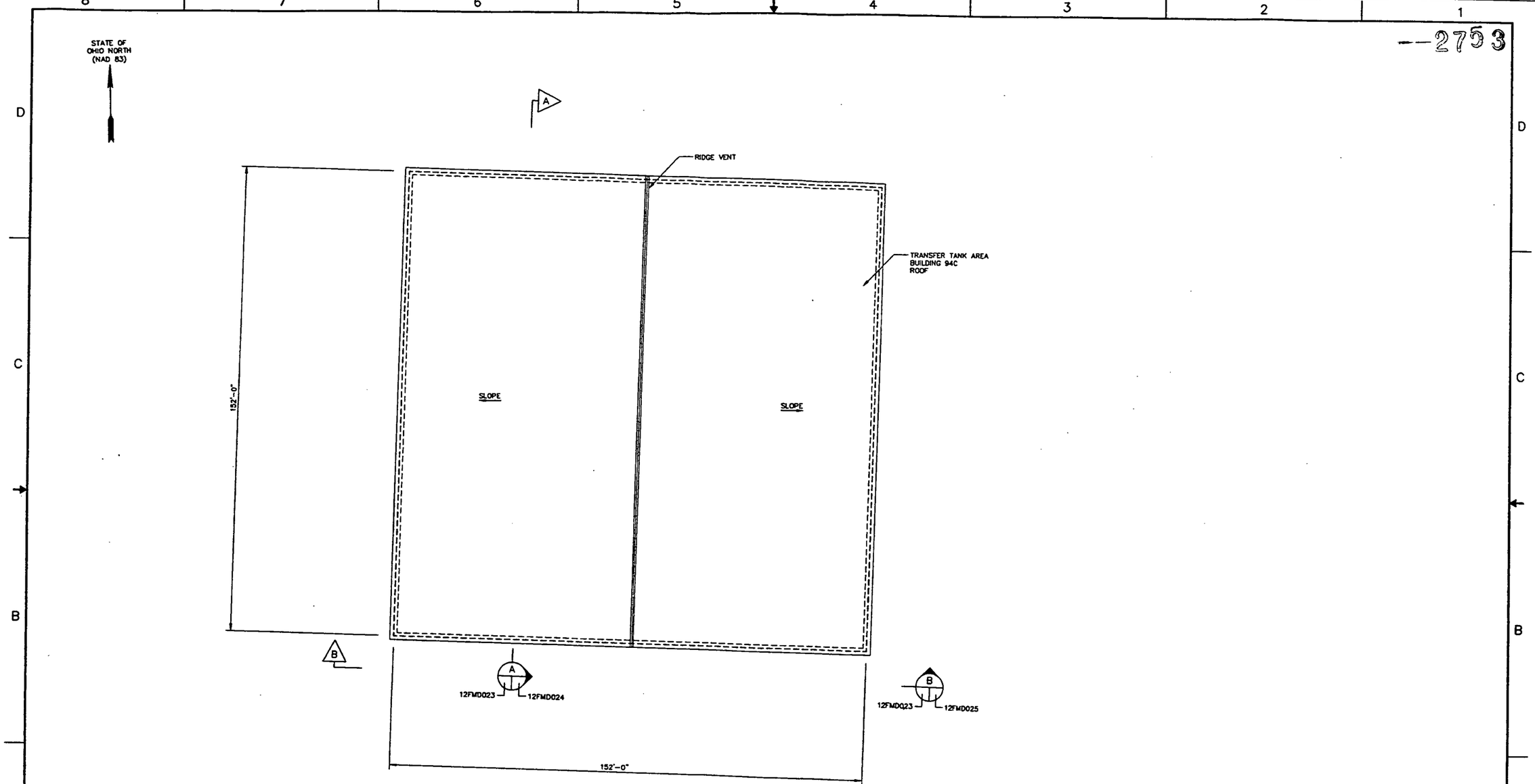
FOSTER WHEELER
FOSTER WHEELER ENVIRONMENTAL CORPORATION

TRANSFER TANK SYSTEM
GENERAL ARRANGEMENT
SHEET 2 OF 6

SIZE	SCALE	DWG. NO.	REV
D	1"=15'-0"	12FMD022	1

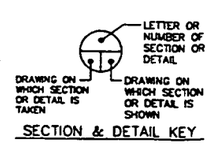
FILENAME: 12FMD022.DWG

2753



PLAN (EL 650'-0")
SCALE: 1"=15'-0"

000261



SECTION & DETAIL KEY

REV	DATE	BY	CHK'D	APR'VD	DESCRIPTION/ISSUE
1	01/07/00	WCB	JLA	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.

KENNETH D. RICHARD — REGISTERED PROFESSIONAL ENGINEER — STATE OF TENNESSEE — NO. 102743

		DATE
DRAWN BY	WCB	01/07/00
DESIGNED BY	WCB	01/07/00
CHECKED BY	JLA	01/07/00
APPROVED BY	Kenneth Richard	01/07/00
APPROVED BY	Opal Jones	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

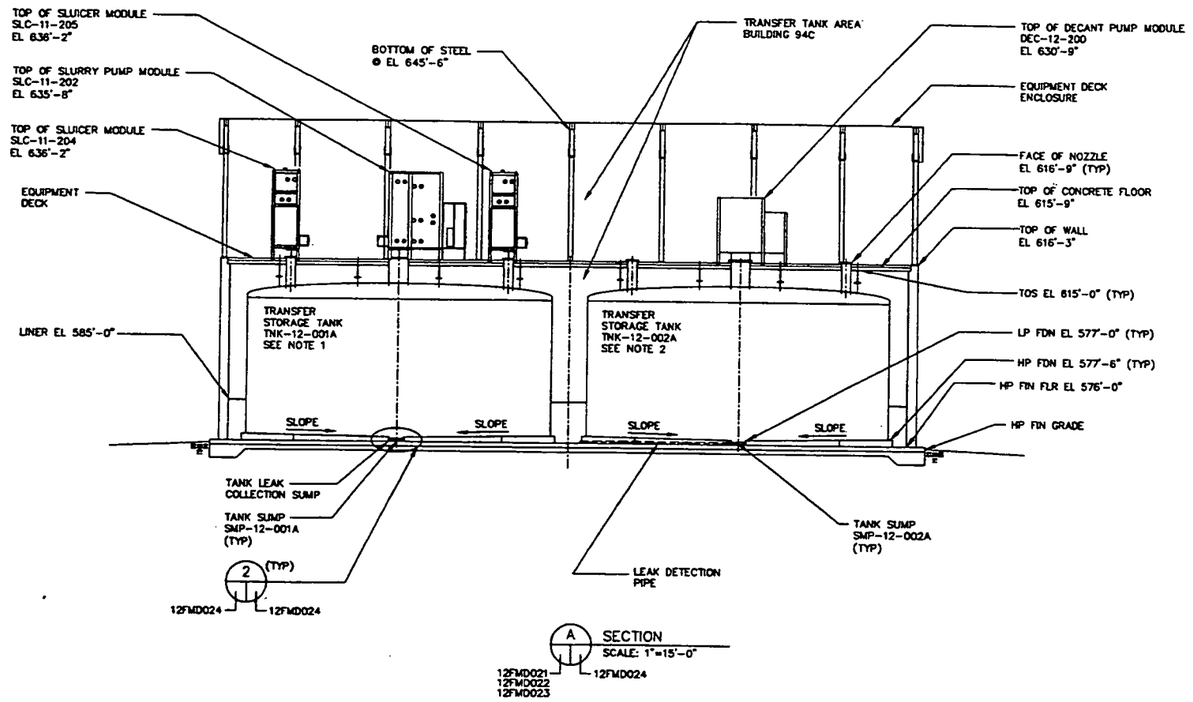
SIZE	SCALE:	DWG. NO.	REV
D	1"=15'-0"	12FMD023	1

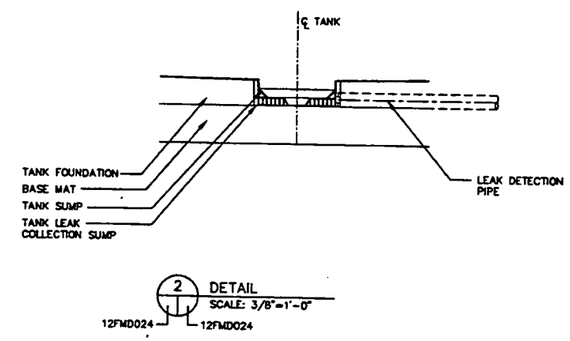
FILENAME: 12FMD023.DWG

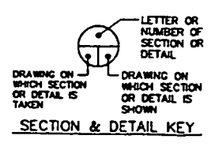
—2753

NOTES:

1. TNK-12-001A IS SHOWN IN TWRS MODE.
2. TNK-12-002A IS SHOWN IN SWRS MODE.







SECTION & DETAIL KEY

REV	DATE	BY	CHK'D	APR'VD	DESCRIPTION/ISSUE
1	[illegible]	[illegible]	[illegible]	[illegible]	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.

KENNETH D. RICHARDS
PROFESSIONAL ENGINEER
REGISTERED
NO. 103743
STATE OF TENNESSEE

000262

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

FOSTER WHEELER
FOSTER WHEELER ENVIRONMENTAL CORPORATION

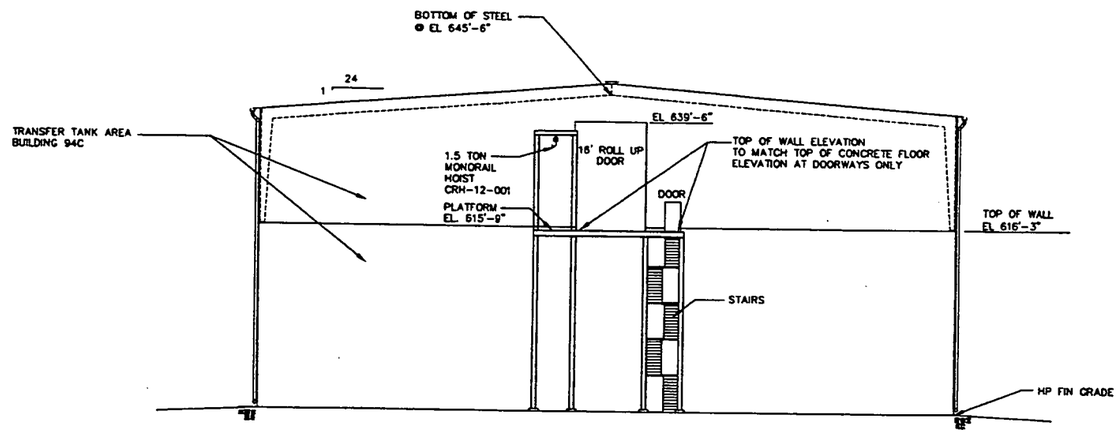
TITLE
TRANSFER TANK SYSTEM
GENERAL ARRANGEMENT
SHEET 4 OF 6

DRAWN BY [illegible]	DATE 01/07/00	
DESIGNED BY [illegible]	DATE 01/07/00	
CHECKED BY [illegible]	DATE 01/07/00	
APPROVED BY Kenneth Richards	DATE 01/07/00	
APPROVED BY John Sawyer	DATE 01/07/00	

SIZE	SCALE	DWG. NO.	REV
D	1"=15'-0"	12FMD024	1

FILENAME: 12FMD024.DWG

—2753



B SECTION
SCALE: 1"=15'-0"
12FMD021
12FMD022
12FMD023
12FMD025

000263

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

REV	DATE	BY	CHK'D	APR'VD	DESCRIPTION/ISSUE
1	[illegible]	[illegible]	[illegible]	[illegible]	CERTIFIED FOR CONSTRUCTION
0	11/01/99	WCB	SWH		PRELIMINARY DESIGN SUBMITTAL

KENNETH D. [illegible] REGISTERED PROFESSIONAL ENGINEER 103742 STATE OF TENNESSEE

DRAWN BY	01/07/00
DESIGNED BY	01/07/00
CHECKED BY	01/07/00
APPROVED BY	01/07/00
APPROVED BY	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.DWG

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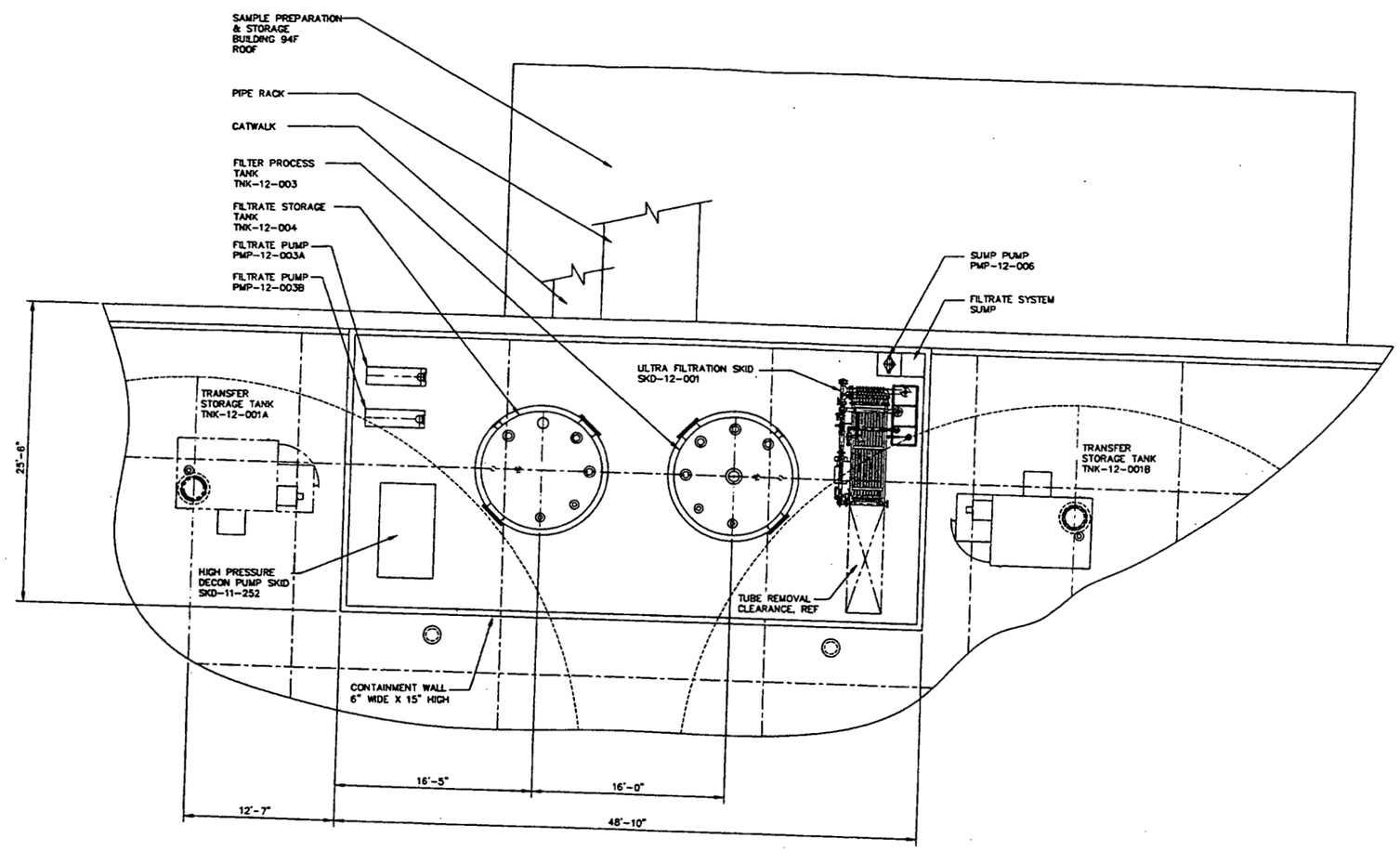

PARTIAL PLAN VIEW–EQUIPMENT DECK

ULTRA FILTRATION SYSTEM AND FILTRATE STORAGE AREA

1 DETAIL
SCALE: 3/16"=1'-0"
12FMD022 — 12FMD026

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	HJK	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. PROCTOR No. 103742 STATE OF TENNESSEE 01/07/00

DRAWN BY 01/07/00
DESIGNED BY 01/07/00
CHECKED BY 01/07/00
APPROVED BY 01/07/00
APPROVED BY 01/07/00

000264

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 D | SCALE: 3/16" = 1'-0" | DWG. NO. 12FMD026 | REV 1

FILENAME: 12FMD026.DWG

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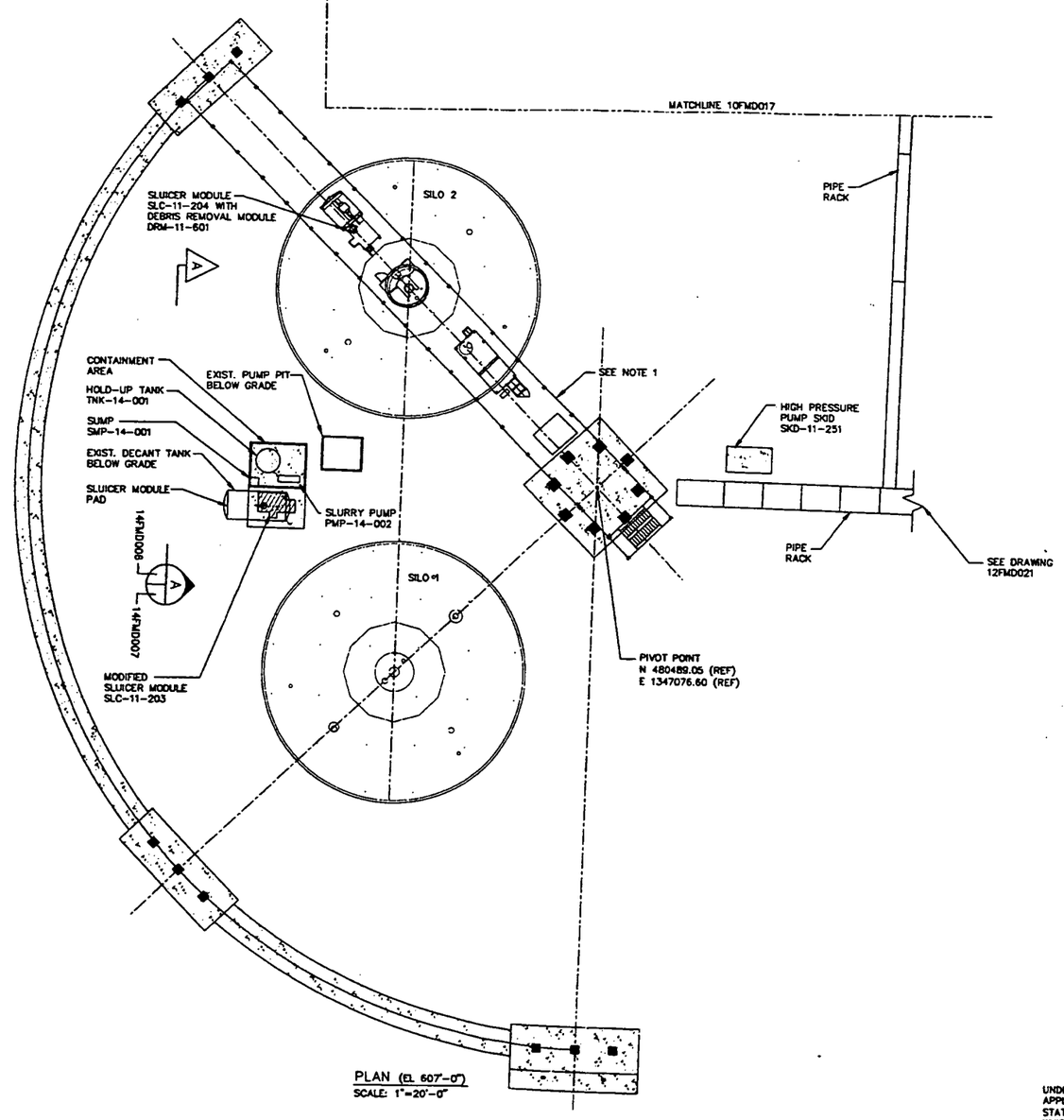
2753

STATE OF OHIO NORTH (NAD 83)

NOTES:

1. BRIDGE CRANE SHOWN IN SILO 2 OPERATION POSITION, SILO 1 IS SIMILAR.



PLAN (EL 607'-0")
SCALE: 1"=20'-0"

REFERENCE DRAWINGS:

05FMD010 GENERAL ARRANGEMENT KEY PLAN

000265

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	KDB	CERTIFIED FOR CONSTRUCTION
1	12/01/99	WCB	SWH		REVISED FOR NOZZLE LOCATIONS
0	11/99	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.

KENNETH D. BURCHETT PROFESSIONAL ENGINEER NO. 105742 STATE OF TENNESSEE

DRAWN BY: 01/07/00
DESIGNED BY: 01/07/00
CHECKED BY: 01/07/00
APPROVED BY: 01/07/00
APPROVED BY: 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
SHEET 1 OF 2

SIZE	SCALE:	DWG. NO.	REV
D	1"=20'-0"	14FMD006	2

FILENAME: 14FMD006.DWG

XREF DRAWINGS: 10FMD010.DWG 05-FMD010.DWG 05-FMD011.DWG

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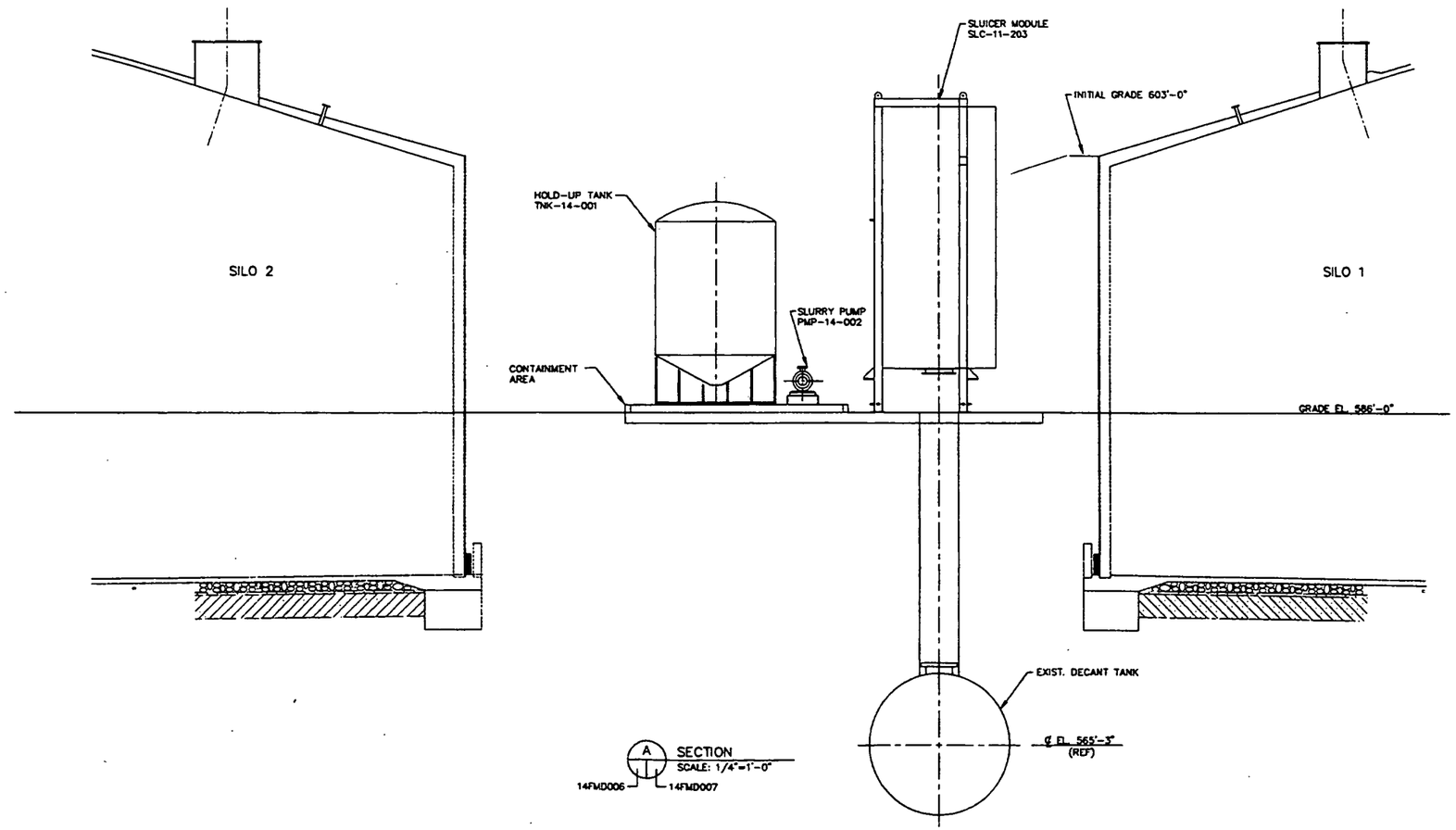
-2753



000266

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

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

KENNETH D. RAMSETT REGISTERED PROFESSIONAL ENGINEER NO. 102742 STATE OF TENNESSEE

		DATE
DRAWN BY	W.C. Bell	01/07/00
DESIGNED BY	W.C. Bell	01/07/00
CHECKED BY	S.W. Hunt	01/07/00
APPROVED BY	Ken Ramsett	01/07/00
APPROVED BY	Jack Tuner	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
SHEET 2 OF 2

SIZE	SCALE:	DWG. NO.	REV
D	1/4" = 1'-0"	14FMD007	2

FILENAME: 14fmd007.DWG

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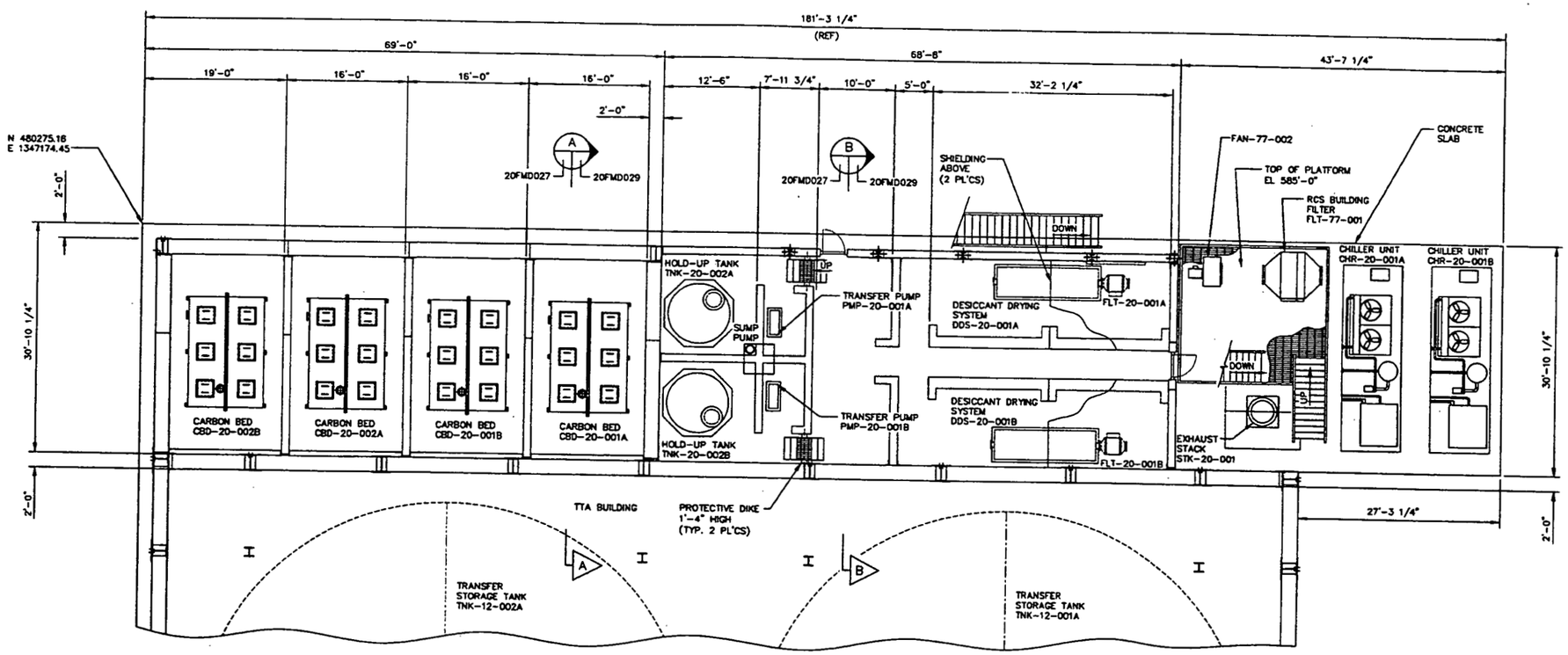

CARBON BUILDING (94D)
AIR HANDLING BUILDING (94E)
FIRST FLOOR PLAN (@EL 576'-0")
SCALE: 1/8"=1'-0"

NOTES:
1. FOR CLARITY SYSTEM 20 RCS AND SYSTEM 77 MISCELLANEOUS HVAC FACILITIES HVAC SYSTEM ARE PRESENTED ON SYSTEM 20 DRAWINGS.

000267

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

REV	DATE	BY	CHK'D	APR'VD	DESCRIPTION/ISSUE
1	01/07/00	WCB	MBF		CERTIFIED FOR CONSTRUCTION
0	01/07/99	WCB	MBF		PRELIMINARY DESIGN SUBMITTAL

RPE KENNETH D. PICKETT MECHANICAL ENGINEER REGISTERED PROFESSIONAL ENGINEER ED 103742 STATE OF TENNESSEE 01/07/00

		DATE
DRAWN BY	W.C. Shaw	01/07/00
DESIGNED BY	W.C. Shaw	01/07/00
CHECKED BY	J.N. Hunt	01/07/00
APPROVED BY	Kenneth D. Pickett	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
GENERAL ARRANGEMENT
1ST FLOOR

SIZE	SCALE:	DWG. NO.	REV
D	1/8"=1'-0"	20FMD027	1

FILENAME: 20FMD027.DWG

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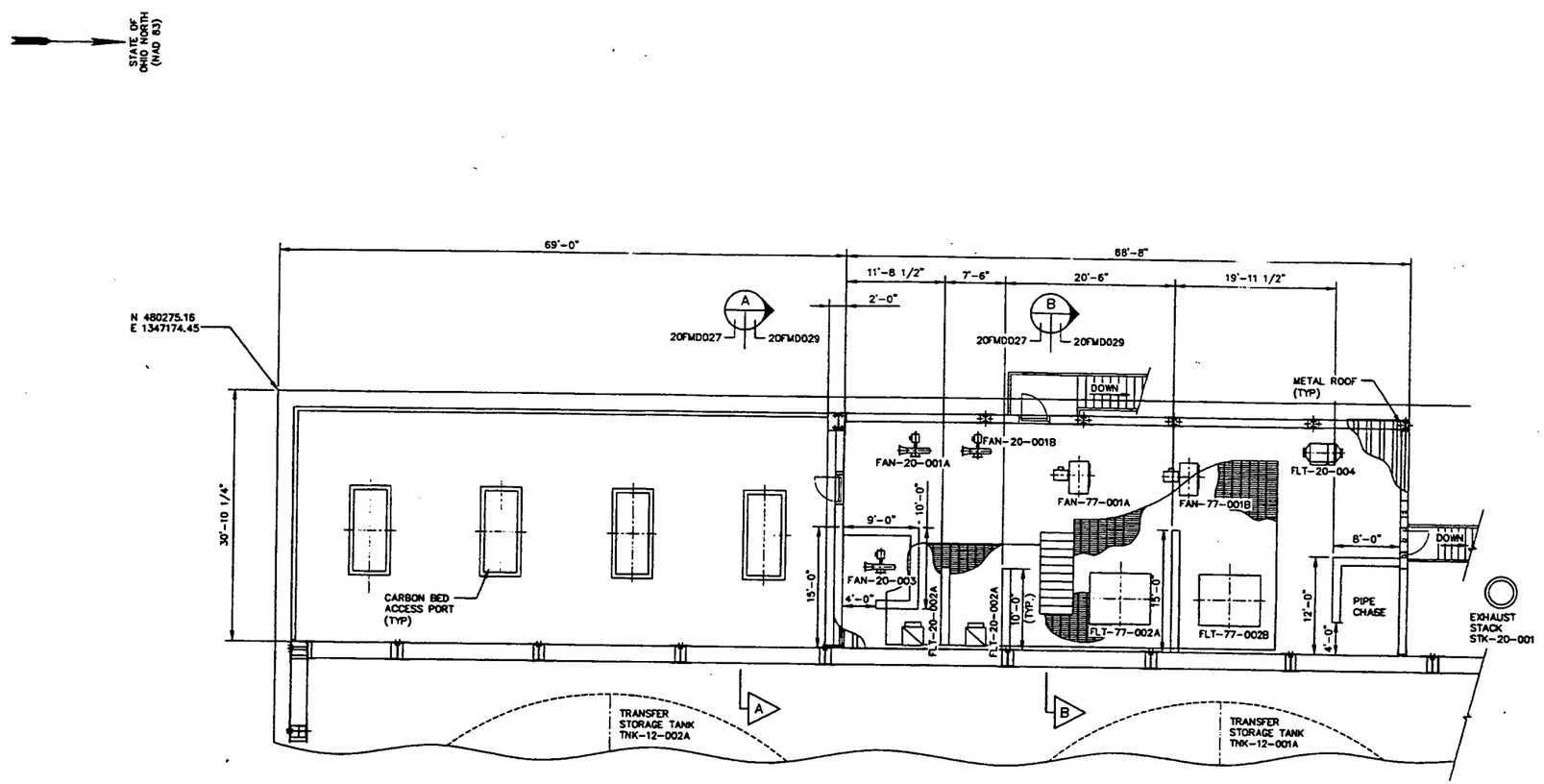

CARBON BED BUILDING (94D)
AIR HANDLING BUILDING (94E)
SECOND FLOOR PLAN (@EL 593'-1")
SCALE: 1/8"=1'-0"

NOTES:
1. FOR CLARITY SYSTEM 20 RCS AND SYSTEM 77 MISCELLANEOUS HVAC FACILITIES HVAC SYSTEM ARE PRESENTED ON SYSTEM 20 DRAWINGS.

000268

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

REV	DATE	BY	CHK'D	APR'VD	DESCRIPTION/ISSUE
1	01/07/00	WCB	MBF	HOF	CERTIFIED FOR CONSTRUCTION
0	11/01/99	WCB	MBF		PRELIMINARY DESIGN SUBMITTAL

KENNETH R. ASBERRY REGISTERED PROFESSIONAL ENGINEER No. 105748 STATE OF TENNESSEE 01/07/00

		DATE
DRAWN BY	WCB	01/07/00
DESIGNED BY	WCB	01/07/00
CHECKED BY	MBF	01/07/00
APPROVED BY	HOF	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
GENERAL ARRANGEMENT
2ND FLOOR

SIZE D | SCALE: 1/8"=1'-0" | DWG. NO. 20FMD028 | REV 1

FILENAME: 20FMD028.DWG

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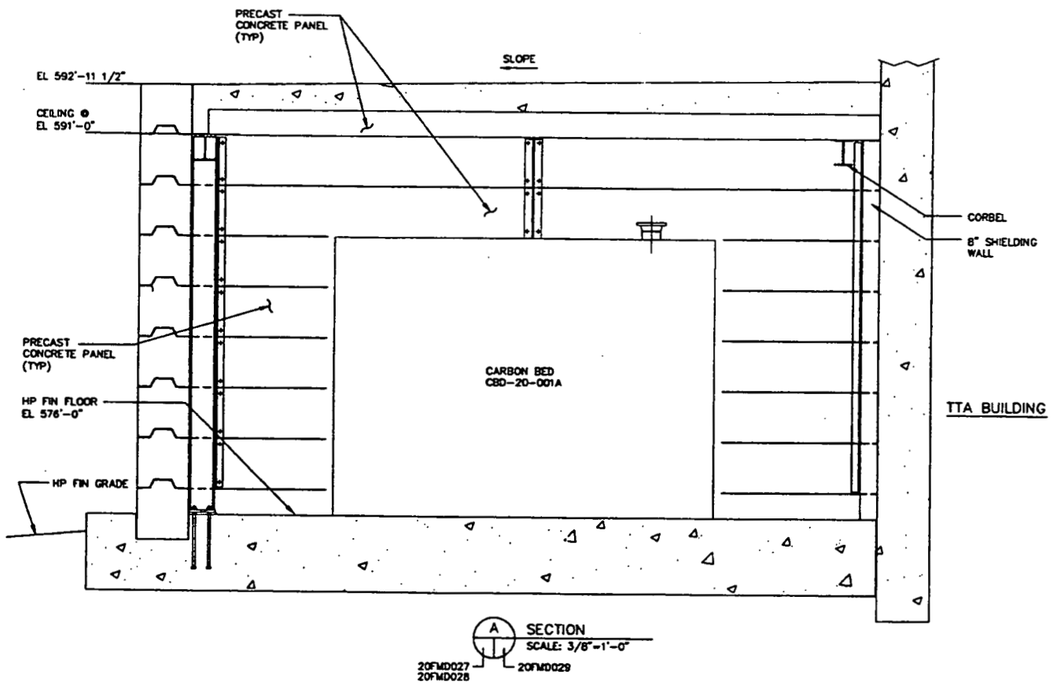
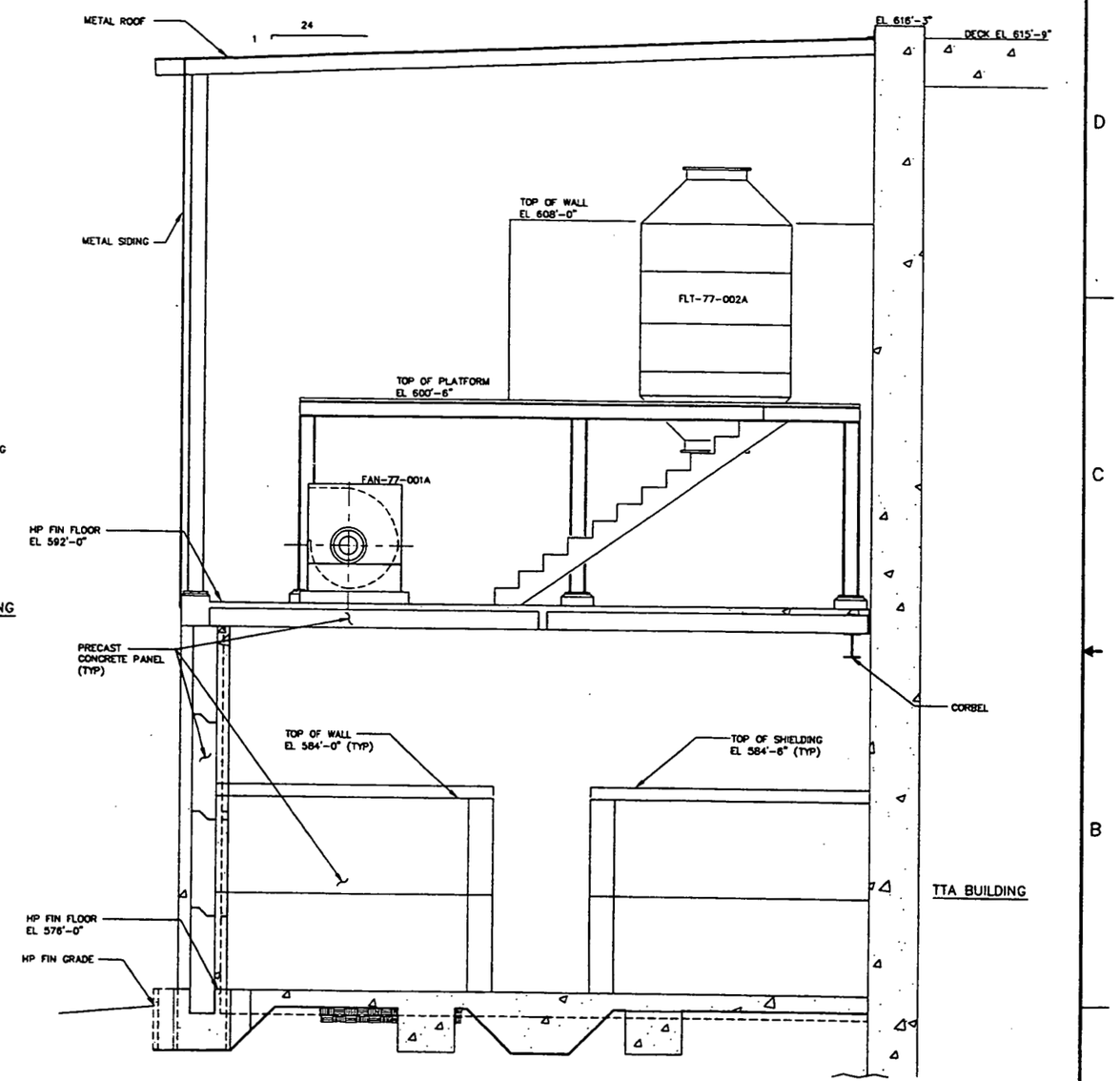
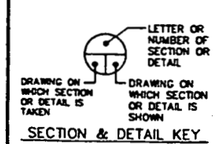




NOTES:

1. FOR CLARITY SYSTEM 20 RCS AND SYSTEM 77 MISCELLANEOUS HVAC FACILITIES HVAC SYSTEM ARE PRESENTED ON SYSTEM 20 DRAWINGS.



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
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0	11/01/99	WCB	MBF		PRELIMINARY DESIGN SUBMITTAL

KENNETH G. BURKETT — REGISTERED PROFESSIONAL ENGINEER — No. 103743 — STATE OF TENNESSEE

		DATE
DRAWN BY	[illegible]	01/01/00
DESIGNED BY	[illegible]	01/01/00
CHECKED BY	[illegible]	01/01/00
APPROVED BY	[illegible]	01/01/00
APPROVED BY	[illegible]	01/01/00

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
SECTIONS & DETAILS

SIZE	SCALE:	DWG. NO.	REV
D	3/8"=1'-0"	20FMD029	1

FILENAME: 20FMD029.DWG

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FOSTER WHEELER

FOSTER WHEELER ENVIRONMENTAL CORPORATION

HVAC FLOW AND CONTROL DIAGRAMS

DOCUMENT NO.
624-P622-23, Rev. C

FOR THE

SILOS 1 AND 2 ACCELERATED WASTE RETRIEVAL (AWR) PROJECT

SUBMITTED TO:
FLUOR DANIEL FERNALD (FDF)
CONTRACT NO. FSC 624

January 7, 2000

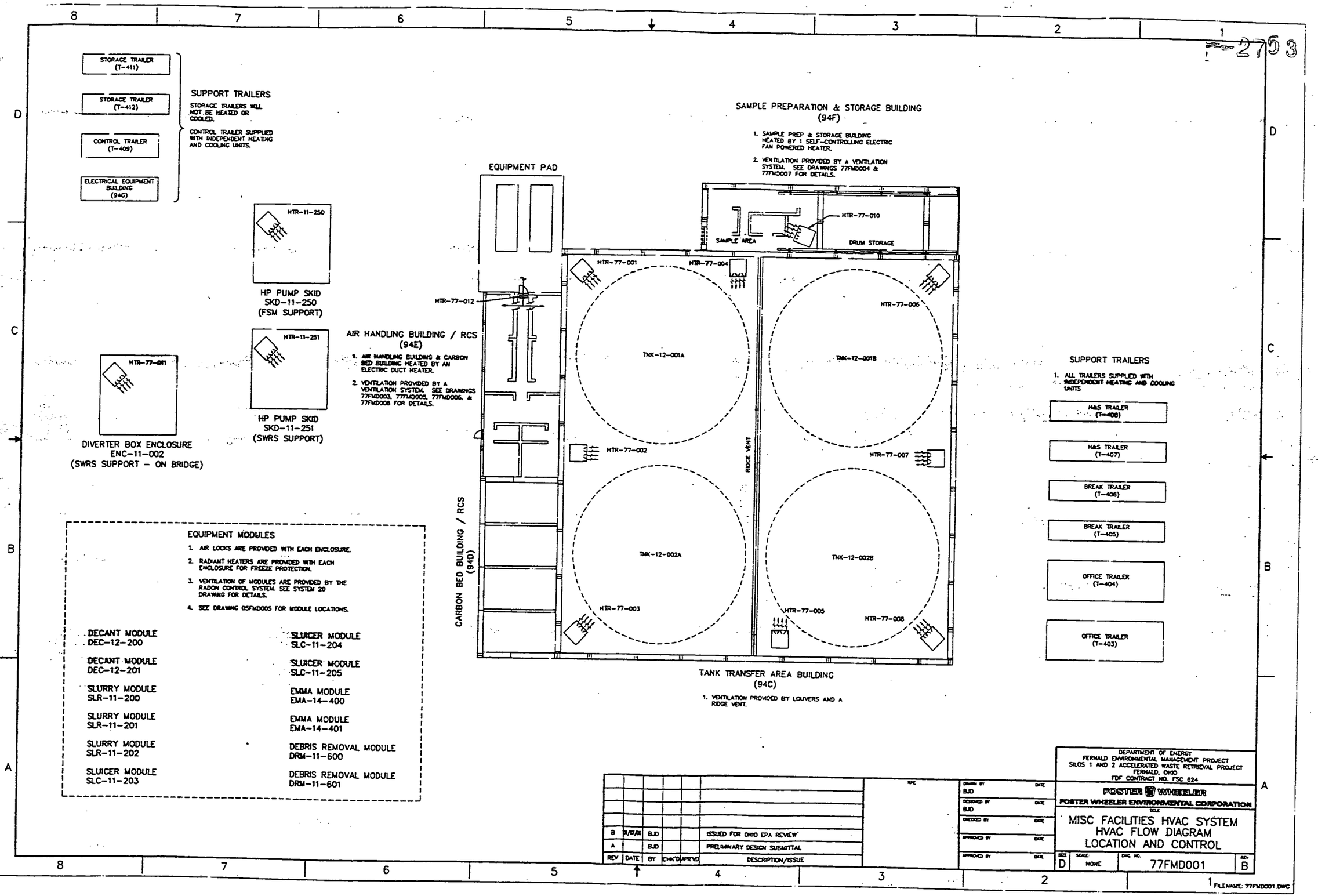
HVAC Flow & Control Diagrams

DOCUMENT NO. 624-P622-23

DRAWING NUMBER	DRAWING TITLE	REVISION
77FMD001	MISC. FACILITIES HVAC SYSTEM HVAC FLOW DIAGRAM LOCATION AND CONTROL	B
77FMD002	MISC. FACILITIES HVAC SYSTEM HVAC FLOW DIAGRAM MASS BALANCE TABLE	B
77FMD003	MISC. FACILITIES HVAC SYSTEM HVAC FLOW DIAGRAM RCS BLDG VENTILATION-1ST FL	B
77FMD004	MISC. FACILITIES HVAC SYSTEM HVAC FLOW DIAGRAM SAMPLE BUILDING VENTILATION	B
77FMD005	MISC. FACILITIES HVAC SYSTEM HVAC FLOW DIAGRAM RCS BLDG VENTILATION-2ND FL	B
77FMD006	MISC. FACILITIES HVAC SYSTEM HVAC CONTROL DIAGRAM RCS BLDG VENTILATION-1ST FL	A
77FMD007	MISC. FACILITIES HVAC SYSTEM HVAC CONTROL DIAGRAM SAMPLE BUILDING VENTILATION	A
77FMD008	MISC. FACILITIES HVAC SYSTEM HVAC CONTROL DIAGRAM RCS BLDG VENTILATION-2ND FL	A

Rev. C

000271


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.
HTR-11-250
HP PUMP SKID SKD-11-250 (FSM SUPPORT)
HTR-11-251
HP PUMP SKID SKD-11-251 (SWRS SUPPORT)
HTR-77-011
DIVERTER BOX ENCLOSURE ENC-11-002 (SWRS SUPPORT - ON BRIDGE)
EQUIPMENT PAD
HTR-77-012
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)
SAMPLE PREPARATION & STORAGE BUILDING (94F)
1. SAMPLE PREP & STORAGE BUILDING HEATED BY 1 SELF-CONTROLLING ELECTRIC FAN POWERED HEATER.
2. VENTILATION PROVIDED BY A VENTILATION SYSTEM. SEE DRAWINGS 77FMD004 & 77FMD007 FOR DETAILS.
HTR-77-010
SAMPLE AREA
DRUM STORAGE
HTR-77-001
HTR-77-004
HTR-77-006
TNK-12-001A
TNK-12-001B
HTR-77-002
HTR-77-007
RIDGE VENT
TNK-12-002A
TNK-12-002B
HTR-77-003
HTR-77-005
HTR-77-008
TANK TRANSFER AREA BUILDING (94C)
1. VENTILATION PROVIDED BY LOUVERS AND A RIDGE VENT.
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
DECANT MODULE DEC-12-201
SLURRY MODULE SLR-11-200
SLURRY MODULE SLR-11-201
SLURRY MODULE SLR-11-202
SLUICER MODULE SLC-11-203
SLUICER MODULE SLC-11-204
SLUICER MODULE SLC-11-205
EMMA MODULE EMA-14-400
EMMA MODULE EMA-14-401
DEBRIS REMOVAL MODULE DRM-11-600
DEBRIS REMOVAL MODULE DRM-11-601
REV | DATE | BY | CHK'D | APRV'D | DESCRIPTION/ISSUE
B | 01/07/00 | BJD | | | ISSUED FOR OHIO EPA REVIEW
A | | BJD | | | PRELIMINARY DESIGN SUBMITTAL
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APPROVED BY
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 HVAC SYSTEM
HVAC FLOW DIAGRAM
LOCATION AND CONTROL
SIZE D
SCALE: NONE
DWG. NO. 77FMD001
REV B
FILENAME: 77FMD001.DWG

2753

RCS BUILDING VENTILATION

STREAM NUMBER	1	2	3	4	5	6	7	13
COMPONENT	TOTAL HVAC MAKE-UP	RCS BUILDING 1ST FLOOR	RCS BUILDING 2ND FLOOR SUPPLY	RCS BUILDING 2ND FLOOR RETURN	RCS BUILDING 1ST FLOOR COMBINED RETURN	SAMPLE BUILDING RETURN	SAMPLE BUILDING SUPPLY	BUILDING VENT TO STACK
AIR (LBS/HR)	30,060	24,030	6,021	6,628	26,434	6,355	5,777	39,422
WATER (LBS/HR)	562	450	112	124	496	118	107	737
TOTAL (LBS/HR)	30,622	24,480	6,134	6,752	26,930	6,473	5,884	40,159
FLOW (CFM)	6,939	5,547	1,390	1,530	6,102	1,467	1,333	9,100
FLOW (GPM)	--	--	--	--	--	--	--	--
RADON (PICOCURIES/L)	0	0	0	0	0	0	0	0
RADON (CURIES/HR)	0	0	0	0	0	0	0	0
TEMPERATURE (DEG F)	75	75	75	75	75	75	75	75
PRESSURE (INCHES WC)	--	--	--	--	--	--	--	--
NOTES	RELATIVE HUMIDITY = 100%					RELATIVE HUMIDITY = 100%		NOTE 2

NOTES:

1. FOR FLOW DIAGRAMS SEE DRAWINGS 77FMD003, 77FMD004, & 77FMD005.
2. STREAM 13 ALSO APPEARS ON 20FMD002.
3. SAMPLE BUILDING & 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.

REV	DATE	BY	CHK'D	APRV'D	DESCRIPTION/ISSUE
B	01/07/00	BJD			ISSUED FOR OHIO EPA REVIEW
A		BJD			PRELIMINARY DESIGN SUBMITTAL

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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. TSC 624

FOSTER WHEELER
FOSTER WHEELER ENVIRONMENTAL CORPORATION

TITLE
MISC FACILITIES HVAC SYSTEM
HVAC FLOW DIAGRAM
MASS BALANCE TABLE

SIZE D | SCALE: NONE | DWG. NO. 77FMD002 | REV B

FILENAME: 77FMD002.DWG

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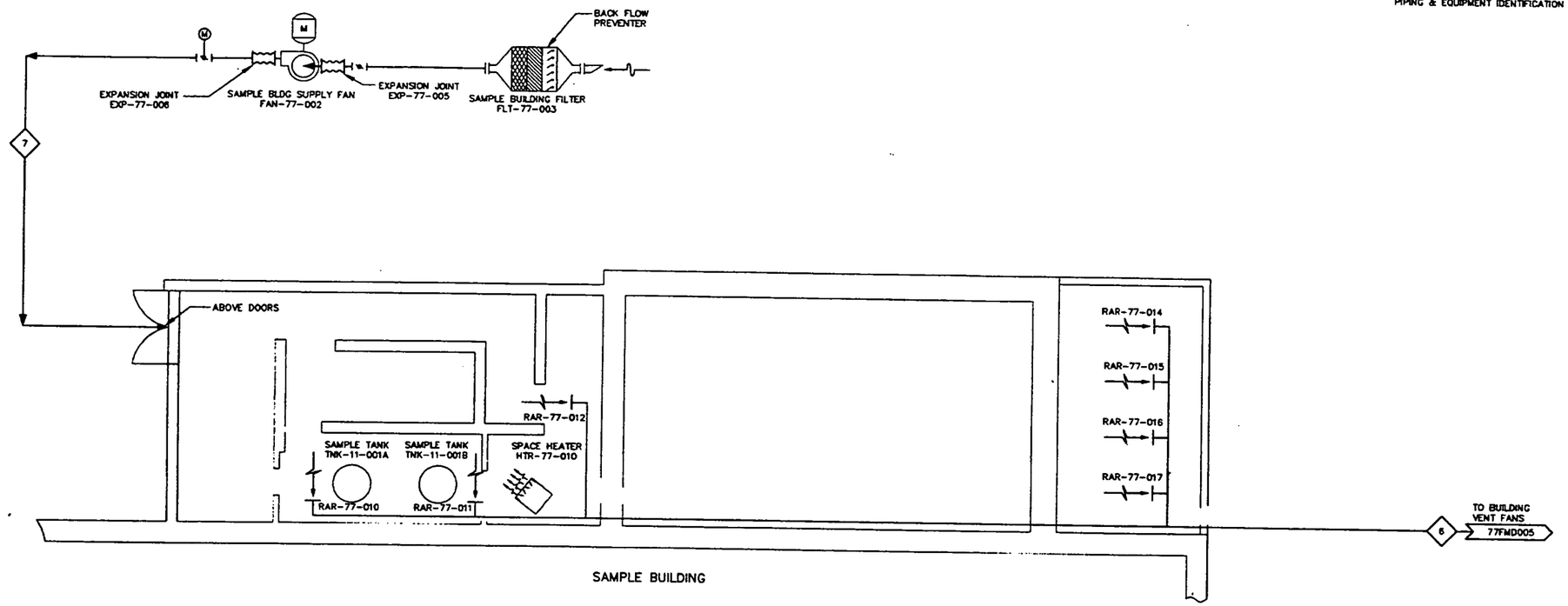
NOTES:

1. FOR GENERAL NOTES SEE DRAWING 05FMD004.
2. FOR MASS BALANCE TABLE SEE DRAWING 77FMD002.

REFERENCE DRAWINGS:

05FMD001	PIPING & INSTRUMENT DIAGRAM – INSTRUMENT IDENTIFICATION
05FMD002	PIPING & INSTRUMENT DIAGRAM – CONTROL SYSTEM STANDARDS
05FMD003	PIPING & INSTRUMENT DIAGRAM – PIPING & EQUIPMENT IDENTIFICATION



REV	DATE	BY	CHK'D	APR'VD	DESCRIPTION/ISSUE
B	01/07/00	BJD			ISSUED FOR OHIO EPA REVIEW
A		BJD			PRELIMINARY DESIGN SUBMITTAL

RPE

DRAWN BY BJD	DATE
DESIGNED BY BF	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
MISC FACILITIES HVAC SYSTEM
HVAC FLOW DIAGRAM
SAMPLE BUILDING VENTILATION

SIZE	SCALE:	DWG. NO.	REV
D	NONE	77FMD004	B

FILENAME: 77FMD004.DWG

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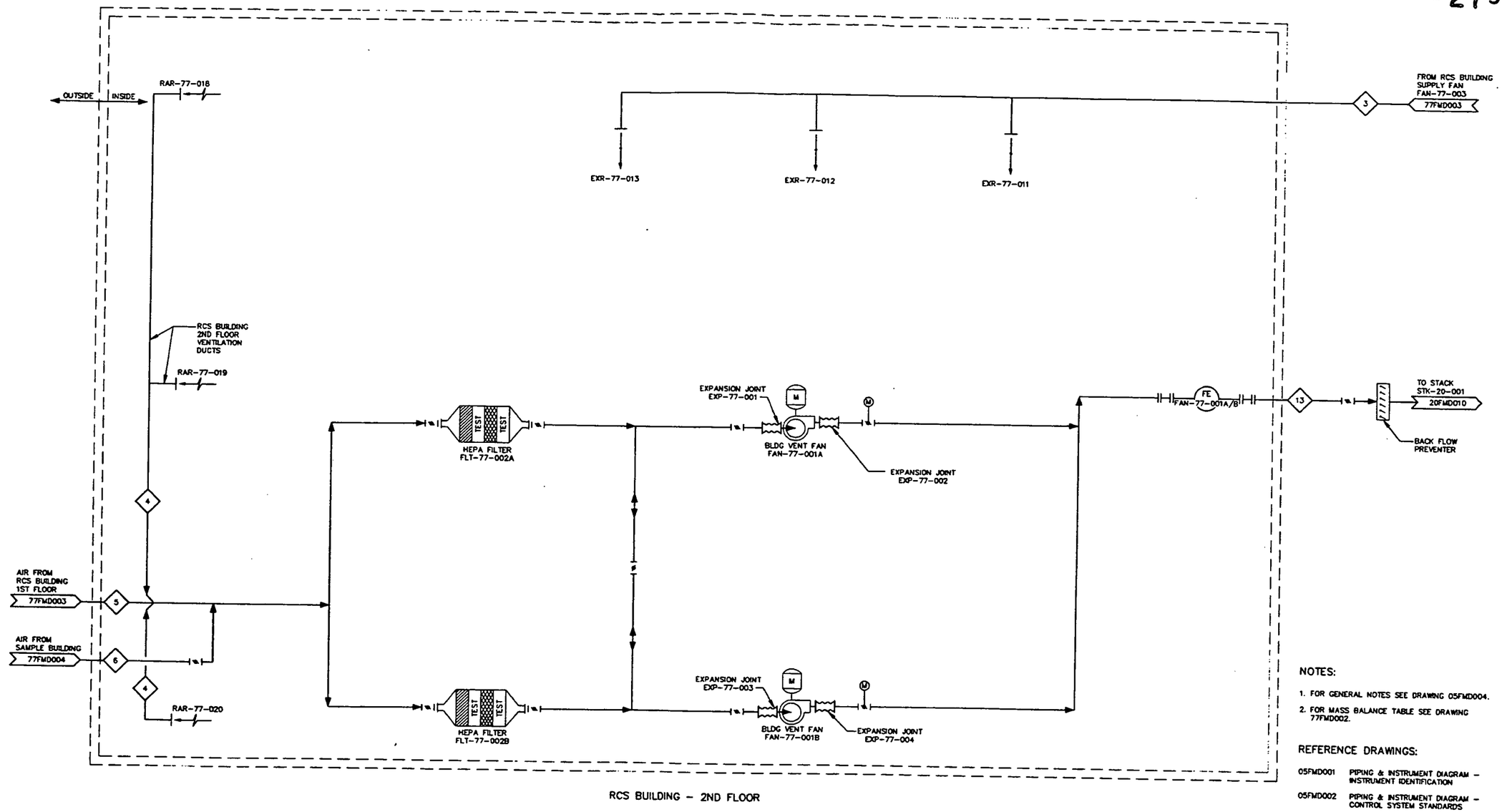

NOTES:

1. FOR GENERAL NOTES SEE DRAWING 05FMD004.
2. FOR MASS BALANCE TABLE SEE DRAWING 77FMD002.

REFERENCE DRAWINGS:

05FMD001 PIPING & INSTRUMENT DIAGRAM – INSTRUMENT IDENTIFICATION

05FMD002 PIPING & INSTRUMENT DIAGRAM – CONTROL SYSTEM STANDARDS

05FMD003 PIPING & INSTRUMENT DIAGRAM – PIPING & EQUIPMENT IDENTIFICATION

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A		BJD			PRELIMINARY DESIGN SUBMITTAL

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DESIGNED BY BF DATE
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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
MISC FACILITIES HVAC SYSTEM
HVAC FLOW DIAGRAM
RCS BLDG VENTILATION–2ND FL

SIZE D | SCALE: NONE | DWG. NO. 77FMD005 | REV B

FILENAME: 77FMD005.DWG

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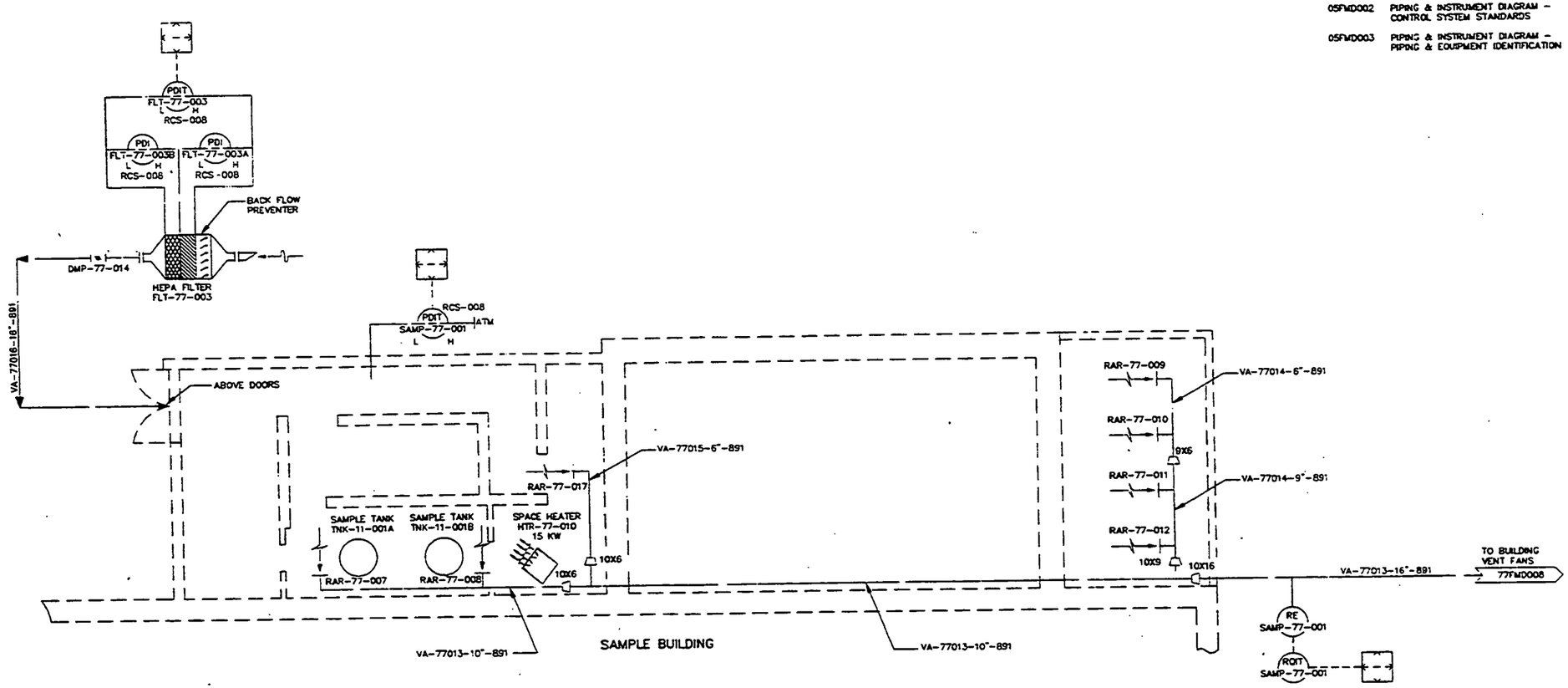
NOTES:

1. FOR GENERAL NOTES SEE DRAWING 05FMD004.
2. FOR MASS BALANCE TABLE SEE DRAWING 77FMD002.

REFERENCE DRAWINGS:

05FMD001	PIPING & INSTRUMENT DIAGRAM – INSTRUMENT IDENTIFICATION
05FMD002	PIPING & INSTRUMENT DIAGRAM – CONTROL SYSTEM STANDARDS
05FMD003	PIPING & INSTRUMENT DIAGRAM – PIPING & EQUIPMENT IDENTIFICATION



PRELIMINARY
NOT FOR CONSTRUCTION

REV	DATE	BY	CHK'D	APR'VD	DESCRIPTION/ISSUE
A					PRELIMINARY DESIGN SUBMITTAL

SPEC

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DESIGNED BY BF	DATE
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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
MISC FACILITIES HVAC SYSTEM
HVAC CONTROL DIAGRAM
SAMPLE BUILDING VENTILATION

SIZE	SCALE:	DWG. NO.	REV
D	NONE	77FMD007	A

FILENAME: 77FMD00

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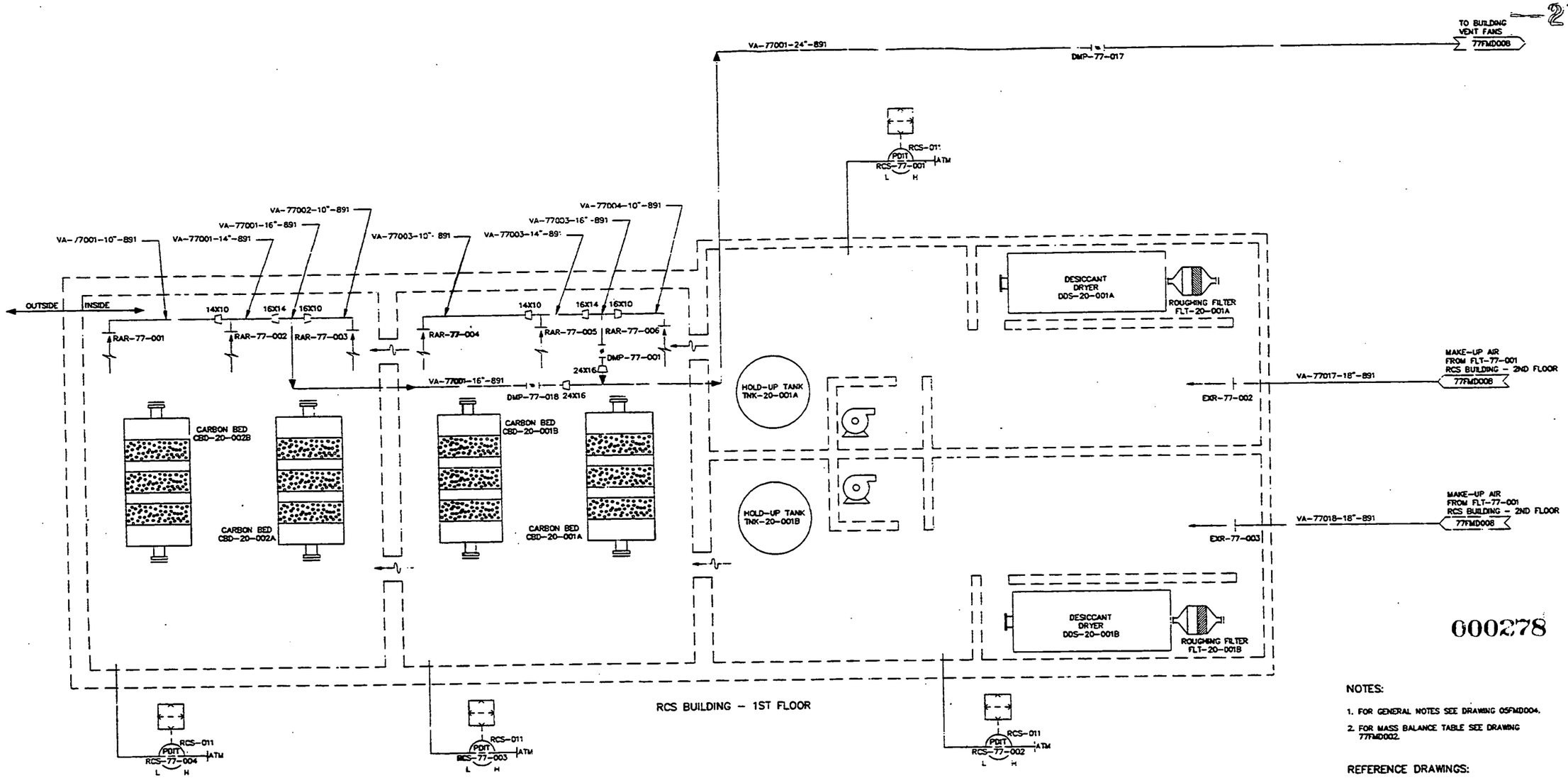

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NOTES:

1. FOR GENERAL NOTES SEE DRAWING 05FMD004.
2. FOR MASS BALANCE TABLE SEE DRAWING 77FMD002.

REFERENCE DRAWINGS:

05FMD001	PIPING & INSTRUMENT DIAGRAM - INSTRUMENT IDENTIFICATION
05FMD002	PIPING & INSTRUMENT DIAGRAM - CONTROL SYSTEM STANDARDS
05FMD003	PIPING & INSTRUMENT DIAGRAM - PIPING & EQUIPMENT IDENTIFICATION

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	A

DRAWN BY BJD	DATE
DESIGNED BY BF	DATE
CHECKED BY	DATE
APPROVED BY	DATE
APPROVED BY	DATE

REV	DATE	BY	CHK'D	APRV'D	DESCRIPTION/ISSUE
A					PRELIMINARY DESIGN SUBMITTAL

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NOT FOR CONSTRUCTION

FILENAME: 77FMD006

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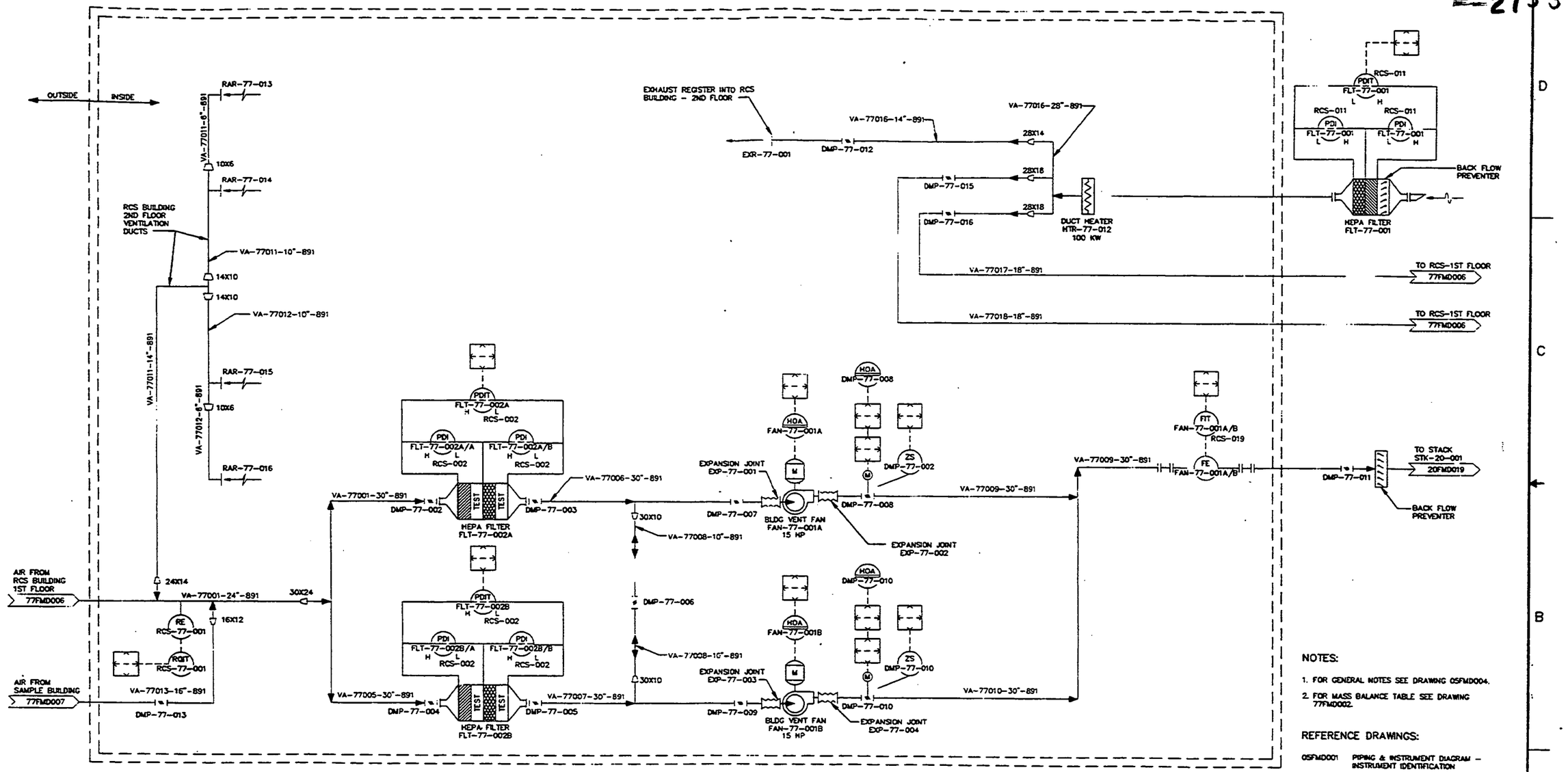

RCS BUILDING - 2ND FLOOR

NOTES:

1. FOR GENERAL NOTES SEE DRAWING 05FMD004.
2. FOR MASS BALANCE TABLE SEE DRAWING 77FMD002.

REFERENCE DRAWINGS:

05FMD001 PIPING & INSTRUMENT DIAGRAM - INSTRUMENT IDENTIFICATION

05FMD002 PIPING & INSTRUMENT DIAGRAM - CONTROL SYSTEM STANDARDS

05FMD003 PIPING & INSTRUMENT DIAGRAM - PIPING & EQUIPMENT IDENTIFICATION

PRELIMINARY
NOT FOR CONSTRUCTION

REV	DATE	BY	CHK'D	APRV'D	DESCRIPTION/ISSUE
A					PRELIMINARY DESIGN SUBMITTAL

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

DRAWN BY: BJD
DESIGNED BY: BF
CHECKED BY:
APPROVED BY:
APPROVED BY:

TITLE: MISC FACILITIES HVAC SYSTEM
HVAC CONTROL DIAGRAM
RCS BLDG VENTILATION-2ND FL

SIZE: D | SCALE: NONE | DWG. NO. 77FMD008 | REV A

FILENAME: 77FMD008.D

CONTENTS

—2753

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 2
1.6 Environmental Protection Measures 3
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

ATTACHED DRAWINGS

11FCD003, Silo Waste Retrieval System – Excavation Plan, Phase 1
11FCD004, Silo Waste Retrieval System – Excavation Plan, Phase 2A & 2B
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

ACRONYMS AND ABBREVIATIONS

--2753

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
ECP	Environmental Control Plan
FAT&LC	Fernald Atomic Trades and Labor Council
FDF	Fluor Daniel Fernald
FEMP	Fernald Environmental Management Project
FSM	Full-Scale Mock-Up
H:V	horizontal:vertical
FWENC	Foster Wheeler Environmental Corporation
SWRS	Silos Waste Retrieval System
WHWP	Waste Handling Work Plan

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 Daniel Fernald (FDF). The AWR Project is being performed by Foster Wheeler Environmental Corporation (FWENC) under FDF 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 construction and operational activities.

1.2 Scope of Work

The primary scope of work for the BEP addresses the excavation of the 3:1 (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 Silos 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 6800 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; it 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.

1.4 Radiological Surveys

Real-time radiological surveys shall be taken prior to any excavation activities to ensure that the soil is not contaminated. This survey program will be continued throughout the construction and operational excavation activities.

The radiological surveys required for berm soils will be performed by a health physics technician provided by FDF under the direction of FWENC. Noncontaminated soil will be loaded into dump trucks and transported to a location designated by FDF.

If the soil is contaminated, the work shall be stopped and FDF notified immediately. The disposition of the contaminated soil will be performed as directed by FDF. Before continuing excavation, written authorization from FDF is obtained.

The compliance requirements of the Waste Handling Work Plan (WHWP) (Document 40710-624-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. Table 2-1 shows the approximate volumes of berm excavation for each phase.

Table 2-1. Estimated Volume of during 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.

Foster Wheeler shall visually monitor the structural condition of the 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 FDF immediately. FDF 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 tri-axle 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.

The Hand Excavation Zone is an area that extends 2 feet from Silo 1 and 2 walls. All soil within 2 feet of the silo walls will be removed by hand excavation.

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). These measures are described in the Environmental Control Plan (ECP), Document 40710-624-P621-10. The ECP includes descriptions and requirements for:

- Air Emissions Control,
- Dust Control,
- Wastewater Control,
- Stormwater Control,
- Erosion Control, and
- Secondary Waste Management.

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 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.

The excavated soils will be directly placed in trailer dump trucks. Two trailers will be used to contain and transport the soil to a location designated by FDF. Th container will be covered for dust control and rain protection.

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

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

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.

Before Phase 1 excavation activities are performed, soil samples and real-time radiological surveys shall be taken to ensure that the soil is clean. Soil samples and real-time radiological surveys will also be performed periodically as the excavation progresses.

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 six members generally will be required. This crew consists of an excavator operator, front-end loader operator, teamster, 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, all 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. Only hand excavation will be performed in this zone.

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.

FDF 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 are coordinated to maintain the berm soil at a level 5 feet ± 1 foot higher than the waste level in the silos. ALARA protection of workers is verified continuously by monitoring equipment.

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To maintain the berm soil at a level of 5 feet ± 1 foot 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.

In all areas except between the two silos, the edge of the excavator, 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 until it is safe to use the excavator. 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 the FDF). 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

NOTES:

1. SEE DRAWING 05FCD011 FOR GENERAL NOTES AND LEGEND.

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SILO 3
SILO 2
SILO 1
PERIMETER ROAD
T-12
UNDERGROUND ELECTRICAL DUCTBANK
PHASE 1 EQUIPMENT PAD
ELEC GEN
ELEC PANEL
FHY
EMH
4" DW
2ND STREET
12" ST
FSMS SURROGATE MATERIAL DEWATERING BIN
STORAGE T-411
STORAGE T-412
VITPP FACILITY
VITPP CONTROL ROOM
30" CONC
CONTROL T-410
EMERGENCY BACKUP GENERATOR
AIR COMPRESSOR
PUMP
MAKEUP WATER STORAGE TANK
TURNTABLE SUPPORT FOUNDATION
94G ELECTRICAL EQUIPMENT BUILDING
HIGH PRESSURE PUMP SKID
K-65 TRENCH
PIPE SUPPORT (TYP.)
PIPE RACK
LIMITS OF GEOTEXTILE AND GRAVEL
PIV
EXIST. MH TOP 576.1 INV. 566.6
EXIST. MH
CHILLERS
SAMPLE PREP & STORAGE BUILDING 94F
STACK
STAIRWAY
EXISTING GATE
APPROX. LOCATION OF EXIST. GRATE
94E AIR HANDLING BUILDING (RCS)
94C TRANSFER TANK AREA BUILDING FFE = 576.0
94D CARBON BED BUILDING (RCS)
ASSEMBLY LAYDOWN/ STAGING AREA
APPROX. LOCATION OF EXIST. ROAD
FOUNDATION FOR SWRS SUPPORT STRUCTURE (TYP.)
EXIST 21" CONC PIPE
EXIST CB INLET
CB
CB-04
CB-03
CB-02
MH-01
CM-101R
SS MODULE ASSEMBLY AREA/ SECONDARY WASTE STAGING AREA
FOUNDATION FOR SWRS SUPPORT STRUCTURE ERECTION
APPROX. LOCATION OF EXIST. GRATE
PROPOSED LOCATION OF NEW GRATE
LIMITS OF GEOTEXTILE AND GRAVEL
EXIST ST
LOADING PLATFORM WITH STAIRWAY
30" CONC DRAIN
PERIMETER ROAD
12" ST
N 480600
N 480400
N 480200
E 1346800
E 1347000
E 1347200
E 1347400
11FCD003
11FCD004
11FCD005
11FCD006
11FCD007
11FCD008
11FCD009
11FCD010
11FCD011

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

30 0 30 60

SCALE IN FEET

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A		WVD			PRELIMINARY DESIGN SUBMITTAL

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DRAWN BY WVD	DATE
DESIGNED BY KEO	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	SCALE:	DWG. NO.	REV
D	1"=30'	11FCD003	B

FILENAME: 11FCD003.DWG

XREF DRAWINGS: 30-EXIST.DWG

STATE OF OHIO NORTH (NAD 83)

PERIMETER ROAD

T-12

UNDERGROUND ELECTRICAL DUCTBANK

FSMS SURROGATE MATERIAL DEWATERING BIN

PHASE 2B EQUIPMENT LIMIT

SILO 2

TURNTABLE SUPPORT FOUNDATION

HIGH PRESSURE PUMP SKID

EXIST 21" CONC PIPE

EXIST CB INLET

2' WIDE HAND EXCAVATION AREA

SILO

EXISTING GATE

APPROX LOCATION OF EXIST GRATE

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

FOUNDATION FOR SWRS SUPPORT STRUCTURE (TYP)

PHASE 2A EQUIPMENT LIMIT

APPROX. LOCATION OF EXIST. ROAD

PROPOSED LOCATION OF NEW GRATE

APPROX. LOCATION OF EXIST GRATE

FOUNDATION FOR SWRS SUPPORT STRUCTURE ERECTION

LIMITS OF GEOTEXTILE AND GRAVEL

EXIST. ST

12" ST

CB-04

CB-03

CB-02

MH-01

CM-101R

PERIMETER ROAD

SCALE IN FEET

NOTES:

1. SEE DRAWING 05FCD011 FOR GENERAL NOTES AND LEGEND.

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DRAWN BY WVD	DATE
DESIGNED BY KEO	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
PHASES 2A AND 2B

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FILENAME: 11FCD004.DWG

000290

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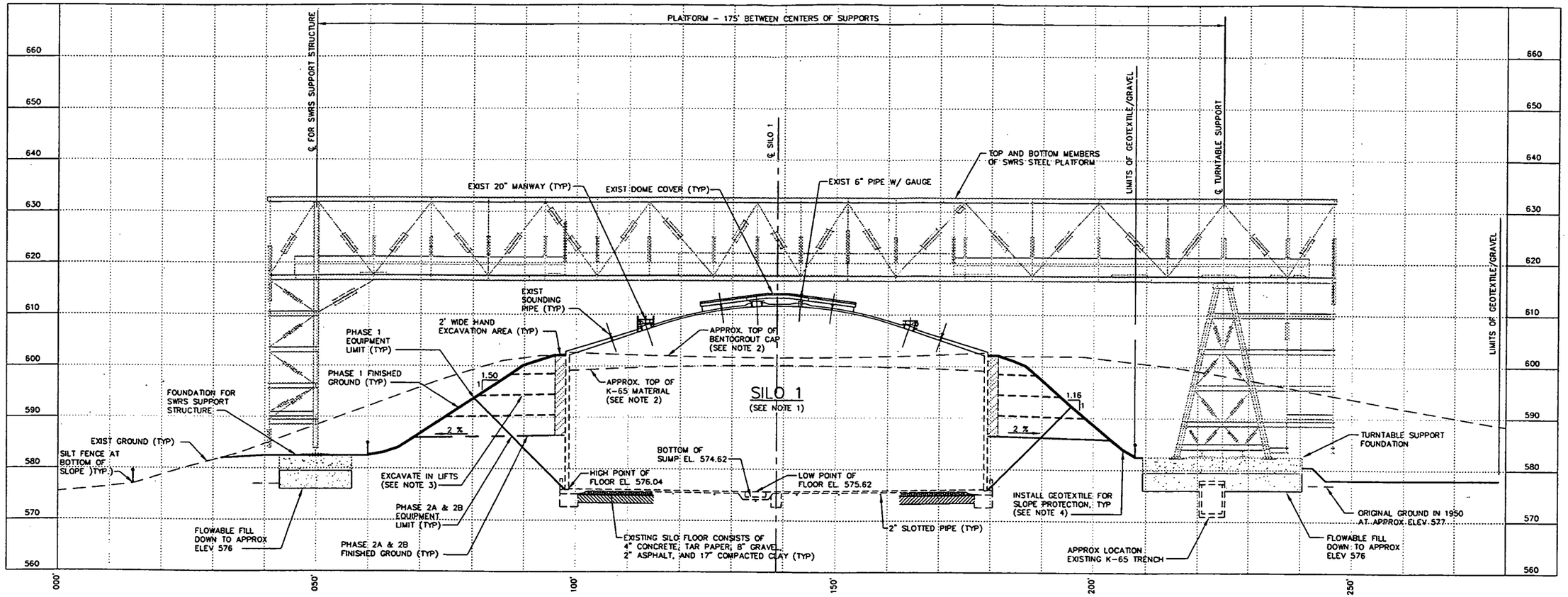

SECTION

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 SUCH THAT THE HEIGHT DIFFERENTIAL ON BOTH SIDES OF SILO WALL DOES NOT 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

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REV	DATE	BY	CHK'D	APR'VD	DESCRIPTION/ISSUE
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DRAWN BY WVD DATE
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CHECKED BY DATE
APPROVED BY DATE
APPROVED BY DATE

000291

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
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FILENAME: 11FCD006.DWG

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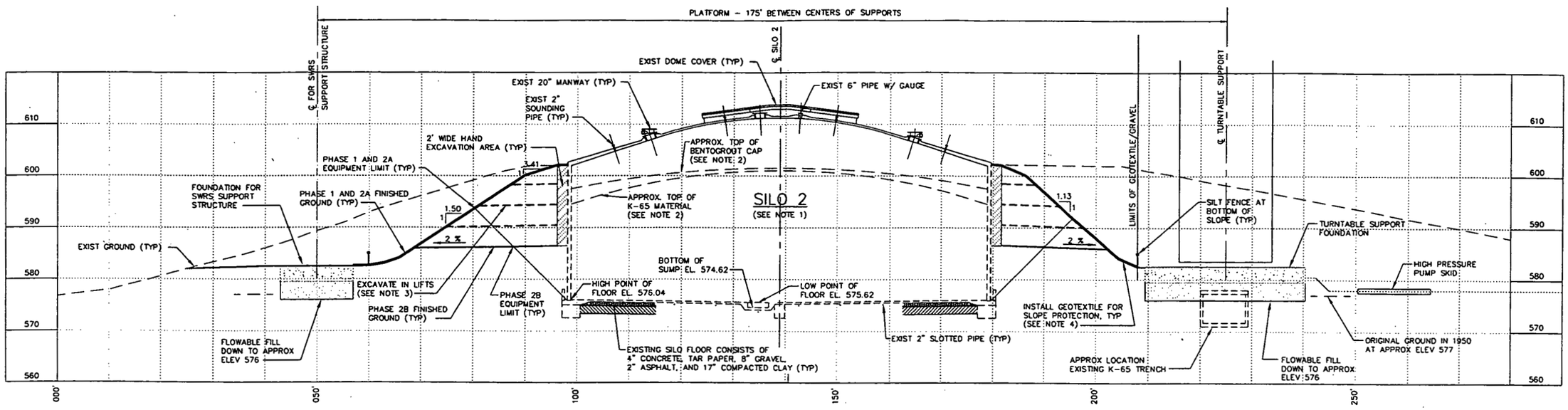

SECTION
SCALE: 1"=10'

C
11FCD003
11FCD004
11FCD009
11FCD010
11FCD007

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

000292

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 SUCH THAT THE HEIGHT DIFFERENTIAL ON BOTH SIDES OF SILO WALL DOES NOT 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.

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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
CROSS SECTIONS
SHEET 3

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

FILENAME: 11FCD007.DWG

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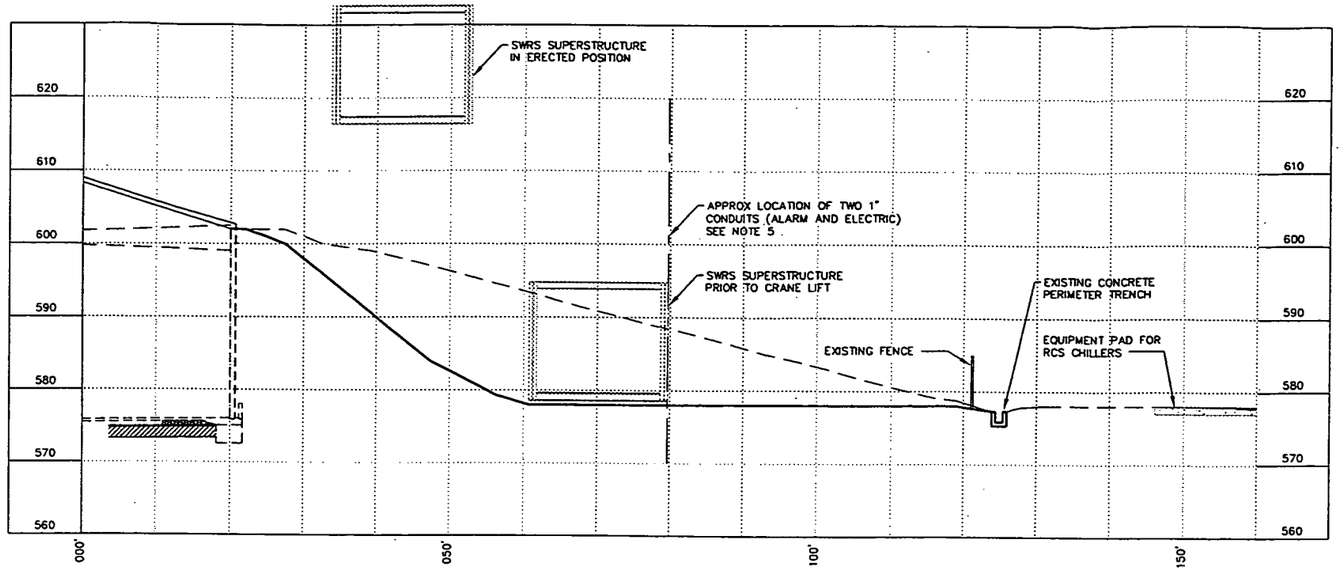

SECTION D
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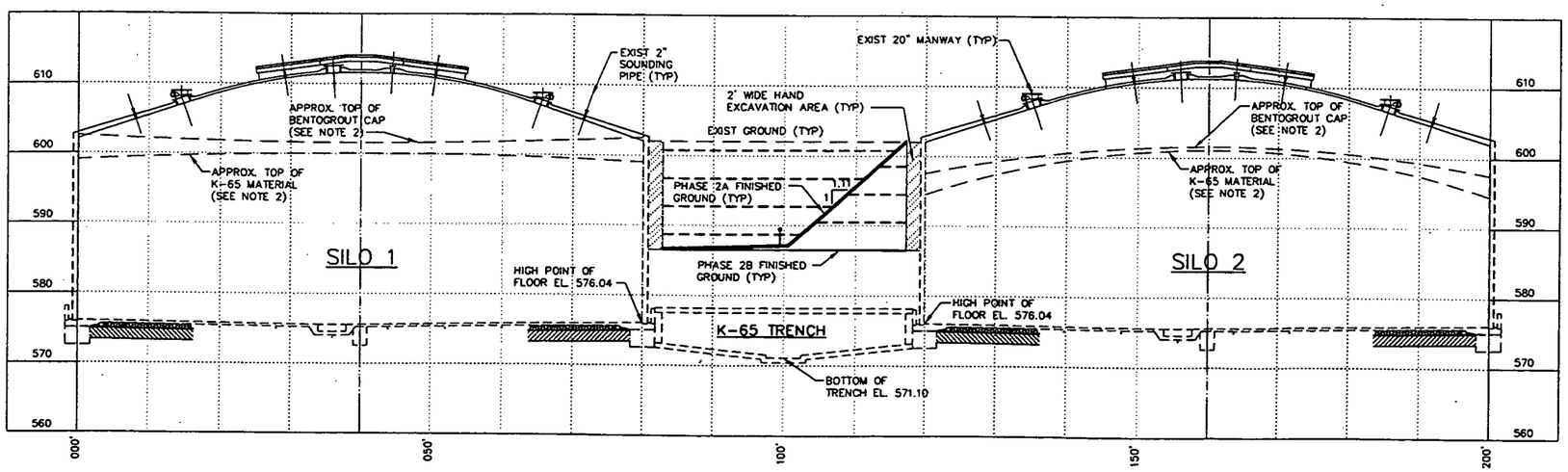

SECTION E
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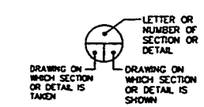
NOTES:

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 SUCH THAT THE HEIGHT DIFFERENTIAL ON BOTH SIDES OF SILO WALL DOES NOT 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.
5. TWO 1" CONDUITS, CARRYING ALARM AND ELECTRIC CABLE, ARE SHOWN ON DRAWING 94X-6100-E-02230.



SECTION & DETAIL KEY

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A		WVD			PRELIMINARY DESIGN SUBMITTAL

RPC

DRAWN BY WVD	DATE
DESIGNED BY KEO	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
CROSS SECTIONS
SHEET 4

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

FILENAME: 11FCD008.DWG

NOTES:

1. SEE DRAWING 05FCD011 FOR GENERAL NOTES AND LEGEND.

2753

PERIMETER ROAD
T-12
E 1346800
E 1347000
E 1347200
E 1347400
N 480600
N 480400
N 480200
UNDERGROUND ELECTRICAL DUCTBANK
CHASE EQUIPMENT BOX
SILO 2
SILO 1
EXISTING DECANT
EXIST 21" CONC PIPE
EXIST CB INLET
CB
MH
TURNTABLE SUPPORT FOUNDATION
HIGH PRESSURE PUMP SKID
PUMP
ELEC GEN
ELEC PANEL
FHY
FSMS SURROGATE MATERIAL DEWATERING BIN
STORAGE T-411
STORAGE T-412
CONTROL T-410
ELECTRICAL EQUIPMENT BUILDING
EMERGENCY BACKUP GENERATOR
AIR COMPRESSOR
MAKEUP WATER STORAGE TANK
VITPP FACILITY
VITPP CONTROL ROOM
FOUNDATION FOR 480V SWITCHGEAR
K-65 TRENCH
12" ST
EMH
4" DW
30" CONC
PIPE SUPPORT (TYP.)
PIPE RACK
LIMITS OF GEOTEXTILE AND GRAVEL
PIV
EXIST. MH TOP 576.1 INV. 566.6
CHILLERS
SAMPLE PREP & STORAGE BUILDING 94F
EXIST. MH
EXISTING GATE
APPROX. LOCATION OF EXIST. GRATE
STACK
STAIRWAY
94E AIR HANDLING BUILDING (RCS)
94C TRANSFER TANK AREA BUILDING FFE = 576.0
ASSEMBLY LAYDOWN/ STAGING AREA
94D CARBON BED BUILDING (RCS)
FOUNDATION FOR SWRS SUPPORT STRUCTURE (TYP.)
LIMITS OF GEOTEXTILE AND GRAVEL FOR SWRS SUPPORT STRUCTURE ERECTION (AFTER RCS IS FUNCTIONAL)
APPROX. LOCATION OF EXIST. ROAD
LIMITS OF GEOTEXTILE FOR SLOPE PROTECTION (TYP.)
CB-04
CB-03
CB-02
CM-101R
11FCD003
11FCD008
11FCD009
PROPOSED LOCATION OF NEW GRATE
LOADING PLATFORM WITH STAIRWAY
EXIST. 61
30" CONC DRAIN
SS MODULE ASSEMBLY AREA/ SECONDARY WASTE STAGING AREA
APPROX. LOCATION OF EXIST. GRATE
FOUNDATION FOR SWRS SUPPORT STRUCTURE ERECTION
LIMITS OF GEOTEXTILE AND GRAVEL
PERIMETER ROAD
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
30 0 30 60
SCALE IN FEET

000294

PRELIMINARY
NOT FOR CONSTRUCTION

REV	DATE	BY	CHK'D	APR'VD	DESCRIPTION/ISSUE
B	1/7/00	WVD			ISSUED FOR OHIO EPA REVIEW
A		WVD			PRELIMINARY DESIGN SUBMITTAL

RPE

DRAWN BY WVD	DATE
DESIGNED BY KEO	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

POSTER WHEELER
POSTER WHEELER ENVIRONMENTAL CORPORATION

TITLE
SILO WASTE RETRIEVAL SYSTEM
EROSION CONTROL PLAN
PHASE 1

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

FILENAME: 11FCD009.DWG

2753

STATE OF OHIO NORTH (NAD 83)

PERIMETER ROAD

T-12

E 1346800 | E 1347000 | E 1347200

N 480600 | N 480400 | N 480200

UNDERGROUND ELECTRICAL DUCTBANK

FSMS SURROGATE MATERIAL DEWATERING BIN

PHASE 2B EQUIPMENT LIMIT

SILO 2

SILO

TURNTABLE SUPPORT FOUNDATION

EXIST 21" CONC PIPE

EXIST CB INLET

2' WIDE HAND EXCAVATION AREA

HIGH PRESSURE PUMP SKID

EXISTING GATE

APPROX LOCATION OF EXIST GRATE

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

FOUNDATION FOR SWRS SUPPORT STRUCTURE (TYP.)

PHASE 2A EQUIPMENT LIMIT

APPROX. LOCATION OF EXIST. ROAD

APPROX. LOCATION OF EXIST. GRATE

FOUNDATION FOR SWRS SUPPORT STRUCTURE ERECTION

LIMITS OF GEOTEXTILE AND GRAVEL

PROPOSED LOCATION OF NEW GRATE

EXIST. 6T

CB-04 | CB-03 | CB-02 | CB

11FCD008 | 11FCD010 | 11FCD006

12" ST

PERIMETER ROAD

CM-101R

30 0 30 60

SCALE IN FEET

NOTES:

1. SEE DRAWING 05FCD011 FOR GENERAL NOTES AND LEGEND.

PRELIMINARY
NOT FOR CONSTRUCTION

REV	DATE	BY	CHK'D	APR'VD	DESCRIPTION/ISSUE
B	1/7/00	WVD			ISSUED FOR OHIO EPA REVIEW
A		WVD			PRELIMINARY DESIGN SUBMITTAL

RPE

DRAWN BY WVD	DATE	
DESIGNED BY KEO	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
EROSION CONTROL PLAN
PHASES 2A AND 2B

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

FILENAME: 11FCD010.DWG

000295

FOSTER WHEELER

FOSTER WHEELER ENVIRONMENTAL CORPORATION

CONTINGENCY PLAN AND EMERGENCY RESPONSE

DOCUMENT NO.
624-P621-09, Rev. A

FOR THE

SILOS 1 AND 2 ACCELERATED WASTE RETRIEVAL (AWR) PROJECT

SUBMITTED TO:

FLUOR DANIEL FERNALD (FDF)

CONTRACT NO. FSC 624

December 9, 1999

—2753

FOSTER WHEELER

FOSTER WHEELER ENVIRONMENTAL CORPORATION

CONTINGENCY PLAN AND EMERGENCY RESPONSE
Revision A

Recommended by:

Foster Wheeler ESQ Manager — Date: 12-9-99

Approved by:

Foster Wheeler Project Manager — Date: 12-9-99

—2703

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ACRONYMS

AEDO	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	Deputy Emergency Director
DOE	U.S. Department of Energy
DWRS	Decant Sump Waste Retrieval System
EAL	Emergency Action Levels
EDO	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	Emergency Response Team
ESQ	Environmental Safety and Quality
EZ	Exclusion Zone
FAT&LC	Fernald Atomic Trades and Labor Council
FDF	Fluor Daniel Fernald
FDS	Facilities Decontamination System
FEMP	Fernald Environmental Management Project
FHA	Fire Hazard Analysis
FSM	Full-Scale Mock-up
FSMS	Full Scale Mock-up System
GCBCTC	Greater Cincinnati Building and Construction Trades Council
GET	General Employee Training
HASP	Health and Safety Plan
HazCat	Hazard Category
ICAT	Integrated Construction Acceptance Test
INZ	Immediate Notification Zone
JIC	Joint Information Center
LEPC	Local Emergency Planning Committee
LOC	level of concern
mrem	milliroentgen
MSDS	Material Safety Data Sheet
NIS	not is scope
NPDES	National Pollutant Discharge Elimination System
OSHA	Occupational Safety and Health Administration
OU	Operable Unit
PAG	Protective Action Guide
PCM	personal contamination monitors

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ACRONYMS

F-2793

PLC	programmable logic control
PHA	Preliminary Hazards Analysis
PM	Project Manager
PPE	personal protective equipment
RCRA	Resource Conservation and Recovery Act
RCS	Radon Control System
RQ	Reportable Quantity
RSO	Radiation Safety Officer
S&H	Safety and Health
SOT	System Operability Test
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

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1.0 INTRODUCTION

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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 Daniel Fernald (FDF) and Foster Wheeler. The FDF 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. Foster Wheeler is to inform the FDF Emergency Duty Officer (EDO) or the 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 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 for which Foster Wheeler is responsible to perform. Controlled copies of this plan are to be distributed among appropriate AWR Project personnel according to AWR Project procedures. FDF 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 (Submittal 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

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.

000302

As the contractor to FDF for this work, Foster Wheeler is designing, constructing, testing and directing the operation and maintenance of the AWR Project. FDF is providing labor for operations and maintenance. The Project consists of four stages:

- **Stage 1.** Radon Control System (RCS) Installation, Operation, & 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 than 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.

- **Transfer Tank Area (TTA).** The TTA consists of transfer tanks to be used as a storage area for residue 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 residue 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.

- **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. For 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 10 or 13 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 FDF under Contract No. FSC 624. The Project Management Plan, Document No. 624-P621-01, describes the Foster Wheeler and FDF 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 FDF work coordination meetings and will coordinate any interference with another contractor through FDF.

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 tornado, earthquakes and excessive precipitation events, and transportation and utility systems.

1.5.1 Geography, Topography and Geology

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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 (FDF 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 (FDF 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.

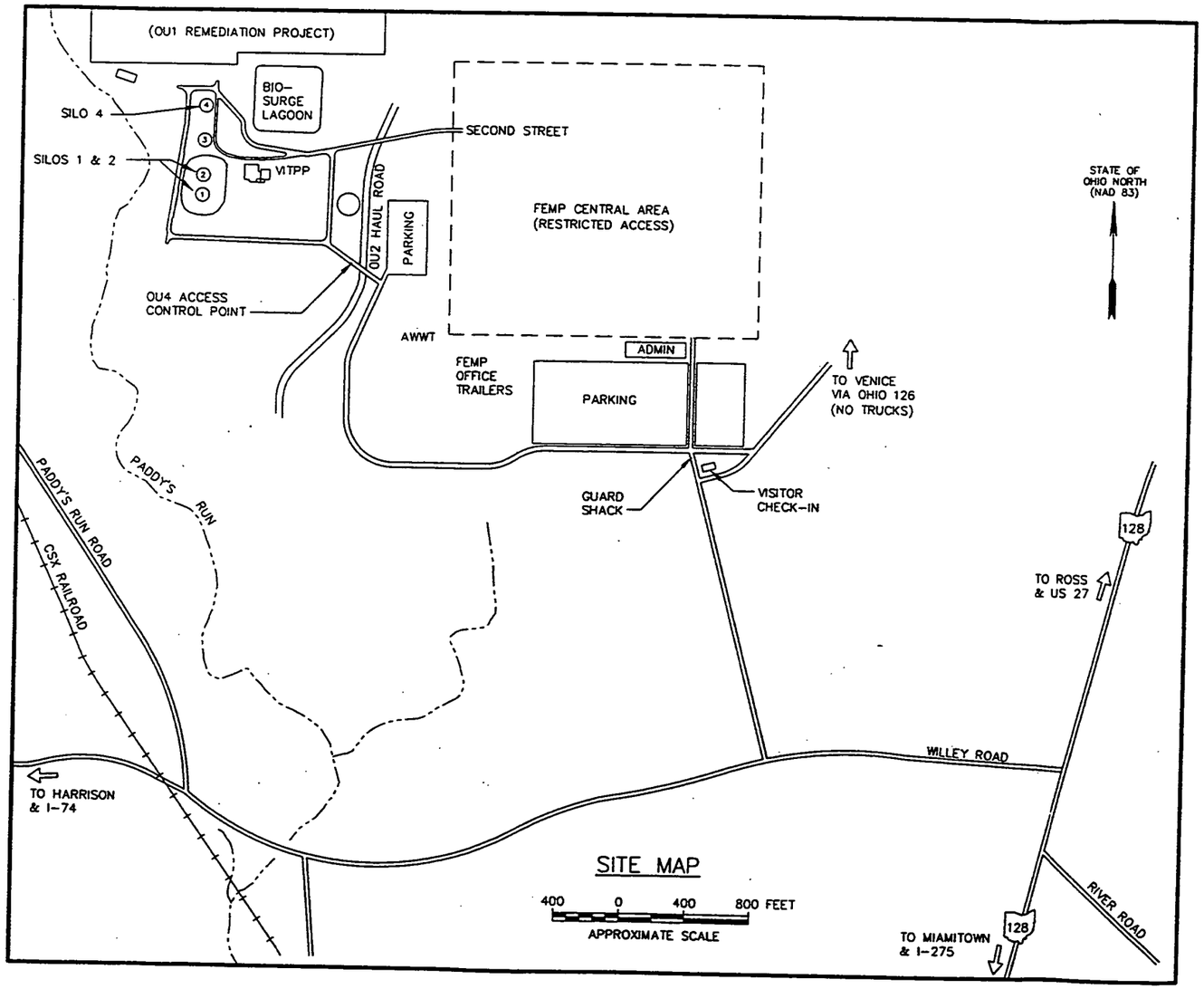
Geology. The FEMP is located in the ancestral valley of the Great Miami River. This valley is about 2 miles wide at the FEMP, with the floor about 200 feet below the present topography. The geology of the FEMP and its surrounding areas can be divided into three primary stratigraphic units: the bedrock, 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 (FDF 1998).

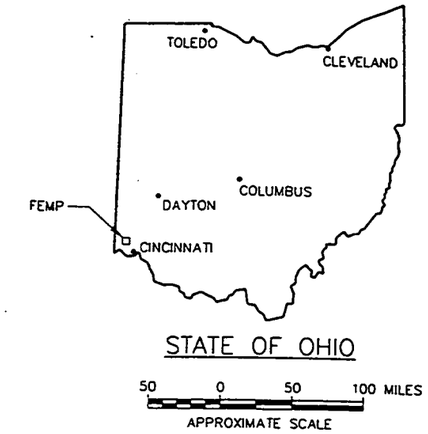
1.5.2 Population Distribution

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 (FDF 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 (FDF 1999). The average monthly wind speeds range from seven miles per hour (mph) in August to 11 mph in March (FDF 1998).





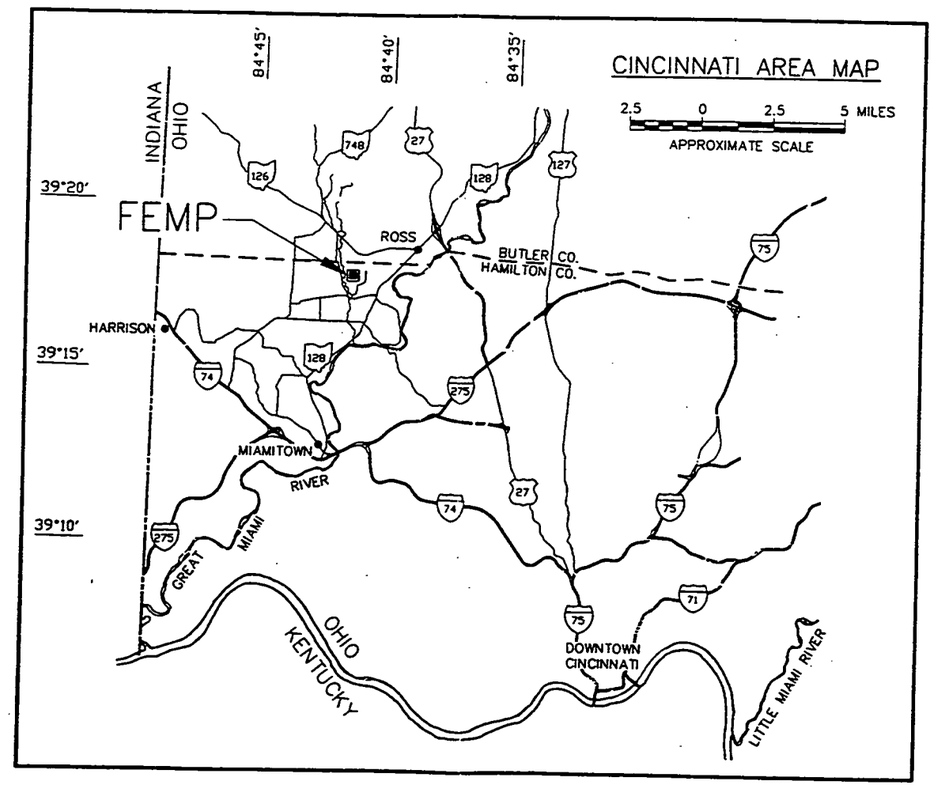


Exhibit 1-1. FEMP Site and Vicinity

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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 (FDF 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 seismicity and the absence of post-Wisconsin faults show that significant damage of local earthquakes at the FEMP is highly unlikely (FDF 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 (FDF 1998).

1.5.5 Transportation, Utility and Security Systems

The FEMP is served by a railroad spur 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 (FDF 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 (FDF 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 (FDF 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 FDF personnel.

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2.0 EMERGENCY RESPONSE ORGANIZATION

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"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 Organization Structure

For the AWR Project at FEMP, the Foster Wheeler individual responsible for emergency planning, preparedness, and response is the AWR Project Environmental Safety and Quality (ESQ) Manager. Both the Site Safety and Health (S&H) Representative and the Radiation Safety Officer (RSO) report directly to the AWR Project ESQ Manager and report functionally to the Foster Wheeler AWR PM, as depicted in Exhibit 2-1.

The AWR Project ESQ Manager oversees and approves the Contingency Plan and performs assessments to determine that the plan is in effect and that pre-emergency requirements are met. He acts as a liaison to FDF regarding regulatory issues and notifies the Occupational Safety and Health Administration (OSHA) of reportable accidents.

During the construction and operations/maintenance/systems closure phases, 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. Operation/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 manager.

The primary interface between FDF and FWENC is between Foster Wheeler's AWR Project Manager and the FDF Project Manager, although, for contractual issues the FDF Contract Administrator communicates directly with the Foster Wheeler AWR PM. Working interfaces also exist at the manager level. The ***primary construction interface*** is between FDF's Construction Contracts Manager and Foster Wheeler's Construction Manager. The ***primary operations and maintenance interface*** (including systems closure) is between FDF'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 FDF is established to work critical issues over the course of the AWR Project. This interface is between FDF'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 the GCBCTC personnel. FDF Team Leaders have the responsibility for managing FAT&LC personnel. FDF Team Leaders are utilized as the liaison between the Foster Wheeler Supervisory and Management personnel and the FAT&LC personnel.

Safety and health, radiation safety, and quality are line management responsibilities. The S&H Representative, the RSO, and the Quality Manager support line management in establishing and maintaining safety, radiological control, and quality control programs. They report, functionally, to the AWR PM. To prevent any potential for conflict of interest, these personnel report directly to Foster Wheeler's AWR Project ESQ Manager.

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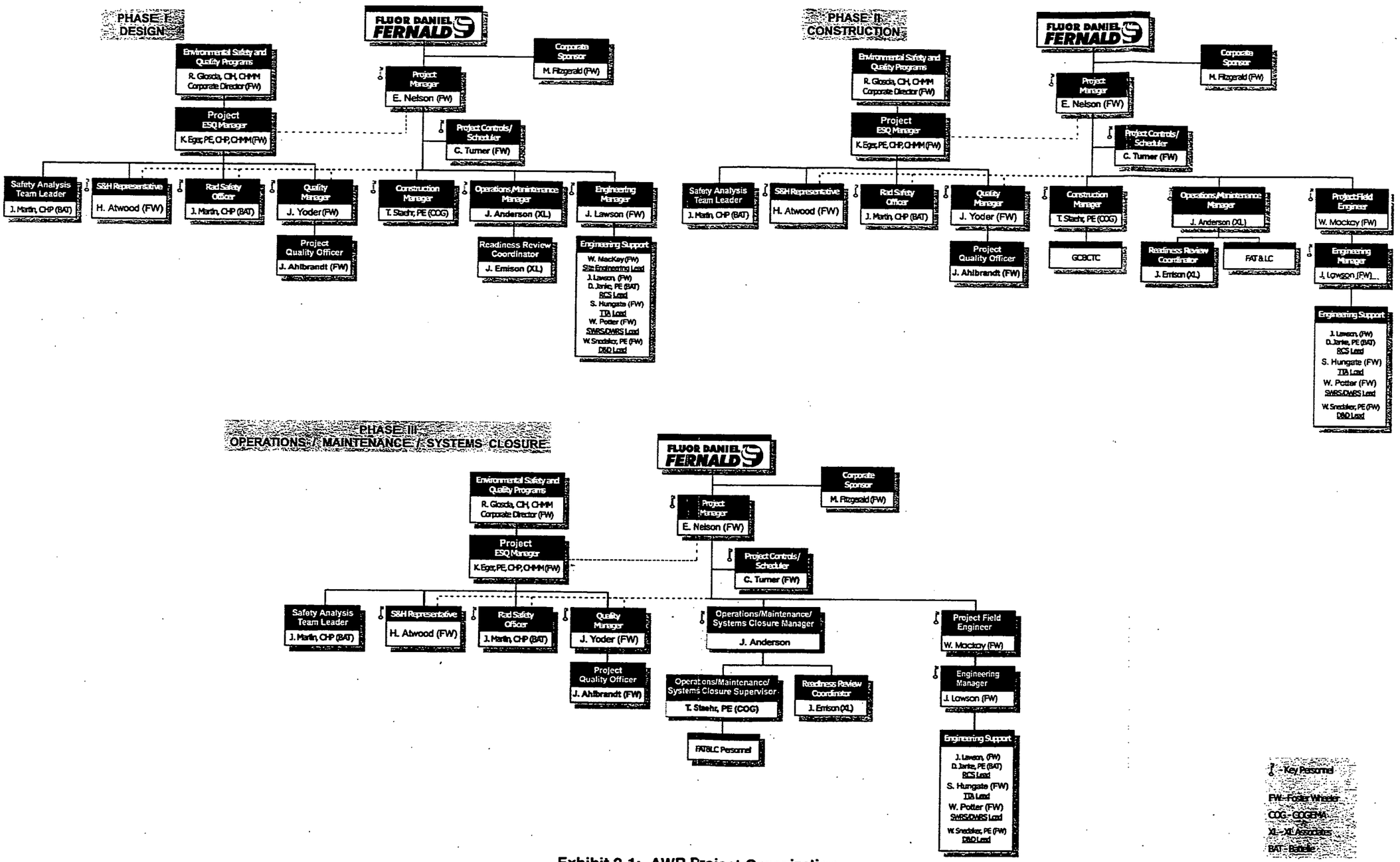

Exhibit 2-1: AWR Project Organization

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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.

2.2.1 Responsibilities of the Emergency Coordinator

The Senior Shift Supervisor (during construction) or the Shift Supervisor on duty (during operations) serves as the Emergency Coordinator for the AWR Project and is responsible for personnel safety and machinery and processes in the event of an emergency or a stop work order. He is required to immediately notify the EDO or AEDO and AWR Project personnel.

In the event of an emergency at the AWR Project site, the Emergency Coordinator reports immediately to the scene of the emergency to assess the seriousness of the situation, immediately notifies the EDO or AEDO and the Foster Wheeler AWR PM, and directs whatever efforts are necessary until the ERT arrives. At his discretion, the Emergency Coordinator may also order closure of the site for an indefinite period. His responsibilities in the event of an emergency include:

- Informs the AEDO of existing conditions and cooperates with the AEDO to resolve the emergency situation,
- Directs the activities of personnel in emergency situations and calls for assistance,
- Assigns employee/alternate to turn off equipment and utilities in the event of an emergency shutdown, as necessary,
- Provides for assistance of physically challenged employees during evacuations, as necessary,
- Assigns/designates employees to perform specific tasks relating to an individual building during an emergency situation, and
- Conducts a Rally Point headcount, or designates an alternate to do so, when the AWR Project area is evacuated.

In addition, the Project Manager, the Construction Manager, or the Operations/Maintenance/ Systems Closure Manager may assume the Emergency Coordinator responsibilities upon arrival at the scene.

2.2.2 Responsibilities of the PM

Throughout all project phases, the Foster Wheeler PM has complete authority and responsibility for Foster Wheeler and subcontractor personnel performance. The AWR 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 personnel has the following responsibilities related to emergency response action to be taken during abnormal situations at the AWR Project site:

- Notifies nearby personnel to evacuate danger areas in the event of an emergency,

- Proceeds in accordance with this Contingency Plan in emergency situations,
- Responds to emergency signals, and
- Supports the Emergency Coordinator and the EDO or AEDO as necessary.

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2.3 Emergency Management Operations

Emergency response related to the AWR Project is a shared responsibility between FDF and Foster Wheeler. The FDF 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 AWR Project Emergency Coordinator is to inform the FDF EDO or the AEDO in the event of an emergency. FDF 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 FDF in external communications, however, all communications for the AWR Project, including those related to emergency response notifications, with outside individuals, agencies, or other stakeholders must go through FDF, as depicted in Exhibit 3-1. When implemented, the FEMP Emergency Plan provides is used as the basis for offsite response interfaces for the FEMP site.

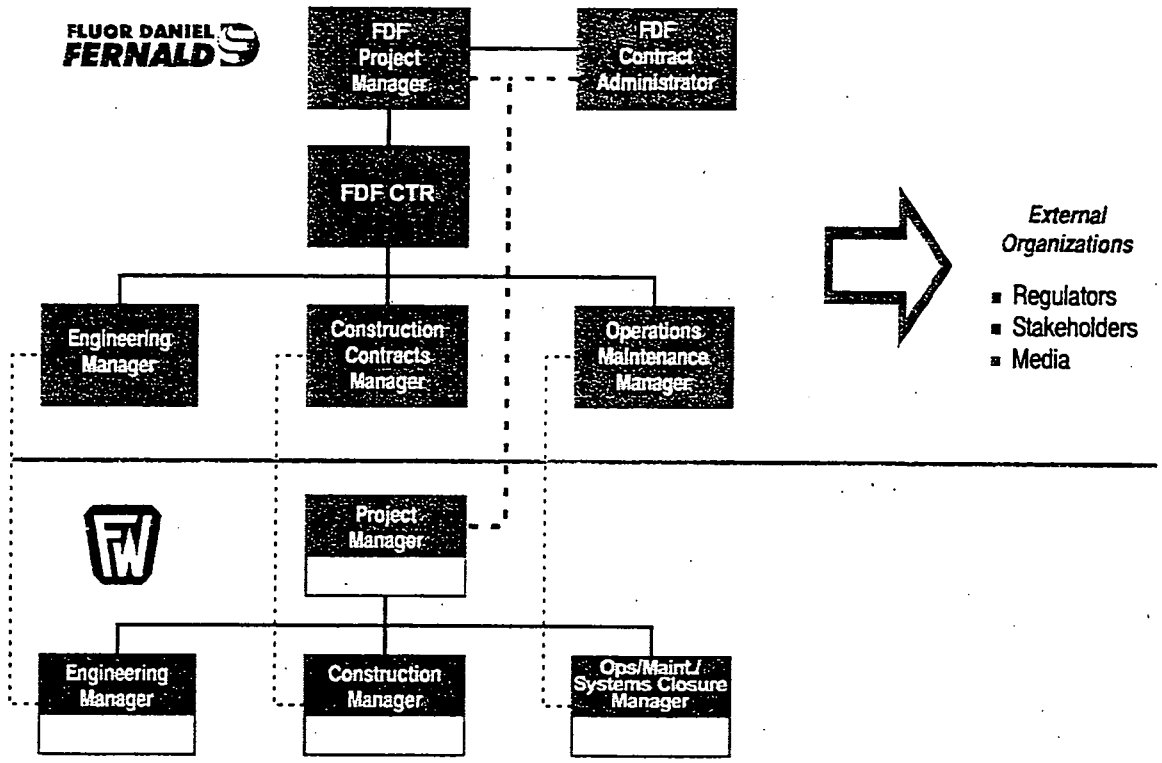

Exhibit 3-1. AWR Project Interfaces

The FEMP maintains mutual aid agreements with local authorities for fire, ambulance, law enforcement, and medical services. The AEDO, with assistance of FDF division commanders, determines the need to invoke these agreements during an emergency (FDF 1999).

4.0 EMERGENCY CLASSIFICATION

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"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 FDF EDO or AEDO will classify each emergency based on information provided by the Foster Wheeler Emergency Coordinator 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 and non-radiological hazardous materials.

During off-normal events, FDF will take over control of the AWR Project work area and implement appropriate actions, with direct input from Foster Wheeler. The FDF EDO or AEDO and the ERT then direct the appropriate emergency actions at the remainder of the site. Foster Wheeler will also notify FDF 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 Emergency Coordinator shall notify the FDF EDO or AEDO in the event of an emergency, in which the FDF ERT will provide emergency response at the AWR Project site. The AEDO and EDO assess and categorize/classify the event. All events are recorded in a daily log by FDF, 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, offsite notifications are handled strictly by FDF and DOE in accordance with the FEMP Emergency Plan. In cases of a fatality or catastrophe in which three or more workers are injured and hospitalized, the Emergency Coordinator notifies the AWR Project ESQ Manager immediately, and the AWR Project ESQ Manager notifies OSHA.

5.2 Onsite Notifications

The Foster Wheeler Emergency Coordinator is required to notify the FDF 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 FDF. 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 Emergency Coordinator (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 <u>not</u> a Foster Wheeler employee.

Written confirmation of verbal reports are to be submitted within 24 hours. The Foster Wheeler accident/incident report forms are provided in Appendix B of 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

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Local evacuation alarms are provided in the Vitrification Pilot Plant (ViTPP) Control Room for the AWR Project. These alarms will activate if the RCS stack alarm or TTA secondary containment leak detection alarms are activated. In addition to these types of emergency communication, the following types of communications may be used at the AWR Project site:

- **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.

- **Radios** – The primary form of communication during an emergency between field groups in the exclusion zone (EZ) and the Emergency Coordinator will be radio communications. Each field team within the EZ shall have a radio. 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.

- **Air Horns** – Air horns shall be carried by field teams or be strategically located within the EZ and shall be maintained at the SZ for announcing emergency evaluation procedures and backup for other forms of communication. The use of air horns will be coordinated with existing FEMP Emergency Management System (EMS), which is the site wide notification system of alarms or alert tones followed by voice messages. Typical air horn signals include the following:

Horn Signal	Meaning
Two short blasts	Shut down equipment, clear radio channels, and await instructions.
Three short blasts	Injured employee, first-aid providers respond.
One continuous blast	Evacuate site.

- **Hand Signals** – Hand signals shall be used by field teams along with the buddy system. These signals shall be known by the entire field team 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.

6.0 CONSEQUENCE ASSESSMENT

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"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 Emergency Coordinator will assist the FDF 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 that 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 are those taken in part from the FEMP Emergency Plan that are to be considered for emergency planning purposes related to the AWR Project, along with general mitigation measures related to the events. Protective actions for these events are summarized in Section 7 of this Contingency Plan.

Severe Weather and Earthquakes. Severe weather is the most likely event to occur at the FEMP with tornadoes 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 tornadoes 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 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.

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 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 could be isolated from additional assistance, especially during the initial hours of such an event. Damage to the silos or AWR Project facilities could cause a radiological release.

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Radiological Release (Dome Collapse/TTA Tank Rupture or Leak). 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). 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 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 (FDF 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 (FDF 1999a).

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 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.

Fires can be potentially prevented by adhering to the following precautions:

- Good housekeeping and storage of materials,
- Storage of flammable liquids and gases away from oxidizers,
- No smoking in the EZ or any work area,
- No hot work without a properly executed hot work permit,
- Shutting off engines to refuel,
- 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.

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.

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 and the discovery of suspicious devices.

6.2 Continuous Assessment and Coordination

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An initial assessment of an incident is performed by the FDF AEDO, with assistance from Foster Wheeler as required, and developed into a tactical attack plan to resolve the incident. A more comprehensive assessment can be performed by the EOC, when activated. As events unfold, the situation is reassessed with input from the field teams and the EOC staff.

7.0 PROTECTIVE ACTIONS AND REENTRY

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"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 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. Further evacuation and protective actions are governed by implementation of the FEMP Emergency Plan. Appendix C of 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 first aid equipment and emergency facilities and equipment for the AWR Project are also provided on the area map.

Once the Foster Wheeler Emergency Coordinator notifies the FDF AEDO and the initial incident assessment has been conducted, the AEDO may direct onsite protective actions. Once the EDO is briefed or the 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 FDF in determining the appropriate emergency class, affected area, and protective actions for onsite and offsite personnel.

Severe Weather and Earthquakes. Sheltering is the preferred action for tornadoes and severe weather emergencies. In this sense, sheltering is defined as moving personnel into permanent buildings and out of temporary buildings or trailers. **WARNING: AVOID WORKING IN HAZARDOUS SITUATIONS SUCH AS HIGH, UNPROTECTED AREAS OR AREAS WHERE MATERIALS MAY BE BLOWN BY WIND.**

When the announcement of severe weather approaching is made, do **ONE** of the following:

- 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.
- If outside, then secure equipment/material and move into nearest permanent structure.
- If in a trailer, smoking shelter, or Tension Support Structure (TSS), then seek shelter in nearest permanent structure.
- If in a permanent structure, then do the following:
  - ✓ Close and secure windows, doors, other openings through 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.

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 Emergency Operations Center

(EOC) operated by FDF ensure command and communications capabilities during such an event.

The following steps shall be taken in event of an earthquake:

- Take shelter under a study 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 of this Contingency Plan) or as directed by Emergency Coordinator.

Radiological Release (Dome Collapse/TTA Tank Rupture or Leak). Possible indications of a radiological release in the silos area, as adapted from FEMP Site Procedure EM-0030, Silos Area Emergency Procedure (FDF 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,
- Activation of remote RCS stack alarms or TTA leak detection alarms, or
- Abnormally high radon working levels.

The following steps are the initial emergency actions to be performed in the event of damage or failure to one of the silos or silo domes or in the event of a rupture to a TTA tank:

- Cease silo 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 (PCM),**
- Proceed to Rally Point #4,
- Notify the Facility Owner or designee of the event and its estimated magnitude, and
- Notify the AEDO.

Dome Collapse: 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. In the event of a partial dome collapse, the FDF AEDO will evaluate the placing of tarps over the collapsed area.

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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 appropriate notifications and upon concurrence from the FDF AEDO.

1. Leak detection is provided by means of level instruments in the containment sump, and is verified visually by closed circuit television (CCTV). Capability is provided to determine which one of the four 750,000-gallon TTA Transfer Storage Tanks is leaking by visual inspection and/or by monitoring tank level. If a leak is detected in the containment sump, then transfer to any tank will be automatically stopped by interlock in the Programmable Logic Control (PLC) system.

2. Upon shutdown of the system, operations personnel shall conduct an investigation to determine the cause of the release to the secondary containment. This investigation is accomplished by CCTV inspection.

3. 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.

4. 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-wt% 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.

5. 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.

6. 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:

   a. The residue level in the tank has been lowered below the affected area.

   b. Visual inspection from inside and outside the tank is made to determine 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.

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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.

Fire. In the event of a fire or explosion, AWR Project personnel are to immediately evacuate the site and meet at Rally Point #4 for accountability. This evacuation is triggered by an air horn, which will sound for a single continuous blast. 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, report directly to the FEMP Communications Center on phone 648-6511, or 911, or use a portable radio. **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 fire cautiously until ERT arrives. **(NOTE: Use METL-X for burning metal fires. Use CO2, 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.)**
- If possible and safe, shut off gas, electrical power, and operating equipment. Remove combustible or other hazardous material to secure location.
- 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 the Rally Point #4 (see Appendix C of this Contingency Plan). **(NOTE: Instruct persons in transit to avoid the facility and surrounding area.)**

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 Emergency Coordinator 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 FDF 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 ERT as requested.

Bomb Threats/Suspicious Devices. Personnel are to respond conservatively to bomb threats and the discovery of suspicious devices. Actions to respond to such an event are addressed in FEMP Site Procedure EM-0023, Bomb Threat Procedure (FDF 1997a) and Site Procedure EM-0020, Building Emergency Procedure (FDF 1998b). Alert FDF AEDO/EDO immediately. Complete the bomb threat checklist, or equivalent, as provided in Appendix D of 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 potentially 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 is 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 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 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 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 EM-0004 of type or quantity to invoke the use of ERPGs.

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 FDF. All events are recorded in a daily log by FDF, and the appropriate notifications and reports 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 of 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 Emergency Coordinator will designate an employee to log the head count and report unaccounted personnel back to the Emergency Coordinator, 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. FDF 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 FDF in this area as requested.

The FDF AEDO, as the FEMP's Incident Commander for emergency response, will be the identified person within the 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 Emergency Coordinator (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 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.

7.9 Communication

Other than the initial notification to onsite AWR Project personnel and the FDF AEDO, all other emergency communications are the responsibility of FDF. These communications include those made to offsite response agencies, as needed, and are performed by DOE and FDF 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 FDF Deputy Emergency Director (DED), in consultation with other 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. Operations are controlled remotely and can be safely shutdown from the ViTPP Control Room 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. However, should an injury occur, no matter how slight, it will be reported to the Foster Wheeler Site S&H Representative immediately. First aid equipment will be available at various locations in and around the AWR Project site, consisting of first aid kits, emergency eye wash stations, and drench showers.

During the site safety briefing of each employee, AWR Project personnel will be informed of the locations of the first aid stations that have been set up. Unless they are in immediate danger, severely injured persons will not be moved until paramedics 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 paramedics, before the ERT arrives at the site or before the injured person can be transported to the hospital, will be followed closely.

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 (FDF 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 Emergency Medical Technicians (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, operate 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 that may serve as the decontamination prior to, or in conjunction with, emergency medical treatment.

8.3 Offsite

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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 FDF 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. FDF uses the criteria provided in FEMP Site Procedure EM-0003, Reentry and Recovery (FDF 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 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.

FDF will conduct recovery operations in accordance with FEMP Site Procedure EM-0003 (FDF 1998a). Foster Wheeler will assist FDF, 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 enter building or area until monitoring has been conducted by FEMP Industrial Hygiene.
- 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 a check for radioactivity has been conducted by FEMP Radiological Safety.

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10.0 PUBLIC INFORMATION

"Public affairs policy and planning requirements apply for all emergencies..."

The dissemination of public information related to emergencies at the FEMP site is the responsibility of FDF and DOE. This dissemination will be conducted in accordance with of the FEMP Emergency Plan. The FDF 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 FDF 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 FDF, as requested, per the interfaces described in Section 3 of this Contingency Plan.

11.0 EMERGENCY FACILITIES AND EQUIPMENT

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"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 at the Fairfield Training Center),
- 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 in Buildings 69 and 78), 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 EMS, FM radios, high frequency/single-side band radios, and pagers,
- Fire/Rescue Equipment such as fire pumpers, rescue vehicle, HAZMAT unit and trailer, water tanker, mobile air supply trailer, and ambulance/life squads,
- Monitoring Equipment for both chemical and radiological constituents,
- 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.

11.3 AWR Project Area Emergency Equipment and Facilities

Foster Wheeler will be supported in emergency response situations by FDF through the use of the FEMP emergency facilities and equipment described above. In addition, local evacuation alarms are provided in the ViTPP Control Room for the AWR Project. These alarms will activate if the RCS stack alarm or TTA secondary containment leak detection alarms are activated. Additional types of emergency communications are available at the AWR Project site such as telephones (e.g., office, cellular, and pagers), radios, and air horns.

First aid equipment will be available at various locations in and around the AWR Project site, consisting of first aid kits, emergency eye wash stations, and drench showers (see Appendix C of 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: 2753

- Burn kit,
- Fire blanket,
- Stretcher,
- 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.

Per FEMP Site Procedure EM-0030, FDF currently identifies emergency equipment in the silos area to include 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 FDF.

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12.0 PROGRAM ADMINISTRATION

"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 and maintain compliance 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 FDF regarding regulatory issues and notifies the OSHA of reportable accidents. The Foster Wheeler Senior Supervisor (during Construction) or the Shift Supervisor on duty (during Operations/Maintenance/Systems Closure) serves as the AWR Project Emergency Coordinator. This person reports directly to the Foster Wheeler AWR 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 FDF 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 (FDF 1999a). Foster Wheeler would also support the FEMP Lessons Learned program for emergency preparedness as requested by FDF.

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 Emergency Coordinator 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.

AWR Project personnel will also be instructed on proper emergency response procedures and locations of emergency telephone numbers during their initial site safety meeting. Foster 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. We 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 FDF.

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
- Notify the supervisor of Emergency Coordinator of emergency or non-routine events immediately.

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.

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13.0 REFERENCES

(DOE 1996) U.S. Department of Energy Order 151.1, Comprehensive Emergency Management, Change 2, August 21, 1996.

(FDF 1997) FEMP Site Procedure EM-0004, Protective Actions, Rev. 1, November 27, 1997.

(FDF 1997a) FEMP Site Procedure EM-0023, Bomb Threat Procedure, Rev. 2, November 21, 1997.

(FDF 1998) Hazards Analysis Report for Operable Unit 4 (OU4) Silos, Rev. 0, May 26, 1998.

(FDF 1998a) FEMP Site Procedure EM-0003, Reentry and Recovery, Rev. 3, April 24, 1998.

(FDF 1998b) FEMP Site Procedure EM-0020, Building Emergency Procedure, Rev. 5 (PCN1), February 17, 1998.

(FDF 1999) 1998 Integrated Site Environmental Report, Fluor Daniel Fernald, June 1999.

(FDF 1999a) FEMP Emergency Plan, Rev. 4, May 25, 1999.

(FDF 1999b) FEMP Site Procedure EM-0030, Silos Area Emergency Procedure, Rev. 3, March 24, 1999.

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APPENDIX A

FEMP EAL Guides Applicable to AWR Project

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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) total effective dose equivalent 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 (JIC) • Monitoring teams • Security (Recall) • Medical (Recall) • Emergency Response Team (Recall) • Mutual Aid (as needed)		

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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. 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, ≥ Level of Concern (LOC).	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.
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 (JIC) • Monitoring teams • Security (Recall) • Medical (Recall) • Emergency Response Team (Recall) • Mutual Aid (as needed)		

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HEALTH AND SAFETY			
Health & Safety	**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 unclear criticality resulting in actual or potential facility damage and /or release of radioactive material to the environment. • Any on-site 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 (JIC) • Monitoring teams • Security (Recall) • Medical (Recall) • Emergency Response Team (Recall) • Mutual Aid (as needed)		

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ENVIRONMENTAL			
Environmental	**Alert**	**Site Area**	**General**
Criteria	The following event 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) 302, that could 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 off-site consequences (e.g., need to relocate people, major wildlife kills, wet-land 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.]		
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 (JIC) • Monitoring teams • Security (Recall) • Medical (Recall) • Emergency Response Team (Recall) • Mutual Aid (as needed)		

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APPENDIX B

AWR Project
Foster Wheeler Accident/Incident Report Forms

CORPORATE ESQ REPORT # 2753

FOSTER WHEELER ENVIRONMENTAL CORPORATION

FOSTER WHEELER ENVIRONMENTAL CORPORATION
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

PROJECT/OFFICE: 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

HOME ADDRESS:

SOCIAL SECURITY #: HOME 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: ☐ ON SITE ☐ DR.'S OFFICE ☐ HOSPITAL

NAME OF PERSON(S) PROVIDING TREATMENT:

ADDRESS WHERE TREATMENT WAS PROVIDED:

TYPE OF TREATMENT:

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FOSTER WHEELER ENVIRONMENTAL CORPORATION
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 as identified in Table 1 of this procedure ASAP, but no later than 24 hours.

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INVESTIGATIVE REPORT

REPORT #: 2753

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/OFFICE MANAGER (PRINT) SIGN:

COMMENTS:

PESM or ESC (PRINT) SIGN:

COMMENTS:

NOTE: Attach additional information as necessary. Supervisor to forward copy of Investigative Report to the PM or OM, PESM or ESC ASAP, 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.

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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.

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INCIDENT/NEAR MISS REPORT AND INVESTIGATION INSTRUCTIONS

General: The incident report (pages 1 and 2) 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, (DO) # and location. If the incident occurs on a Consulting and Engineering (C&E) 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 [FOL] 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 off-site 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 personal protective equipment (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.

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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).

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.

Response Action Taken: Describe the mitigation efforts, as well as any reports made, beyond initial notification.

Permit Exceedence

Type of Permit: List name of permit including the agency name where applicable (e.g., NPDES, PSAPCA NOC).

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 described on page 1 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 (next page) should be the same person.

Investigative Report

Report No.: This is the same as the project/office 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 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 example on page 4. 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 on page 1 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.

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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 (ESS), Quality Control (QC), 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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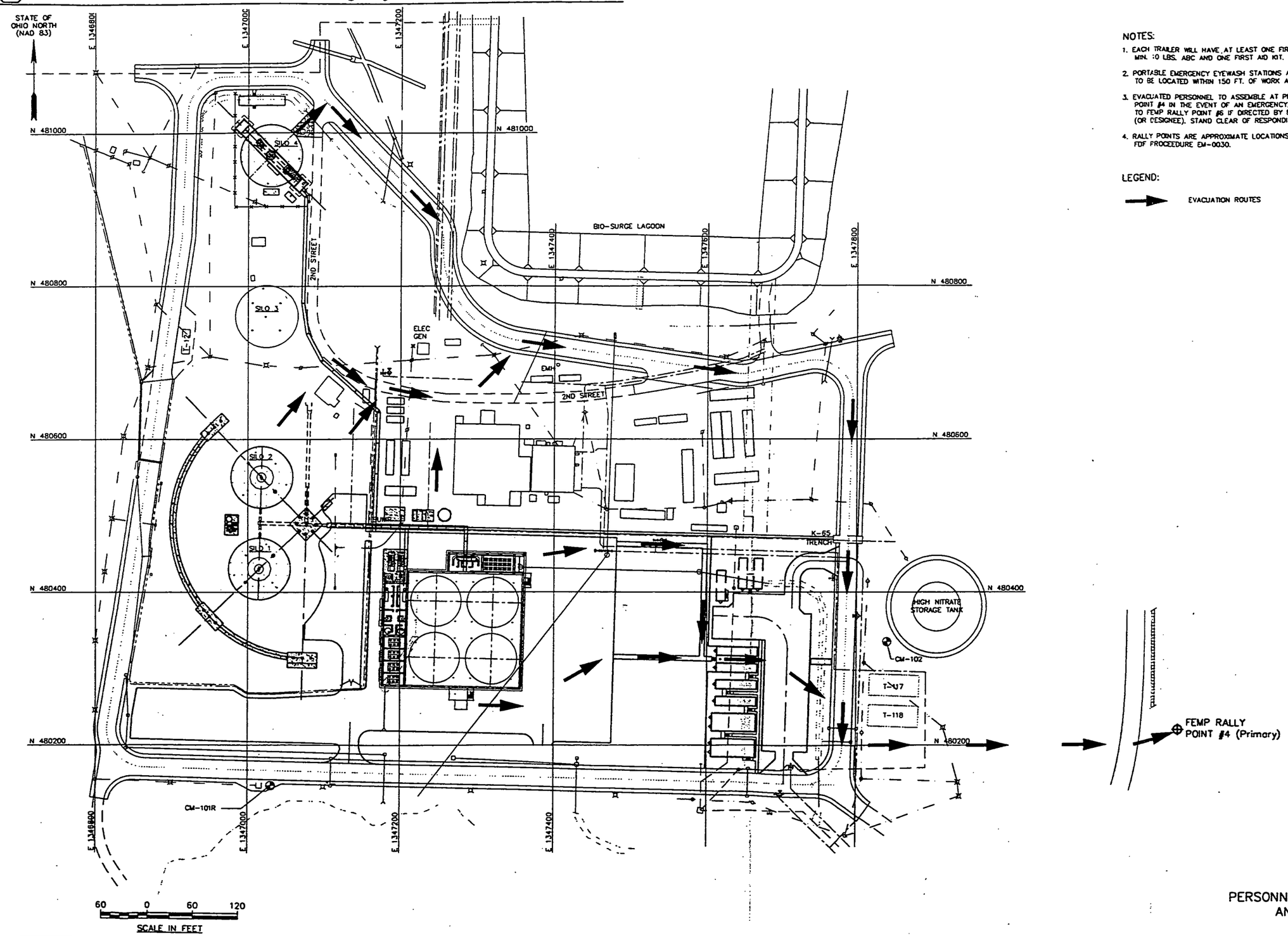

NOTES:

1. EACH TRAILER WILL HAVE AT LEAST ONE FIRE EXTINGUISHER RATED MIN. 10 LBS. ABC AND ONE FIRST AID KIT.
2. PORTABLE EMERGENCY EYEWASH STATIONS AND DRENCH SHOWERS TO BE LOCATED WITHIN 150 FT. OF WORK AREA.
3. EVACUATED PERSONNEL TO ASSEMBLE AT PRIMARY FEMP RALLY POINT #4 IN THE EVENT OF AN EMERGENCY, AND WILL PROCEED TO FEMP RALLY POINT #6 IF DIRECTED BY EMERGENCY COORDINATOR (OR DESIGNEE). STAND CLEAR OF RESPONDING VEHICLES.
4. RALLY POINTS ARE APPROXIMATE LOCATIONS TAKEN FROM FDF PROCEEDURE EM-0030.

LEGEND:

EVACUATION ROUTES

FEMP RALLY POINT #6 (Alternate)

FEMP RALLY POINT #4 (Primary)

PERSONNEL EVACUATION ROUTES AND RALLY POINTS

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APPENDIX D

AWR Project
Bomb Threat Checklist (Typical)

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Bomb Threat Checklist (Typical)

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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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APPENDIX E

AWR Project Contingency Plan
Glossary

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GLOSSARY

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Accident (Operational): An event stemming form technological and man-made hazards which presents a potential threat to life, health, property, or the environment.

Assistant Emergency Duty Officer (AEDO): The 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 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 instrument, normally worn by personnel at 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 (EC): The shift Safety and Fire Inspector who leads the Emergency Response Team.

Emergency Director (ED): The FERMCO President or his designee has overall authority and responsibility for activities at the FEMP, including emergency management.

Emergency Duty Officer (EDO): Trained senior management personnel responsible for the management and oversight of the FEMP emergency response activities until the FEMP Emergency Operations Center (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 form planned or expected behavior or course of events that could endanger or adversely affect people, property, or the environment.

Exercise: An event that test the integrated capability and a major portion of the basic elements of emergency preparedness as specified in emergency plans and procedures.

Facility Owner: The person designated as building custodian or the senior supervisor on-shift in a plant.

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Health Physics: The science concerned with recognition, evaluation, control, and management of health hazards from ionizing radiation.

Joint Information Center (JIC): The Fluor Daniel 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 (NAWAS): 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 form evacuated facilities.

Reporting: Either (1) communicating, in any medium, further information of 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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AWR Sample Plan

FOSTER WHEELER

FOSTER WHEELER ENVIRONMENTAL CORPORATION

SAMPLING PLAN

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

FOR THE

SILOS 1 AND 2 ACCELERATED WASTE RETRIEVAL (AWR) PROJECT

SUBMITTED TO:

FLUOR DANIEL FERNALD (FDF)

CONTRACT NO. FSC 624

January 7, 2000

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FOSTER WHEELER ENVIRONMENTAL CORPORATION

SAMPLING PLAN
Revision A

Recommended by:

John Lawson

Foster Wheeler Engineering Manager

1/07/00

Date

Approved by:

Foster Wheeler Project Manager

1/07/00

Date

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ACRONYM LIST

ALARA	as low as reasonably achievable
APHA	American Public Health Association
ASL	analytical support level
AWR	Accelerated Waste Retrieval
AWWA	American Water Works Association
AWWT	Advanced Wastewater Treatment
CAA	Clean Air Act
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
FDF	Fluor Daniel Fernald
FEMP	Fernald Environmental Management Project
FWENC	Foster Wheeler Environmental Corporation
gpd	gallons per day
gpm	gallons per minute
HASP	Health and Safety Plan
kg/day	kilograms per day
LANL	Los Alamos National Laboratory
lb/day	pounds per day
LCS	Laboratory Control Sample
MeV	million electronvolts
MS/MSD	Matrix Spike/Matrix Spike Duplicate
NPDES	National Pollutant Discharge Elimination System
O&M	operations and maintenance
PM	Project Manager
ppm	parts per million
pCi/L	picocuries per liter
QA	quality assurance
QA/QC	quality assurance/quality control
QC	quality control
RCS	Radon Control System
SW	solid waste
TEDE	total effective dose equivalent
TRD	Technical Requirements Document
TSS	total suspended solids
TTA	Transfer Tank Area
WAC	waste acceptance criteria
WEF	Water Environment Federation

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1.0 INTRODUCTION

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This Sampling Plan addresses the requirements for the collection and analysis of 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 Daniel Fernald (FDF).

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 operates on a 24-hour basis while waste transfer activities take place, as well as during construction and waste storage periods, 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 a 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 Plan.

1.2 Scope and Purpose of Plan

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

- 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 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, as determined by FDF, and therefore, limited discussion is provided in this Plan as to its characterization.

1.3 Organization of Plan

This Plan has been prepared to address the requirements of the AWR Contract, specifically paragraph 3.1.13 of the Technical Requirements Document (TRD), FDF No. 40710-RP-0001, February 3, 1999, Revision 1. This Plan and its implementation will comply with the FEMP

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Sitewide CERCLA Quality Assurance Project Plan (FD-1000) and applicable local, state, and federal regulatory requirements.

Section 1 of this 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 Plan, supporting technical information is provided in several appendices to this Plan, as listed below:

- Appendix A AWWT WAC;
- Appendix B Summary of Analytical Procedures, Containers, Preservatives, and Holding Time Requirements for Water Samples (including typical and alternative radiological analytical methods);
- Appendix C Water Sample Collection Procedure;
- Appendix D Typical and Alternative Analytical Methods for Air Emissions Analyses;
- Appendix E Air Monitoring – RCS Stack Procedures; and
- Appendix F Manual COC Procedure.

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2.0 DATA QUALITY OBJECTIVES AND QUALITY CONTROL

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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 FDF and Foster Wheeler. These members include the Project Manager (PM), operations and maintenance (O&M) supervisors, 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

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 Water

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 for final treatment and discharge in accordance with the FEMP National Pollutant Discharge Elimination System (NPDES) permit. Water found to exceed the AWWT WAC limits will be returned to the waste retrieval system to be used in the sluicing process or treated to meet the WAC.

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 AWWT WAC is provided in Appendix A of this Plan.

2.1.2 Air

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. Emissions from the RCS stack will be monitored to ensure emission standards are being met.

The continuous monitoring systems, as later described in Sections 3 and 4 of this 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 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 AWR Contract 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 room. Mitigation measures and corrective actions will be implemented accordingly. In addition, if the radon concentrations do not exceed the preset alarm level for the

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stack, then the RCS is functioning within limits and no mitigative actions are required. 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 room. Mitigation measures and corrective actions will be implemented accordingly.

2.1.3 Silo Residues

During the waste transfer process, samples of the silo residues will be drawn from the process and stored onsite in 30-gallon polyethylene drums overpacked in 55-gallon drums. The residues will be stored for future use as determined by FDF. There are no specific DQOs or analytical requirements currently associated with the silo residues sampling, and therefore, this sampling is not discussed in detail in this Plan.

2.2 Elements of Quality Control

This section presents QC requirements relevant to the analysis of environmental samples that shall be followed by the laboratory during all analytical activities producing definitive data (i.e., data not measured using onsite instruments). The purpose of this QC program 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. This program provides a mechanism for ongoing control and evaluation of data quality measurements.

Laboratory QC samples (i.e., blanks and laboratory control samples [LCS]) 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 environmental samples. The type of QC samples used for spiking will include all 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. All samples shall have LCS spiked with appropriate analytes of interest. The laboratory 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, all 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 all affected results.

2.2.2 Internal Standards (IS)

IS are measured amounts of certain compounds added prior to analysis of samples. They 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

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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 laboratory-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 all applicable parameters. The method blank is used to determine the level of laboratory 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 laboratory 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.

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 laboratory personnel performing the analysis.

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

An aliquot of a matrix (water) is fortified (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.

2.2.6 Analytical Methods

Analysis of the water and air emissions shall comply with procedures approved by the U.S. Environmental Protection Agency (EPA) or other regulatory agencies. These procedures are identified in Appendices B and D, respectively. No specific analysis is planned for the archived K-65 silo residues at this time.

2.3 Supplies and Consumables

The laboratories used for this evaluation shall 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. The inventory and storage system for these materials will assure use before manufacturer's expiration dates and storage under safe and chemically compatible conditions.

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3.0 SAMPLING MEDIA AND SOURCES

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Both water and air 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 Plan provide details regarding the respective methods used for sample collection.

3.1 Water

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. Water 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 AWWT facility.

Foster Wheeler has identified two wastewater streams requiring segregation and transfer to the AWWT, 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 prior to discharge to the AWWT. The second wastewater stream is a portion of the water used during the slurry transfer activities, including water from the Decant Sump Tank. Although the wastewater from the sluicing operation is recycled to reduce water usage, a portion of this water is processed through a filtration system. Water may be removed as filtrate for transfer to the AWWT 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 prior to final transfer to the AWWT. The sampling procedure for water media is summarized in Section 4 of this 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 water (in the latter stages of the AWR Project) will be processed through a filtration system for final transfer to the AWWT. The sampling procedure for water media is summarized in Section 4 of this Plan and provided in Appendix C to this Plan.

3.2 Air

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.

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

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particulate emissions in the RCS stack using an isokinetic sampler (supplemented by laboratory analyses of filter paper composites) is also required to demonstrate compliance with the dose limit in Title 40 of the Code of Federal Regulations (CFR) Part 61, Subpart H.

Monitoring of particulate emissions will be conducted using an isokinetic sampler in the RCS stack. This continuous sampler will be inspected at least weekly, and the filter changed at that time. These filter papers will then be analyzed either onsite or by the Contract Services Laboratory (CSL) using the methods provided in Appendix D of this Plan to confirm real-time 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) for compliance with 40 CFR 61 and DOE Order 5400.5. Emissions from the RCS stack will be monitored for compliance with emissions standards. The monitors used for this sampling are described in Section 4 of this Plan. The sampling procedure for air media is provided in Appendix E to this Plan.

3.2.2 Process Monitoring of Radon Concentrations

Carbon bed performance is instrumental in reducing the concentrations of radon in the silos and TTA headspaces and in minimizing 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 Contract requirement that the dose rate from radon in the silo headspaces is reduced to below 10 mrem/hr during the construction and operation phases of the AWR Project.

A representative air stream will be diverted through an in-line monitor to measure radon concentrations upstream of the four carbon bed systems to assess the performance of the RCS in the reduction of radon concentrations in the headspaces. It also serves as a "before" measurement for comparing "before" and "after" concentrations to assess the performance of each carbon bed. A representative air stream will 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.

3.3 Silo Residues

Samples of silo residues will be collected and archived for future testing and analysis. The silo residues will be collected at a rate of one pound per 1,000 pounds of waste transferred. This Plan does not address the testing or analysis of the collected silo residues.

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4.0 FIELD SAMPLING PROCEDURES

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Representative samples must be collected to appropriately characterize process wastewater and air emissions from the AWR Project in accordance with this 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 Water

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, analysis, data receipt and reporting, etc., as required, to determine that the AWWT WAC requirements are met. The transfer of wastewater to the AWWT cannot occur without FDF approval.

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 water samples. These ports will be the source of water collected for sampling under this Plan. To ensure a representative water sample is collected at the appropriate source, the tank is recirculated and three line volumes will be purged prior to collection of the sample. One line volume will include water held in the piping from the individual tank to the sampling port.

Samples of wastewater (approximately 1 liter or less) will be collected in plastic bottles from sampling ports on the RCS condensate tanks and the TTA filtrate storage tank. The outside of the bottles will be cleaned and bagged to prevent cross contamination, and the bottles will be field screened with a gamma spectroscopy system. This system will consist of a sodium iodide detector and a multi-channel analyzer. Gamma spectrum analysis software will be used to estimate the concentration of predominant radionuclides present (e.g., Ra-226, Th-228, etc.). This estimate should provide an adequate screening evaluation to determine whether the samples are likely to be less than or greater than the WAC discharge limits.

For field screening of AWR Project wastewater samples, the samples need to be properly collected and then analyzed by means of gamma spectroscopy to determine the presence of specific radionuclides, and if present, determine the quantities for each nuclide present. If the field screening finds the levels of radionuclides to be below WAC, then the water sample will be processed for shipping to the CSL (see Section 4.1.1 below) for a complete analysis. Refer to Appendices B and C of this Plan for proposed wastewater analyses and sampling procedures, respectively. Water found to exceed the AWWT WAC limits (see Appendix A) will be returned to the waste retrieval system to be used in the sluicing process or treated to meet the WAC.

4.1.1 Gamma Spectroscopy

The CSL will conduct high-resolution gamma spectra analysis with a large, sensitive germanium detector system. The 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). The 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

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approximately one-half of the discharge limits specified. For further explanation of this analysis strategy, see Table 4-1 and the related text in Section 4.1.2.

4.1.2 Analysis Strategy

The following paragraphs provide a description of how each radionuclide, listed in Table 4-1 below, will be measured to meet the wastewater DQOs for the AWR Project.

Table 4-1: WAC Discharge Limits and Analytical Approach or Method

Paragraph No.	Radionuclide	Discharge Limit, pCi/L	Analytical Approach or Method
1	Ac-227	10	Equilibrium with Pa-231
2	Pb-210	30	Inferred from Ra-226
3	Po-210	80	Equilibrium with Pb-210
4	Pa-231	10	Gamma spectroscopy
5	Ra-226	100	Gamma spectroscopy
6	Ra-228	100	Equilibrium with Th-232
7	Th-228	400	Gamma spectroscopy
8	Th-230	300	Gamma spectroscopy
9	Th-232	50	Gamma spectroscopy
10	U-234	500 (or 5 ppm)	Gamma spectroscopy
11	U-235/236	600 (or 5 ppm)	Gamma spectroscopy
12	U-238	600 (or 5 ppm))	Gamma spectroscopy

1) Ac-227 is primarily a low energy beta emitter (0.034 and 0.044 million electronvolts [MeV], maximum) with a very low abundance of photons at 0.070 MeV (0.017%), 0.100 MeV (0.032%), and 0.160 MeV (0.019%) and a 21.77 year half-life. Ac-227 photons will not be readily detectable by gamma spectroscopy because of the presence of Ra-226 and its decay products. It will be in equilibrium with Pa-231.

2) Pb-210 is essentially a pure beta emitter [0.016 MeV (80%) and 0.063 MeV (20%), maximum] with a 22.3 year half-life. Pb-210 will not be detectable by gamma spectroscopy. It may be possible to infer Pb-210 concentrations from measurable Ra-226 concentrations.

3) Po-210 is essentially a pure alpha emitter (5.305 MeV) with a 138.4-day half-life. Po-210 will not be detectable by gamma spectroscopy. It will be in equilibrium with Pb-210.

4) Pa-231 is an alpha emitter (4.95 to 5.058 MeV) with a reasonable abundance of photons at 0.0274 MeV (9.3%), 0.2837 MeV (1.6%), 0.300 MeV (2.3%), 0.3027 MeV (4.6%), and 0.330 MeV (1.3%) and a 32,760 year half-life. Pa-231 will be readily detectable by gamma spectroscopy and it will provide a basis for inferring the concentration of Ac-227.

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5) Ra-226 is an alpha emitter (4.60 and 4.78 MeV) with a photon at 0.168 MeV (3.28%) and a 1,600-year half-life. Ra-226 is easily detectable by gamma spectroscopy and it may provide a basis for estimating the concentration of Pb-210.

6) Ra-228 is essentially a pure beta emitter (0.034 MeV, maximum) with a 5.75 year half-life. Ra-228 will not be detectable by gamma spectroscopy, but it will be in equilibrium with the Th-232 present (having grown into equilibrium over the past 47 years or 8 half-lives).

7) Th-228 is an alpha emitter (5.34 and 5.42 MeV) with a low abundance of photons at 0.084 MeV (1.19%), 0.132 MeV (0.11%), 0.166 MeV (0.08%), 0.216 MeV (0.27%) and a 1.913 year half-life. Th-228 will be readily detectable by gamma spectroscopy and it will be in equilibrium with Ra-228 and Ra-224.

8) Th-230 is an alpha emitter (4.621 and 4.688 MeV) with a low abundance of photons at 0.0677 MeV (0.37%), 0.142 MeV (0.07%), 0.144 MeV (0.045%) and a 77,000 year half-life. Th-230 should be detectable by gamma spectroscopy (the 0.0677 MeV photon) and it should be possible to determine its concentration relative to that of U-234, which is not in equilibrium.

9) Th-232 is an alpha emitter (3.83, 3.95, and 4.01 MeV) with a low abundance of photons at 0.059 MeV (0.19%) and 0.126 MeV (0.04%) and a 14 billion year half-life. Th-232 should be detectable by gamma spectroscopy (the 0.059 MeV photon) and it will be in equilibrium with its decay products.

10) U-234 is an alpha emitter (4.72 and 4.77 MeV) with a low abundance of photons at 0.053 MeV (0.12%) and 0.121 MeV (0.04%) and a 244,500 year half-life. U-234 should be detectable by gamma spectroscopy (the 0.053 MeV photon), and it should be possible to determine its concentration relative to that of Th-230, which is not in equilibrium.

11) U-235 is an alpha emitter (4.2 to 4.6 MeV) with a good abundance of photons at 0.1438 MeV (10.5%), 0.163 MeV (4.7%), 0.1857 MeV (54%), 0.205 MeV (4.7%) and a 0.7 billion year half-life. U-235 will be readily detectable by gamma spectroscopy and it will be possible to determine its concentration relative to that of Pa-231, which is not in equilibrium. U-236 is not likely to be detected in any of the Silos 1 and 2 waste.

12) U-238 is an alpha emitter (4.15 and 4.20 MeV) with a low abundance on one weak photon at 0.0496 MeV (0.07%) and a 4.47 billion year half-life. However, the short lived daughters of U-238, Th-234 and Pa-234m have more detectable gamma radiation [0.063 MeV (3.5%) and 0.093 MeV (4%) for Th-234, and 0.765 MeV (0.3%) and 1.001 MeV (0.6%) for Pa-234m]. The presence of these radionuclides can be used to establish the concentration of U-238.

4.2 Air

The stack 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 at least weekly. The emissions will also be monitored for radon. Refer to Appendices D and E of this Plan for proposed air emissions analyses and sampling procedures, respectively.

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4.2.1 Stack Monitoring

The RCS stack must be monitored and inspected at least weekly as specified in the Clean Air Act (CAA) regulations (40 CFR 61) and DOE Order 5400.5. 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 Plan. Further explanation relating to the use of field monitoring methods for radon and particulate emissions is provided below and 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 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 AB5 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.

For particulate monitoring of RCS air effluent, the type of isokinetic sampler to be used in the RCS stack is an EG&G Berthold Alpha in Air Aerosol Monitor LB 150 R, 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 measurement technique is able to distinguish between alpha radiation emitted by short-lived radon daughters (5.45 to 7.69 MeV) and that emitted by long-lived radionuclides like Th-230 (4.68 MeV).

4.2.2 Radon Process Monitoring

As previously described in Section 3.2.2, radon concentrations will be measured in five 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 fifth monitoring location will be in the ductwork just upstream of the carbon beds. It serves 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. This monitoring is real-time in nature, and therefore, is not addressed in Appendix E to this Plan.

The type of monitor to be used downstream of each carbon bed filter will be a continuous monitor such as a Pylon AB5 Radon Measurement System, or equivalent. The Pylon 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.

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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 all sampling activities. The logbook will be a bound book with no loose pages. All entries shall be made in permanent waterproof black ink. No pages shall be removed from the logbook for any reasons. If corrections are necessary, 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, 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. 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 Mylar tape.

Each sample will have a sample label 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 will be packaged in a second bag containing wet ice. The second bag will be sealed to prevent leakage.

Samples to be shipped to an offsite laboratory will be packaged and shipped in a U.S. Department of Transportation (DOT)-approved container. 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 ≥ 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

For samples shipped for analysis, a Chain-of-Custody (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 all 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. The COC procedure for the AWR Project is provided in Appendix F of this 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.

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5.6 Analytical Data

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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 Water Samples

For water samples, the CSL is to provide a data package consistent with the quality assurance/quality control (QA/QC) requirements of the CSL's approved Quality Assurance (QA) Program. It is anticipated that the CSL will meet the FEMP-defined analytical level of "Analytical Support Level (ASL) B", which provides qualitative, semi-qualitative, and quantitative analyses. 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 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.

For air emission monitoring, the CSL will perform a semi-annual composite analysis on the particulate filters for long-lived alpha and beta emitters. The CSL data package should be received within a 30-day turnaround time period. The CSL is to provide a data package consistent with the QA/QC requirements of the CSL's approved QA Program. Radon monitoring for the stack will meet the FEMP-defined analytical level of "ASL B", which provides qualitative, semi-qualitative, and quantitative analyses.

The filter paper from 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. The weekly onsite or CSL analysis will meet the FEMP-defined analytical level of "ASL B", and the semi-annual composites are considered either "ASL C" (quantitative with fully defined QA/QC) or "ASL E" (non-standardized protocols), as determined by FDF.

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.

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6.0 WASTE MANAGEMENT

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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.

6.1 Water

All 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

All consumables (e.g., gloves, personal protective equipment [PPE], etc.) will be disposed of in accordance with FEMP site procedures.

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7.0 REFERENCES

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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 Waste Water Discharge 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
FD-1000	Sitewide CERCLA Quality Assurance Project Plan
PT-0006	Packaging Low Level Radioactive Waste (LLRW) in ISO containers
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

Other references used in the development of this Plan include:

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.

Standard Methods for the Examination of Water and Wastewater, 20th Edition, American Public Health Association (APHA), American Water Works Association (AWWA), and Water Environment Federation (WEF), 1998.

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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.

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APPENDICES

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APPENDIX A

Advanced Wastewater Treatment Facility
Waste Acceptance Criteria

Radionuclides		
Parameter	**Discharge Limit (pCi/L)**	
Actinium-227	10	
Lead-210	30	
Polonium-210	80	
Protactinium-231	10	
Radium-226	100	
Radium-228	100	
Thorium-228	400	
Thoroum-230	300	
Thorium-232	50	
Radionuclides		
Parameter	**Discharge Limits (ppm)**	
Uranium-234	5	
Uranium-235/236		
Uranium-238		
Metals		
Parameter	**Discharge Limits**	
	kg/day	**lb/day**
Arsenic	0.14	0.3
Barium	2.7	6.0
Cadmium	0.006	0.013
Chromium	0.14	0.3
Iron	0.03	0.06
Lead	0.03	0.07
Mercury	0	0
Selenium	0.03	0.06
Silver	0.0014	0.003
General Chemistry		
Parameter	**Discharge Limit**	
Total Suspended Solids	1000 ppm	

Notes: pCi/L = picocuries per liter; ppm = parts per million; kg/day = kilograms per day; lb/day = pounds per day.

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APPENDIX B

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

Radionuclides				
Matrix-Water	**Analytical Procedure[1]**	**Holding Time**	**Preservative Requirements**	**Number/Type Containers Per Sample**
Actinium-227	EPA 907	1-Year	HNO_3 < 2 pH	1-1Liter Plastic
Lead-210	EPA 909	1-Year	HNO_3 < 2 pH	1-1Liter Plastic
Polonium-210	EPA 912	1-Year	HNO_3 < 2 pH	1-1Liter Plastic
Protactinium-231	EPA 908.0	1-Year	HNO_3 < 2 pH	1-1Liter Plastic
Radium-226	EPA 903.1	1-Year	HNO_3 < 2 pH	1-1Liter Plastic
Radium-228	EPA 904	1-Year	HNO_3 < 2 pH	1-1Liter Plastic
Thorium-228	EPA 910	1-Year	HNO_3 < 2 pH	1-1Liter Plastic
Thorium-230		1-Year	HNO_3 < 2 pH	1-1Liter Plastic
Thorium-232		1-Year	HNO_3 < 2 pH	1-1Liter Plastic

Radionuclides				
Matrix-Water	**Analytical Procedure[1]**	**Holding Time**	**Preservative Requirements**	**Number/Type Containers Per Sample**
Uranium-234	EPA 908.0	1-Year	HNO_3 < 2 pH	1-1Liter Plastic
Uranium-235/236		1-Year	HNO_3 < 2 pH	1-1Liter Plastic
Uranium-238		1-Year	HNO_3 < 2 pH	1-1Liter Plastic

Metals				
Matrix-Water	**Analytical Procedure[1]**	**Holding Time**	**Preservative Requirements**	**Number/Type Containers Per Sample**
Arsenic	SW-846 6010B	6-Months	HNO_3 < 2 pH	1-1Liter Plastic
Barium	SW-846 6010B.	6-Months	HNO_3 < 2 pH	1-1Liter Plastic[2]
Cadmium	SW-846 6010B	6-Months	HNO_3 < 2 pH	1-1Liter Plastic[2]
Chromium	SW-846 6010B	6-Months	HNO_3 < 2 pH	1-1Liter Plastic[2]
Iron	SW-846 6010B	6-Months	HNO_3 < 2 pH	1-1Liter Plastic[2]
Lead	SW-846 6010B	6-Months	HNO_3 < 2 pH	1-1Liter Plastic[2]
Mercury	SW-846 7470A	28-Days	HNO_3 < 2 pH	1-1Liter Plastic[2]
Selenium	SW-846 6010B	6-Months	HNO_3 < 2 pH	1-1Liter Plastic[2]
Silver	SW-846 6010B	6-Months	HNO_3 < 2 pH	1-1Liter Plastic[2]
General Chemistry				
Matrix-Water	**Analytical Procedure[1]**	**Holding Time**	**Preservative Requirements**	**Number/Type Containers Per Sample**
Total Suspended Solids	EPA 0160.2	7-Days	Cool to 4°C	1-100 ml Plastic

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

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APPENDIX B (CONT.)

Typical Analytical Methods for Wastewater Analyses

Parameter	Analytical Method
Radionuclide	
Actinium – 227	907[1]
Lead – 210	909[2]
Polonium – 210	912[2]
Protactinium – 231	908.0[1]
Radium – 226	903.1[1]
Radium – 228	904[1]
Thorium – 228	910[2]
Thorium – 230	
Thorium – 232	
Uranium – 234	908.0[1]
Uranium – 235/236	
Uranium – 238	
Metal	
Arsenic	6010B[3] or 3120B[4], or 0200.7[5]
Barium	6010B[3] or 3120B[4], or 0200.7[5]
Cadmium	6010B[3] or 3120B[4], or 0200.7[5]
Chromium	6010B[3] or 3120B[4], or 0200.7[5]
Iron	6010B[3] or 3120B[4], or 0200.7[5]
Lead	6010B[3] or 3120B[4], or 0200.7[5]
Mercury	7470A[3], 3112B[4], or 0245.2[5]
Selenium	6010B[3] or 3120B[4], or 0200.7[5]
Silver	6010B[3] or 3120B[4], or 0200.7[5]
General Chemistry	
Total suspended solids	0160.2[5]

Notes: [1] EPA Report Number 600/4-80-032 (EPA 1980) specifies test methods and detection limits;
[2] EPA Region I Library Local Call Number 01A0004860 (EPA 1983) specifies test methods and detection limits;
[3] EPA Report Number SW-846 (EPA 1998) specifies test methods and detection limits;
[4] Standard Methods (APHA 1998) specifies test methods and detection limits; and
[5] EPA Report Number 600/4-79-020 (EPA 1979) specifies test methods and detection limits.

Alternative Radiological Analytical Methods for Wastewater Analyses

Parameter	Analytical Method
Radionuclide	
Radioactivity, Gross Alpha and Gross Beta	900.0[1]
Radionuclides, Gamma Emitting	901.1[1]

Notes: [1] EPA Report Number 600/4-80-032 (EPA 1980) specifies test methods and detection limits.

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APPENDIX C

FOSTER WHEELER ENVIRONMENTAL CORPORATION
Accelerated Waste Retrieval Sampling and Analysis Procedures

SUBJECT: WATER SAMPLE COLLECTION PROCEDURE

I. Scope and Application

This procedure applies to water samples collected for the Accelerated Waste Retrieval (AWR) Project at the U.S. Department of Energy (DOE) Fernald Environmental Management Project (FEMP) site. The goal of this procedure is to ensure water samples collected from either of the two condensate tanks or water selectively removed from the waste transfer system is representative of the water scheduled for discharge into the Advanced Wastewater Treatment (AWWT) facility.

II. Summary of Method

This procedure outlines the collection of water from components of the AWR and ensures the water samples collected are representative of water to be released to the AWWT.

III. Comments

This procedure will be applied to water samples collected during operation of the AWR. Samples will be collected in a timely manner and with such care to avoid resampling, thus minimizing project delays.

IV. Equipment

The following equipment shall be necessary for the collection of water samples from the condensate tanks and waste transfer system:

A. Container(s) to collect purge water (pre-sampling);
B. Sample container with label;
C. Preservative as applicable, and
D. Spill containment materials.

V. Safety

Only AWR Project personnel, trained as directed in the Site Health and Safety Plan (HASP), will be allowed to perform or participate in the collection of samples. Refer to Site HASP for specifics dealing with appropriate training and level of personal protective equipment (PPE) required for sampling.

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VI. Procedure

A. AWR Condensate Tanks

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 water;

5. Purge or evacuate a minimum of three line volumes from the line between the tank and the sampling port. One line volume shall consist of water contained in the line between the tank and the sampling port and shall be determined based on post-construction measurements;

6. Return the purged water back into the waste transfer system;

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

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

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

10. Store dedicated purge water container in predetermined location;

11. Dispose of polyethylene sheeting;

12. Remove area barricades; and

13. Process samples per Manual COC Procedures.

B. Filtrate Storage Tank

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 water;

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5. Recirculate tank contents. Purge or evacuate a minimum of three line volumes from the line between the filtration system and the sampling port. One line volume shall consist of water contained in the line between the filtration system and the sampling port and shall be determined based on post-construction measurements;

6. Return the purged water back into the waste transfer system;

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

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

9. Complete sample container labeling per Manual COC Procedures;

10. Store dedicated purge water container in predetermined location;

11. Dispose of polyethylene sheeting;

12. Remove area barricades; and

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. All 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.

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APPENDIX D

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Typical Analytical Methods for Air Emissions Analyses

Parameter	Analytical Method
Radionuclide	
Actinium – 227	EML Th-01 mod[1]
Lead – 210	EML Pb-01 mod[1]
Polonium – 210	EML Po-02 mod[1]
Protactinium – 231	EPA 908[2]
Radium, alpha-emitting isotopes	EPA 903[2]
Radium – 228	EPA 904[2]
Thorium – 228	EML Th-01 mod[1]
Thorium – 230	
Thorium – 232	
Uranium – 234	EML U-02 mod[1]
Uranium – 235/236	
Uranium – 238	

Notes: [1]Environmental Measurements Laboratory (EML) procedure specifies test methods and detection limits.
[2]EPA Method specifies test methods and detection limits.

Alternative Analytical Methods for Air Emissions Analyses

Parameter	Analytical Method
Radionuclide	
Gross alpha and beta	EPA 900.0 mod[1]
Gamma isotopic	LANL ER-130[2]

Notes: [1]EPA Method specifies test methods and detection limits.
[2]Los Alamos National Laboratory (LANL) procedure specifies test methods and detection limits.

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APPENDIX E

FOSTER WHEELER ENVIRONMENTAL CORPORATION
Accelerated Waste Retrieval Sampling and Analysis Procedures

SUBJECT: AIR MONITORING – RCS STACK STAMPLING PROCEDURES

I. Scope and Application

This procedure describes air sampling for radioactive particulate matter using isokinetic sampling to ensure a representative composite particulate sample is obtained. The isokinetic filter sample will be continuously monitored and collected weekly.

II. Summary of Method

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 determined over a designated period of time, typically 24 hours.

III. Comments

A number of interferences can bias the sampling results. Factors such as vapors, insects, large particles, heavy dust, and moisture can overload the filter and reduce the flow rate across the face of the filter.

IV. Equipment

A. Isokinetic sampler;
B. EG&G Berthold Alpha in Air Aerosol Monitor LB R, or equivalent;
C. Filter (pre-weighed); and
D. Flow-Rate Recorder.

V. Safety

Only personnel, trained as directed in the Site Health and Safety Plan (HASP), will be allowed to perform or participate in the collection of samples. Refer to Site HASP for specifics dealing with appropriate training and level of personal protective equipment (PPE) required for sampling.

VI. Procedure

A. Radon Control System (RCS) Stack

1. Calibrate the sampler per manufacturer's instructions and record the calibration in the logbook;

2. Use filters of predetermined weight;

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3. Mount the filter in the filter holder and clamp onto the sampler; —— 2793

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 one week, 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 all 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); and

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. All 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.

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APPENDIX F

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FOSTER WHEELER ENVIRONMENTAL CORPORATION
Accelerated Waste Retrieval Sampling and Analysis Procedures

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

I. Scope and Application

This procedure applies to samples collected for the Accelerated Water Retrieval (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. The documentation will trace possession of samples from their collection through all transfers of custody until final disposition, including archiving where required. This procedure excludes K-65 waste collected and archived for future testing.

II. Summary of Method

Chain-of-custody (COC) is a procedure for tracking of samples. The components of Foster Wheeler's COC are: sample labels or tags, sample seals, field logbooks, chain-of-custody records, sample requests for analysis, and shipping/transport information. Each document is filled out to transmit appropriate data and to track the sample.

III. Comments

A. This procedure will be applied to samples collected during operation and maintenance of the AWR project, including air and water samples. COC procedures are not required for transfer of samples between sampling team members.

B. 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.

IV. Equipment

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

V. Safety

Only personnel, trained as directed in the Site Health and Safety Plan (HASP), will be allowed to perform or participate in the collection of samples. Refer to Site HASP for

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specifics dealing with appropriate training and level of personal protective equipment (PPE) required for sampling.

VI. Procedure

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 persons physical possession;
2. The sample is in the line-of-sight of the person after he/she as taken possession;
3. The sample is secured by that person so any tampering can be detected; and
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 will be affixed to all 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. 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 Seals

Sample 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

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shipping container. Seals will be affixed to the container before they leave the custody of the sampling personnel.

Sample seals will be waterproof paper or plastic with adhesive backs. All samples designated for shipment, which 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

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

E. COC Records

The sampling personnel will complete the chain-of-custody record at the time of the sampling event. 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.

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.

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. All 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.

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Excavation Activities and Soil Management

The following section describes the various phases of excavation, the associated volumes, and also locations for interim and final placement.

Phase 1

Phase 1 will consist of excavation for mobilization (trailers, utilities, lay down areas) and the construction of the Transfer Tank Area (TTA). This phase is expected to generate an estimated volume of 9,000 cubic yards of soil. Currently, it is estimated that this excavation will take approximately 45 days. This soil will be loaded and trucked to the lime sludge pond area or soil pile1 and/or soil pile4. It will be managed and placed in the OSDF at a later date.

Phase 2

Phase 2 will consist of excavation of the berm for the construction of the Silo Waste Retrieval System (SWRS). This phase is expected to generate an estimated 11,000 cubic yards of soil. Currently, it is estimated that this excavation will take approximately 15 days. This soil will be loaded and trucked to SP1 and SP4. It will then be managed and placed in the OSDF at a later date.

Phase 3

Phase 3 will consist of excavation of the berm soil during operations. This phase is expected to generate an estimated 6,400 cubic yards of soil. Currently, it is planned for this excavation to happen in phases and last approximately 11 months. This soil will be loaded into roll off containers and transported to the OSDF transfer are for later placement

Attached is a site map showing the locations for generation and also for placement of the soil. There are also letters from the agencies confirming that the sampling and analyses plan done by Fluor Fernald is adequate and no further sampling and analyses is necessary.

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To J.D.	From Bob Hanson
Co.	Co
Dept.	Phone # 9372856453
Fax # 5136485131	Fax #

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OhioEPA
State of Ohio Environmental Protection Agency
Southwest District Office
401 East Fifth Street
Dayton, Ohio 45402-2911
(513) 285-6357
FAX (513) 285-6249

Voinovich
Governor

May 18, 1999

RE: DOE FEMP APPROVAL:
PROPOSED PHASE II
SOIL SAMPLING AND ANALYSES
WITHIN SOIL REMEDIATION AREA 7

Mr. Johnny Reising
U.S. Department of Energy, Fernald Area Office
P.O. Box 538705
Cincinnati, OH 45253-8705

Dear Mr. Reising:

Ohio EPA has reviewed DOE's April 20, 1999 submittal "Proposed Phase II Soil Sampling and Analyses within Soil Remediation Area 7 and Response to Comments". Based upon our review, Ohio EPA approves this document.

If you have any questions, please contact Michelle Waller or me.

Sincerely,

Thomas A Schneider
Fernald Project Manager
Office of Federal Facilities Oversight

cc: Jim Saric, U.S. EPA
Terry Hagen, FDF
Ruth Vandergrift, ODH
Mark Shupe, HSI GeoTrans
Francie Barker, Tetra Tech EM Inc.
Manager, TPSS/DERR,CO

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UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION 5
77 WEST JACKSON BOULEVARD
CHICAGO, IL 60604-3590

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REPLY TO THE ATTENTION OF
SRF-5J

Mr. Johnny W. Reising
United States Department of Energy
Feed Materials Production Center
P.O. Box 398705
Cincinnati, Ohio 45239-8705

RE: A7 Phase II Soil Sampling

Dear Mr. Reising:

The United States Environmental Protection Agency (U.S. EPA) has completed its review of the United States Department of Energy's (U.S. DOE) revised Phase II soil sampling of Area 7 (A7).

The plan proposes collecting and analyzing additional soil samples in A7 to support future construction activities in the Silos project area.

The plan appears adequate and is consistent with similar documents. Therefore, U.S. EPA approves the Phase II sampling in A7.

Please contact me at (312) 886-0992 if you have any questions regarding this matter.

Sincerely,

James A. Saric
Remedial Project Manager
Federal Facilities Section
SFD Remedial Response Branch #2

cc: Tom Schneider, OEPA-SWDO
Bill Murphie, U.S. DOE-HDQ
John Bradburne, FERMCO
Terry Hagen, FERMCO
Tom Walsh, FERMCO

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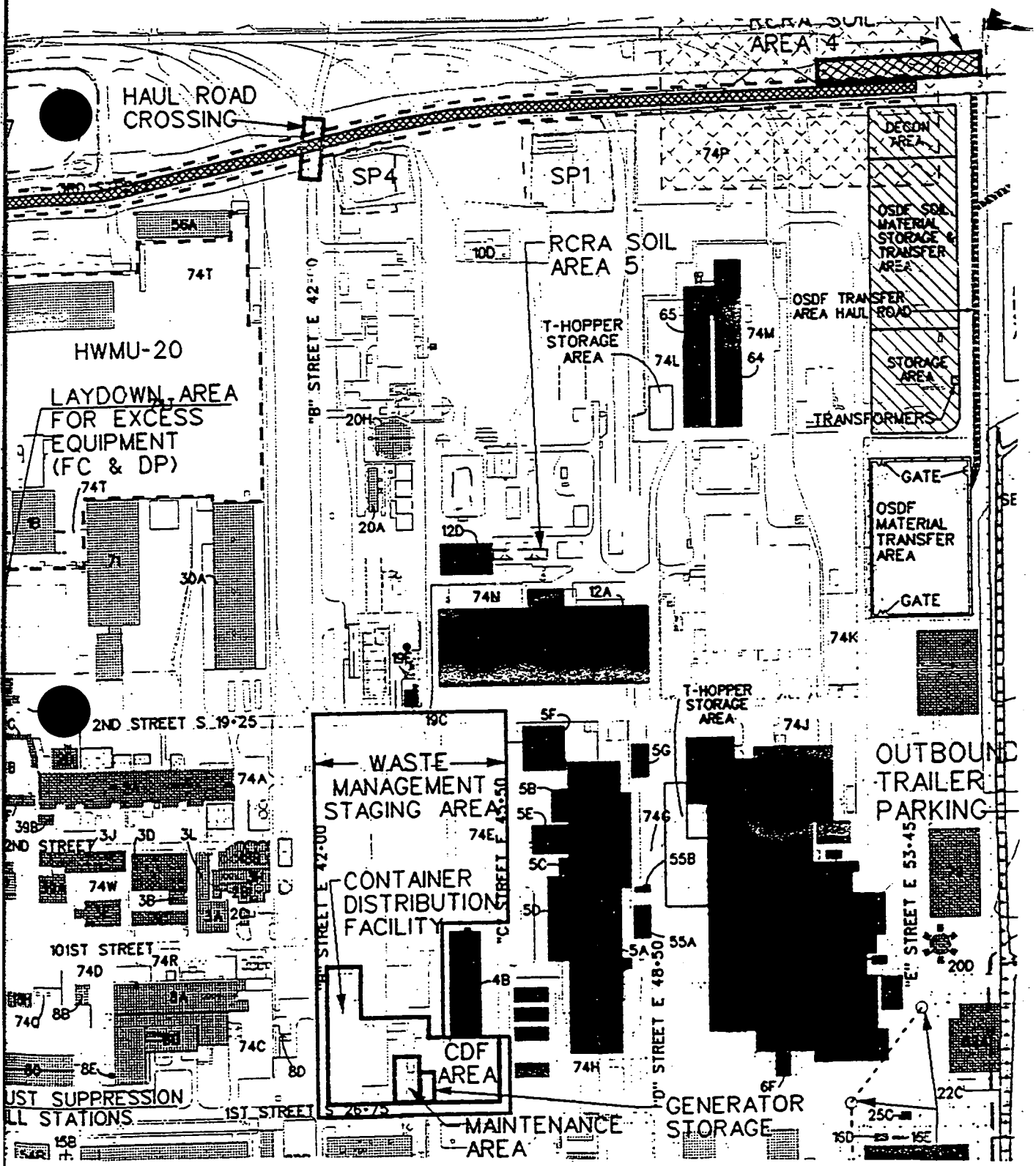
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HAUL ROAD CROSSING
SP4
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DESIGN AREA
OSDF SOIL MATERIAL STORAGE & TRANSFER AREA
56A
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RCRA SOIL AREA 5
OSDF TRANSFER AREA HAUL ROAD
T-HOPPER STORAGE AREA
65
74M
74L
64
STORAGE AREA
HWMU-20
LAYDOWN AREA FOR EXCESS EQUIPMENT (FC & DP)
"B" STREET E 42+00
20H
TRANSFORMERS
GATE
OSDF MATERIAL TRANSFER AREA
GATE
20A
12D
74N
12A
74K
30A
2ND STREET S 19+25
19C
T-HOPPER STORAGE AREA
74J
WASTE MANAGEMENT STAGING AREA
5F
5G
5B
5E
74G
OUTBOUND TRAILER PARKING
74A
39B
2ND STREET
3J
3D
3L
74E
5C
55B
74W
3B
CONTAINER DISTRIBUTION FACILITY
5D
101ST STREET
74R
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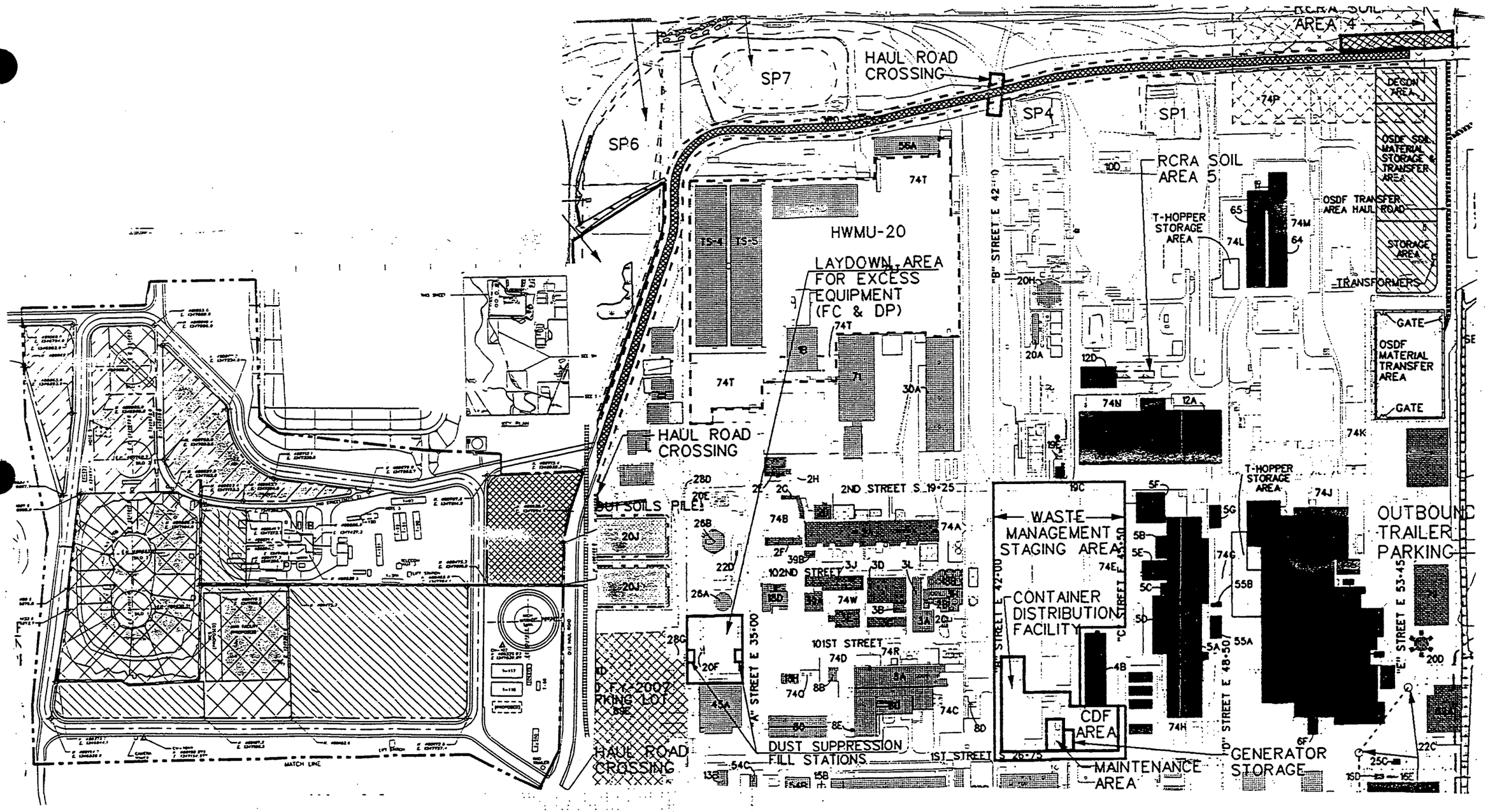
4B
74C
8B
8D
8E
CDF AREA
74H
6F
22C
25C
15D
15E
1ST STREET
MAINTENANCE AREA
GENERATOR STORAGE
"D" STREET E 48+50
"E" STREET E 53+45


RCRA SOIL AREA 4
HAUL ROAD CROSSING
SP7
SP6
SP4
SP1
DECON AREA
OSDF SOIL MATERIAL STORAGE & TRANSFER AREA
OSDF TRANSFER AREA HAUL ROAD
STORAGE AREA
TRANSFORMERS
RCRA SOIL AREA 5
T-HOPPER STORAGE AREA
HWMU-20
LAYDOWN AREA FOR EXCESS EQUIPMENT (FC & DP)
"B" STREET E 42'-0"
GATE
OSDF MATERIAL TRANSFER AREA
GATE
HAUL ROAD CROSSING
2ND STREET S 19'-25
BUT SOILS PILE
WASTE MANAGEMENT STAGING AREA
T-HOPPER STORAGE AREA
OUTBOUND TRAILER PARKING
102ND STREET
CONTAINER DISTRIBUTION FACILITY
"C" STREET E 45'-50
"A" STREET E 35'-00
"E" STREET E 53'-45
101ST STREET
CDF AREA
"D" STREET E 48'-50
DUST SUPPRESSION FILL STATIONS
1ST STREET S 26'-75
MAINTENANCE AREA
GENERATOR STORAGE
HAUL ROAD CROSSING
MATCH LINE

SILOS OCCUPATIONAL MONITORING PLAN

1.0 INTRODUCTION

Activities within Operable Unit 4 (OU4) of the Fernald Environmental Management Project (FEMP) involve the interim storage, removal, transport, treatment, and disposal of radon generating radium bearing residues. Operating practices of both the Accelerated Waste Retrieval (AWR) and Silo 3 Waste Project are expected to result in elevated levels of radon gases and their short-lived decay daughters in various indoor and outdoor process areas. Exposure to radon progeny is linked to an increased risk of lung cancer, as determined in several epidemiological studies conducted among uranium miners. Individual occupational exposure resulting from radon is difficult to assess, as these exposures cannot be measured by in vivo or in vitro means. Omission of these exposures from personal dose records would not comply with the existing requirements of 10 CFR 835, *Occupational Radiation Protection*, thus establishing the requirement for an occupational radon/thoron-monitoring program to be implemented for OU4 projects.

As a function of the Fluor Daniel Fernald (FDF) Radiological Protection Program (RPP), the Decision Basis Document (DBD) *Radon/Thoron Occupational Monitoring Decision Basis*, (FDF 1999) establishes the goals, general methodologies, and instruments to be used for monitoring and controlling radon and thoron exposures at the FEMP in accordance with the requirements of 10 CFR 835. The (DBD) also establishes the methodologies for converting exposure results from monitoring into worker dose equivalents. This document, together with the DBD, provides the basis for implementing occupational exposure requirements for OU4.

2.0 BACKGROUND

Title 10 Code of Federal Regulations Part 835 (10 CFR 835) requires that dose assessment, monitoring, and posting be conducted where the above-background levels of radon or thoron, and their progeny, exceed defined limits. Unless otherwise stated, hereinafter all references to "radon" will infer radon, thoron, and their decay products (daughters). Primary and secondary exposure limits established in 10 CFR 835 are adopted from ICRP Publications 26 *Recommendations of the ICRP*, ICRP Publication 30, *Limits for Intakes of Radionuclides by Workers* (ICRP 1980), and ICRP Publication 32 *Limits for Inhalation of Radon Daughters by Workers* (ICRP 1981). The primary

limits are established as individual dose limits. The secondary exposure limits are established as Annual Limits on Intake (ALI), Annual Limits on Exposures (ALE), and Derived Air Concentration (DAC) values for specific radionuclides. The sum of internal and external doses are controlled by limiting the total effective dose equivalent (TEDE) to less than 5 rem (0.05 sieverts), where internal doses are calculated as committed effective dose equivalents (CEDEs). As in all radiation protection standards, 10 CFR 835 contains the provision that all exposures must be maintained as low as reasonably achievable (ALARA).

Although 10 CFR 835 does not explicitly state the dose conversion conventions that were used to develop the standards for radon or thoron progeny, the dose conversion factors are published in ICRP Publication 32. At this point, it is important to mention that the dose conversion factors of ICRP Publication 32 are not representative of the latest information provided by the ICRP. In fact, after 10 CFR 835 was developed, the ICRP issued Publication 65, *Protection Against Radon-222 at Home and at Work* (ICRP 1994) which provides revised guidance on protection against exposures to radon-222 and its progeny. The new dose conversion factors indicate a decrease in dose per unit exposure of approximately 250 percent. Although significantly different from the values addressed in ICRP Publication 65, the conservative dose conversion convention stated in ICRP Publication 32 is used to form the logical basis for the radon monitoring program and to fulfill the requirements of 10 CFR 835.

Both the Department of Energy (DOE) and Fluor Daniel Fernald (FDF) recognized the technical difficulties associated with differentiating occupational exposures from background levels of radon, when given a committed effective dose equivalent (CEDE) monitoring threshold of 100 mrem[1]. FDF responded to this difficulty by submitting formal exemptions to applicable portions of 10 CFR 835. As a result, a monitoring threshold of 500 mrem CEDE from all sources of radon including background has been chosen as a basis for the occupational monitoring program. This is consistent with the monitoring threshold under U.S. Nuclear Regulatory Commission radiation protection regulations.

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[1] "For the purposes of monitoring individual exposures to internal radiation, internal dose evaluation programs (including routine bioassay programs) shall be conducted for: (1) Radiological workers who, under typical conditions, are likely to receive 0.1 rem (0.001 sievert) or more committed effective doe equivalent, and/or 5 rems (0.05 sievert) or more committed doe equivalent to any organ or tissue, from all occupational radionuclide intakes in a year." [835.403 8 (1)]

2.0 DEFINITIONS

1. Annual Limit on Exposure (ALE) is the derived limit for the amount of potential alpha energy exposure from any mixture of short-lived ^{222}Rn or ^{220}Rn daughters that would result in a committed effective dose equivalent of 5 rems (0.05 sievert) to an individual. The ALEs for radon and thoron are 4 WLM and 12 WLM, respectively.

2. Continuous air monitor (CAM) is an instrument that continuously samples and measures the levels of airborne radioactive materials on a "real-time" basis, has alarming capabilities, and is specifically designed to meet the requirements as specified in 835.403(a)(2) and (3). For the purposes of radon monitoring, alphaNUCLEAR 595 CWLM and Pylon WLx can be used as "CAMS".

3. Derived Air Concentration (DAC) is the concentration of a radionuclide in air, which if inhaled over the period of a work year, would result in the ALI for that radionuclide being reached. The DAC for radon is obtained by normalizing the Annual Limit on Exposure (ALE) to WL-hrs and then dividing by the time worked during a working year (2000 hours).

Equation 1

$$DAC_{Rn\text{-}220} = 4WLM \frac{170WL\text{-}hrs}{WLM} \cdot \frac{Year}{2000\,hrs} \cong 0.33\ WL$$

Equation 2

$$DAC_{Rn\text{-}220} = 12WLM \frac{170WL\text{-}hrs}{WLM} \cdot \frac{Year}{2000\,hrs} \cong 1\ WL$$

4. DAC-hour is a quantity equivalent to the product of the concentration of airborne radioactivity (expressed as a fraction of a multiple of the DAC for each radionuclide) and the time (in hours) of exposure to that radionuclide. A 2000 DAC-h exposure will result in an intake of one ALI which is equivalent to a CEDE of 5 rem (0.05 sievert). The administrative trigger level requiring dose assessment as identified in this document is expressed as 1.2 WL-hrs and 4.0 WL-hrs for radon and thoron respectively.

5. Equilibrium Equivalent Concentration (EEC) is that activity concentration of radon gas in radioactive equilibrium with its short-lived daughters that has the same Potential alpha energy concentration (PAEC) as the non-equilibrium mixture to which it refers.

Equation 3

$$EEC_{Rn\text{-}222}\left(\frac{pCi}{L}\right) = 100 \cdot PAEC_{Rn\text{-}222}\,(WL)$$

Equation 4

$$EEC_{Rn\text{-}220}\left(\frac{pCi}{L}\right) = 7.43 \cdot PAEC_{Rn\text{-}220}\,(WL)$$

6. Equilibrium factor (F) is the ratio of the equilibrium equivalent concentration (EEC) of radon to the actual activity concentration of radon (C_{Rn}) the air.

Equation 5

$$F = \frac{EEC}{C_{Rn}}$$

7. Potential Alpha Energy Concentration (PAEC) is the kinetic energy potentially released in a unit volume of air by alpha particles emitted by the short-lived radioactive progeny of radon. PAEC is normally expressed in Working Levels (WL) or milli-Working Levels (mWL). 1 mWL = 0.001 WL.

8. Potential Alpha Energy Exposure (PAEE) is the average potential alpha energy concentration (PAEC) to which an individual is exposed multiplied by the time of exposure. PAEE = PAEC x time. PAEE is expressed in Working Level Months (WLM) or Working Level Hours (WL-hrs).

9. Working Level (WL) is the unit of potential alpha energy concentration, defined as any combination of the short-lived radioactive progeny, in one liter of air without degree of equilibrium, that will result in the ultimate emission of 1.3 E+05 MeV of alpha energy.

10. Working Level Month (WLM) is the unit of potential alpha energy exposure, defined as exposure for one working month of 170 hours to an airborne concentration of 1 WL.

3.0 SUMMARY OF REQUIREMENTS

3.1 *Individual Monitoring*

For the purpose of monitoring *individual* exposures to internal radiation as a result of exposures to radon, internal dose evaluation programs will be conducted for:

1) Radiological workers who, under typical working conditions, are likely to receive 0.5 rem (0.005 sievert) or more committed effective dose equivalent, as a result of intakes from all contributing sources of radon (including background) in a year.

2) Minors and members of the public who are likely to receive, in 1 year, an intake resulting in a committed effective dose equivalent in excess of 0.05 rem (0.0005 sievert) *[835.207, 208, and 402(c)(3)].* To preclude monitoring and demonstrate compliance with the stated provisions, FDF will limit visitor access to AWR Controlled Areas to less than 200 hours annually.

Bioassay methods to assess dose from the intake of radon are inadequate. A representative air-sampling program will be developed should a potential exist to exceed the guidelines mentioned above *[835.209(c)(2) and (3)].*

3.2 *Reporting*

In accordance with 10 CFR 835.702, dosimetry records will include the following quantities for internal dose resulting from intakes received during the year:

1) Committed effective dose equivalent.
2) Committed dose equivalent to any organ or tissue of concern.
3) Estimated intake and identity of radionuclides.

3.3 *Area Monitoring*

Measurements of radon concentrations in the ambient air of the workplace will be performed as follows:

1) Radon monitoring will be performed in occupied areas where, under typical conditions, an individual is likely to receive an annual Potential Alpha Energy Exposure (PAEE) of 0.4 Working Level Months (WLM) and 1.2 WLM, radon thoron respectively.

2) Real-time radon monitoring, using continuous air monitors, will be performed in normally occupied areas where an individual is likely to be exposed to a Potential Alpha Energy Concentration (PAEC) of 0.33 Working Level (WL) or 1WL ^{222}Rn, ^{220}Rn respectively, when averaged over one week. The real-time air monitors will have alarm capability and sufficient sensitivity to alert potentially exposed individuals that immediate action is necessary in order to minimize or terminate inhalation exposures.

3.4 *Posting and Monitoring Requirements*

1) The words "Caution, Airborne Radioactivity Area" will be posted for any occupied area in which the PAEC exceeds, or are likely to exceed 0.03 WL or 0.1 WL ^{222}Rn, ^{220}Rn respectively, when averaged over one week *[835.603 (d)].*

2) Individuals exiting radiological areas established to control removable contamination and/or airborne radioactivity will perform appropriate monitoring to detect and prevent the spread of contamination *[835.404 (f)].*

3) The DOE Radiological Control Manual defines "appropriate monitoring" when exiting an airborne area as: Personnel exiting Contamination, High Contamination or Airborne Radioactivity Areas will perform whole body frisking to detect personnel contamination *[0256T.335 (3)(b) and 0256T.338 (1)(a)].*

4) Egress from airborne areas will not warrant whole body monitoring based solely on short-lived progeny contamination. An exception to this would be working in extremely high levels, such as opened containment of K-65 silos 1 or 2, where fully encapsulated personnel protective equipment is required to prevent inhalation of radon. Performing individual monitoring is not technically justified since:

   a) Radon progeny is an inhalation (lung) hazard. Controlling the potential spread of attached progeny resultant from radon concentrations in excess of the DAC provides no known

radiological protection advantage. The attached radon progeny is tightly adherent; therefore contamination migration from a person's clothing or skin to the lung is not probable.

b) Radon progeny activity attached to clothing as a result of routine changes in environmental radon concentrations typically exceeds the alarm set points of whole body monitoring equipment specified for long-lived contamination control. Maximum allowable progeny contamination values are not specified.

4.0 OU4 Occupational Monitoring Equipment

FDF currently maintains an occupational radon monitoring program using passive alpha-track detectors. The monitors are collected and processed on a quarterly basis. The results are published at the end of each monitoring period. The current OU4 monitored areas are T-117, T-118, T-92, and the Vitrification Pilot Plant (VitPP). Additional areas will be assigned to the program following contractor mobilization.

In addition to the passive detectors, a variety of instrumentation, providing both continuous and integrated radon concentration measurements, have been and will continue to be utilized to assess worker exposures. This following section provides a brief overview of two specific instruments currently used to support OU4 activities. Regulatory considerations that dictate the performance criteria of FDF approved instrumentation are documented in the DBD (FDF 1999).

4.1 *Alpha-Nuclear's Personal Alpha Dosimeter (PAD)595.*

4.1.1 Description

Battery operated belt-mounted, personal air-sampler that provides for real-time radon exposure measurements.

4.1.2 Quantity Available

5 Units

4.1.3 Discussion

The alpha-Nuclear Model 595 draws air through a replaceable filter using a servo-controlled pump, and counts the activity resulting from the alpha particle decay of radon progeny captured on the filter. The number of counts per preset time interval is stored in the instruments internal memory throughout the pre-programmed exposure period. At the end of the programmed run, or when stored in the instrument's battery charging rack, the pump is shut off and the monitor continues to record data for an additional 3.5 hours post-exposure period. At the conclusion of this post-exposure counting period, if connected to a computer, the computer software algorithms convert the completed time sequence of measurements into radon and thoron working levels using predetermined detector calibration and efficiency factors.

The battery is sized to allow for an 8-hour (one shift) monitoring period. Following the monitoring period, the radon concentration results and exposure estimates are provided via computer report output. These results are readily made available and are sufficient to fulfill the goals of providing personal exposure histories during OU4 activities involving high radon concentrations.

It should be noted that the monitor does not provide a direct, real-time working level readout, but does have a series of warning lights (red, yellow, and green), which are triggered when the ^{218}Po counts from the monitors previous 10 minute count period, falls within three corresponding user-set ranges. Therefore, a direct, real-time indication of the concentration may also be obtained for exposure control during operations involving high radon concentrations.

4.2 *Pylon WLx Working Level Monitor*

4.2.1 Description

Portable, battery or AC powered real-time radon area monitor.

4.2.2 Quantity

3 Units

4.2.3 Discussion

Air is drawn onto a membrane filter by a servo pump, utilizing complex flow controlling circuitry to ensure proper volumes. The filter is counted using a solid state alpha detector and a 256-channel multi-channel analyzer. Several on-board algorithms are available for both grab and continuous sampling methods. A user defined alarm function is also provided. The unit is capable of both radon and thoron progeny monitoring. In addition, a software interface and exhaust gas outlet port are provided to couple the AB-5 scintillation gas monitor to the WLx system. This provides an effective device for establishing representative equilibrium ratios.

5.0 OCCUPATIONAL MONITORING THRESHOLDS

In accordance with the requirements specified in the DBD, FDF has established a set of monitoring thresholds for action levels to minimize and assess radon exposures. These threshold values are derived in accordance with the requirements of 10 CFR 835 and provide a basis for implementing engineering and administrative controls with respect to occupational radon exposure. The threshold values are shown in Table 6-1 below.

Table 6-1: Radon Monitoring Thresholds

Monitoring Thresholds[a.]		1) DAC: EEC (pCi/l)[b.] 2) DAC: PAEC (WL)[c.] 3) ALE (WLM)[d.] 4) DAC gas only(pCi/L)		Area and Worker Monitoring: 10 % of DAC or 4 DAC-hrs per week (8 hr per day time weighted) 1) outdoor/indoor (pCi/l)[e.] 2) (mWL) 4) Average/Peak (pCi/l)[f]		
		Rn	**Tn**	**Rn**		**Tn**
Radon and Radon Progeny	**1**	30	8	4.3	7.5	N/A
	2	0.33	1	33		100
	3	4	12	N/A		N/A
Radon Gas	**4**	4000	6800	100/1000		100/1000

Explanation of Notes:

(a) Programmatic monitoring thresholds for radon and thoron and their progeny.

(b) Equilibrium Equivalent Concentration, EEC, the activity concentration of radon, in equilibrium with its short lived decay products, which would have the same potential alpha energy concentration as the existing non-equilibrium mixture.

(c) Potential Alpha Energy Concentration, PAEC, the concentration of short-lived radon decay products in air in terms of the alpha energy released during complete decay.

(d) An exposure limit expressed in WLM is not an annual limit on intake (ALI), but an annual limit on exposure (ALE), as explained in ICRP's Publication 32 (ICRP 1981). For short-lived progeny of radon and thoron, the ALI is correctly expressed in joules (J) of potential alpha energy exposure (PAEE), where an intake of 0.02 J corresponds roughly to 4 WLM.

(e) NCRP Report No. 45, NCRP, 1975 states that for indoor and outdoor atmospheres the ratio of radon to its short-lived daughters is 1/0.5/0.3/0.2 and 1/0.9/0.7/0.7 (^{222}Rn/RaA/RaB/RaC) respectively. Therefore, unless empirically determined, the equilibrium correction factor (F_{eq}) for indoor and outdoor measurement values are 0.4 and 0.7 respectively.

(f) If average radon concentrations exceed 100 pCi/l or if peak concentrations exceed 1000pCi/l, then the cognizant radiological engineer will evaluate and implement controls necessary to maintain exposures to radon As Low As Reasonably Achievable.

6.0 References

(DOE 1992) U.S. Department of Energy (US DOE), *Radiological Control Manual* (DOE/EH-0256T), Washington DC; United States Government Printing Office; 1992a.

(ICRP 1994) International Commission on Radiological Protection, *Protection against Radon-222 at Home and at Work*, ICRP Publication 65 (Pergamon Press, New York).

(ICRP 1981) International Commission on Radiological Protection, *Limits for Inhalation of Radon Daughters by Workers*, ICRP Publication 32 (Pergamon Press, New York)

(ICRP 1980) International Commission on Radiological Protection, *Limits for Intakes of Radionuclides by Workers*, ICRP Publication 30 (Pergamon Press, New York).

(ICRP 1977) International Commission on Radiological Protection, *Recommendations of the ICRP, ICRP Publication 26* (Pergamon Press, New York).

(NCRP 1975) National Council on Radiation Protection and Measurements, *Natural Background Radiation in the United States*, NCRP Report No. 45, National Council on Radiation Protection and Measurements, Bethesda, Maryland.

(FDF 1999) SD-1015, Radon/Thoron Monitoring Decision Basis, Fluor Daniel Fernald; 1999

SILOS ENVIRONMENTAL MONITORING PLAN

A General

The current focus of environmental monitoring at the FEMP is the implementation of: 1) site-wide environmental monitoring; and 2) project-specific environmental monitoring. Site-wide environmental monitoring is addressed in the Integrated Environmental Monitoring Plan (IEMP) while project-specific environmental monitoring will be addressed by project-specific environmental monitoring plans. For the OU4 implementation plan for Silos 1 and 2 Accelerated Waste Retrieval Project (AWR Project), the project-specific environmental monitoring requirements are described below.

A.1 Integrated Environmental Monitoring

The IEMP has been prepared in a manner that focuses on monitoring air, direct radiation, groundwater and surface water necessary to ensure protection of human health and the environment during the site-wide remediation activities. The IEMP incorporates new regulatory requirements for site-wide monitoring, reporting, and tracking and serves as the central reporting mechanism to the regulators and stakeholders for the ongoing emission control/ monitoring activities at the FEMP. Site-wide reporting under the IEMP does not preclude project-specific reporting for the OU4 Silos 1 and 2 AWR Project.

A.2 Project-Specific Environmental Monitoring

This project-specific environmental monitoring plan addresses sampling of air, direct radiation, and surface waters (i.e., slurry wastewater, decontamination wastewater, storm water runoff) within and surrounding specified project boundaries. The need and extent of project-specific monitoring is based on the evaluation of the following three criteria:

- project complexity, extent of contamination, and scope;
- applicable ARARs, Occupational Safety and Health Act requirements and DOE Orders; and,
- existing monitoring data, modeling, and monitoring programs.

This project-specific environmental monitoring plan for OU4 Silos 1 and 2 AWR Project considers the location and project-specific constraints. Modeling for potential emissions early in the project design is the basis for identifying and instituting process controls and emission controls. 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.

A.2.1 Environmental Radiological Air Emissions Monitoring

Environmental radiological air monitoring during the AWR Project will consists of three programs: 1) the IEMP Air Monitoring Program; 2) the AWR stack monitoring program; and

3) the Radon Control System (RCS). The IEMP Air Monitoring Program is an established program that will continue throughout remediation. Within the IEMP Air Monitoring Program, the radon monitoring network has been designed and is highly focused on monitoring the K-65 Silos headspace, radon levels in the vicinity of the silos, as well as radon levels at the site fenceline. The second and third programs are described in detail in the Environmental Control Pan and System Description. During the AWR Project, radiological contaminants represent the primary contaminants of concern in Silos 1 and 2, therefore the focus of environmental air monitoring will be for radionuclides; however, monitoring for other contaminants of concern will be added as warranted.

During the AWR Project, remediation activities that are directed towards the removal, processing, and storage of radon generating wastes create the potential for the release of radon to the environment. In order to better monitor radon levels in the K-65 area, four 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 AWR Project 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 at the K-65 exclusion fence, designated KSO
- To the east of Silo 4, midway between Silo 4 and the Bio-Surge Lagoon, 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

The map of entire IEMP radon monitoring network is shown in Dwg. 94X-5500-G-SK-1051 (A)

A.2.2 Direct Radiation Monitoring

In addition to airborne emissions, direct radiation is also a radiological hazard of concern at the FEMP. Direct radiation is the result of ionizing radiation emitting from radionuclides stored onsite. The largest source of direct radiation are the wastes stored in the K-65 silos. The IEMP environmental monitoring network includes thirty-two TLD locations to monitor direct radiation levels associated with the storage of radionuclides at the FEMP. This network is well established and monitoring locations were strategically placed to ensure a monitoring envelope for each radiation source. During the AWR Project, the major source of direct radiation at the FEMP will be relocated. The removal and relocation of the silo wastes requires an enhancement to 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 may 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.

A.2.3 Surface Water

Wastewater from the silo slurry, decontamination, and other waste streams will be

discharged to the FEMP Advanced Wastewater Treatment (AWWT) facility, if the wastewater characterization indicates the wastewater stream does not meet AWWT WAC, then pretreatment of the stream using ultra-filtration may be performed.

Project specific storm water management is governed by the FEMP Storm Water Pollution Prevention Plan (DOE 1996c), and any monitoring associated with that program is managed by the Aquifer Restoration Project. To ensure that the applicable performance requirements of that plan are followed during the AWR Project, Specification Section 01515 (Part 1.5.A.1.c of Rev. 0) requires the subcontractor provide for FEMP approval the plans to be employed to control storm water runoff, migration of wastewater, and erosion control. These pollution prevention plans are described in the in detail in the AWR Project, Storm Water Drainage Plans, and Environmental ALARA Report, Appendix E, Attachment 2 (Environmental Control Plan).

A.2.4 Groundwater Monitoring

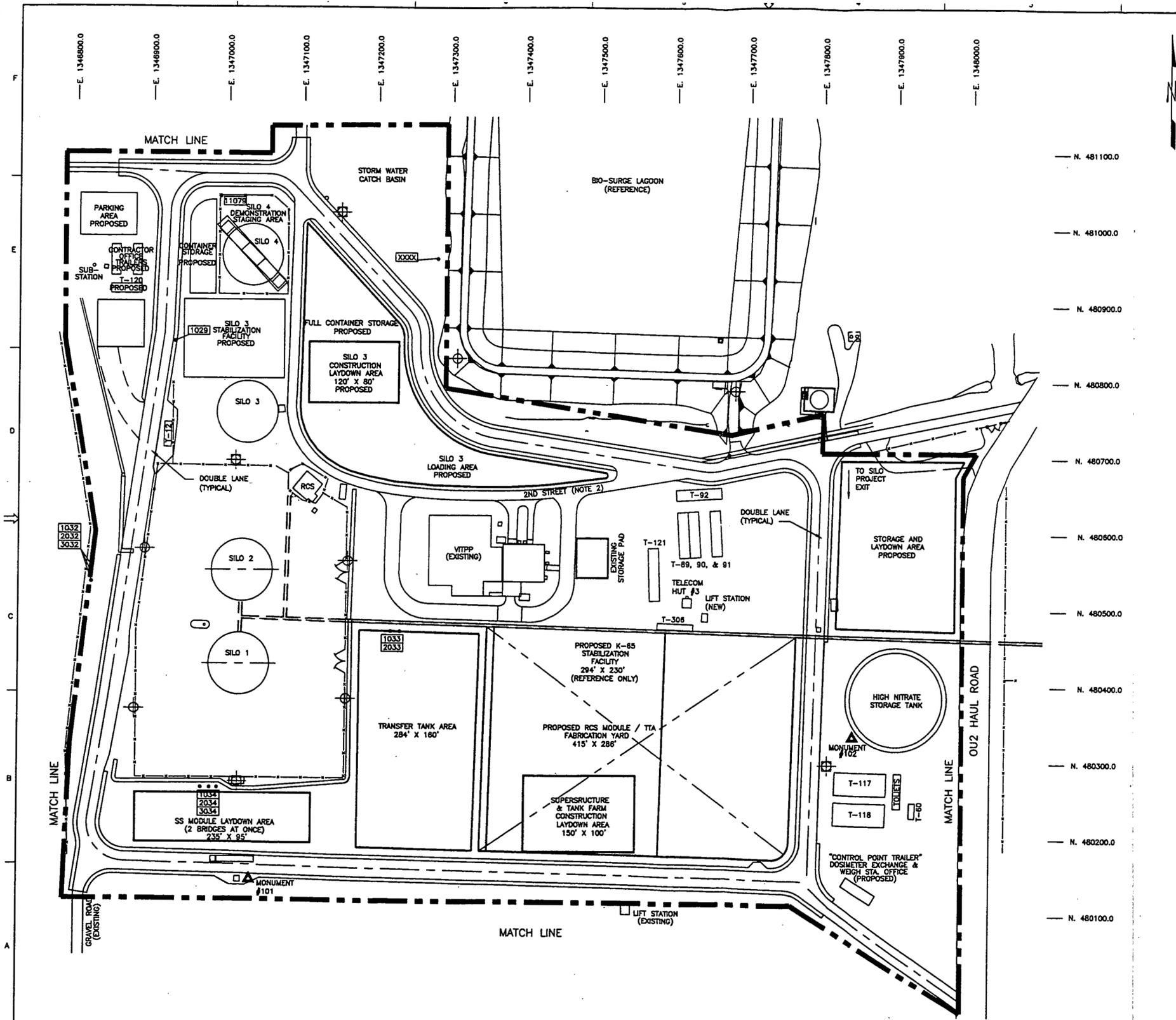
Groundwater monitoring is currently being managed by the Aquifer Restoration Project (ARP). The ARP currently provides the monitoring necessary to identify the effect of the current FEMP activities and are adequate for assessing potential impacts on groundwater quality due to the AWR Project. In the event that collection of groundwater samples is needed to support the AWR Project (or to assess any incidental releases), ARP managers will be notified to coordinate the appropriate activity.

A.3 Reporting

All project-specific environmental monitoring will be reported in the AWR Project completion report, which will include a summary of the results generated during the project. For project-specific 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 direct radiation monitoring, the report will include TLD locations and a summary of quarterly results. For surface waters, the report will include a summary of the results from sampling and analysis of water samples generated during the AWR Project.

Additionally, project-specific environmental monitoring data may be reported as necessary in IEMP quarterly status reports and Integrated Site Environmental Report (ISER) in order to explain changes in the data from the IEMP environmental monitoring program.

275 3



NOTES:

1. LOCATION OF FENCES, GATES AND CHECK POINTS TO BE DETERMINED.
2. THIS SECTION OF 2nd STREET TO BE USED BY PEDESTRIAN, LIGHT DUTY, OCCASIONAL DELIVERIES TO OU1, AND EMERGENCY TRAFFIC ONLY.
3. CONTRACTOR'S FACILITY LAYOUT SHOWN FOR INFORMATION ONLY. CONTRACTOR IS RESPONSIBLE FOR FINAL DESIGN AND LAYOUT WITHIN WORK ZONE.
4. CONSTRUCTION AND OPERATIONS PERSONNEL WILL USE EXISTING SITE PARKING LOT.
5. FDF SHALL COORDINATE LAND USE WITH THE WASTE PIT REMEDIAL ACTION PROJECT (WPRAP) HEALTH AND SAFETY REPRESENTATIVE, PRIOR TO FINALIZATION OF LAND USE. FAILURE TO DO SO COULD PRESENT AN UNREVIEWED SAFETY QUESTION, THUS INVALIDATING EITHER OF THE PROJECT'S (SILO 3 AND/OR WPRAP) SAFETY BASIS.
6. INFRASTRUCTURE ROAD IS TO BE DOUBLE LANE.

LEGEND OF SYMBOLS

- ▲ = MONUMENT
- 1029 = MONITORING WELL NUMBER
- ⊕ = EXISTING MONITOR
- ⊕ = NEW MONITOR

CONFIGURATION MANAGEMENT

0 25 50 100 150 200 250
GRAPHIC SCALE
1" = 50'

000414

SK-1051

UNITED STATES DEPARTMENT OF ENERGY
FERNALD ENVIRONMENTAL MANAGEMENT PROJECT

THIS DRAWING PREPARED BY
FLUOR DANIEL FERNALD
SILOS PROJECT
CINCINNATI, OHIO

DRAWING TITLE
RADON MONITOR LOCATION
SITE PLAN
OU 4 SILOS PROJECT

DRAWN BY J. THOMPSON	DATE 1/10/00	DESIGNED, CHECKED BY	DATE	CHECKED BY	DATE
PLANT/BLDG. NO. OU4		PLOT		SCALE 1"=50'	PLOT
SUBMITTED FOR APPROVAL		APPROVAL RECOMMENDED			
A-E DATE		OPERATING CONTRACTOR DATE			
DOE PROJECT NO.	SPEC. CONTL. PROJ. NO. 04424331	DRAWING NO. 94X-5500-G-SK-1051		SHEET NO. 1	REV. NO. A

DISTRIBUTION CODE: XXX

ACAD

INITIALS: JST
DATE: 1/10/99

Draft Construction Specifications

DRAFT
This document is in government specification format. Technical requirements are correctly stated.

SECTION 02924

SEEDING

PART 1 GENERAL

1.1 RELATED SECTIONS

01330 Submittal Procedures

1.2 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by the basic designation only.

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM D 4427	(1992; R 1996) Peat Samples by Laboratory Testing

COMMERCIAL ITEM DESCRIPTIONS (CID)

CID A-A-1909	Fertilizer

DEPARTMENT OF AGRICULTURE (DOA)

DOA FSA	(January 1985) Federal Seed Act Rules and Regulations of the Secretary of Agriculture
DOA SSIR	(April 1984) Soil Survey Investigation Report No. 1, Soil Survey Laboratory Methods and Procedures for Collecting Soil Samples, Soil Conservation Service

1.3 DEFINITIONS

1.3.1 Stand of Turf

95 percent ground cover of the established species.

1.4 SUBMITTALS

Submit the following in accordance with Section 01330, "Submittal Procedures."

SD-03 Product Data

Wood cellulose fiber mulch

Fertilizer

Include physical characteristics, and recommendations.

[ ] A - Conforms to the Subcontract Requirements
[ ] B - Minor Comment - Incorporate and Resubmit
[ ] C - Revise and Resubmit
Sig:_____ Date:_____

000415

Lime

Peat

SD-06 Test Reports

Topsoil composition tests as specified in DOA SSIR

SD-07 Certificates

State Approval for seed

1.5 DELIVERY, STORAGE, AND HANDLING

1.5.1 Delivery

1.5.1.1 Seed Protection

Protect from contamination during delivery, on-site storage, and handling.

1.5.1.2 Fertilizer and Lime Delivery

Deliver to the site in original, unopened containers bearing manufacturer's chemical analysis, name, trade name, trademark, and indication of conformance to state and federal laws. Instead of containers, fertilizer and lime may be furnished in bulk for hydro-seeding with certificate indicating the above information.

1.5.2 Storage

1.5.2.1 Seed, Fertilizer and Lime Storage

Store in cool, dry locations away from contaminants.

1.6 TIME RESTRICTIONS AND PLANTING CONDITIONS

1.6.1 Restrictions

Do not plant when the ground is frozen, snow covered, muddy, or when air temperature exceeds 90 degrees Fahrenheit.

1.7 TIME RESTRICTIONS AND PLANTING CONDITIONS

1.7.1 Seed

All disturbed areas must be seeded within seven days of knowing that the area will be idle for 45 days or more.

Seeding shall be from March 1 through October 31.

PART 2 PRODUCTS

2.1 SEED

2.1.1 Classification

Provide State-approved seed of the latest season's crop delivered in original sealed packages, bearing producer's guaranteed analysis for percentages of mixtures, purity, germination, weed seed content, and inert material. Label in conformance with DOA FSA and applicable state seed laws. Wet, moldy, or otherwise damaged seed will be rejected.

Each variety of seed shall: have a purity of not less than 90 percent, have a percentage of germination not less than 80 percent, have a weed to seed content of not more than 0.75 percent and contain no noxious weeds. These percentages are by weight.

2.1.2 Seed Mixture Composition

Creeping Red Fescue – 20 pounds/acre
Annual Ryegrass – 10 pounds/acre
Kentucky Bluegrass – 15 pounds/acre
Aliske Clover – 5 pounds/acre
Flatpea – 5 pounds/acre

Seed mixtures should be prepared by a seed vender for the above mixture compositions. Field mixes will be acceptable when field mix is performed on site in the presence of FWENC.

2.2 TOPSOIL

2.2.1 Existing Soil

Modify existing soil to conform to the requirements specified in paragraph entitled "Composition."

2.2.2 On-Site Topsoil

Reusable surface soil stripped and stockpiled on site if requirements specified for topsoil in paragraph entitled "Composition" are met.

2.2.3 Off-Site Topsoil

Conform to requirements specified in paragraph entitled "Composition." Additional topsoil shall be furnished by FWENC or obtained from topsoil borrow areas identified by Fluor Fernald.

2.2.4 Composition

Containing from 5 to 20 percent organic matter as determined by the topsoil composition tests of the Organic Carbon, 6A, Chemical Analysis Method described in DOA SSIR.

Maximum particle size, 3/4 inch, with maximum 3 percent retained on 1/4 inch screen. Other components shall be within the following percentages:

Silt	25-50
Clay	10-30
Sand	20-35
pH	5 to 7.6
Soluble Salts	600 PPM maximum

2.3 PH ADJUSTERS

2.3.1 Lime

Commercial grade limestone containing not less than 50 percent of total oxides, gradation, as follows: Minimum 75 percent passing 100 mesh sieve and 100 percent passing 20 mesh sieve.

2.3.2 Aluminum Sulfate

Commercial grade.

2.4 SOIL CONDITIONERS

Provide singly or in combination as required to meet specified requirements for topsoil. Soil conditioners shall be nontoxic to plants.

2.4.1 Peat

Peat humus derived from a freshwater site and conforming to ASTM D 4427 as modified herein. Shred and granulate peat to pass 1/2 inch mesh screen and condition in storage pile for minimum 6 months after excavation.

2.4.2 Sand

Clean and free of materials harmful to plants.

2.4.3 Perlite

Horticultural grade.

2.4.4 Vermiculite

Horticultural grade.

2.4.5 Rotted Manure

Composted, horse or cattle manure containing maximum 25 percent by volume of straw, or other bedding materials. Manure shall be free of stones, sticks, and soil, viable weed seed, and other materials harmful to plants.

2.4.6 Composted Wood Derivatives

Ground bark, nitrolized sawdust, humus, or other wood green waste material free of stones, sticks, and soil stabilized with nitrogen and having the following properties:

2.4.6.1 Particle Size

Minimum percent by weight passing:

No. 4 mesh screen	95
No. 8 mesh screen	80

2.4.6.2 Nitrogen Content

Minimum percent based on dry weight:

Fir Sawdust	0.7
Fir or Pine Bark	1.0

2.4.7 Calcined Clay

Granular particles produced from montmorillonite clay calcined to minimum temperature of 1200 degrees F to the following gradation: minimum 90 percent passing 8 mesh screen, 99 percent retained on 60 mesh screen and, maximum 2 percent passing 100 mesh screen. Bulk density: 40 pounds maximum per cubic foot.

2.5 FERTILIZER

2.5.1 Commercial Grade Fertilizer

CID A-A-1909, free flowing, uniform in composition with nitrogen-phosphorous-potassium ratio of 12-12-12, composed of pills coated with plastic resin to provide continuous release of fertilizer for at least 6 months.

2.6 SURFACE TOPDRESSING (MULCH)

Free from noxious weeds, mold, and other deleterious materials.

2.6.1 Humus

95 percent decomposed vegetable matter and wood fiber with a particle size of 1/4 to 1/2 inch.

2.6.2 Straw

Stalks from oats, wheat, rye, barley, or rice. Furnish in air-dry condition and of proper consistency for placing with commercial mulch blowing equipment.

2.6.3 Hay

Air-dry condition and of proper consistency for placing with commercial mulch blowing equipment. Provide only marsh hay for lawn areas.

2.6.4 Wood Cellulose Fiber Mulch

Processed to contain no growth or germination-inhibiting factors and dyed an appropriate color to facilitate visual metering of materials application. Composition on air-dry weight basis: 9 to 15 percent moisture, pH range from 3.5 to 5.0. Use with hydraulic application of grass seed and fertilizer.

2.7 WATER

Suitable quality for irrigation.

2.8 EROSION CONTROL MATERIALS

2.8.1 Net

Heavy twisted jute mesh, plastic net, biodegradable paper fabric with knitted yarns, or standard weave burlap.

2.8.2 Blanket

Fiber

PART 3 EXECUTION

3.1 PREPARATION

3.1.1 Soil Preparation

Remove existing topsoil to a minimum depth of 2 inches and stockpile. After areas have been brought to finish subgrade elevation, thoroughly till to minimum depth of 6 inches by scarifying, disking, harrowing, or other methods approved by FWENC. Remove debris and stones larger than one inch in any dimension remaining on surface after tillage.

3.1.2 Topsoiling

Spread stockpiled topsoil evenly to provide positive drainage. Provide off-site topsoil to meet indicated finish grade if required. Do not spread topsoil when frozen or excessively wet or dry. Thoroughly mix subgrade and topsoil and off-site topsoil to a depth of 6 inches by disking, harrowing, tilling or other method approved by FWENC. Correct irregularities in finished surfaces to eliminate depressions. Protect finished prepared soil areas from damage by vehicular or pedestrian traffic.

3.1.3 Fertilizer, Lime, pH Adjuster, and Soil Conditioners

Apply at rates as determined by laboratory soil analysis of the soils at the job site or at the standardization rates of:

Agriculture Lime at two tons per acre and Fertilizer (12-12-12) at 500 pounds per acre.

3.2 SEEDING

3.2.1 Seed Application Seasons and Conditions

Immediately before seeding, restore soil to proper grade and thoroughly moisten soil to a depth of 6 inches. Do not seed when ground is muddy frozen, snow covered or in an unsatisfactory condition for seeding. If special conditions exist that may warrant a variance in the above seeding dates or conditions, submit a written request to FWENC stating the special conditions and proposed variance. Apply seed within twenty-four hours after seedbed preparation. Sow seed by approved sowing equipment.

3.2.2 Seed Application Method

3.2.2.1 Broadcast and Drop Seeding

Use broadcast or drop seeders. Cover seed uniformly to a maximum depth of 1/2 inch by means of spike-tooth harrow, cultipacker, raking or other approved devices.

3.2.2.2 Hydroseeding

First, mix water and fiber. Fiber shall be added at 1,000 pounds, dry weight, per acre. Then add and mix seed and fertilizer to produce homogeneous slurry. When hydraulically sprayed on the ground, material shall form a blotter like cover impregnated uniformly with grass seed. Spread with one application with no second application of mulch.

3.2.3 Top Dressing (Mulch)

Spread straw, hay, humus over seed bed area to an even depth of 1/2 inch. Take precautionary measures to prevent topdressing materials from spilling onto pavements or utilities structures.

3.2.4 Rolling

Immediately after seeding, firm entire area except for slopes in excess of 3 to 1 with a roller not exceeding 90 pounds for each foot of roller width. If seeding is performed with cultipacker-type seeder or by hydroseeding, rolling may be eliminated.

3.3 ROTECTION OF TURF AREAS

Immediately after turfing, protect area against traffic and other use.

3.4 MAINTENANCE

3.4.1 Start watering areas seeded as required by temperature and wind conditions. Apply water at a rate sufficient to insure thorough wetting of soil to a depth of 2 inches without run off. During the germination process, seed is to be kept actively growing and not allowed to dry out.

3.4.2 Mow turfed area to an average height of 1-½ inches when average height of grass becomes greater than 4 inches.

3.5 FIELD QUALITY CONTROL

3.5.1 Final Inspection and Acceptance

Final acceptance will be based upon a satisfactory stand of turf.

Within 3 weeks, germination must occur over 95 percent of the area with no single bare area greater than 3 square feet.

Within 3 months, 95 percent of the area must be covered with mature perennial grass. Replant within specified planting dates areas which do not have a satisfactory stand or turf.

End of Section

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SECTION 02300
EARTHWORK

PART 1 GENERAL

1.1 SUMMARY

A. This section includes requirements for excavation, fill, and backfill to meet required grades and elevations, placement of topsoil, and protection and access requirements.

B. Excavation and backfilling requirements for utility trenches are specified in Section 02324, Utility Trenching.

C. Related Sections:

1. Section 02060, Aggregate.
2. Section 02230, Site Demolition.
3. Section 02325, Flowable Fill.
4. Section 02370, Slope Protection and Erosion Control.
5. Section 02375, Geotextiles.
6. Section 02924, Seeding.
7. Section 16xxx, Site Grounding.

1.2 DEFINITION OF TERMS

A. Earth Excavation: Removal of material to lines, elevations, and dimensions shown on drawings and disposition of materials encountered in grading and excavation work except that classified as rocks/obstructions excavation.

B. Rock/Obstructions Excavation: Removal of materials such as boulders or obstructions in conformance with lines, grades, and dimensions shown on drawings. Rock/obstruction material must be greater than 1 yd^3 in volume or other hard material that cannot be excavated by heavy construction equipment such as a Caterpillar 325 power excavator or a Caterpillar D9 bulldozer equipped with a single tooth hydraulic ripper.

C. Unauthorized Excavation: Excavation not required by specifications or drawings which is not authorized in writing by the FDF Construction Manager.

D. Backfill: Materials used to replace material excavated during construction. Spread and compact backfill in same manner as fill. Do not use any concrete or masonry product as fill or backfill material.

E. Subgrade: Compacted fill or backfill, or undisturbed soil surface which supports additional soil, aggregate, or rock construction.

F. Undercutting: Removal of soft or undesirable materials as determined by Construction Manager, encountered in undisturbed subgrade below grades specified for excavation.

G. Shoring: A structure such as a metal, hydraulic, mechanical, or timber shoring system that supports sides of an excavation and which is designed to prevent cave-ins, in accordance with Occupational Safety and Health Administration (OSHA), *Code of Federal Regulations* 29 CFR 1926, Subpart P -Excavation.

H. Soils Engineer: The soils engineer shall be a professional engineer registered in the state of Ohio. The engineer shall have a minimum of 10 years experience in soils testing and placement.

I. Soils Technician: The soils technician shall have passed the National Institute for Certification in Engineering Technologies (NICET) certification program in the subfield of soils and have a minimum of 5 years experience in sampling and testing procedures. The soils technician shall be under the direct supervision of the soils engineer.

J. Soils Testing Laboratory: The soils testing laboratory shall be approved by U.S. Army Corps of Engineers and meet the criteria detailed in ASTM D 3740. The testing laboratory shall be an independent firm procured by the contractor.

1.3 REFERENCES

A. American Society for Testing and Materials (ASTM).

1. ASTM A 328, Standard Specification for Steel Sheet Piling.
2. ASTM D 422, Standard Test Method for Particle-Size Analysis of Soils.
3. ASTM D 698, Standard Test Method for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft^3).
4. ASTM D 1556, Standard Test Method for Density and Unit Weight of Soil in Place by the Sand-Cone Method.
5. ASTM D 2216, Standard Test Method for Laboratory Determination of Water (Moisture) Content of Soil and Rock.
6. ASTM D 2487, Standard Classification of Soils for Engineering Purposes (Unified Soil Classification System).
7. ASTM D 2922, Standard Test Methods for Density of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth).
8. ASTM D 3017, Standard Test Method for Water Content of Soil and Rock in Place by Nuclear Methods (Shallow Depth).
9. ASTM D 3740, Standard Practice for Minimum Requirements for Agencies Engaged in the Testing and/or Inspection of Soil and Rock as Used in Engineering Design and Construction.
10. ASTM D 4318, Standard Test Method for Liquid Limit, Plastic Limit, and Plasticity Index of Soils.
11. ASTM D 4972, Standard Test Method for pH of Soils.

B. Health and Safety Plan for xxxxxxx, Foster Wheeler Environmental Corporation, sometime 1999.

C. Occupational Safety and Health Administration (OSHA), Code of Federal Regulations 29 CFR 1926, Subpart P – Excavation.

D. Ohio Department of Transportation (ODOT), Construction and Material Specifications, January 1997.

E. Waste Handling Workplan for the Silos 1 and 2 AWR Project, Document 40710-624-ACR007-01, Revision A, Foster Wheeler Environmental Corporation, April 1999.

1.4 SUBMITTALS

A. The contractor shall submit the qualifications of the soils engineer, soils technician, and soils testing laboratory.

B. The contractor shall submit soils testing results prior to transporting soil to site, for the material specified in Articles 2.1A and 2.1C.

C. The soils engineer or soils technician shall document activities associated with the construction, monitoring, and testing of soil material with daily earthwork reports and shall include any oral communications. Daily earthwork reports shall record the location and results for all inspections and tests conducted on that day.

1.5 PROJECT CONDITIONS

A. See Berm Excavation Plan for silo area earthwork.

B. Existing utility lines shown represent approximate locations only. The Contractor shall field verify all existing utility lines prior to beginning grading operations. Prior to beginning any excavation work, a Penetration Permit shall be obtained in accordance with the Health and Safety Plan. Any deviations from the locations shown on the construction drawings or the Penetration Permit, or any unknown obstructions or conditions that affect construction, shall be reported in writing to the FDF Construction Manager, immediately for further instructions prior to beginning or continuing operations. Any unidentified material encountered while performing work shall be reported immediately to the Plant Protective Services (574-8315), Security (574-8315), and Classification (574-7731) for further instructions prior to continuing operations.

C. The existing adjacent facilities will continue in normal use and operation for the duration of work performed under this contract. Any potential unscheduled impacts to adjacent facilities shall be reported immediately to the FDF Construction Manager.

D. It shall be the Contractor's responsibility to remove, replace, or relocate overhead utilities/obstacles, or to perform work within the existing available clearance. If removal or relocation is required, such operations will be performed in a timely manner. All required utility outages shall be approved by the Construction Manager 14 days in advance.

E. During trenching, any concrete live electrical ductbank removed or damaged, or any live electrical conduit/cable removed or damaged shall be repaired and replaced with materials and red concrete encasement in accordance to Division 16. If existing electrical conduit/cable does not have concrete encasement at point of excavation, it shall be encased with concrete prior to backfill.

PART 2 PRODUCTS

2.1 MATERIALS

A. Borrow Sources

1. All soils required from offsite borrow sources shall be subject to Construction Manager's approval based on submittals of the specified tests, prior to soils being transported to the construction site.

2. Provide borrow soil that is classified by ASTM D 2487 as GW, GP, GM, GC, SW, SP, SM, SC, CH, ML, or CL and has a plasticity index (PI) of less than 30 in accordance with ASTM D 4318. Material shall be free of organic matter, rock fragments exceeding 4 inches in any dimension, and any other deleterious material.

B. Aggregate: Shall be in accordance with Section 02060, Aggregate.

C. Topsoil: Shall be natural, friable, fertile, fine sandy loam soil reasonably free from noxious weeds, stones larger than 1 inch diameter, lime, cement, ashes, slag, or other deleterious matter which will prevent the formation of a suitable seed bed. Topsoil requirements for pH are contained in Section 02924, Seeding.

D. Riprap: Shall be in accordance with Section 02371, Riprap.

E. Geotextile: Shall be in accordance with Section 02375, Geotextile.

2.02 EQUIPMENT

Choice of equipment to perform required operations in conformance with these specifications shall be the responsibility of the Contractor. However, any equipment that results in waste, damage of material, inaccurate work, or is otherwise objectionable shall be promptly replaced.

PART 3 EXECUTION

3.1 PREPARATION

A. Identify required lines, elevations, and limits to support earthwork operations.

B. Verify that subgrade and material placed from the previous work shift is not soft, spongy, or composed of otherwise unsuitable material. If unsuitable material is discovered and can not be corrected, stop work and notify the FDF Construction Manager.

C. Verify that areas to be filled or backfilled are free of snow, ice, or water and that surfaces are not frozen.

D. Verify that excavations and foundations are braced or underpinned to support surcharge forces imposed by grading and backfilling operations.

3.2 GENERAL PROCEDURES.

A. Maintain fill areas free from water, and dispose of water through a siltation

control device or devices which includes, but is not limited to, one or more of the following: silt fence, rock check dam, straw bales, or silt trap.

B. Pumped water shall not contain sufficient sediment to discolor the receiving stream. Report immediately any spring or seepage water encountered to the FDF Construction Manager.

C. Provide erosion and sediment control to minimize erosion and transport of sediment beyond limits of work area. Methods shall conform to Section 02370, Slope Protection and Erosion Control.

D. Provide temporary shoring and bracing as necessary to safely support excavation. Shoring shall be in accordance with OSHA 29 CFR 1926, Subpart P - Excavations. Remove shoring and bracing from excavation as backfilling progresses. Do not disturb or damage nearby structures and utilities.

E. Do not place fill material when weather conditions, condition of the subgrade, or condition of the fill material precludes obtaining the specified compaction. Do not use frozen material for fill, and do not place fill material on or against frozen surfaces.

F. Excavation and backfilling around structures, sumps, manholes, and cleanouts shall be performed carefully with the material being installed at uniform depth on all sides. Material within 4 feet of structures, sumps, manholes, and cleanouts shall be compacted with hand-operated power tampers or other approved means to the specified requirements. Tracks or wheels of heavy equipment shall not pass within 4 feet of structures.

G. Finished surfaces shall be free from irregular surface changes to prevent ponding. Maintain newly graded areas until final acceptance by the Construction Manager. Restore areas showing settlement or washes to specified grades.

3.3 EXCAVATION

A. Notify the FDF Construction Manager if unexpected subsurface conditions are discovered and discontinue affected work. Grade top perimeter of excavation to prevent surface water from draining into excavation.

B. Slope banks with machine to angle of repose or less until provisions for shoring or slope stabilization are ready to be implemented. Do not interfere with 45-degree bearing splay of foundations.

C. Hand trim excavation and remove loose matter. Correct overexcavated areas with backfill and compact, or replace with flowable fill as necessary.

3.4 FILL, BACKFILL, AND COMPACTION

A. Maintain optimum moisture conditions of fill and backfill material prior to placement and during transportation.

B. All areas which are not excavated shall be scarified to a depth of 6 inches and proofrolled.

C. Spread fill and backfill in layers that will not exceed 6 inches after compaction. After placement of loose material, adjust moisture content to bring material within required moisture content limits to achieve proper density.

D. Compact fill and backfill to a minimum of 95% of maximum dry density at not less than 2% below nor more then 2% above the optimum moisture content as determined by ASTM D 698. Compact material not accessible to self-propelled or towed compactors by hand-operated power tampers.

E. Areas which do not support structures, utilities or traffic shall be compacted to a minimum of 90% of maximum dry density at not less than 4% below nor more than 4% above the optimum moisture content as determined by ASTM D 698.

F. Place flowable fill at locations shown on the construction drawings in accordance with Section 02325, Flowable Fill. Flowable fill may also be used at locations where access is constricted. Use of flowable fill shall meet the requirements of structural fill.

3.5 TOPSOIL PLACEMENT

A. Verify that subgrade elevations are within 0.10 feet of specified grades. Scarify areas to receive topsoil to a depth of 3 inches.

B. Place topsoil material to a depth of 4 inches and bond to subgrade using a dozer. Compact topsoil by two complete passes with a tracked piece of equipment, perpendicular (up and down) with the slope to reduce erosion potential.

C. Seeding requirements shall conform to Section 02924, Seeding. If seeding operations do not commence prior to a precipitation event which produces erosion rills, the affected areas shall be reshaped and tracked with a dozer immediately prior to seeding.

D. Finished surfaces shall be reasonably smooth, without high or low points, and shall not be more than 0.10 feet above or below specified grades. Restore areas showing settlement or washes to specified grades as necessary.

3.6 STOCKPILES

A. Excess material that can not be immediately loaded onto trucks for transportation may be stockpiled onsite until final disposition of the material is determined. Positive surface flow shall be maintained to avoid ponding, and changes to the existing surface drainage flow patterns shall be minimized.

B. Excess material may be stockpiled in loose lifts approximately 12 inches thick. Maximum stockpile slopes shall be 3:1 (horizontal to vertical) with a maximum height of 15 feet.

3.7 FIELD QUALITY CONTROL

A. General Testing Requirements

All soil laboratory testing shall be performed by the soils testing laboratory prior to incorporating soil materials into the construction. All required field testing shall be performed by the soils technician or soils engineer. Additional tests may be

necessary if testing indicates improper work, based on the following conditions:

1. Fill materials appear to have improper moisture content or the moisture content is not uniform.
2. Fill materials appear to differ substantially from those specified or previously tested.
3. The degree of compaction is questionable or does not appear uniform.

B. Laboratory Testing

1. Laboratory testing to classify soil shall be performed prior to placement at a minimum frequency of one test per 5,000 yd^3. In addition, a sample shall be obtained by the soils technician or soils engineer each time a change in appearance of the material is noted, for classification by laboratory testing in accordance with ASTM D 2487.
2. Standard compaction tests (ASTM D 698), for each soil that is specified to be compacted to a percentage of a maximum dry density, shall be performed prior to placement. In addition, a sample shall be obtained by the soils technician each time a change in appearance of the material is noted, with standard compaction testing being performed on the sample.
3. The pH tests (in accordance with ASTM D 4972) for borrow topsoil shall be performed prior to placement. A minimum of one test shall be performed on soils from each borrow source. In addition, a sample shall be obtained by the soils technician or soils engineer each time a change in appearance of the material is noted, with pH testing being performed on the sample.

C. Field Testing

1. Compaction of fill and backfill to the specified moisture-density relationship shall be verified by the soils technician or soils engineer using ASTM D 2922 or other approved ASTM in-place density tests.
2. Testing for moisture content of soils shall be in accordance with ASTM D 2216 or ASTM D 3017. Testing will be performed by the soils technician or soils engineer.
3. In-place density tests and moisture tests shall be conducted after each layer is placed at a frequency of one test per 5,000 ft^2 of surface area of a compacted layer, with a minimum of one test performed on each layer.
4. The location of density tests and moisture tests shall be selected randomly by the soils technician or soils engineer.
5. The soils technician will visually inspect soils being placed during construction to ensure soils classification. Soils which fail visual inspection shall not be covered with additional lifts until additional tests are performed verifying acceptability.
6. Soil placed in lifts which do not meet the compaction requirements shall be reworked and retested to confirm that compaction requirements are met prior to beginning the next lift.

D. The soils technician and/or soils engineer shall perform the following field activities at a minimum:

1. Take soil samples for classification, standard compaction, particle size, and pH laboratory testing as specified.
2. Observe soils for materials not meeting requirements. Take additional samples for laboratory testing as specified each time a change in appearance or gradation of the material is noted.
3. Perform and document nuclear gauge in-place density and moisture tests as specified.
4. Observe the prepared final surface of each layer for firmness, smoothness, and absence of abrupt changes in grade.
5. Observe utility trenching activities and perform testing as specified in Section 02324, Utility Trenching.
6. Provide daily earthwork reports and other documentation in a neat and organized fashion.

3.8 PROTECTION

A. Protect existing structures, utilities, seeded areas, and other features adjacent to work area during construction activities.

B. Provide adequate shoring and bracing as required to protect and maintain stability of existing structures and facilities. Follow all requirements of OSHA 29 CFR 1926, Subpart P. Barricade open excavations occurring as part of this work and post with warning lights.

C. Protect structures, utilities and other facilities from damage caused by settlement, lateral movement, undermining, washout, and other hazards created by earth operations.

END OF SECTION

ATTACHMENT 1

EARTHWORK FORMS

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SECTION 02370
SLOPE PROTECTION AND EROSION CONTROL

PART 1 GENERAL

1.1 SUMMARY

A. This section includes temporary control measures for slope protection and controls to reduce erosion and sedimentation through the use of erosion control devices.

B. Related Sections:

1. Section 02300, Earthwork.
2. Section 02375, Geotextiles.
3. Section 02924, Seeding.

1.2 REFERENCES

A. American Association of State Highway and Transportation Officials, AASHTO M 288, Geotextile Specification for Highway Applications.

B. Ohio Department of Natural Resources (ODNR), Rainwater and Land Development, Dan Mecklenburg, Second Edition, 1996.

C. Ohio Department of Transportation (ODOT), Construction and Material Specification, January 1997.

1.3 SUBMITTALS

Submit manufacturer's data on silt fence and erosion control matting. Include installation instructions and maintenance instructions.

1.4 PROJECT CONDITIONS

A. Provide temporary pollution control features to ensure that effective and continuous erosion control is maintained throughout the construction period.

PART 2 PRODUCTS

2.1 MATERIALS

A. Silt Fence

1. Geotextile Filter Fabric: Shall be made of pervious sheets of strong rot-proof plastic fabric meeting the requirements of AASHTO M 288 for Sediment Control Fabrics.

2. Reinforcement Backing: Shall either be minimum 14 gauge steel wire and maximum mesh spacing of 6 inches, or synthetic netting of equal strength. Use reinforcement backing as recommended by manufacturer of geotextile filter fabric. Reinforcement backing can be eliminated if post

spacing is a maximum of 6 feet and the geotextile tensile strength is at least 200 pounds.

3. Posts: Shall be either wood or steel with minimum length of 4 feet. Wood posts shall be at least 2 inches by 2 inches of oak or similar hardwood. Steel posts shall be round or shaped as a "U", "T", or "C". Steel posts shall have a minimum weight of 1.33 pounds per linear foot and shall have projections for fastening reinforcement to silt fence.

4. Wire Staples: Shall be at least 9 gauge thickness with a minimum length of 1 inch.

5. A preassembled silt fence meeting the material requirements may be used instead of a field constructed silt fence.

B. Excelsior Matting: In accordance with ODOT Item 668.

2.2 EQUIPMENT

The choice of equipment to perform erosion control operations shall be the responsibility of the Contractor. However, any equipment that results in waste, damage of material, or inaccurate work shall be promptly replaced.

PART 3 EXECUTION

3.1 PREPARATION

A. Coordinate use of erosion control measures with requirements of Section 02300, Earthwork. Silt fences and rock check dams shall be installed as a first step in clearing and earthwork and maintained throughout the construction period.

B. Temporary measures may be removed at the beginning of the workday but must be replaced at the end of the workday. Erosion and sediment control measures shall be inspected at the end of each workday.

C. Prepare subgrade at locations to receive erosion and sediment control measures. Compact surface by use of hand or mechanical tamps. Replace pockets of soft soil as necessary. Do not install on frozen or spongy subgrades.

3.2 GENERAL REQUIREMENTS

A. Existing vegetative ground cover shall not be destroyed, removed, or disturbed more than 14 calendar days prior to grading operations.

B. Comply with local, state, and federal stormwater discharge quality regulations. All pumped water shall be discharged through a siltation control device that removes all visible sediment. Pumped water shall not discolor the receiving stream.

C. All points of construction ingress and egress shall be protected to prevent tracking of mud or soil onto paved roads. Tracked mud or soil shall be removed by the contractor at the end of each workday using shovels and brooms.

D. Seed and mulch within 14 days of completion of grading activities. Perform temporary or permanent seeding in accordance with Section 02924, Seeding.

3.3 SILT FENCE

A. Install silt fence on the downhill side of all work limits and along natural drainage areas to reduce the quantity of sediment and flow velocities to downstream areas. Terminate silt fences on the uphill portion of work limits at a distance that prevents short-circuiting around the ends of silt fence.

B. Posts shall have a maximum spacing of 6 feet for silt fences constructed without reinforcement backing, or a maximum spacing of 10 feet for silt fences constructed with reinforcement backing. Install posts at least 2 feet into ground.

C. Excavate trench approximately 6 inches wide and 6 inches deep upslope from the posts. Securely fasten wire reinforcement (if used) to upslope side of posts using wire staples, tie wires, or hog rings. Attach geotextile filter cloth directly to posts and wire reinforcement backing using wire, staples, or other means recommended by the silt fence manufacturer. Install filter fabric so that the fabric height above grade is at least 2 feet and the fabric length below grade is at least 12 inches. Do not use fabric with defects, rips, holes, deterioration or other types of damage. Backfill trench and compact soil.

3.4 EXCELSIOR MATTING

A. Install excelsior matting with anchoring devices on all disturbed slopes of 10% or greater, and on all disturbed waterways and channels not designated to receive riprap. Install in accordance with manufacturer's recommended written instructions for slopes and for drainage channels.

B. Shape waterway, channel, and slope areas to required shape and grade. Thoroughly compact after seedbed preparation in accordance with Section 02924, Seeding. Remove rocks, sticks, and dirt clods that may prevent contact of excelsior matting with soil surface.

C. The spacing of anchoring devices shall be based on loose soil conditions. Mulch and tackifier are not required on areas to receive excelsior matting.

3.5 MAINTENANCE

A. The contractor shall maintain an erosion control checklist and an erosion control inspection log. Inspection records shall be maintained in proper order at the project site until after the construction is completed and accepted. Inspection records shall be given to FDF and to state officials upon request.

B. Inspect erosion control devices immediately after each rainfall, at least daily during prolonged rainfall, and weekly during dry periods. Remove sediment deposits after each storm event. Repair or replace damaged devices as necessary.

END OF SECTION

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ATTACHMENT 1

EROSION CONTROL FORMS

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SECTION 02375
GEOTEXTILES

PART 1 GENERAL

1.1 SUMMARY

A. This section includes description and installation of geotextiles for separation and infiltration purposes. Geotextile shall provide a permeable barrier between aggregate and soils.

B. Related Sections:

1. Section 02060, Aggregate.
2. Section 02300, Earthwork.
3. Section 02370, Slope Protection and Erosion Control.
4. Section 02371, Riprap.

1.2 DEFINITION OF TERMS

A. Geotextile Separation: A geotextile barrier placed between dissimilar materials so that the integrity of both materials can remain intact or be improved.

B. Geotextile Filtration: A geotextile barrier which allows passage of liquid while retaining the drainage of solid materials on the upstream side.

C. Nonwoven Geotextile: A geotextile made by extruding and spraying fibers onto a moving conveyor belt to form a continuous web, which is then bonded by melt-bonding, resin-bonding, or needle punching.

D. Woven Geotextile: A geotextile made by weaving polymeric threads on a loom.

E. Minimum Average Roll Value (MARV): The minimum average value of a representative number of tests made on selected rolls of a production lot, with a minimum of a 95% confidence level.

1.3 REFERENCES

A. American Society for Testing and Materials (ASTM).

1. ASTM D 3786, Standard Test Method for Hydraulic Bursting Strength of Knitted Goods and Nonwoven Fabrics – Diaphragm Bursting Strength Tester Method.
2. ASTM D 4491, Standard Test Methods for Water Permeability of Geotextiles by Permittivity.
3. ASTM D 4533, Standard Test Method for Trapezoid Tearing Strength of Geotextiles.
4. ASTM D 4632, Standard Test Method for Grab Breaking Load and Elongation of Geotextiles.

5. ASTM D 4751, Standard Test Method for Determining Apparent Opening Size of a Geotextile.

6. ASTM D 4833, Standard Test Method for Index Puncture Resistance of Geotextiles, Geomembranes, and Related Products.

B. Ohio Department of Transportation (ODOT), Construction and Material Specification, January 1997.

1.4 QUALITY ASSURANCE

The manufacturer shall maintain a competent laboratory at point of production to ensure quality control in accordance with ASTM testing procedures. The manufacturer shall maintain records of its quality control results and provide, prior to shipment, a manufacturer's material certificate.

1.5 SUBMITTALS

Submit manufacturer's material certificates for each type of geotextile. The certificate shall include the name and address of manufacturer, chemical composition, product description, lot number, statement of compliance to specification requirements, and signature of authorized official attesting to the information supplied.

1.6 DELIVERY, STORAGE, AND HANDLING

A. General delivery and storage procedures are contained in Section 01600, Product Requirements. Identify geotextile rolls in shipments with a number or symbol which corresponds to the production run.

B. Geotextiles will be shipped in rolls that are wrapped with a protective covering to protect the geotextiles from mud, dirt, dust, and debris. The geotextiles will be free of defects or flaws that significantly affect its physical properties.

PART 2 PRODUCTS

2.1 MATERIALS

A. Geotextiles to be installed underneath aggregate base and riprap areas shall be woven or nonwoven construction consisting of polypropylene or polyester filaments or fibers.

B. Geotextiles shall be inert to commonly encountered chemicals and hydrocarbons. Geotextiles shall be resistant to mildew, rot, insects, and rodents.

C. Minimum average roll values (MARV) for strength properties of individual rolls tested from manufacturing lot or lots of a particular shipment shall be equal to or greater than the minimum average roll value stipulated in ODOT, Construction and Material Specification, Section 712.09, Geotextile Fabrics.

PART 3 EXECUTION

3.1 PREPARATION

A. Verify that grades and elevations are correct. Verify that the subgrade does not contain sharp objects. Trim slopes and ground surface as necessary.

B. Verify that the subgrade does not contain soft or unsuitable material. Remove mud and soft soils from the subgrade which would clog geotextile openings.

3.2 INSTALLATION

A. Install geotextile to limits and grades indicated on construction drawings. Exposure of geotextiles to the elements between laydown and cover shall be a maximum of 14 days. Place geotextile loosely to conform to minor surface irregularities.

B. The geotextile shall be placed in such a manner as to ensure minimum handling without extensive dragging. Repairs shall be performed prior to placement of the geotextile if possible.

C. Geotextile shall be field joined by a minimum of 18 inches overlap. Carefully place initial lift of riprap onto geotextile to avoid damage by heavy equipment blades, buckets, or tracks.

D. Minimize drop height when placing materials on top of geotextile to avoid puncture or displacement. Use sand bags or other weight for temporary anchoring.

3.3 FIELD QUALITY CONTROL

All overlaps shall be 100% visually inspected for completeness. Damaged areas on geotextiles used in the construction of riprap and access roads shall be repaired by extending a geotextile patch 3 feet beyond the perimeter of the tear or damage.

Table 1
Physical Requirements for Geotextiles
Used in Riprap and Access Road Construction

Property	Physical Properties (MARV)	Test Method
Tensile (Grab) Strength (lb)	200 (Note 1)	ASTM D 4632
Elongation (%)	15 (Note 1)	ASTM D 4632
Puncture (lb)	80	ASTM D 4833
Burst Strength (psi)	200	ASTM D 3786
Trapezoidal Tear (lb)	60 (Note 1)	ASTM D 4533
Permittivity (sec^{-1})	0.10 (Note 2)	ASTM D 4491
Apparent Opening Size	50 to 140 (U.S. Sieve)	ASTM D 4751

Note 1: For woven geotextiles, minimum property shall be the lowest value of the geotextile tested in the machine direction and the cross-machine direction.
Note 2: Permittivity value as tested with either the falling head method or the constant head method.

END OF SECTION

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This document is to be converted to government specification format before final submittal. However, technical requirements are correctly stated.

SECTION 02630
STORM DRAINAGE

PART 1 GENERAL

1.1 SUMMARY

A. This section includes materials and installation for storm drainage piping, fittings and accessories, and structures.

B. This section does not include gutters and downspouts. Roof drainage is either discharged onto the ground for overland flow or into storm drainage manholes that are specified by this section.

C. Related sections:

1. Section 02060, Aggregate.
2. Section 02300, Earthwork.
3. Section 02370, Slope Protection and Erosion Control.
4. Section 02371, Riprap.

1.2 QUALITY ASSURANCE

A. Furnish materials of quality required by American Society for Testing and Materials (ASTM) standards or other approved standards and specifications.

B. All materials will be subject to inspection upon delivery to the project site. Any product that has been broken, cracked, or otherwise damaged before or after delivery shall be removed from the project site.

1.3 REFERENCES

A. American Association of State Highway and Transportation Officials (AASHTO), AASHTO M36, Standard Specification for Corrugated Steel Pipe, Metallic-Coated, for Sewers and Drains.

B. ASTM C 144, Standard Specification for Aggregate and Masonry Mortar.

C. ASTM C 478, Standard Specification for Precast Reinforced Concrete Manhole Sections.

D. Ohio Department of Transportation (ODOT), Construction and Materials Specifications, January 1997.

1.4 SUBMITTALS

E. Submit product data and manufacturer's installation instructions for pipes, pipe fittings and accessories, grates, and covers.

F. Submit a source QA plan for all precast concrete units. Source QA plan shall include mix design, reinforcement methods, procedures, tests, and inspections to ensure that the precast units are structurally sound. Source QA plan shall also include joint details and lifting details.

G. Submit a certificate from the manufacturer that each product meets or exceeds the specified requirements of this section.

H. Submit redline drawings that show the installed locations and elevations of storm drainage pipes and structures.

1.4 DELIVERY, STORAGE, AND HANDLING

A. Deliver piping, fittings, and valves to site in a clean and protected condition. Maintain end seals of pipes, valves, and flange covers in place, and remove only as necessary for cleaning, fabrication, erection, or inspection. Exercise care in handling and storage of piping materials and prefabrication so that contamination by moisture, grease, dirt, or injurious foreign matter does not occur.

B. Precast concrete units shall be inspected upon delivery to the project site. Mark units with identification and location information, including orientation (up/down, N/S/W/E). Deliver and handle precast units using the manufacturer's lifting features or by using blocking, softeners, or webbing slings to protect edges from damage. Store precast units to prevent discoloration or contamination.

PART 2 PRODUCTS

2.1 MATERIALS

A. Corrugated Metal Pipe: Shall be galvanized steel, 12 gauge thickness, with helical corrugations in accordance with AASHTO M36.

B. Coupling Bands: Shall be corrugated, galvanized steel in accordance with AASHTO M36. Helical pipe sections with rerolled ends shall be joined with annular corrugated connecting bands. Couplings shall be watertight, such as an O-ring gasket or similar construction.

C. PVC Pipe: Shall be in accordance with ASTM D 3034 with a SDR of xx. Joints shall be integral wall bell and spigot, rubber ring, with provisions for expansion and contraction of each joint. Gaskets shall be in accordance with ASTM F 477.

D. Precast Concrete Structure: Shall be a monolithic precast reinforced concrete base section and a flat slab top section. Structure shall be manufactured, tested, and marked in accordance with ASTM C 478. Joints shall be tongue and groove type. Grates, frames, and covers shall be cast integral with concrete structure and shall be the size, type, and location as shown on the construction drawings.

Steps shall cast into the side of the precast structure at intervals.

E. Mortar:. Shall be composed of one part Portland cement and two parts clean sand conforming to ASTM C 144. Up to 20 pounds of hydrated lime may be added per sack of cement. Retempered mortar will not be allowed.

F. Aggregate bedding under junction structure bases shall be No. 57 stone or No. 4 stone in accordance with ODOT Section 703.

PART 3 EXECUTION

3.1 PREPARATION

A. Hand trim excavation for accurate placement of pipe.

B. Coordinate installation of storm drainage work with other utilities and with building excavations. Placement of storm drainage structures and pipes shall proceed in an organized manner to ensure proper installation.

C. All existing sewers, force mains, water lines, underground conduits, pavement, electric lines, and other utilities and structures shall be carefully protected by the contractor.

D. Verify that excavations, dimensions, and elevations are correct as indicated on construction drawings.

E. Place bedding material at trench bottom and level materials in a continuous layer not exceeding 8 inches compacted depth. Maintain optimum moisture content of bedding material to attain required compaction density.

3.2 INSTALLATION OF DRAINAGE PIPE

A. Each section of pipe shall be carefully inspected before it is placed. Defective or damaged pipe shall be removed from the project site. Prior to laying metal pipe, coat areas where galvanizing finish has been removed or damaged with a zinc-enriched paint.

B. Lay pipe to slope gradients noted on drawings with maximum variation from indicated slope of 1/8 inch in feet. Make adjustments to line and grade by scraping away or by filling in under the pipe barrel; do not wedge or block any portion of pipe. Each joint shall be laid so that it forms a close fit with true alignment to the adjoining pipe or structure.

C. Water shall not be allowed to run or stand in trench while pipe laying is in progress, before the joints are completely set, or before trench has been backfilled. Divert overland flow wherever possible and dewater each section as work progresses.

D. Keep interior of pipe clean as work progresses. Remove all earth, trash, rags, and other foreign matter from interior after each length of pipe has been laid.

E. Connect pipe to manholes, sumps, and existing culverts as shown on the construction drawings.

F. Backfilling of trenches shall be started immediately after the installed pipe is inspected and approved. Backfill shall be compacted in accordance with Section 02324.

3.3 INSTALLATION OF DRAINAGE STRUCTURES

A. Form bottom of excavation clean and smooth to the correct elevation. Place bedding in accordance with Paragraph 3.1E.

B. Establish elevations and pipe inverts for inlets and outlets as indicated on construction drawings.

C. Lift each section of the drainage structure using installed holes for handling. Each section may have not more than two holes for handling; the holes shall be plugged with rubber stoppers or mortar after installation.

D. Sections shall be joined by applying a preformed butyl joint sealant in accordance with ASTM C 990.

E. Mount lid and frame level in grout, secured to top cone section to elevation indicated. Protect pipe and aggregate cover from damage or displacement until backfilling operation is in progress.

1. Take care not to damage or displace installed pipe and joints during construction of pipe supports, backfilling, testing, and other operations.

2. Repair or replace pipe that is damaged or displaced from construction operations.

3.4 FIELD QUALITY CONTROL

A. The alignment of each run of storm drainage pipe shall be visually inspected. Clean all dirt and foreign materials from inside of storm drainage pipes. After installation but prior to backfilling, all storm drainage pipes shall be inspected for broken or cracked fittings. All defective pipes or workmanship shall be replaced.

B. Inspect precast concrete units after installation to ensure that they are not damaged. Precast units which have hairline cracks larger than 0.10 inches or which are structurally impaired must either be repaired or replaced.

END OF SECTION