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SILOS 1 AND 2 ACCELERATED WASTE RETRIEVAL PROJECT

DRAFT FINAL

REMEDIAL DESIGN PACKAGE

REVISION 2

SEPTEMBER 2002

FERNALD ENVIRONMENTAL MANAGEMENT PROJECT

SILOS 1 AND 2 ACCELERATED WASTE RETRIEVAL PROJECT REMEDIAL DESIGN PACKAGE, Rev 2

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1.0 INTRODUCTION

The Silos 1 and 2 Accelerated Waste Retrieval (AWR) Project is one of the initial steps in the remediation of Silos 1 and 2 within Operable Unit 4 (OU4) at the Fernald Environmental Management Project (FEMP). The primary purpose of the AWR Project is to retrieve the K-65 material from Silos 1and 2 and transfer it to a newly constructed Transfer Tank Area (TTA) for safe staging pending transfer to the Silos 1 and 2 Remediation Facility, which is currently being designed, and is to be located immediately east of the TTA. According to the current project schedule, operation of the Silos 1 and 2 Remediation facility is to be initiated while retrieval and transfer of Silos 1 and 2 material to the TTA is still in process. The project also includes the construction of a Radon Control System (RCS) to provide mitigation of radon emissions from the silos, the TTA, and from the future Silos 1 and 2 Remediation Facility.

Fluor Fernald had placed a contract with Foster Wheeler Environmental Corporation (FWENC) for the design, construction, start-up, testing and operation of the systems and facilities required for the implementation of the AWR project. A Remedial Design (RD) Package was prepared, based upon the design developed under that contract, and submitted to the United States Environmental Protection Agency (USEPA) and the Ohio Environmental Protection Agency (OEPA). The RD Package for the AWR Project was approved by the U.S. EPA in January 2001 and by the OEPA in May 2001.

Due to contractual issues between Fluor Fernald and FWENC, the contract was terminated in June 2001. As an initial step in assuming execution of the AWR Project, Fluor Fernald performed a due diligence assessment of the AWR design during the contract closeout. This due diligence review, as well as the subsequent AWR Design Optimization Process resulted in revisions to the AWR design prepared under the contract with FWENC.

1.1 PURPOSE

The content of this Remedial Design (RD) Package is consistent with that of the previous Silo 1 and 2 AWR Project RD Package. The intent of the revised RD Package is to provide to the USEPA and OEPA with substantive information from the detailed engineering, and design documentation concerning the revised design for the AWR Project. This information is to provide the USEPA and OEPA with an understanding of the proposed design, retrieval, operation and environmental controls necessary to ensure protection of worker and public health and safety and the environment.

1.2 SCOPE

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

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

Construction activities on the RCS and TTA tanks and walls have been initiated. This revised RD Package (Revision 2) documents the current AWR design, which incorporates the changes to the original design resulting from the Due Diligence and Design Optimization processes. This RD Package incorporates the changes to the RCS and TTA designs previously documented in DCN's resulting from the RCS Due Diligence review, which were provided to USEPA and OEPA. A summary of these DCN's is included in Attachment 1-1. This RD Package also incorporates the design optimization changes to the AWR waste retrieval design. The principal design elements detailed in this RD Package are as follows:

- Design of the TTA (incorporate DCNs)
- Design of the RCS (incorporate DCNs)
- Design of the Silo Waste Retrieval System, modified to 1) move the slurry pump module in the center of the silos and addition of another sluicer module; 2) include a twin bridge over both silos; and 3) add slurry pump and sluicer modules over both silos.
- Plans for excavation and disposition of the Silo berm material in support of the Silo superstructure installation
- Design of the Transfer Tank Waste Retrieval System modified to include modules over every tank and the addition of a valving area to for operational flexibility
- Plans for characterization and disposition of secondary wastes generated during the construction and operation activities
- Environmental controls for air emissions, wastewater, and storm water generated during the construction and operation activities
- Sampling and analysis requirements

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

ATTACHMENT 1-1
AWR PROJECT DCN'S SUBMITTED FOR USEPA / OEPA REVIEW

DCN No.	DESCRIPTION	SUBMITTED TO EPA	APPROVED BY OEPA	COMMENT
001	RCS Stack Modifications – additional sampling ports stack to facilitate stack testing and add flexibility in selection of stack monitor	9/11/01	9/21/01	
002	TTA Tank Coatings – add interior coating to TTA Tanks	8/22/01	8/28/01	
004	Carbon Bed Ducting Modification – redesign supply and return –piping to facilitate future expansion of Carbon Bed Capacity	10/1/01	10/10/01	
005	Desiccant Dryer Installation – modification of equipment layout to facilitate adequate maintenance access	12/4/01	12/11/01	Mechanical redesign coordinated with DCN-067
014	Silo Pressure Relief Valve Piping – redesign of proposed piping of Silo PRV's to exhaust stack. DCN will add instrumentation to log opening/closing and monitor release rather than hard piping. will include sensor alarms added in DCN022	4/10/02	4/18/02	
015	RCS Pipe Rack Modifications – structural enhancements to supports and foundations for RCS Pipe Rack	11/19/01 12/12/01**	11/26/01 1/3/02**	**additional information to incorporate foundation 8/8A into current construction scope submitted 12/12/01
021	Carbon bed System Heater DHT-20-001 – delete in-line duct heater and add a moisture monitor at the outlet of each carbon bed	1/24/02		Disapproved by OEPA 1/30/02. Response & supplemental info submitted 1/31/02; Comment from USEPA 2/11/02; additional supporting information is included in Revised RD Package (Process Description Section 2.8).
024	RCS Condensate Ductwork – add piping, valves, and controls to route condensate trap discharge to either condensate tank	3/22/02	4/2/02	Will allow condensate to be routed to either condensate tank, rather than Tank B only
025	RCS Ductwork Isolation Damper – add additional manual isolation damper adjacent to DMP-024	11/7/01	11/16/01	

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ATTAC...ENT 1-1
AWR PROJECT DCN'S SUBMITTED FOR USEPA / OEPA REVIEW

DCN No.	DESCRIPTION	SUBMITTED TO EPA	APPROVED BY OEPA	COMMENT
067	RCS Expanded Capacity – add equipment (increased fan and filter capacity, duct size, etc) to support potential future expansion of RCS capacity from 1000 cfm to 2000cfm.	1/30/02	2/11/02	Add necessary upstream equipment &/or capacity to support future addition of carbon bed capacity, if needed
081	RCS Utility Reroute - new support system for cable trays and water between Bldg 94G and VITT Plant	1/8/02	1/16/02	
083	RCS Carbon Bed Enclosure Structural Issues - Revise Dwgs 20FSD009, 016& 074 to address Due Diligence Review comments.	1/28/02	1/30/02	
089	Pipe Rack Foundations – reconfigure foundations for bents 4/5, 7, & 8/8A (DCN015) to avoid underground utility interference	1/14/02	1/25/02	
105	HEPA Filter isolation valves – install new manual butterfly dampers on discharge side of HEPA's	3/22/02	3/25/02	

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

1.3 AWR PROJECT RD PACKAGE – SUMMARY OF SIGNIFICANT CHANGES

The significant changes to each section of the April 2001 AWR RD Package, Revision 1 are summarized below:

Table of Contents

- Updated to reflect the format and content of the June 2002 Revision 2 RD Package

Section 1.0 Introduction

- Updated to reflect the current changes associated with the AWR Project Design Optimization and Due Diligence reviews.

Section 2.1 Process Description

- Revised to include the design changes determined during the AWR Project Due Diligence and Design Optimization processes. These changes are as follows:
    - Utilizing a fixed bridge over both silos to eliminate the technical risks in moving the pivoting bridge. The fixed bridge setup allows for silo waste retrieval from either silo therefore minimizing operational schedule impacts.
    - Moving the Slurry Pump Module to the center of the silos. This change was identified during a DOE Silo Waste Retrieval Summit based on previous experiences. Changing the placement of the Slurry Pump allows for better sluicing and slurry pump performance and will reduce the dead zone in the silos and minimize the heel material left after the bulk slurry activities.
    - Addition of another sluice module on the SWRS. This change was identified during a Department of Energy (DOE) Silo Waste Retrieval Summit based on previous experiences. The benefit of the additional sluicer module is that it allows for better sluicing and slurry pump performance and will reduce the dead zone in the silos and minimize the heel material left after the bulk slurry activities.

- Elimination of heel (silo material remaining after bulk waste retrieval and discrete objects) removal and removal of solids from the decant sump tank from the scope of the AWR design. These two activities will take place as part safe shutdown activities following the completion of bulk waste retrieval.
- Deletion of the Easily Manipulated Mechanical Arm (EMMA). The purpose of EMMA was to support bulk waste retrieval activities and to support the heel and debris removal activities. EMMA was deleted due to several technical and operational concerns. The bulk slurry support EMMA was providing is being addressed by relocation of the slurry pump and the additional sluicer modules. The EMMA functions for heel and debris removal are being redesigned as part of the Heel Removal activities.
- Addition of a valving area to increase operational flexibility to allow Silo waste retrieval slurry and sluicing water from any TTA tank and the valving between TTA tanks.
- Addition of Slurry and Sluice Modules over each of the TTA tank to enhance operational flexibility.
- TTA tank internal coating for additional corrosion allowance.
- RCS design changes to resolve issues identified during the Due Diligence review.
- Expansion of the total capacity of the RCS to 2000 CFM to support the potential for concurrent waste retrieval and Silos 1 and 2 treatment operations, and support the future addition of additional carbon beds if needed.
- Replacement of Full-Scale Mock-up testing on Silo #4 with slurry pump and sluicing testing in a Cold Loop Testing facility.

Section 2.2 Process Control Summary

- Revised to be consistent with the design modifications discussed in Section 2.1.

Section 3.0 Sampling Plan

- Revised to be consistent with the design modifications discussed in Section 2.1.

Section 4.0 Berm Excavation Plan

- Revised to reflect excavation for a fixed twin-bridge and elimination of berm excavation concurrent with bulk waste retrieval.

Section 5.0 Environmental Control Plan

- Revised to be consistent with the design modifications discussed in Section 2.1.

Section 5.1 ARAR Compliance Matrix

- Revised to be consistent with the design modifications discussed in Section 2.1.

Section 5.2 RCS Performance Calculation

- RCS Phase 2 calculations revised to reflect potential for "concurrent" retrieval from Silos 1 and 2.

Section 5.3 Stormwater Drainage Plan

- Revised to be consistent with the design modifications discussed in Section 2.1.

Section 5.4 Waste Handling Work Plan

- Revised to be consistent with the design modifications discussed in Section 2.1.

Section 5.5 Silos Projects Environmental Monitoring Plan

- Revised to incorporate minor edits and current monitoring plans.

Section 6.0 Health and Safety Controls

- Revised to incorporate the latest site procedures and information previously contained in the Contingency Plan.

Section 7.0 Contingency Plan

- Deleted text of the Contingency Plan incorporated into the Health and Safety Controls

Appendix A Process Flow Diagrams

- Revised to be consistent with the design modifications discussed in Section 2.1

- Previous content of the Heat and Material Balance appendix is included in the Process Flow Diagrams

Appendix B General Arrangement Drawings

- Revised to be consistent with the design modifications discussed in Section 2.1.

Appendix C Heat and Material Balances

- Appendix deleted. Material Balance tables are contained in Appendix A.

Appendix D System Design Description

- Appendix deleted. Relevant detail has been added to the Process Description (Section 2.1).

Appendix E Piping and Instrumentation Drawings

- Appendix deleted - relevant information incorporated elsewhere in the RD Package.

Appendix F Easily Manipulated Mechanical Arm (EMMA) Information

- Appendix deleted because EMMA removed from project scope.

Appendix G Process Control Plan (Balance of Plant)

- Appendix deleted - relevant detail has been added to the Process Control Summary (RD Package Section 2.2)

Appendix H Process Control Plan (Radon Control System)

- Appendix deleted - relevant detail has been added to the Process Control Summary (RD Package Section 2.2)

1.4 REMEDIAL DESIGN PACKAGE DOCUMENTATION

1.4.1 Process Description

The Process Description document provides an overview of each of the systems that comprise the AWR process. The systems consist of the following:

- Silo Waste Retrieval System (SWRS)
- Radon Control System (RCS)
- Transfer Tank Area (TTA)
- Transfer Tank Waste Retrieval System (TWRS)

1.4.2 Process Control Summary

The Process Control Summary describes the controls systems for the RCS and Waste Retrieval Systems. The Process Control Summary describes how these control systems interface and function. The Process Control Summary also provides an overview of the process control philosophy.

1.4.3 Sampling Plan

The Sampling Plan describes the sampling and analysis effort associated with the AWR project. These efforts are summarized as follows:

- Ensure that the excess water from the AWR project meets the criteria for transfer to the AWWT facility prior to being transferred
- Ensure that the air emissions associated with the AWR project, meet the applicable regulatory and site standards

1.4.4 Berm Excavation Plan

This plan details the procedures and controls for excavation of the Silo berm material as required for construction of the fixed twin-bridge. In addition to the excavation methods used to prevent impact on structural integrity of the silos, the plan defines the stormwater controls and management and disposition of the excavated berm soil.

1.4.5 Environmental Control Plan

The Environmental Control Plan (ECP) details the methods and controls that are incorporated into the AWR design to comply with Applicable or Relevant and Appropriate Requirements (ARARs) and to-be-considered (TBC) requirements, and minimize impacts on the environment. The plan summarizes air emission control, wastewater management, stormwater control, and waste management aspects of the design.

<u>ARAR Compliance Matrix</u>

ARARs and TBC requirements for the AWR Project are identified in the July 13, 2000 Record of Decision Amendment for Operable Unit 4 Silos 1 and 2 Remedial Action. The ARAR Compliance Matrix identifies each ARAR applicable to the AWR Project, the impact on the design and the strategy utilized to meet the requirement.

Radon Control System Performance Calculation

The RCS Performance calculation documents the estimates of radon emissions during each phase of the AWR Project, and dispersion modeling of the offsite impact of these emissions. Radon emissions are evaluated for both of the following phases:

- Phase 1 – Silos 1 and 2 Headspace Reduction
- Phase 2 – Bulk Waste Retrieval

As stated previously, the RCS has also been designed to support operation of the Silos 1 and 2 Remediation Facility. Current planning has identified the possibility for concurrent bulk waste retrieval and Silos 1 and 2 Remediation Facility operations. The design documented in this RD Package includes the capability (fan and duct size, HEPA filter capacity, etc) to operate at expanded capacity and to accept the addition of additional carbon beds if necessary, to support concurrent operation of both facilities. The parameters (necessary RCS flow and carbon adsorption capacity) for operation of the RCS in support of the Silos 1 and 2 Remediation Facility will be developed based upon data collected during RCS Phase 1 operation. These parameters and the impact on RCS emissions will be provided for review prior to initiating Silos 1 and 2 Remediation Facility operation.

Stormwater Drainage Plan

The Stormwater Drainage Plan describes the stormwater and erosion controls during the various phases of the AWR Project.

Waste Handling Work Plan

This plan defines the primary and secondary waste streams expected to be generated during implementation of the AWR project. For each potential waste stream, the plan identifies the estimated generation rate as well as the planned management and disposition options.

Silos Projects Environmental Monitoring Plan

The current focus of environmental monitoring at the FEMP is the implementation of site-wide and project-specific environmental monitoring. Site-wide monitoring is implemented in accordance with the FEMP Integrated Environmental Monitoring Plan (IEMP), while project-specific monitoring is implemented in accordance with the Remedial Design and Remedial Action documentation for each project. The Silos Projects Environmental Monitoring Plan documents the planned project-specific monitoring for the AWR and Silo 3 Projects, and describes the interface between this monitoring and the site-wide IEMP program.

1.4.6 Health and Safety Controls

The Health and Safety Controls portion of the Remedial Design Package is designed to illustrate the planned preventative or mitigative measures to address the occupational hazards identified for the Silos Project. The Health and Safety Controls are presented consistent with the Silos Health and Safety Plan. The Silos Health and Safety Plan takes into account the specific hazards inherent to the Silos Project site and presents procedures to be followed by Fluor Fernald, its subcontractors, and all other on-site personnel to avoid and, if necessary, protect against health and/or safety hazards.

1.4.7 Appendices

The appendices to the RD Package contain the following drawings:

- Process Flow Diagrams, including material balance data
- General Arrangement Drawings

1.5 Silos 1 and 2 Remediation Facility

The Silos 1 and 2 Remediation Facility is currently in the final design and initial construction phase, will be located immediately east of the TTA Facility. According to current project schedules, operation of the Silos 1 and 2 Remediation Facility will be initiated during the transfer if Silos 1 and 2 material from the silos to the TTA. Although the design of the Silos 1 and 2 Remediation Facility will be documented in a separate RD Package, and is not part of the scope of this document, several aspects of the Silos 1 and 2 remediation facility are integrated into the design of the AWR Project.

As discussed in Section 3.6 of the Process Description, the RCS is designed to collect and treat particulate and radon emissions from the operation of the Silos 1 and 2 Remediation Facility. Expected emissions from the Silos 1 and 2 Remediation Facility will be evaluated based upon data from RCS Phase 1 operation, to determine the for any additional radon removal capacity.

The design of the Silos 1 and 2 Remediation Facility includes three 83,800-gallon Slurry Receipt Tanks. Installation of these tanks is included in the initial phase of Silos 1 and 2 Remediation facility construction so that the tanks will be available to provide capacity to support AWR sluicing operations. Prior to the start of operation of the Silos 1 and 2 Remediation Facility, the slurry receipt tanks can provide 'contingency' capacity in the event that additional capacity is required for storage of wastewater or slurry, during AWR operations.

Water stored in the Slurry Receipt Tanks will be utilized to begin sluicing Silos 1 and 2 material from the TTA to the Remediation Facility. Once slurry transfer is initiated, water will be recycled from the slurry receipt tanks and clarifier to continue the sluicing operation.

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DESCRIPTIO
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2.1- PROCESS
DESCRIPTION

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PROCESS DESCRIPTION DOCUMENT FOR THE ACCELERATED WASTE RETRIEVAL PROJECT

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Document No. 40710-RP-0015

August 29, 2002

Revision 0

FERNALD
Environmental Management Project

Prepared Under DOE

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JACOBS

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ACRONYMS

AC	Alternating current
API	American Petroleum Institute
AWR	Accelerated Waste Retrieval
AWWA	American Water Works Association
BOP	Balance of Plant
CATS	Conditioning and Transfer System
CCTV	closed circuit television
CFR	*Code of Federal Regulations*
DCS	distributed control system
D&D	decontamination and demolition
DOE	U.S. Department of Energy
EMMA™	Easily Manipulated Mechanical Arm
FEMP	Fernald Environmental Management Project
FSMS	Full Scale Mock-Up System
FWENC	Foster Wheeler Environmental Corporation
HEPA	high-efficiency particulate air
HMI	human machine interface
I/O	input/output
Jacobs	Jacobs Engineering
OEPA	Ohio Environmental Protection Agency
PLC	programmable logic controller
RCS	Radon Control System
RD	remedial design
ROV	Remotely Operated Vehicle
SWRS	Silo Waste Retrieval System
TTA	Transfer Tank Area
TWRS	TTA Waste Retrieval System
USEPA	U.S. Environmental Protection Agency
UPS	uninterruptible power supply

1.0 INTRODUCTION

Silos 1 and 2 are located at the U.S. Department of Energy (DOE) Fernald site near Cincinnati, Ohio. The silos contain K-65 material, a residue that contains radionuclides, including radium (the primary contaminant of concern), which was generated in processing high-grade uranium ores.

As part of the remediation of Silos 1 and 2, silo material will be removed and staged into a shielded and ventilated storage tank system. Future plans call for the transferring the K-65 material from the Transfer Tank Area (TTA) to the Silos 1 and 2 Remediation Facility (currently in final design) for treatment prior to off-site disposal.

The current Fernald baseline schedule calls for the Silos 1 and 2 Remediation Facility to be constructed concurrently with the Accelerated Waste Retrieval (AWR) Project. The current schedule also reflects some degree of operational overlap between the operating of the AWR process and the Silos 1 and 2 Remediation Facility process; however, the Silos 1 and 2 Remediation Facility Project is not within the scope of the AWR Project or this document.

The AWR technical objectives and criteria are defined in "The AWR Technical Requirements Document Doc. No. 40710-RP-001." In December 2000, the Foster Wheeler Environmental Corporation (FWENC) prepared a final design report, supporting the AWR Technical Requirements Document. Based upon this design a Remedial Design (RD) Package was submitted to and subsequently approved by the U.S. Environmental Protection Agency (USEPA) and Ohio Environmental Protection Agency (OEPA).

Subsequent to the December 2000 AWR Final Design submittal, the FWENC's Contract was terminated and Fluor Fernald acquired the services of Jacobs to review, modify, and optimize the existing FWENC design in an effort to reduce project risk and enhance the probability of the AWR Project's success.

Based upon the Jacobs AWR design optimization efforts, a modified AWR design description has been prepared. The objectives of this document are the following:

1. Define the relevant technical baseline modifications;

2. Define the relevant AWR Design Basis modifications;

3. Define the major changes to the FWENC December 2000 Final Design as defined in the RD Package; and

4. Generally describe the modified AWR Design in terms of the processes and equipment needed to meet the applicable AWR technical baseline requirements.

2.0 DEFINITION OF AWR MODIFICATIONS

Modifications to the AWR Technical Baseline have been made as a result of the design optimization process and to correct design deficiences in the FWENC Final Design package discovered during the Due Diligence review process. Accordingly these modifications have generated changes in the AWR Design Basis and ultimately the physical AWR design. These changes are defined below. The defined changes are in addition to or in clarification of those listed in the Fernald Environmental Management Project (FEMP) Baseline Closure Plan, Volume VII: Silos Project Silos 1 And 2, AWR Project, Change Proposal (40000-PL-0011), Revision 2, December 2001.

2.1 BASELINE SCHEDULE MODIFICATIONS

The Fernald Baseline Schedule has been modified to reflect concurrent construction of the AWR Facilities and the Silos 1 and 2 Stabilization Facility. The baseline schedule also reflects concurrent operation of both facilities during the later phases of the AWR Project.

2.1.1 Resulting Design Basis Changes

The AWR design has been modified to include the capability to transfer material from either Silo 1 or Silo 2 to any of the four TTA tanks while transferring sluicing material from any TTA tank to the Silos 1 and 2 Remediation Facility.

2.1.2 Resulting Physical Design Changes

1. A fixed bridge will be constructed over each silo to support waste retrieval operations.
2. Each bridge will be provided with two sluicing cannon modules and a slurry/decant pump module.
3. Two sluicing cannon modules and a slurry/decant pump module will be provided on the TTA deck above each TTA tank.

2.2 SILO CAP REMOVAL

In the FWENC design the 30-ft-diameter plywood and steel framing silo caps were to be left in place during Silos Waste Retrieval System (SWRS) activities.

However, having these plywood caps creates technical challenges with the Silo Waste Retrieval equipment risers. Therefore, to mitigate this technical risk the silo caps will be removed prior to the installation of the SWRS equipment. The caps are being removed to expose the concrete silo domes to facilitate in installing new silo equipment access risers.

2.2.1 Resulting Design Basis Changes

The AWR design has been modified to include the removal of the 30-ft plywood and steel framing caps.

2.3 POSTPONEMENT OF HEEL MATERIAL AND DISCRETE OBJECT REMOVAL FROM THE SILOS

Removal of discrete objects and debris from the silos has been removed from the AWR scope. Bulk waste retrieval operations will continue until the slurry pumps can no longer be operated. Heel material is defined as material that cannot be readily removed using the AWR Past Practice Sluicing Technology. The discrete objects and heel material will be removed using more direct techniques than the past practice sluicing technology. The heel material will be removed during AWR safe shutdown activities after the completion of bulk waste retrieval. The specific design of the heel removal system will be developed based upon the experience and actual data on the amount and condition of discrete objects and heel material gained during bulk waste retrieval.

2.3.1 Resulting Design Basis Change

No provisions are provided to remove the heel material or discrete objects from the silos during the bulk waste retrieval phase of the AWR Project. The current concept for heel removal being considered by Fluor Fernald and DOE EM-50 involves the use of a Remotely Operated Vehicle (ROV) to move heel material into the Silo Sump Pit, from which it would be pumped to the TTA. The specific details of discrete object and heel removal and final decontamination of the silos will be finalized based on information and experience gained during bulk waste retrieval and will be defined in the safe shutdown documentation submitted for regulatory review.

2.3.2 Resulting Physical Design Changes

1. The conditioning and transfer system (CATS) designed for heel removal and consisting of the Silo (Waste) Retrieval End Effector, a hose bundle, a jet pump, and the slurry pump heel attachments is eliminated from the design.

2. The debris removal system is eliminated from the AWR design.

3. The Easily Manipulated Mechanical Arm (EMMA) is eliminated from the AWR design because its primary function was removal of discrete objects and to assist with manipulating the silo waste retrieval end effector during the CATS heel removal activities.

2.4 POSTPONEMENT OF HEEL MATERIAL AND DISCRETE OBJECTS FROM DECANT SUMP

The Decant Sump Tank is located underground and just west of and between the silos. The decant sump is known to contain a small quantity of residual sludge material. Similar to the situation involving the silo heel material, this residual sludge material would be very difficult to remove using past practice sluicing; therefore the decant sump residual material is projected to be a small quantity and will be removed during silo decontamination and demolition (D&D) activities. The details of decant sump tank solids removal will be defined in the Safe Silo D&D Project shutdown documentation submitted for regulatory review.

2.4.1 Resulting Design Basis Change

No provisions are required in the AWR design basis to remove the residual sludges from the Silo Decant Sump. The AWR design basis does require that an automated level control and liquid removal system be placed in the decant sump during SWRS activities.

2.4.2 Resulting Physical Design Change

1. The Decant Waste Retrieval System is eliminated from the AWR design.

2. As described in detail in Section 3.2, decant sump tank liquid level instrumentation and capability to automatically pump out accumulated liquid is maintained in the AWR design.

2.5 FULL SCALE MOCK-UP SYSTEM

The Full Scale Mock-Up System (FSMS) has been eliminated from the scope of the AWR Project. However, a cold test loop involving the testing and optimization of AWR process equipment has been added to the scope of the AWR Project. The cold test loop is intended to provide data similar to that expected from the FSMS.

2.5.1 Resulting Design Basis Change

1. No provisions are required for a full-scale mock-up of the AWR process at FEMP.

2. A cold testing system to demonstrate the key AWR design parameters and process equipment must be developed.

2.5.2 Resulting Physical Design Change

1. The FSMS, which includes all the process equipment associated with Silo 4, is eliminated from the AWR design.

2. A cold testing system to demonstrate the key AWR design parameters and process equipment must be developed. The key process parameters will include: materials of construction, deposition velocities, material conveying properties, and design approach. Key process equipment will include the sluicing cannons, slurry pumps, slurry instrumentation, and valves.

2.6 MODIFICATION OF AWR WASTEWATER MANAGEMENT STRATEGY

2.6.1 The Resulting Design Basis Change

The previous design basis specified treating AWR wastewater by one of the following three methods:

- Ultra-filtration followed by discharge to the Advanced Wastewater Treatment (AWWT).

- Hold-up of wastewater for radon decay followed by discharge to AWWT.
- Treatment of wastewater via skid-mounted ion exchange and filtration followed by discharge to the AWWT.

The modified Wastewater Management Plan specifies the following methods of wastewater dispensation.

- During Radon Control System (RCS) Phase I prior to the availability of the TTA tanks, condensate from the dehumidification system is stored in the condensate hold-up tanks for radon decay. Following radon decay the condensate is transferred to the AWWT for further treatment. The design of the condensate hold-up tanks is based on a radon decay stay time of 20 days and a condensate flow rate from desiccant dryers of 0.08 gpm see RCS Phase 1 Mass Balance Table for more information.
- At the time the TTA tanks become available for use condensate is pumped to the TTA tanks for use during sluicing operations.
- Excess water from bulk waste retrieval will be transferred to the Silos 1 and 2 Remediation Facility for storage pending use in the Silos 1 and 2 treatment process, or sampling and discharge to the AWWT.

2.7 THE DESIGN CAPACITY OF THE RCS HAS INCREASED TO 2,000 SCFM

2.7.1 Resulting Design Basis Change

The components comprising the RCS must be sized to adequately treat 2000 scfm at the design conditions of 100 percent relative humidity and 95°F. The 2000 scfm capacity will be utilized if expanded radon treatment is identified as necessary to support concurrent operation of bulk waste retrieval and the Silos 1 and 2 Remediation Facility.

2.7.2 Resulting Physical Design Change

The ducting and fans have increased in size to accommodate a process flow rate of 2,000 scfm. The drying system and the discharge high-efficiency particulate air (HEPA) filters have been reconfigured to allow parallel operation at 2,000 scfm.

2.8 THE DUCT HEATERS HAVE BEEN ELIMINATED FROM THE RCS DESIGN

2.8.1 Resulting Design Basis Change

As a result of reevaluation of both the original assumptions regarding the risk of ignition of the carbon, and the need to use heated air in order to provide adequate drying, the decision to eliminate the duct heaters from the RCS design. Reevaluation by an independent fire hazard analysis expert predicted an auto-ignition temperature for the carbon, under the conditions expected in the RCS, significantly lower than what was previously assumed (and lower than the drying temperature specified in the design). The

modified design utilizes unheated, dried air from the desiccant dryer system rather than heated air to provide necessary drying.

2.8.2 Resulting Physical Design Change

Since the RCS design includes redundant desiccant dryers, as well as demisters upstream of the beds to dry all air entering the carbon beds, buildup of excessive moisture, and the need to dry a bed is not expected to occur frequently. Radon monitors and moisture monitors will be used to monitor the condition and effectiveness of each bed. Based on the data from these monitors, the need to regenerate a bed will be identified and initiated. Regeneration will be accomplished by isolating the bed requiring drying and recycling dried air from the desiccant drying system through the bed until is has been sufficiently dried. The RCS provides sufficient excess carbon adsorption capacity maintain specified emission limits while the impacted carbon bed is being dried.

3.0 SYSTEMS IDENTIFICATION AND DESCRIPTIONS

This section provides brief descriptions of the operational strategy and major process systems that are associated with successfully completing the AWR Project operations. While Silos 1 and 2 contain two distinct layers of material that must 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-in. deep in the center of the silo and 3-ft deep 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 material is over 20 ft deep. The primary contaminant associated with the K-65 waste material is radium and radon, which is produced by the radioactive decay of radium.

The AWR Project baseline consists of four distinct objectives:

Objective 1: Construct a radon treatment system to reduce the concentration of each of the silos' headspace before other AWR activities begin and to maintain safe radon concentrations during all AWR activities.

Objective 2: Retrieve the K-65 materials from the silos and transfer the waste material to a safe storage area.

Objective 3: Stage the K-65 material in the TTA until it is transferred to the Silos 1 and 2 Remediation facility.

Objective 4: Retrieve the K-65 material from the TTA facility and transfer the K-65 material to the Silos 1 and 2 Remediation Faciltiy.

To accomplish these project objectives in accordance with the current technical baseline the AWR Project is provided with the major process systems listed below.

RCS – The RCS controls and reduces radon concentrations in the silos and the AWR process facilities. The RCS consists of a ducting system, an air chilling/drying system, an activated carbon system, HEPA filtration, controls, and a monitored stack.

SWRS – The SWRS utilizes a technique referred to as past practice sluicing to retrieve and transfer material from the silos. Past practice sluicing utilizes a low to medium pressure (50 to 200 psi), high volume (200 to 350 gpm) liquid stream to dislodge, slurry, and convey waste material to the intake of a transfer pump. The transfer pump is used to convey the slurried material to a storage facility. The AWR Project utilizes two 300-gpm sluicing nozzles and one 350-gpm centrifugal slurry pump on each silo. The sluicing nozzles and the slurry pumps are housed in sealed steel structures. The steel structures are supported on fixed bridge structures constructed over each silo. The sluicing nozzles are located approximately 50 ft apart. The slurry pump is located between the sluicing nozzles. The sluicing nozzles and slurry pumps enter the top of the silos through

engineered penetrations. The sluicing nozzles and slurry pumps are designed to allow their placement through the entire vertical profile of the silos.

TTA System – The TTA system consists of four 750,000-gal American Petroleum Institute (API) 650 carbon steel storage tanks located in a shielded concrete vault. Each of the tanks is ventilated by the RCS for radon control. The tank vaults are provided with leak detection and a means to remove liquid wastes. The K-65 material will be stored in the TTA until it is transferred to the Silos 1 and 2 Remediation facility.

Transfer Tank Area Waste Retrieval System (TWRS) – In the future, the TWRS will retrieve the K-65 from the TTA and transfer it for processing at the Silos 1 and 2 Remediation Facility. Past practice sluicing will be utilized to transfer the waste from the TTA in much the same manner in which it is removed from the silos. Two 300 gpm sluicing nozzles and one 350-gpm slurry pump are provided for each TTA tank. The sluicing nozzles and slurry pumps are housed in sealed steel structures (equipment modules). The design of the sluicing and slurry systems comprising the TWRS are identical to those in the SWRS operation. During SWRS, the TWRS slurry pumps are used to provide sluicing water to the silo sluicing nozzles. Supernatant resulting from the settling of solids within the TTA tanks is used to supply sluicing water.

3.1 SILOS 1 AND 2 WASTE RETRIEVAL SYSTEM

The SWRS retrieves K-65 material, BentoGrout™, and residues from the silos and transfers them to the transfer tanks. Prior to the initiation of SWRS activities the plywood and steel caps are removed from the silo structures to expose the silo's concrete surface for ease of equipment installation. Past practice sluicing techniques are used to recover the majority of waste in the silos. Three video cameras with lights that are deployed through risers located in the silo roof provide the global view required to maneuver and control in-silo equipment during waste retrieval and assessments.

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

- Silo 1, Sluicer 1
- Silo 1, Sluicer Module No. 1
- Silo 1, Sluicer 2
- Silo 1, Sluicer Module No. 2
- Silo 1, Slurry/Decant Pump
- Silo 1, Slurry/Decant Pump Module
- Silo 1, Slurry transport piping
- Silo 1, Closed-Circuit Television (CCTV) Video Camera and Light, Nos. 1, 2, and 3

- Silo 1, High Pressure Decontamination Pump
- Silo 2, Sluicer 1
- Silo 2, Sluicer Module No. 1
- Silo 2, Sluicer 2
- Silo 2, Sluicer Module No. 2
- Silo 2, Slurry/Decant Pump
- Silo 2, Slurry/Decant Pump enclosure
- Silo 2, Slurry transport piping
- Silo 2, CCTV Video Camera and Light, Nos. 1, 2, and 3
- Silo 2, High Pressure Decontamination Pump
- Silo Diverter Valves
- Silo Bridge Enclosure
- Silo Decant Sump Tank Sump Pump
- Silo "C" Bridge
- Long Reach Manipulator Tool

Bulk retrieval of the silo waste material is accomplished using two sluicing nozzles and a slurry pump. Each silo has its own dedicated bulk retrieval equipment. The silo slurry pump is located in a module on the bridge over the center riser of the silo. The two sluicing nozzles are located in a module on the bridge over risers inline with the slurry pump along the silo's perimeter at 0° and 180° (co-linear with the pump) and approximately 50 ft apart. The automatic actuators to the systems' control valves are electric and normally controlled from the Control Room. Local control panels provide valve actuator control on the bridge decks. Sluicing liquid is decanted from the TTA tanks and will be supplied by the TTA Slurry Pumps.

Initially, the sluicing nozzle stream(s) are directed as close to the slurry pump inlet as possible to create a slurry pool (approximately 6 ft in diameter by 1.5 to 3 ft 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. The slurry pump also has a high-pressure water jet ring at the pump suction that can assist in breaking up hard material into pumpable slurry. The sluice nozzle then begins cutting a vertical "canyon" into the silo waste, pushing it toward 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. If debris becomes lodged in the inlet screen plate of the slurry pump and cannot be removed by operating the spray ring or by jogging the pump, a Long Reach Manipulator Tool could be manually used to clear away the debris from the pump inlet screen plate. If these activities are not successful, the pump can be raised up into the slurry pump enclosure and the obstruction can be physically removed. After each day's sluicing operations, the slurry line, slurry pump, sluice line, and sluicer are flushed with decant water and then rinsed with domestic water. If plugging occurs during normal operations, the decant water can be redirected to the slurry line to back-flush the plug out of it.

As the waste level in the silo decreases, the slurry pump is periodically lowered further into the tank, until it reaches the small sump in 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 cavitating and minimize plugging.

The pump has a discharge pressure gauge and mass flow meter. The mass flow meter 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 that the slurry transfer pipeline flow is in the target solids concentration range to prevent plugging. The accuracy of the flow meter at the nominal process solids loading (10 to 15 weight percent [wt%]) and volumetric flow rate (300 to 350 gpm) is estimated at ± 0.11 percent. If the solids wt% increases sharply or indicates an increasing trend, sluice water is injected directly into the slurry transfer line to maintain the target solids content and to help ensure that solids do not settle in the transfer piping by maintaining the pipeline velocity.

The sluicing nozzle is lowered periodically as the waste level is decreased. Lowering the nozzle increases waste mobilization efficiency by attacking the waste at a more direct angle and shorter distance. The total 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 gpm. The sluicer is equipped with pan and tilt capability for fine control of angle of attack.

There may be times when the sluicing nozzle is not adequate to break up the waste. The slurry pump has a high-pressure spray ring to assist in breaking up the hardened material. Liquid for the spray ring is supplied from the site domestic water systems, using the high-pressure pumps. The operation of the spray ring is being optimized as part of the AWR Cold Loop Test.

3.8.1 Silo Sluicers

Each silo has two sluicers; each sluicer is installed in its dedicated module that is mounted on the bridge. Silo sluicer nozzles are approximately ¾-in. inside diameter and normally operate independently at 200 psi and 300 gpm. This will create a sluicing stream having approximately 140 ft/sec velocity. Total sluicing flow rate will be fixed with a maximum total flow of 300 gpm whether operating one or two nozzles to maintain silo water balance during bulk retrieval.

Optimizing and selecting sluicing nozzle size, flow, pressure, and operating configurations are part of the cold loop testing. Each nozzle is articulated remotely from the Control Room in an automatic or manual mode to allow for either vertical channel cutting or horizontal sweeping as necessary. Each sluicer has a 340° horizontal rotation and 105° vertical rotation capability.

As waste level decreases, the two sluicers also have the ability to be lowered to achieve the proper angle of attack on the waste. Mast sections containing sluicing piping are manually added with the assistance of a hoist to raise and lower the nozzle. The mast hoist in each of the sluicer enclosures accomplishes fine adjustment of either of the main nozzles' elevation. The mast hoist is normally operated from the Control Room but also may be operated locally when adding or removing sections.

3.1.2 Silo Sluicer Enclosures

The sluicing deployment system for the sluicers is housed in a Sluicer Module. The module serves as secondary containment and drains to the silo. The module measures approximately 6 ft by 10 ft by 20 ft high. The enclosure weighs approximately 15,000 lb and has several gloveport panels, an 11-ft by 3-ft access door and a 2-ft by 2-ft 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 sluicer nozzles are removed from the silos they are decontaminated by a high-pressure spray ring and passed through a radiation-monitoring ring. Manual washing with a spray wand occurs through the glove ports as the equipment is removed to ensure that the equipment is properly cleaned. Water to the spray ring and manual spray wand is domestic water and is supplied from the high-pressure decontamination pump. The sluicer module has a large interface opening to allow the sluicing equipment to pass into and out of the silo. During sluicing, the interface opening is covered by a panel.

3.1.3 Silo Slurry Pump

The slurry pump is a centrifugal-style, submersible sump pump. Normal operation of the pump is expected to be approximately 350 gpm and 150 psi during SWRS activities. The impeller and wear components are made of an abrasion-resistant material. A cutter is included ahead of the pump inlet to break up large chunks of material as well as shred plastic and other similar debris, allowing it to be pumped rather than plug or blind over the pump's inlet. A high-pressure spray ring is also mounted ahead of the pump's suction. The agitator and spray ring keep the solids in slurry form as well as help the pump "dig" into the K-65 and BentoGrout™ material. Additionally, a strainer screen plate is mounted ahead of the pump's suction to protect the pump from damaging debris entering it. The pump is supported from a cable and winch system. The pump is variable speed to control and match flows with the other pumps. The drive motor is a super severe duty (Service Factor = 1.35), which would require 480 VAC, 60 Hz, three-phase power. The motor and pump assembly are mounted on a vertical-positioning system 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 its travel, the assembly is manually secured and another section of mast is installed. A level instrument remotely displays the pumps' elevation. The pump has liquid-level and lower travel-limit instrumentation that indicates when the pump is 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 20,000 lb.

3.1.4 Silo Slurry Pump Module

The slurry pump deployment assembly is housed in a Slurry Pump Module. The module serves as secondary containment and drains to the silo. Currently the module measures approximately 9 ft wide by 18 ft long by 20 ft high. The module has a horizontal-sliding carrier that assists with pump and mast section assembly and stowage. The module has multiple gloveport panels, a 10-ft by 3-ft access door, and a 2-ft by 2-ft pass-through.

The module contains piping and valves needed to support the pumping, flushing, dilution, and decon operations. Valves and piping will include motor operated multi-way ball valves and piping/hoses to direct the flows. The module also contains a spray ring to decontaminate the pump assembly when it is removed from the tank.

The weight of the slurry pump system is supported off the silo bridge platform. The slurry/decant pump system is connected to the silo by a flexible coupling that allows vertical or horizontal bridge platform movement without inducing stresses to the silo. When the slurry pump is retracted from the silo it is decontaminated by a high-pressure spray ring, which is mounted at the bottom of the enclosure. Manual washing with a spray wand and radiation monitoring occur through the gloveports as the equipment is removed to ensure that the equipment is properly cleaned. Water to the spray ring and manual spray wand is potable water from the high-pressure decontamination pumps.

3.1.5 Silo Slurry Transport Pipeline

The slurry transport pipeline is a pipe-in-pipe design that provides secondary containment. The slurry transport pipeline is insulated and heat-traced. The pipeline is also provided with automated systems to detect leaks, monitor pipeline pressures, and measure 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 gravity-draining.

The slurry transport pipeline runs from each of the silo modules to the silo diverter valve enclosure located on the support bridge connecting the two silo bridges. From the valve enclosure the slurry lines run along a pipe bridge to the TTA Building until they terminate at the TTA diverter valve room containment area. The TTA valve enclosure is located centrally to the waste storage tanks. From the valve room the slurry is discharged into the Transfer Storage Tanks. If plugging occurs during normal operations, the decant water to the sluicers is directed into the slurry line to clear the blockage. Capability is provided for forward flushing and back flushing to clear a clogged line. In addition to flushing capability, clean-outs are provided in the transfer piping at intervals of approximately every

80 ft between the Silo Bridges and the TTA. A spare slurry transfer line is also provided that enables operations to continue until the end of the operating period. Pressure gauges located at intervals along the transfer piping are used to determine the location of the blockage.

Once the approximate location of the blockage is pinpointed, using a quick disconnect the line will be flush to remove blockage.

The slurry pump is equipped with an inlet screen plate to minimize the size of debris. Therefore clogs will most likely consist of K-65 and BentoGrout™ material. This material will remain in the pipe and be flushed to the Transfer Storage Tank after the blockage has been cleared.

3.1.6 Silo Bridge

All silo equipment modules, skidded equipment, and piping are supported by a steel bridge structure. The bridge is a fixed "C" shape with each leg of the "C" extending out over each of the silos. Design of the bridge should consider safe access to the modules and other equipment as well as operations and maintenance (O&M) activities.

A containment area enclosure is placed at the center of the bridge. The enclosure contains the piping, valves and/or manifold and hose jumpers, and possibly the sluicer booster pumps needed to support the pumping, flushing, dilution, and decon operations. Valves and piping include motor-operated multi-way valves and piping/hoses to direct the flows. The flanges within these areas are fitted with flange guards to prevent spray from a leaking joint.

3.1.7 Silo Decant Sump Tank

The Decant Sump Tank is located underground and just west of and between the silos. The Decant Sump Tank is carbon steel, 9,000-gal, 18-ft-long, and 9-ft-diameter cylindrical tank with dished ends. The tank is buried horizontally with a 20-in. opening centered at the top of the tank. A 30-in. corrugated man way centered over the 20-in. opening extends approximately 33 ft to the ground surface.

Before silo recovery is initiated, a submersible pump and level monitoring system is provided to control level in the sump. The level monitoring system is designed to monitor both level of liquid in the tank and the rate of level change in the tank. If the level set points are exceeded, the level monitoring system automatically annunciates alarms, terminates the operation of the TTA sluicing water supply pumps in the TTA, and initiates the operation of the sump pump. The sump pump is capable of pumping liquids to either Silo 1 or Silo 2 at the operator's discretion. The sump pump's operation automatically terminates on low level in the decant sump.

3.1.8 Long Reach Manipulator Arms

Long reach manipulator arms consist of lightweight mechanical linkages with various detachable heads. The detachable heads could be a hook, scrapper, gripper, or other mechanical assembly. These devices are used as necessary to clear away debris from the pump inlet screen plate.

3.2 DECANT SUMP WATER MANAGEMENT DURING SWRS

The Decant Sump Tank is located underground and just west of and between the silos. Underground drains beneath the silos and underground in the vicinity of the silos drain to the decant sump; therefore, during SWRS activities, the decant sump is monitored to ensure that the SWRS activities do not result in a significant increase in the volume of drainage observed in the decant sump.

Prior to the initiation of SWRS activities, existing liquids are pumped out of the Decant Sump Tank and a control system is installed in the decant sump. The level control system consists of level instrumentation and a submergible sump pump. The level instrumentation and the pump are lowered into the Decant Sump Tank through the Decant Sump Tank's 20-in. opening. The pump and level instrumentation remain in the sump throughout SWRS operations. The level instrumentation continuously monitors the liquid level in the decant sump. The level system also continuously monitors the rate of change in sump's liquid level. If the level rises in the tank above a set point during SWRS operations (a liquid level of 5 ft, which equates to approximately 50 percent of capacity), an alarm is initiated and the sump pump automatically begins to transfer liquid from the sump to the silos (Operations is responsible for determining which silo receives the liquid). The level instrumentation system also monitors the rate of level in the decant sump. If an abnormal rate of rise (greater than 7 in./hour) is observed during SWRS operations, the flow of sluicing water from the TTA to the silos will be terminated and the decant sump pump will automatically transfer liquids to the silos. The capacity of the sump pump (40 gpm) is large enough to ensure that overfilling of the Decant Sump Tank is prevented. The silo slurry transfer pumps will then transfer the liquid and any solids suspended by operation of the sump pump to the TTA.

3.3 TRANSFER STORAGE TANK AREA SYSTEM

The purpose of the TTA System is to stage residues received from Silos 1 and 2 for transfer to the Silos 1 and 2 Remediation facility which is to be located immediately east of the TTA. The TTA consists of a building that houses four 750,000-gal storage tanks, piping, a valve network for receiving and transferring slurried material, and auxiliary equipment.

Primary TTA System includes:

- Transfer Storage Tank 001A
- Transfer Storage Tank 001A Slurry/Decant Module

- Transfer Storage Tank 001A Sluicer Modules 1 and 2
- TTA Tank No. 001A CCTV Video Camera and Light
- Transfer Storage Tank 001B
- Transfer Storage Tank 001B Slurry/Decant Module
- Transfer Storage Tank Sluicer Modules 1 and 2
- TTA Tank No. 001B CCTV Video Camera and Light
- Transfer Storage Tank 002A
- Transfer Storage Tank 002A Slurry/Decant Module
- Transfer Storage Tank 002A Sluicer Modules 1 and 2
- TTA Tank No. 002A CCTV Video Camera and Light
- Transfer Storage Tank 002B
- Transfer Storage Tank 002B Slurry/Decant Module
- Transfer Storage Tank 002B Sluicer Modules 1 and 2
- Transfer Storage Tank No. 002B CCTV Video Camera and Light
- Equipment Deck
- Transfer Storage Tank Transfer Piping and Diverter Valves
- TTA Containment Area A
- TTA Containment Area B
- Transfer Storage Tank Leak Detection Sumps
- Make-up Water Storage Tanks
- Make-up Water Transfer Pumps
- High-Pressure Pump
- Long Reach Manipulator Arms

The TTA System is used in support of two different retrieval operations: SWRS and TWRS. The design description and functions of the TTA in support of each operation is provided in the following sections.

Four Transfer Storage Tanks are provided for storing wastes from Silos 1 and 2. The combined inventory of K-65 material and BentoGrout™ from Silos 1 and 2 is received, stored, and divided among the four Transfer Storage Tanks.

3.3.1 Transfer Storage Tanks

The carbon steel transfer storage tanks each have a capacity of 750,000 gal and are constructed in accordance with API 650. The design life of these tanks is 20 years. The tank volume allows for a maximum settled storage level of 90 percent of total capacity, although the tanks are designed for filling to their maximum capacity. The tanks are 66 ft in diameter, have a straight side dimension of 30 ft, and are provided with 1/4-in. corrosion allowance and an internal Plasite corrosion coating. The tank roofs are dome-shaped and are supported by rafters to minimize the overall height to 33 ft, 6 in. (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 operation.

The four 750,000-gal storage tanks are connected at their overflow nozzles by a 6-in.-diameter pipe. This overflow arrangement together with the use of level measurement devices in each tank minimizes the potential of exceeding the capacity of any one tank. All four tanks are ventilated to the RCS which is operated to maintain pressure in the tank headspaces between −2.0 and +0.5 in W.C. Pressure and vacuum relief devices provide additional (back up) pressure and vacuum relief.

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-in.-diameter nozzle located in the center for the Slurry/Decant Pump
- Two 20-in.-diameter nozzles located 180° apart for the Sluicer Modules
- One 20-in.-diameter nozzle for the RCS inlet
- Six 12-in.-diameter nozzles for the level switch, pressure differential transmitter, camera, and light, and three are spares
- Three 6-in.-diameter nozzles for level, slurry inlet, and RCS outlet

- One 12-in.-diameter nozzle for relief/vent
- One 6-in.-diameter nozzles overflow, located in the shell

Tank corrosion considerations include adding 1/4-in. additional thickness above that required for stress to the steel tanks, coating the interior surface with a Plasite protective coating (with a 30 mils dry film thickness), and painting the tank exterior steel surfaces. The decision to use and the choice of interior coating is based on the K-65 corrosion test results over a 20 year design life. The tanks are housed completely within a concrete and steel enclosure. The tanks are grounded to the TTA grounding grid. The grounding grid maintains building steel, including reinforcing steel, and components at the same electrical potential.

3.3.2 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 ft long, 152 ft wide, and approximately 40 ft tall with concrete walls for radiation shielding. Sealing the concrete floor and the walls to a level 8 ft above the floor provides secondary containment. This containment is equivalent to 100 percent of the volume that liquid from one 750,000-gal tank would occupy.

The floor is sloped to a centrally located sump to facilitate detecting leaks and removing spills. A tank foundation sump under each tank collects any leakage that may occur through or around the tank bottoms. The four-tank foundation sumps gravity-drain to the main enclosure sump through piping embedded in the tank foundation pads. Access to the sump pump is through an opening in the diverter valve containment area 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 back to the transfer storage tanks. Each tank has an exposed bottom sump drain line that empties into the central sump trench, thus allowing the operator to identify which tank is leaking by the camera system that can view all four sump lines.

If leaks are observed, the sump pump is used to transfer liquids from the sump to a non-leaking TTA tank. The TTA tank and piping system also allow liquid transfer from any of the four tanks to any other of the four tanks. This provision allows the contents of a leaking tank to be transferred to the remaining three tanks if a leak were to be observed.

3.3.3 Equipment Deck

The equipment deck covers the storage tanks. A steel column and beam system designed to carry floor and equipment loads supports the equipment deck. The support steel is primed and painted. The floor is concrete over steel. The equipment deck provides some level of radiation shielding from the stored residues.

A loading platform located on the southern side of the TTA is provided. The loading platform is fitted with a 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 through a 16-ft-wide, 24-ft-high roll-up door. Two staircases provide access and egress to/from the equipment deck. One staircase is located on the northern end of the eastern side of the TTA, and the other is located adjacent to the loading platform on the southern side of the TTA.

3.3.4 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 are directed to the storm drainage system. The deck enclosure is insulated and provided with heaters to maintain a target temperature of 55°F during cold months. Louvers and vents provide natural ventilation.

Personnel typically occupy the equipment deck area only when lines have been flushed and the transfer systems have been shut down for maintenance. The deck enclosure is also provided with doors, lights, gutters, and downspouts. A compressed air and domestic water header is routed around the perimeter of the enclosure with several drops provided to support maintenance activities.

3.3.5 TTA Transfer Piping

Sluice and slurry transfer piping is double-walled, except within the diverter valve containment areas and modules. Outdoor pipelines are insulated and heat traced. The pipeline is also provided with automated systems to detect leaks, monitor pipeline pressures, and measure slurry density.

Two containment areas are located on the TTA Equipment Deck. Within these areas, piping is single walled and enables use of flanged joints for valves and equipment. The flanges within these areas are fitted with flange guards to prevent spray from leaking joints. These areas are provided with sloped bottoms, sumps equipped with level instrumentation, and sump pumps. The sump pumps discharge collected liquids to the Transfer Storage Tanks.

3.3.6 TTA Containment Area A

Containment Area A is located on the northern side of the TTA Equipment Deck. Diverter valves are located in Containment Area A. This area is provided with a sloped bottom, level instrumentation, and a sump pump. The sump pump is designed to discharge collected liquids to the Transfer Storage Tanks.

3.3.7 Transfer Storage Tank Area Containment Area B

Containment Area B is located centrally on the TTA Equipment Deck. This area provides access to the Tank Vault sump. This area is provided with a sloped bottom, level instrumentation, and a sump pump. The sump pump is designed to discharge collected liquids to the Transfer Storage Tanks.

3.3.8 Make-Up Water Tanks

One 10,000-gal and two 7,500-gal storage tanks (Tank 51-001, Tank 51-002, and Tank 51-003, respectively) provide domestic water storage. The tanks are normally used together, acting as a single water source, but may be isolated in case one tank needs to be taken out of service for maintenance or other reasons. The three tanks are installed so that the top of the tanks are at the same elevation. This allows the common discharge header to equalize the tank level. Combined these three tanks have sufficient capacity to supply the silo sluicers backup water at full flow for approximately 1 hour. The tanks are equipped with level instruments to control the potable fill water valve based on tank level.

The tanks are constructed in accordance with API 650. They have flat bottoms supported on a concrete foundation. Corrosion considerations include painting external tank steel surfaces and providing a corrosion allowance of 1/16 in. Additionally, the interior of these tanks will have a 30-mil dry film thickness Plasite coating.

3.3.9 Make-Up Water Pumps

Make-up water is transferred from the make-up water tanks by one of two centrifugal pumps located adjacent to Make-up Water Tank. The make-up water pumps transfer domestic water to the Remediation Facility RCS, the SWRS and TWRS process water to Silos 1 and 2, and the Transfer Storage Tanks. The programmable logic controller (PLC) automatically stops the pumps on low tank level.

3.3.10 Slurry/Decant Pumps

The Slurry/Decant Pumps, used to supply supernatant for silo sluicing and also to retrieve slurry from the transfer storage tanks, are deployed from their modules located over the center nozzle of each Transfer Storage Tank. Slack hose and cable are suspended in the tank with enough length to allow the pump to reach the bottom of the tank. As the tank is filled and the pump is raised, lengths of cable and hose are disconnected and retracted from the riser.

There are four independent Slurry/Decant Pump systems. One Slurry/Decant Pump will be dedicated to each transfer storage tank. This arrangement allows critical operational and water management flexibility.

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 Slurry/Decant Pump is a centrifugal-style, submersible sump pump. The pump normally delivers 300 gpm to the silo sluicing nozzles at 200 psi. The impeller and wear components are made of abrasion-resistant material. An agitator and high-pressure spray ring are included ahead of the pump suction. The agitator and spray ring keep the solids in a slurry form as well as help the pump "dig" into the K-65 and BentoGrout™ material. The spray ring shuts off during sluicing supply operations. Additionally, a strainer screen plate is mounted at the pump suction to protect the pump from damaging debris entering it. The

Slurry/Decant Pump drive motor is a super severe duty (Service Factor = 1.35), requiring 480 VAC, 60 Hz, three-phase power. The pump is provided with variable speed control to allow for flow control.

3.3.11 Slurry/Decant Pump Enclosure

The Slurry/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 door, and sufficient gloveports and windows to allow equipment maintenance. The enclosure contains the equipment needed to allow the pump to function. Equipment includes a hoisting mechanism 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 motor-operated multi-port valves and piping/hoses to direct flows. 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 are 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 enclosure atmosphere control.

3.3.12 Transfer Storage Tank Sluicers

Each TTA tank has two sluicers installed in it. Each sluicer is contained in a steel module, which is mounted on the equipment deck. To maintain TTA flow balance during bulk retrieval, the total sluicing flow rate is fixed whether operating one or both sluicing nozzles. Each of the nozzles are remotely articulated from the Control Room in an automatic or manual mode to allow either vertical channel cutting or horizontal sweeping as necessary. Each sluicer has a 340° horizontal rotation and 105° vertical rotation capability.

As the level of the waste decreases, the TTA sluicers also have the ability to be 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 mast hoist in each of the sluicer enclosures accomplishes fine adjustment of either of the main nozzle's elevation. The mast hoist is normally operated from the Control Room but may also be operated locally when adding or removing sections.

The sluicing deployment system for the TTA sluicers is housed in a Sluicer Enclosure. The enclosure serves as secondary containment and drains to the TTA tank. Currently the enclosure measures approximately 6 ft by 10 ft by 20 ft high. The enclosure weighs approximately 15,000 lb and has several gloveport panels, an 11-ft by 3-ft access door, and a 2-ft by 2-ft pass-through. The weight of the sluicing system is supported off the TTA equipment deck. The sluicing system is connected to the TTA tank by a flexible coupling or bellows that allows small vertical or horizontal movement without inducing stresses to the TTA tank.

The TTA sluicers are removed from the TTA tank while being decontaminated by a high-pressure spray ring passed through a radiation-monitoring ring. Manual washing with a spray wand occurs through the glove ports as the equipment is removed to ensure that the equipment is properly cleaned.

3.3.13 Polymer System

A polymer additive system mounted on a skid is provided as a contingency plan to aide settling in the TTA tanks. Rapid solids settling in the TTA tanks ensure that an adequate supply of sluicing water is available. The polymer addition system is provided as a contingency and may not be used if the waste materials settle quickly without polymer addition. Provisions are made to add polymer directly to the slurry lines connecting the silos to the TTA and to the decant lines connecting the four TTA tanks.

3.3.14 Long Reach Manipulator Tools

Long reach manipulator tools consist of lightweight mechanical linkages with various detachable heads. The detachable heads could be a hook, scrapper, gripper, or other mechanical assembly. These devices are manually used as necessary to clear away debris from the pump inlet screen plate.

3.4 TRANSFER STORAGE TANK WASTE RETRIEVAL SYSTEM

The TWRS is designed to access, mobilize, and transfer waste residue stored in the TTA System. The function of the TWRS is to provide the capability to retrieve and transfer the entire inventory of waste from the Transfer Storage Tanks to the Remediation Facility for final treatment process. Each TTA tank is provided with two sluicing systems and a slurry pump system. The equipment on each TTA tank and on the silo bridges is of the same design and fully interchangeable. During TWRS activities, the Slurry/Decant Pump system is operated as a slurry transfer system rather than as a sluicing water supply system. To accomplish slurry transport the variable speed pump controls are used to adjust the discharge of the pump to 350 gpm at 150 psi.

Equipment is provided for the transfer of stored residues from any one of the four TTA tanks to any other TTA tank. Motor-operated multi-way diverter valves with flange connections will be provided for connecting slurry and sluice water piping. Sluice water for TWRS operations are supplied from the Silos 1 and 2 Remediation Facility. The TTA System provides piping and valves between the new Remediation Facility interface point and each of the four TTA tanks. The two sluicer modules and the Slurry/Decant Pump module are connected to each storage tank so that any TTA tank can be emptied, even as it is being filled. The operation is repeated until the four tanks are emptied.

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 the site's yearly limit. Operating controls for the TWRS are included in the Control Room. These controls allow the shutdown or start-up of TWRS equipment. Local controls for the TWRS subsystems are provided on the TTA Equipment Deck.

Automated functions of the TWRS are controlled by a PLC. These controllers process system events that require alarming. Local evacuation alarms are staged on the TTA Equipment Deck. The alarms also may be activated from the Control Room. Alarms are recorded and annunciated locally and in the Control Room.

3.5 WASTE RETRIEVAL OPERATING MODES

The AWR project encompasses multiple modes of operation as the K-65 material is transferred from the silos to the TTA and ultimately to the Silos 1 and 2 Remediation Facility.

For the AWR Project, the silos, Transfer Storage Tank System, and Remediation Facility are designed to operate in three possible general configurations – SWRS, TWRS, and Remediation Facility Slurry Recycle. The valve configuration design creates this operating flexibility. Based on the possible tank and valve configurations, four operating scenarios are considered likely to occur. One scenario occurs when slurry is retrieved from one of the silos. Another likely scenario is to retrieve slurry from one of the Transfer Storage Tanks. A third scenario is to operate SWRS and TWRS concurrently. The fourth possible scenario is to concurrently retrieve slurry from any one of the Transfer Storage Tanks and recycle slurry from the Remediation Facility to a different Transfer Storage Tank. These are not the only possible scenarios, they are considered to be most likely.

3.5.1 SWRS Mode

In this mode, supernatant (sluice water) is pumped from one Transfer Storage Tank to the sluice nozzle(s) in one silo, while slurry retrieved from that silo is pumped to a different Transfer Storage Tank. The concept (see Figure 3.5.1) depicted is to use supernatant from one Transfer Storage Tank to retrieve slurry from one of the silos. The slurry will be pumped into a different Transfer Storage Tank and allowed to settle. In the SWRS mode, supernatant, if available, potentially may be drawn from any of three Transfer Storage Tanks and supplied to either silo. Depending on level in a particular Transfer Storage Tank, retrieved slurry could be pumped to any Transfer Storage Tank except the tank from which supernatant is being drawn. In this operating configuration, one silo and two Transfer Storage Tanks are operating, and the other silo and two Transfer Storage Tanks are idle.

Figure 3.5.1

Silo Waste Retrieval System (SWRS) Operating Mode

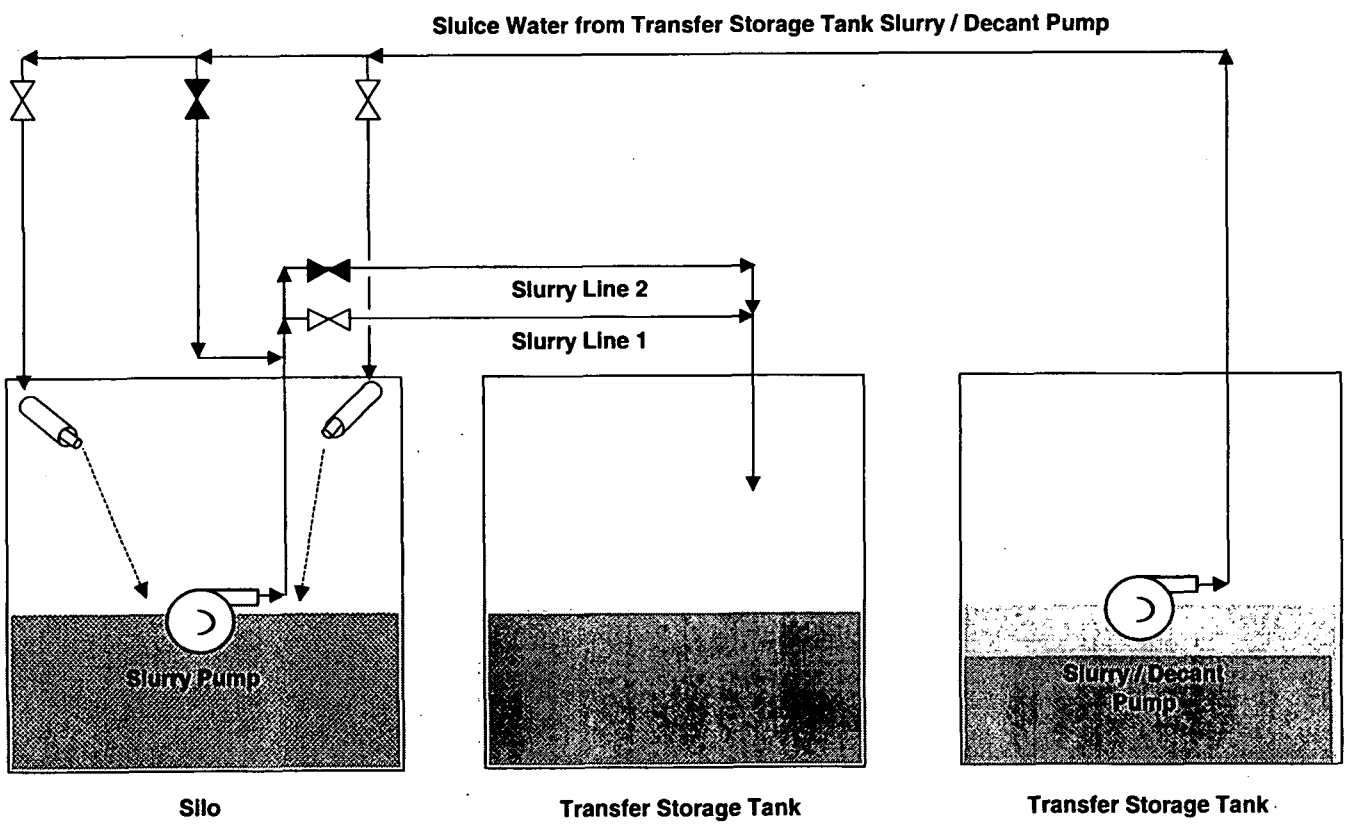


Figure 3.5.2

Transfer Storage Tank Waste Retrieval System (TWRS) Operating Mode

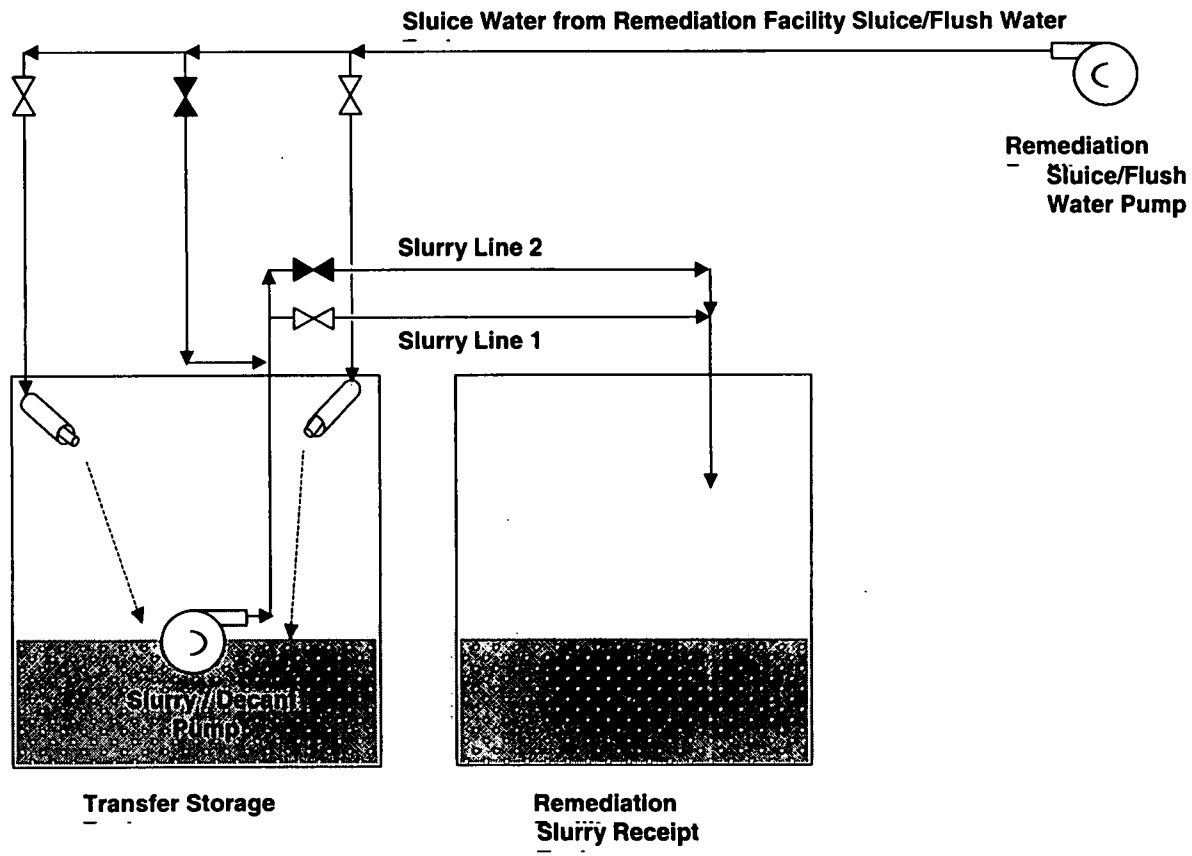
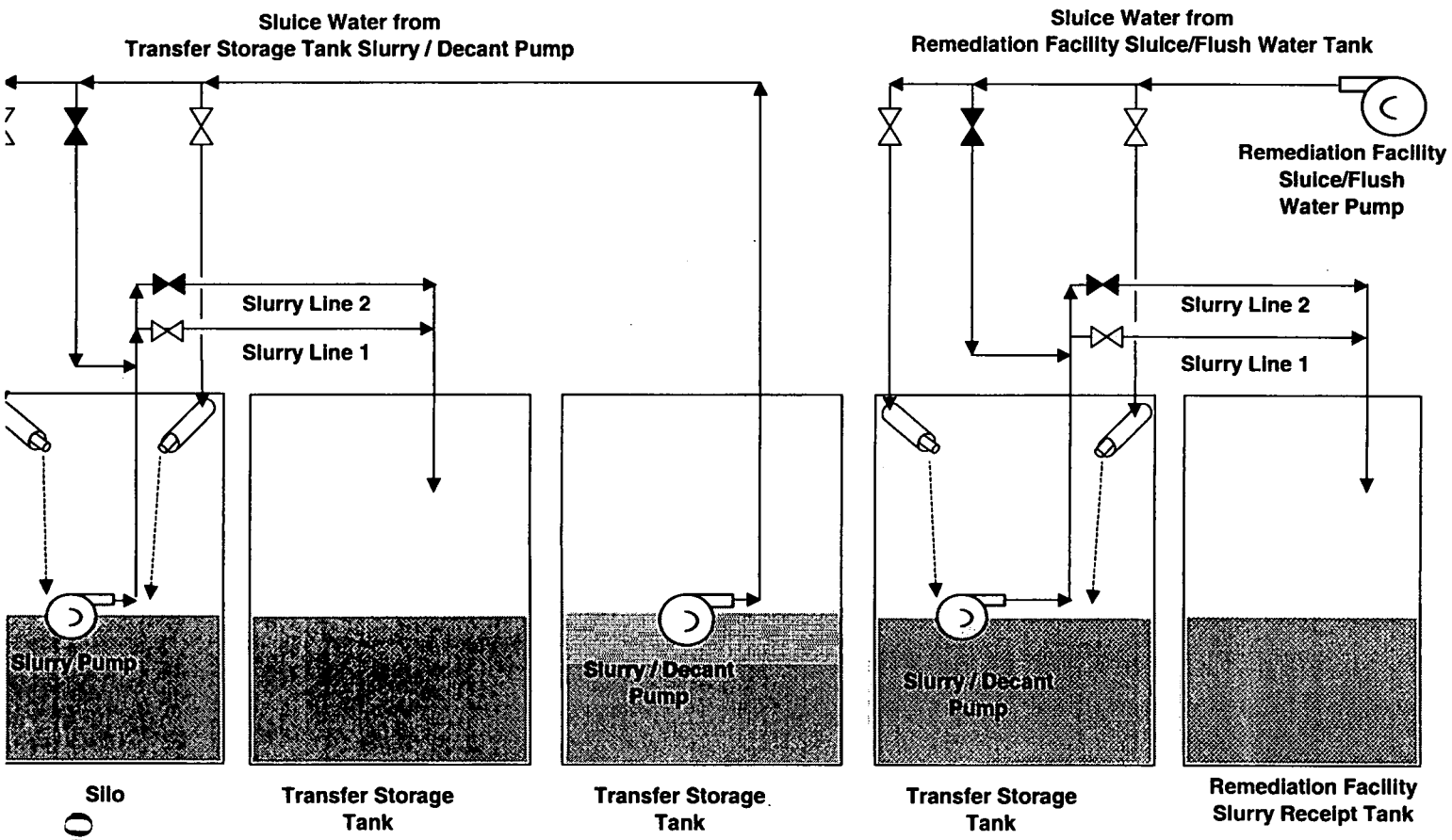


Figure 3.5.3
Concurrent Silo Waste Retrieval System (SWRS) and Transfer Storage Tank Waste Retrieval System (TWRS) Modes



When slurry transfer is complete, sluice water or process water will be used to flush the slurry lines between the silo and Transfer Storage Tank.

3.5.2 TWRS Operating Mode

In this mode, supernatant (sluice water) is pumped from the Remediation Facility to the sluice nozzle(s) in one Transfer Storage Tank, and slurry retrieved from that tank is pumped to the Remediation Facility. The concept (see Figure 3.5.2) depicted is to use supernatant from the Remediation Facility to retrieve slurry from any one of the four Transfer Storage Tanks. In this configuration, one Transfer Storage Tank is operating and both silos and three Transfer Storage Tanks are idle.

When slurry transfer is complete, sluice water or process water will be used to flush the slurry lines between the silo and Transfer Storage Tank and the Remediation Facility.

3.5.3 Concurrent SWRS and TWRS Operating Modes

In this mode, two operations are occurring concurrently (see Figure 3.5.3). Supernatant (sluice water) is pumped from the Transfer Storage Tank to the sluice nozzle(s) in one silo, while slurry retrieved from that silo is pumped to a different Transfer Storage Tank. Simultaneously, supernatant (sluice water) is pumped from the Remediation Facility to the sluice nozzle(s) in a third Transfer Storage Tank, and slurry retrieved from that tank is pumped to the Remediation Facility. This operation leaves one Transfer Storage Tank to operate in the decant mode, in which slurry water and slurry solids separate to generate supernatant on top of the slurry material.

When slurry transfer is complete, sluice water or process water will be used to flush the slurry lines between the silo and Transfer Storage Tank and the Remediation Facility.

3.6 RADON CONTROL SYSTEM

The RCS receives off-gases from the following sources: the silos, SWRS, all residue transfer systems, the TTA System, and the future Silos 1 and 2 Remediation Facility. The RCS removes radon from gas streams, reduces radon releases to the atmosphere, monitors all releases to the atmosphere for radon and other radiological material, and mitigates system upsets. The RCS is constructed in two phases:

- RCS Phase 1 reduces and controls radon concentrations in the silos' headspace prior to construction in the silos area and prior to the initiation of waste retrieval.
- RCS Phase 2 reduces and controls radon concentrations in the associated Silos Project Facilities (e.g., TTA, Silos 1 and 2 Remediation Facility).

3.6.1 RCS – Requirements

The RCS is designed according to the following requirements and criteria.

- Prevent over/under pressurization of the silos and transfer tanks beyond +0.5 in. W.C. and -2.0 in. W.C. beyond their design.
- Maintain radiation fields on the surface of the silos' domes below 50 mrem/hr during non-construction periods of Phase 1.
- Maintain radiation fields on the surface of the silos' domes below 10 mrem/hr during construction periods of Phase 1 and during all of Phase 2.
- Provide sufficient shielding and exclusion area fence to maintain the area outside the RCS facility as a Radiation Access Zone 1 (less than 0.4 mrem/hr) during all phases.
- Ensure that there are no uncontrolled releases of radon to the atmosphere.
- Provide local evacuation alarms.
- Provide both local and remote monitoring and control to verify RCS process control.
- Provide a design life of 20 years.
- Provide isokinetic sampling, monitoring, and recording on all stack exhaust streams to atmosphere in accordance with 40 *Code of Federal Regulations* (CFR) Part 61, Subpart H. Provide remote alarm capability to indicate buildup of radioactive particulate. Provide continuous monitoring of the stack exhaust radon concentration.
- Maintain radon emissions from the exhaust stack below the level resulting in an annual average concentration of 0.5pCi/L above background at the FEMP fence line.
- Provide safe shutdown, secure stand-by, and restart capability.

3.6.2 RCS–Process Description

The RCS includes two separate treatment equipment configurations or phases. Phase 1 continuously reduces and controls the concentration of radon in the silos' headspace until the SWRS is operational. Phase 1 recycles air from the silo headspaces through a radon treatment system to lower headspace radon concentration. After the radon count is lowered in the headspace and waste transfer is ready to begin, additional equipment will be added to the Phase 1 equipment for conversion to the Phase 2 system.

Phase 2 provides control of radon during waste removal and transport of residues and residue staging in the TTA. Phase 3 operation supports transfer from the TTA and operation of the Silos 1 and 2 Remediation Facility. The fans and other equipment have been designed to support concurrent operation of bulk waste retrieval and the Silos 1 and 2 Remediation Facility with a total flow of 2,000 cfm. Additional carbon beds may be added to support operation at 2,000 cfm, if identified as necessary based upon data collected during Phase 1 operation. The Phase 2 and 3 Systems are designed to provide a

minimum of 25 ft per minute minimum capture velocity during events in which contaminated areas are opened to the atmosphere.

Phase 1 is a recirculating system operating four carbon beds in a parallel configuration. Each carbon bed contains 40,000 lb of carbon. Headspace air is pulled from the silos at 500 cfm per silo and combined into one air stream. The 1,000 cfm combined air stream passes first through a dehumidification and chilling system to remove excess moisture and chill the air to approximately 45°F. The chilled air passes through a desiccant drying system, which removes the remaining moisture and heats the air up to about 80°F. The air stream then passes through another cooler to cool it back down to 40°F prior to entering the carbon beds. The air stream (conditioned to 40°F and 15 percent relative humidity) then passes through the carbon beds for radon removal. The four carbon beds are connected in parallel, each receiving a generated flow of 2,500 cfm. The headspace air is monitored for radon both upstream and downstream of the carbon beds to determine the removal efficiency. Upon exiting the carbon beds the air stream passes through the recirculation fan before being returned to the silo headspaces.

Phase 2 is designed as a once-through treatment system using the same process equipment as that described for Phase 1. During Phase 2 the recirculation fans are utilized to produce an induced draft ventilation stream through the silos, TTA tanks condensate tanks, and the various equipment modules. During normal Phase 2 operations the treated air stream will pass through the carbon beds, HEPA filter train and exhaust through a monitored stack to the atmosphere. If abnormal radiological conditions are detected at the stack, the RCS's control system automatically alarms and switches from the once through mode of operation to the recycle mode of operation.

During Phase 3 the RCS operates in the same manner as Phase 2 except Silos 1 and 2 Remediation Facility ventilation is added to the RCS treatment process. The addition of Silos 1 and 2 Remediation Facility ventilation increases the flow; therefore the RCS has been designed to handle this increased capacity to 2,000 scfm.

Additional carbon beds may be added during Phase 2 to enhance the system's radon removal capabilities. The need for additional carbon beds will be evaluated during Phase 1 operation.

The 500 cfm vent rate from each silo should maintain the silo headspaces at less than 500,000 pCi/L based on pre-bentonite rates of radon emanation into the silo headspaces. The 160,000 lb of carbon provided is designed to keep radon emissions to atmosphere to less than 0.2 Ci/day per silo.

3.6.3 Air Drying and Cooling

Previous radon control studies have indicated that the efficiency of radon adsorption onto carbon is enhanced when moisture and temperature are reduced. This air conditioning system is common to all Phases of the RCS operation. The air-drying and -cooling system is composed of three components: condenser, air dryer, and cooler. The air pulled from

the silos is first passed through a water-cooled condenser. The air temperature is dropped to 40°F saturated air based on inlet conditions 95°F air at 100 percent relative humidity. This step removes the readily condensable moisture and helps to minimize the required capacity of the air dryers. The air dryers use desiccant to remove the remaining moisture from the air stream. Using desiccant to dry the air raises the air stream temperature above the optimum temperature for removing radon with carbon beds. Therefore, prior to entering the carbon beds, the air stream is passed through a cooler. The conditioned air enters the carbon beds at 40°F and 15 percent relative humidity.

3.6.4 Carbon Beds

Radon is a radioactive inert gas with a short half-life (3.82 days). Because radon is an inert gas, it does not react with other chemicals. Radon has an affinity for activated carbon, which can be used to trap radon and allow it to decay to its daughter products. For the carbon beds to be effective, the air must be cool and dry as it enters. Phases 1 and 2 use four carbon beds operated in parallel. If required, Phase 3 may add additional beds to the system. Each carbon bed includes a 15-ft-long by 10-ft-wide by 10-ft-high steel shell containing 40,000 lb of activated carbon.

Since the RCS design includes redundant desiccant dryers, as well as demisters upstream of the beds to dry all air entering the carbon beds, buildup of excessive moisture, and the need to dry a bed is not expected to occur frequently. Radon monitors and moisture monitors will be used to monitor the condition and effectiveness of each bed. Based on the data from these monitors, the need to regenerate a bed will be identified and initiated. Regeneration will be accomplished by isolating the bed requiring drying and recycling dried air from the desiccant drying system through the bed until it has been sufficiently dried. The RCS provides sufficient excess carbon adsorption capacity maintain specified emission limits while the impacted carbon bed is being dried.

3.6.5 HEPA Filter Train

All gasses discharged from the RCS pass through a HEPA filter system downstream from the carbon units to remove particulate material prior to exhausting through the stack. The HEPA filters are used to trap fine particulates and typically have an efficiency rating of 99.97 percent for 0.3-micron particles.

The HEPA filters are housed in a steel frame. They are single stage HEPA filters with 45 percent pre-filters. The HEPA housings are designed for bag-in/bag-out filter changes. and are equipped with dioctyl phthalate testing ports, static pressure taps, and lifting lugs.

3.6.6 Stack and Monitor

The exhaust stack is located adjacent to the west of the RCS building. The stack is constructed of carbon steel and is approximately 150 ft tall. The stack is equipped with both continuous radon and isokinetic particulate monitoring. Isokinetic monitoring will include continuous flow recording. Scaffolding and equipment platforms to support the

monitoring in accordance with 40 CFR Part 60, Appendix A, Method 1, are included in the design.

3.6.7 RCS – Facility Description

The RCS facility houses RCS process equipment and the carbon beds. This includes the desiccant drying system, condensate holdup tanks, filters, and fans. The carbon beds are located in precast concrete vaults adjacent to the building. Vaults are provided with shield walls. The concrete vaults are designed in a modular fashion so that additional carbon beds can be added with very little down time. The first floor of the RCS building houses the roughing filters, chilling coils, desiccant dryers, and condensate tanks. The first floor area is provided with 2-ft-thick walls for shielding. The RCS building is ventilated and heated to maintain appropriate operating temperatures and be as low as reasonably achievable compliant. The RCS building ventilation system maintains the RCS building at a negative pressure relative to the atmosphere and ensures that airflow through the building is directed from less contaminated areas to more contaminated areas. Floors are coated with a sealant to facilitate decontamination and provide secondary containment for the condensate hold-up tanks. The carbon bed vaults are provided with an independent ventilation system designed to maintain the carbon beds at 60°F or less. Air passing through the RCS building is discharged from the monitored RCS stack.

4.0 AWR SUPPORT SYSTEMS

4.1 CONTROL SYSTEMS

The AWR Project consists of several separate phases and activities that require different process controls. The AWR RCS is required to operate continually throughout the waste retrieval operation, prior to any construction activities around and on the silos and during the staging of silo material in the TTA tanks. The silo waste retrieval activities are batch processes and require controls to start, stop, and periodically control operation. To accomplish these multiple functions and activities the AWR Process Control Philosophy is to use two independent control systems. These systems are (1) the Balance of Plant (BOP) Control System and (2) the RCS.

The two independent control systems are integrated through a fiber optic cable link and the Siemens Profibus operating system. The primary plant operating system is the BOP Control System, which is responsible for total control of plant operations with exception of the RCS. The RCS system is provided with an independent control system but is provided a link to the BOP Control System.

The BOP Control System does not provide control input signals to the RCS control systems, but it does receive and log status and alarm signals from the RCS Control. In the case of an alarm or status signal requiring action from the RCS control system, the operator will need to operate the appropriate human-machine interface (HMI) and take the necessary action.

4.1.1 System Concept

The AWR Project distributed control systems (DCS) will be a PLC-based system with distributive input/output (I/O) data collection and control nodes. The PLCs and redundant operator HMI stations will be located in the Control Room. The data collection and control nodes are expected to be located at the Silo Bridge, high-pressure pumps, and the TTA building. The distributive I/O data collection and control nodes will be connected to the PLCs by a fiber optic network. The individual equipment items located at the I/O nodes will be connected to the nearest I/O node with field wiring.

4.1.2 Distributed Control System

The AWR Project DCS will be an integrated system that will allow both local control at the equipment site and remote control at the central control room station, located in the Control Room. The AWR Project DCS supports operations during SWRS and TWRS waste removal operations, as well as TTA System monitoring.

4.1.3 Silo Maintenance and Control Facility

The Control Room for the AWR Project will be used to support all of the Silos 1 and 2 waste removal and transfer operations. It will be located in the former Vitrification Pilot Plant. The Control Room will have an operator station for the control of the waste removal, transfer, and support equipment. The Control Room will have wiring distribution for field 120 VAC power and uninterruptible power supply (UPS) 120 VAC power.

4.1.4 Controls Utility Requirements

The following utilities are anticipated to support the AWR Project DCS.

Electrical Power – UPS 120 VAC, single-phase power will be provided to the AWR Project Control Room. UPS 120 VAC, single-phase power is provided to each I/O data collection and control node. 120 VAC power, single-phase will be provided to the Control Room.

Fiber Optic – Fiber optic cables will be 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 will be provided.

Interfaces – Interfaces to equipment systems include the RCS, SWRS, TTA, and TWRS.

Maintenance – The required maintenance on the AWR Project DCS is expected to be low. Low maintenance results from using quality components and a modular design within the AWR Project DCS.

4.1.5 DCS General Requirements

The AWR Project DCS will be designed incorporating the following general requirements:

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

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PROCESS CONTROL SUMMARY FOR THE ACCELERATED WASTE RETRIEVAL PROJECT

Document No. 40710-RP-0020

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Revision 0

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ACRONYMS

API	American Petroleum Institute
AWR	Accelerated Waste Retrieval
BOP	Balance of Plant
HMI	human-machine interface
HEPA	high-efficiency particulate air
PLC	programmable logic controller
RCS	Radon Control System
SWRS	Silo Waste Retrieval System
TTA	Transfer Tank Area
TWRS	Tank Waste Retrieval System
WC	Water Column

1.0 INTRODUCTION

1.1 SCOPE

This Process Control Plan provides a list of the monitoring and control instrumentation, set points, normal operating ranges, and actions to be taken should the defined operating ranges be exceeded. It provides the programming philosophy, operation interlocks, and sequencing required for Accelerated Waste Retrieval (AWR) operations. The set point values identified on the tables in Sections 2 and 3 represent initial set points based design information. These initial values will be fine-tuned and adjusted if necessary during startup and initial operations to ensure operation within environmental, health and safety, and other limits, while avoiding unnecessary shutdown or inefficient control due to normal equipment fluctuations.

1.2 OBJECTIVE

The objective of this document is to provide an overview of the AWR Project controls, operating parameters, and alarms. The AWR process control systems are designed to support the treatment of radon, waste retrieval, and staging of waste in the Transfer Tank Area (TTA).

1.3 OVERVIEW

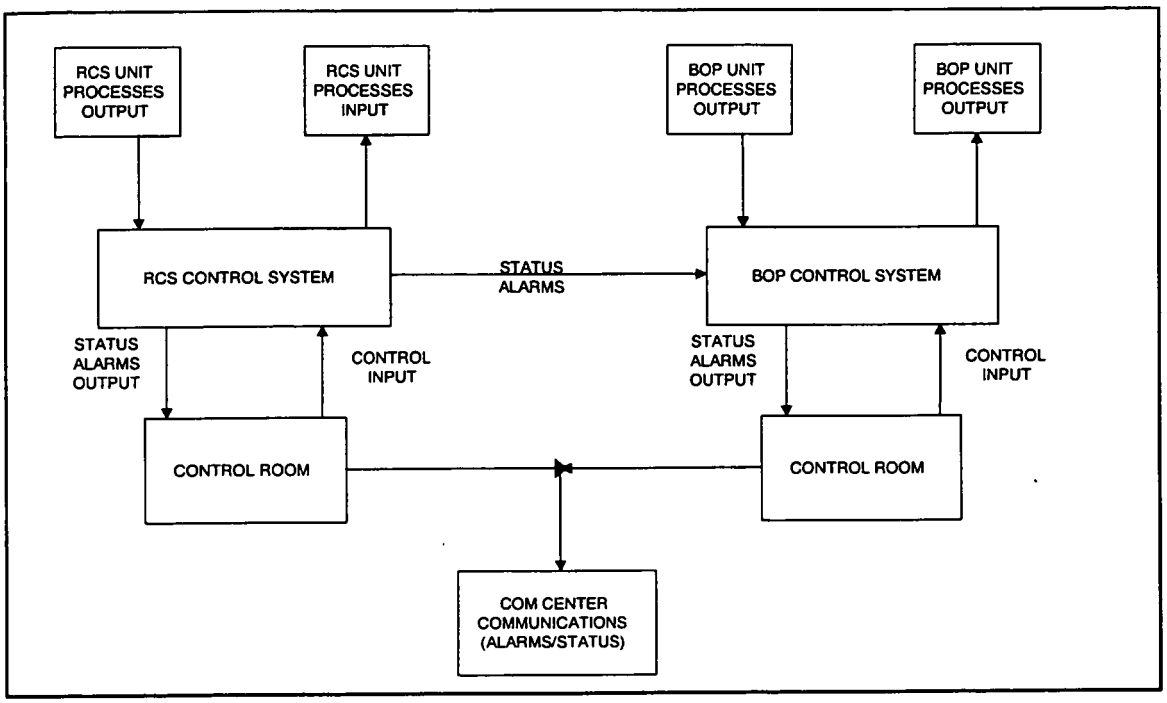
The AWR Project consists of several separate phases and activities that require different process controls. The AWR Radon Control System (RCS) operates intermittently prior to any construction activities around or on the silos to maintain worker exposure as low as reasonable achievable (Phase 1) and continually throughout the waste retrieval operation, prior to any construction activities around and on the silos and during the staging of silo material in the TTA tanks (Phase 2). The silo waste retrieval activities require controls to start, stop, and control operation. To accomplish these multiple functions and activities the AWR Process Control Philosophy is to use two independent control systems: the Balance of Plant (BOP) Control System and the RCS.

These independent control systems are integrated through a fiber optic cable link and the Siemens Profibus operating system. The primary plant operating system is the BOP Control System, which is responsible for total control of plant operations with the exception of the RCS. The RCS is provided with an independent control system; however, it communicates with the BOP Control System as depicted in Figure 1-1 of this report.

The BOP Control System does not provide control input signals to the RCS control system, but it does receive and log status and alarm signals from the RCS control

system. In the case of alarm or status signal requiring action from the RCS control system, the operator will need to operate the appropriate human-machine interface (HMI) and take the necessary action.

Figure 1-1



2.0 BALANCE OF PLANT CONTROL SYSTEM DESCRIPTIONS

2.1 BALANCE OF PLANT CONTROL SYSTEM

The BOP involves all AWR facilities and activities except for the RCS. The BOP can be functionally separated into the following three subsystems:

1. Silo Waste Retrieval System (SWRS) involves the retrieval and transfer of waste material from the silos to the four 750,000-gal storage tanks.

2. Tank Waste Retrieval System (TWRS) involves the retrieval and transfer of waste material from the four 750,000-gallon storage tanks to the Silo 1 and 2 Remediation Facility.

3. The TTA is a 152-ft X 152-ft structure. The first floor of the TTA provides shielding and secondary containment for the four 750,000-gal storage tanks. The second floor of the TTA provides structural support and weather protection for several ancillary components associated with the SWRS and TWRS subsystems.

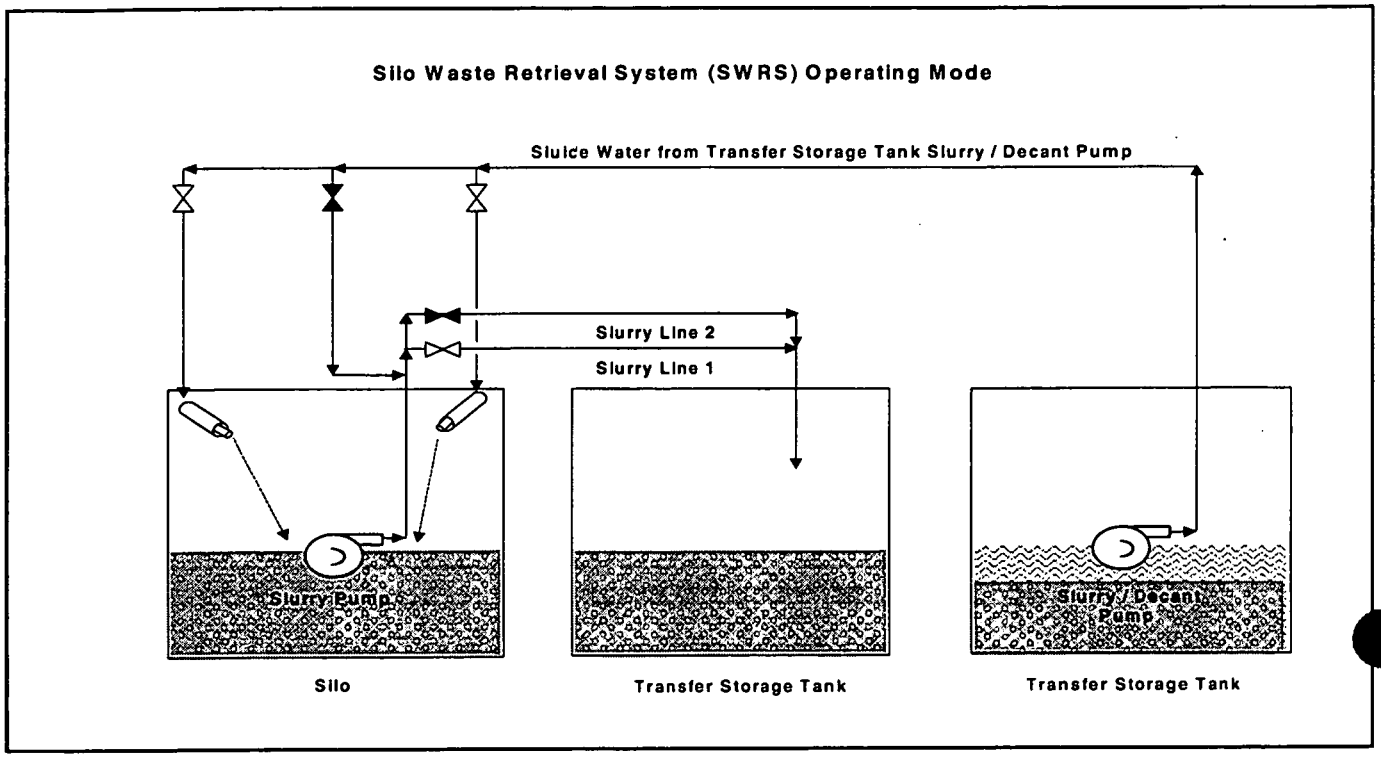
The BOP control system is responsible for controlling the flow rates, operating pressures, liquid levels, and solids concentrations during waste transfer operations. It is also responsible for providing monitoring and status functions during waste storage operations. The BOP control system includes programmable logic controller (PLC) controls and redundant HMI consoles for each AWR subsystem. The HMI consoles are located in the AWR Project Control Room and are capable of accessing status and alarm information from the RCS system. Each subsystem in the BOP can be operated locally through the PLC with safety interlocks to prevent inadvertent operation of equipment. The subsystems comprising the BOP are discussed below.

2.2 SWRS CONTROL DESCRIPTION

2.2.1 SWRS Operating Philosophy

The objective of the SWRS is to retrieve waste material from the silos and transfer it to the TTA tanks. Figure 2-1 illustrates the basic operating scheme for SWRS activities. Past practice sluicing is used to achieve this objective. Past practice sluicing utilizes a low-to-medium pressure [200 pounds per square unit (psi)], high volume [300 gal per minute [gpm]) liquid stream to dislodge, slurry, and convey waste material to the intake of a slurry transfer pump. The slurry transfer pump then conveys the slurried material from the silos to the TTA.

Figure 2-1



The AWR Project utilizes two 300-gpm sluicing nozzles and one 350-gpm centrifugal slurry pump on each silo. The silo sluicing nozzles are supplied with sluicing water from decant/slurry pumps located inside each of the TTA tanks. Each TTA tank is provided with one decant/sluicing pump. The AWR is designed so that either silo can be mined during a given period, but the silos cannot be mined simultaneously. The AWR is also designed so that material can be conveyed from either silo to any of the four TTA tanks. The design also allows two TTA tanks to operate in the SWRS mode while either of the remaining TTA tanks operate in the TWRS mode, with the fourth tank being offline for solids settling.

As shown in Figure 2-1 sluice water is pumped from the TTA decant slurry pumps to the silo sluicing nozzles. Prior to the start of SWRS activities, water is placed in each TTA tank to serve as sluice water during start-up of the SWRS. As material is slurried into the TTA tanks, suspended solids will settle, leaving a relatively solids-

free supernatant layer of water above the solids layer. This supernatant layer will be used as the source of sluicing water as the project proceeds. As a process contingency a polymer addition system is provided to ensure rapid settling of the solids and the availability of sluicing water should settling issues arise. The operating scheme allows for filling one of the TTA tanks while using a second of the four TTA tanks as the sluicing water supply. The two remaining TTA tanks would be off-line in the solids clarification mode to provide sluice water when the supply in the second tank is exhausted. Rotating the function of the tanks in this manner provides maximum settling time for each tank and allows all four tanks to reach their holding capacity at approximately the same time.

2.2.2 TTA Decant/Sluicing Pump Control

A decant/sluicing pump is provided in each TTA tank. The decant/sluicing pumps are used to provide sluicing water to the silo sluicing nozzles during SWRS operations. The pumps can also be used to pump water/waste from one TTA tank to any other TTA tank. The pumps are deployed from an enclosed equipment module into the TTA tanks with a cable and hoist arrangement. The TTA decant/slurry pumps are submersible with an open impeller, centrifugal-type design and are provided with programmable variable speed controls. During SWRS activities the pumps will be programmed to deliver a flow of 300 gpm at 200 psi to the silo sluicing nozzles. The control functions for the decant/sluicing pumps are discussed in this section and summarized in Table 2-1.

Starting/stopping of the decant/sluicing pumps is controlled either from the Control Room or from the TTA deck. Running lights are provided at both locations.

The discharge pressure and flow rate of the TTA decant/sluicing pumps are continuously monitored. The control system will sound an alarm on low pressure, high pressure, low flow, or high flow.

The solids concentration in the sluice water should be maintained within the optimum range as determined in the cold test loop. Each decant/sluicing module is provided with an instrument to measure the solids concentration in the sluicing pump discharge stream. The control system will sound an alarm on high solids concentration.

The decant/sluicing pumps are provided with level instrumentation to continuously monitor the submergence level of the pump. The control system will activate an alarm on low level and discontinue pump operation on low-low level to allow the slurry level to regain or to signal to lower the pump. Additionally, the decant/sluicing pumps are interlocked with level instrumentation in the silos and in the Remediation Facility Receipt Tank. On high-high level in the silos or in the Remediation Facility receipt tanks the operation of the decant/slurry pumps

automatically terminates. The sluice water supply lines are automatically flushed when the operation of the decant/slurry pumps is terminated.

Table 2-1 – Control Functions for the Decant/Sluicing Pumps

ALARM	FUNCTION	SET POINT	RANGE
High-Flow	Notifies operator of high-flow conditions. High-flow conditions may indicate or result in the following: (1) flooded conditions, (2) improper process water balance, (3) improper valve alignment, (4) improper control settings, or (5) mechanical failure.	350 gpm	100–500 gpm
Low-Flow	Notifies operator of low-low conditions. Low flow conditions may indicate or result in the following: (1) flooded conditions, (2) improper process water balance, (3) improper valve alignment, (4) improper control settings, (5) line blockage, or (6) mechanical failure.	200 gpm	100–500 gpm
Low-Level	Notifies the operator of less than desired pump submergence. This condition may indicate: (1) sluicing water supply is low, (2) improper valve alignment, (3) improper control settings, or (4) mechanical failure.	3.5 ft	1–30 ft
Low-Low Level	Shuts down pump operation to protect the pump from mechanical damage.	1.5 ft	1–30 ft
High Pressure	Notifies operator of high-pressure conditions. High-pressure conditions may indicate or result in the following: (1) plug in pipeline, (2) improper valve alignment, (3) improper control settings or (4) mechanical failure.	225 psi	0–500 psi
Low Pressure	Notifies operator of low-pressure conditions. Low-pressure conditions may indicate or result in the following: (1) leaks in pipeline, (2) improper valve alignment, (3) improper control settings, or (4) mechanical failure	100 psi	0 500 psi

Table 2-1 Control Functions for the Decant/Sluicing Pumps (Cont'd)

ALARM	FUNCTION	SET POINT	RANGE
High Solids	Notifies operator that solids content has exceeded design conditions. May indicate mechanical difficulties.	2 wt%	0–25 wt%
High-High Solids	Notifies operator that solids content has significantly exceeded design conditions. Control System will automatically begin to dilute discharged slurry	3 wt%	0–25 wt %

2.2.3 Silo Sluicing Nozzles

The silo sluicing nozzles are designed to dislodge, slurry, and convey waste material to the silo slurry pump intake nozzle. Each silo is provided with two sluicing nozzles. The nozzles are deployed from an enclosed equipment module into the silo structures with a rigid mast assembly. The nozzles can travel the full vertical profile of the silo structures. Vertical motion is accomplished by adding or removing mast sections. The nozzles are provided with pan and tilt motion to modify the angle of attack as required by mining conditions. The pan and tilt features are computer-controlled from the Control room or from the silo bridge deck. The control functions for the silo sluicing nozzles are discussed in this section and summarized in Table 2-2. Sluicing water flow can be directed to a single nozzle or split between two nozzles on the same silo. The SWRS is designed to allow either Silo 1 or Silo 2 to receive sluicing water at the operator's discretion. The design does not permit simultaneous flow of sluicing water to both Silo 1 and Silo 2. The nozzles are designed to provide a sluicing stream at a maximum total flow of 300 gpm and 200 psi. The flow rate and pressure are continuously monitored. Alarms will be annunciated on out of design flow or pressure conditions.

Table 2-2 – Control Functions for the Silo Sluicing Nozzles

ALARM	FUNCTION	SET-POINT	RANGE
High flow	Notifies operator of sluicing water flow rates exceeding design parameters. High flow conditions may indicate or result in the following: (1) flooded conditions, (2) improper process water balance, (3) improper valve alignment, (4) improper control settings), or (5) mechanical failure.	350 gpm	100–500 gpm
Low flow	Notifies operator that insufficient sluicing water is available. . Low flow conditions may indicate or result in the following: (1) flooded conditions, (2) improper process water balance, (3) improper valve alignment, (4) improper control settings, (5) line blockage, or (6) mechanical failure	200 gpm for single nozzle operating configuration or 100 gpm for two nozzle operating configuration.	100–500 gpm
High pressure	Notifies operator of high- pressure conditions. High- pressure conditions may indicate or result in the following: (1) plug in pipeline, (2) improper valve alignment, (3) improper control settings or (4) mechanical	225 psi	0–500 psi
Low pressure	Notifies operator of low-pressure conditions. Low pressure conditions may indicate or result in the following: (1) leaks in pipeline, (2) improper valve alignment, (3) improper control settings, or (4) mechanical	100 psi	100–500 psi

2.2.4 Silo Slurry Transfer Pump

A slurry pump is provided in each silo. The slurry pumps are used to pump slurried waste material from the silos to the TTA. The pumps are deployed from an enclosed equipment module supported from a bridge structure into the silos with a cable and hoist arrangement. The slurry pumps are submersible with an open impeller, centrifugal-type design and are provided with programmable variable speed controls. During SWRS operations the pumps will be programmed to deliver a flow of 350 gpm to the TTA tanks. The control functions for the silo slurry pumps are

discussed in this section and summarized in Table 2-3.

Starting/stopping of the slurry pumps is controlled either from the control room or from the silo bridge structure. Running lights are provided at both locations.

The discharge pressure and flow rate of the slurry pumps are continuously monitored. The control system will activate an alarm on low pressure, high pressure, low flow or high flow. Pressure monitoring is provided at various locations along the length of the slurry line between the silos and the TTA. The pipeline pressure monitors are used to locate blockages.

The present AWR design basis calls for maintaining the solids concentration below 15 percent (weight basis). The solids concentration in the slurried waste stream is continuously monitored. Each slurry module is provided with an instrument to measure the solids concentration in the slurry pump discharge stream. The control system will sound on alarm when the solids concentration exceeds 15 percent. If the solids concentration reaches 17 percent, the control system will automatically divert sluicing water into the slurry pipeline to dilute the slurry stream. Motorized valves are used to accomplish this procedure. The valving system is designed to provide enough sluicing water to drop the solids concentration to less than 15 percent. These control values are programmable. If the AWR Cold Loop Test or field conditions demonstrate that the design values are incorrect, the control system can be modified to reflect the more accurate values.

The slurry pumps are provided with level instrumentation to continuously monitor the submergence level of the pump. The control system will activate an alarm on low submergence level and discontinue pump operation on low-low submergence level. Additionally, the slurry pumps are interlocked with level instrumentation in the TTA tanks. On high-high level in the TTA tanks, the operation of the slurry pumps automatically terminates.

Table 2-3 – Control Functions for the Slurry Transfer Pumps

ALARM	FUNCTION	SET POINT	RANGE
High-flow	Notifies operator of high flow conditions. High flow conditions may indicate or result in the following: (1) flooded conditions, (2) improper process water balance, (3) improper valve alignment, (4) improper control settings), or (5) mechanical failure.	400 gpm	100–500 gpm
Low flow	Notifies operator of low flow conditions. Low flow conditions may indicate or result in the following: (1) flooded conditions, (2) improper process water balance, (3) improper valve alignment, (4) improper control settings, (5) line blockage, or (6) mechanical failure.	200 gpm	100–500 gpm
Low level	Notifies the operator of less than desired pump submergence This condition may indicate: (1) sluicing water supply is low, (2) improper valve alignment, (3) improper control settings, or (4) mechanical failure.	3.5 ft	1–30 ft
Low-low level	Shuts down pump operation to protect the pump from mechanical damage.	1.5 ft	1–30 ft
High Pressure	Notifies operator of high-pressure conditions. High-pressure conditions may indicate or result in the following: (1) improper valve alignment, (2) improper control settings, or (3) mechanical failure.	225 psi	0–500 psi
Low Pressure	Notifies operator of low-pressure conditions. Low pressure conditions may indicate or result in the following: (1) leaks in pipeline, (2) improper valve alignment, (3) improper control settings, or (4) mechanical failure.	100 psi	0–500 psi

Table 2-3 – Control Functions for the Slurry Transfer Pumps (Cont'd)

ALARM	FUNCTION	SET POINT	RANGE
High Solids	Notifies operator that solids content has exceeded design conditions. May indicate mechanical difficulties.	15 wt%*	0–25 wt%*
High-High Solids	Notifies operator that solids content has significantly exceeded design conditions. Control System will automatically begin to dilute discharged slurry.	17 wt%*	0–25 wt%*

Note: *Subject to change based on the results of the AWR Cold Loop Test

2.2.5 Decant Sump Tan

The Decant Sump Tank is located underground and just west of and between the silos. Prior to the initiation of SWRS activities, a control system is installed in the decant sump tank. The control functions for the decant sump level control system are discussed in this section and summarized in Table 2-4. The level control system consists of level instrumentation and a submergible sump pump. The level instrumentation and the pump are lowered into the Decant Sump Tank through the Decant Sump Tank 20-in. opening. The pump and level instrumentation remain in the sump throughout SWRS operations. The level instrumentation continuously monitors the liquid level in the decant sump. The level system also continuously monitors the rate of change in sump's liquid level. If the level rises in the tank above a set point during SWRS operations, an alarm is initiated and the sump pump automatically begins to transfer liquid from the sump to a silo as determined by operations. Presently it is anticipated that a liquid level of 5 ft will be maintained in the decant sump. The level instrumentation system also monitors the rate of level in the decant sump. If an abnormal rate of rise (greater than 7 in./hour) is observed during SWRS operations, the flow of sluicing water from the TTA to the silos will be reduced, and the decant sump pump will automatically transfer liquids to the silos. The silo slurry transfer pumps will then transfer the liquid to the TTA.

Table 2-4 – Decant Sump Control Functions

ALARM	FUNCTION	SET-POINT	RANGE
Low level	Stops pump on low level in Decant Sump.	1 ft	1–10 ft
High level	Pump starts to reduce level in Decant Sump.	5 ft	1–10 ft
Level rate high	Pump starts when fluid level rises in the sump faster than the anticipated rate.	7 in./hr	0–100 in./hour

2.3 TWRS OPERATING PHILOSOPHY

The objective of the TWRS is to retrieve waste material from the TTA tanks and transfer it to the Silo 1 and 2 Remediation Facility. Past practice sluicing is used to achieve this objective in a similar manner as that used to accomplish the transfer of waste from the silos to the TTA. Figure 2-2 depicts the basic flow of material during TWRS operations.

As shown in Figure 2-2, sluice water is pumped from the Silo 1 and 2 Remediation Facility's sluice water supply tanks to the TTA sluicing nozzles. Prior to the start of TWRS activities, 50,000-gal of water is placed in each Remediation Facility Sluice Water Tank to serve as sluice water during the TWRS operation activities.

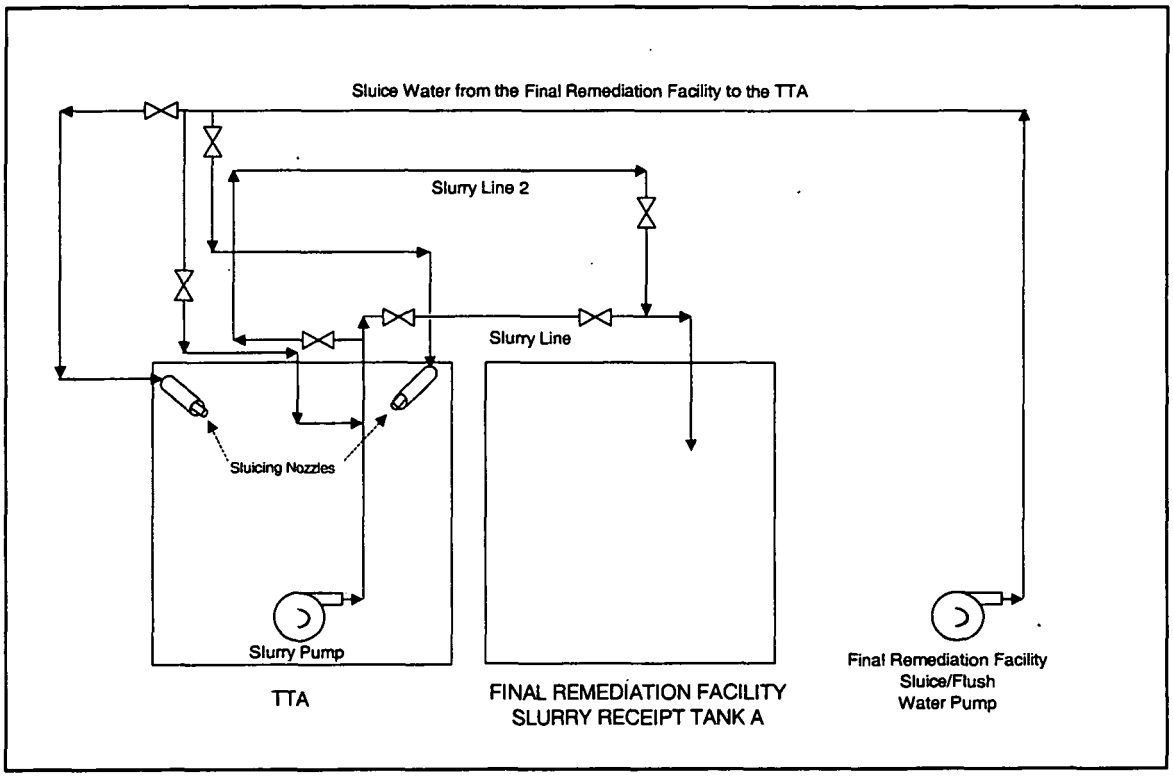
2.3.1 TTA Slurry Transfer Pump

A slurry pump is provided in each TTA tank. The same pumps used for providing sluice water during the SWRS activities are used to slurry material from the TTA tanks to the Final Remediation Facility in TWRS Operations and are designated decant/slurry pumps. The pumps can also be used to pump waste material from one TTA tank to any other TTA tank. The pumps are deployed from an enclosed equipment module supported from the TTA equipment deck with a cable and hoist arrangement. The slurry pumps are submersible with an open impeller, centrifugal-type design and are provided with programmable variable speed controls. During TWRS activities, the pumps will be programmed to deliver a flow of 350 gpm to the Remediation Facility. The control functions for the TTA slurry transfer pumps are discussed in this section and summarized in Table 2-5.

Starting/stopping of the slurry pumps is controlled either from the Control Room or from the TTA equipment deck. Running lights are provided at both locations.

The discharge pressure and flow rate of the slurry pumps are continuously monitored. The control system will activate an alarm on low pressure, high pressure, low flow, and high flow. Pressure monitoring is provided at various locations along the length of the slurry line between the TTA and the Remediation Facility to locate blockages.

Figure 2-2



The solids concentration in the slurried waste stream is continuously monitored. The present design calls for maintaining the solids concentration below 15 percent (weight basis). Each slurry module is provided with an instrument to measure the solids concentration in the slurry pump discharge stream. The control system will sound an alarm when the solids concentration exceeds 15 percent. If the solids concentration reaches 17 percent, the control system will automatically divert sluicing water into the slurry pipeline to dilute the slurry stream. Motorized valves are used to accomplish this procedure. The valving system is designed to provide enough sluicing water to drop the solids concentration to less than 15 percent. These control values are programmable. If field conditions demonstrate that the design values should be adjusted, the control system can be modified to reflect the more accurate values.

The slurry pumps are provided with level instrumentation to continuously monitor the submergence level of the pump. The control system will activate an alarm on low submergence level and discontinue pump operation on low-low submergence level. Additionally, the slurry pumps are interlocked with level instrumentation in the Silo 1 and 2 Remediation Facility Receipt Tanks. On high-high level in the

Silo 1 and 2 Remediation Facility Receipt Tanks the operation of the slurry pumps automatically terminates.

Table 2-5 – Control Functions for the TTA Slurry Transfer Pumps

ALARM	FUNCTION	SET POINT	RANGE
High flow	Notifies operator of high flow conditions. High flow conditions may indicate or result in the following: (1) flooded conditions, (2) improper process water balance, (3) improper valve alignment, (4) improper control settings), or (5) mechanical failure.	350 gpm	100–500 gpm
Low flow	Notifies operator of low flow conditions. Low flow conditions may indicate or result in the following: (1) flooded conditions, (2) improper process water balance, (3) improper valve alignment, (4) improper control settings, (5) line blockage, or (6) mechanical failure.	200 gpm	100–500 gpm
Low level	Notifies the operator of less than desired pump submergence This condition may indicate: (1) sluicing water supply is low, (2) improper valve alignment, (3) improper control settings, or (4) mechanical failure.	3.5 ft	1–30 ft
Low-low level	Shuts down pump operation to protect the pump from mechanical damage.	1.5 ft	1–30 ft
Low Pressure	Notifies operator of low-pressure conditions. Low pressure conditions may indicate or result in the following: (1) leaks in pipeline, (2) improper valve alignment, (3) improper control settings, or (4) mechanical failure.	100 psi	0–500 psi
High Solids	Notifies operator that solids content has exceeded design conditions. May indicate mechanical difficulties.	15 wt%*	0–25 wt%*
High-High Solids	Notifies operator that solids content has significantly exceeded design conditions. Control System will automatically begin to dilute discharged slurry.	17 wt%*	0–25 wt%*

Note: *Subject to change based on results of AWR Cold Loop Test

2.3.2 TTA Sluicing Nozzles

The TTA sluicing nozzles are designed to dislodge, slurry, and convey waste

material to the TTA slurry pump intake nozzle. Each TTA tank is provided with two sluicing nozzles. The nozzles are deployed from an enclosed equipment module into the silo structures with a rigid mast assembly. The nozzles can travel the full vertical profile of the silo structures. Vertical motion is accomplished by the addition or subtraction of mast sections. The nozzles are provided with pan and tilt motion to modify the angle of attack as required by mining conditions. The pan and tilt features are computer-controlled from the control room or from the silo bridge deck. The control functions for the sluicing nozzles are discussed in this section and summarized in Table 2-6. Sluicing water flow can be directed to a single nozzle or split between two nozzles on the same TTA tank. The TWRS is designed to allow any TTA tank to receive sluicing water at the operator's discretion. The design also allows two TTA tanks to operate in the SWRS mode while either of the remaining TTA tanks operate in the TWRS mode, with the fourth tank being off-line for solids settling. The nozzles are designed to provide a sluicing stream at 300 gpm and 200 psi. The flow rate and discharge pressure are continuously monitored. Alarms will be annunciated on out-of-design flow or pressure conditions.

Table 2-6 – Control Functions for the TTA Sluicing Nozzles

ALARM	FUNCTION	SET-POINT	RANGE
High flow	Notifies operator of sluicing water flow rates exceeding design parameters. High-flow conditions may indicate or result in the following: ((1) flooded conditions, (2) improper process water balance, (3) improper valve alignment, (4) improper control settings), or (5) mechanical failure.	350 gpm	100–500 gpm
Low flow	Notifies operator that insufficient sluicing water is available. Low-flow conditions may indicate or result in the following: (1) flooded conditions, (2) improper process water balance, (3) improper valve alignment, (4) improper control settings, (5) line blockage, or (6) mechanical failure.	200 gpm	100–500 gpm

High pressure	Notifies operator of high-pressure conditions. High-pressure conditions may indicate or result in the following: (1) plug in pipeline, (2) improper valve alignment, (3) improper control settings, or (4) mechanical failure.	225 psi	0–500 psi

Table 2-6 – Control Functions for the TTA Sluicing Nozzles (Cont'd)

ALARM	FUNCTION	SET-POINT	RANGE
Low Pressure	Notifies operator of low-pressure conditions. Low pressure conditions may indicate or result in the following: (1) leaks in pipeline, (2) improper valve alignment, (3) improper control settings, or (4) mechanical failure.	100 psi	100–500 psi

2.4 TTA OPERATIONAL FUNCTIONS

The TTA System is used to support both the SWRS and the TWRS modes of operation control. The TTA is a 152-ft by 152-ft structure. The first floor of the TTA provides shielding and secondary containment for the four 750,000-gal TTA storage tanks. The second floor of the TTA provides structural support and weather protection to the ancillary components associated with the SWRS and TWRS.

2.4.1 Transfer Storage Tanks

Each carbon steel transfer storage tank has a capacity of 750,000 gal and is constructed in accordance with American Petroleum Institute (API) 650. The control functions for the TTA Tanks are discussed in this section and summarized in Table 2-7.

Each of the TTA tanks is provided with instrumentation to continually monitor tank level, tank pressure, and the radon concentration inside each tank.

The four 750,000-gal storage tanks are connected at their overflow nozzles by a 6-in.-diameter pipe. This overflow arrangement together with the use of level measurement devices in each tank minimizes the potential of exceeding the capacity of any one tank. The level instrumentation in each tank also provides status and alarm signals to alert operations of high or low level conditions within the tanks. Additionally, the TTA tank level instrumentation is interlocked with the

silo slurry transfer pumps and the Remediation Facility sluicing water supply pumps to ensure that the TTA tanks are not overfilled from these sources.

The TTA tank pressure is continuously monitored to ensure that the tanks are maintained within a pressure range of -2.0 in. to +0.1 in. WC. Through an automated system of fans and control dampers the RCS is responsible for maintaining the TTA tank pressure boundaries.

The radon concentration in each TTA tank is also continuously monitored. Again, through an automated system of fans and control dampers the RCS is responsible for directing its adequate volume of ventilation air through each TTA tank to maintain tank conditions within an acceptable range of radon concentrations.

Table 2-7 – Alarm Conditions for TTA Tanks

ALARM	FUNCTION	SET-POINT	RANGE
High level	Notifies operator that tank volume is nearing capacity	75%	0–100%
High-high level	Shuts down pumps feeding the tank to prevent overfilling.	90%	0–100%
Low level	Notifies operator that tank level is low.	25%	0–100%
Low-low level	Terminates the operation of pump within the low level tank to protect pumps from damage.	5%	0–100%
High pressure	Notifies operator that internal tank pressure is nearing design pressure.	0.1 in. WC	0–5 in. WC
High-high pressure	Shuts down all pumps and airflows into the TTA tanks.	2 in. WC	0–5 in. WC
Low pressure	Notifies operator that internal tank pressure is nearing the vacuum relief device set point.	- 2 in. WC	0–5 in. WC
Low-low pressure	Notifies operator of potential vacuum relief device failure and need for immediate action to protect tank integrity.	- 3 in. WC	0– -5 in. WC
High radon	Notifies operator of current radon levels inside the TTA tanks.	250,000 pCi/L	0–1E6 pCi/L

2.4.2 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 ft long, 152 ft wide, and approximately 40 ft tall with concrete walls for radiation shielding. Sealing the concrete floor and the walls to a level 8 ft above the floor provides secondary containment. This containment is equivalent to 100 percent of the volume that liquid from one 750,000-gal tank would occupy.

The enclosure floor is sloped to a central sump to facilitate detecting leaks and removing spills from each of the four tanks. The foundation sump under each tank collects leakage that may occur through or around the tank bottoms. The four-tank foundation sumps gravity-drain to the central sump through piping embedded in the tank foundation pads.

The central sump is provided with a level instrumentation system and a submersible sump pump. The level instrumentation system continuously monitors the level in the sump and controls the operation of the sump pump. The sump level control system will initiate an alarm on high level and automatically initiate the operation of the sump pump. The sump pump discharge system is designed to pump liquids to

any of the four TTA tanks at the operator's discretion. The sump level control system will terminate the operation of the sump pump on low level in the sump. Access to the sump pump is through an opening in the diverter valve containment area located on the equipment deck above the main sump. The central sump and the exposed drain lines are under continuous video surveillance. The video camera system provides a view of all four tank sump drain lines, thus allowing visual identification of leaking tanks.

2.4.3 Equipment Deck Enclosure

The Equipment Deck Enclosure is a pre-engineered metal building constructed over the equipment deck to protect the TTA equipment from the elements. The equipment deck also provides run-off management. Rain and melting snow are directed into the storm water drainage system. The deck enclosure is insulated and provided with heaters to maintain a target temperature of 55°F during cold months. Louvers and vents provide natural ventilation.

Personnel typically occupy the equipment deck area only when lines have been flushed and the transfer systems have been shut down 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.

3.0 RCS PROCESS CONTROL SYSTEM

The RCS is a treatment system that uses air conditioning, dehumidification, activated carbon, and high-efficiency particulate air (HEPA) filtration to provide Best Available Technology for control of radon emissions and other radionuclides to the environment. The RCS is designed to provide adequate treatment capacity during the following phases of the AWR project:

- Phase 1 Radon Control in the Silo Headspaces to Support Construction Activities
- Phase 2 Radon Control during SWRS Activities
- Phase 3 Radon Control during SWRS TWRS and Silos 1 and 2 treatment concurrent activities

3.1 PHASE 1

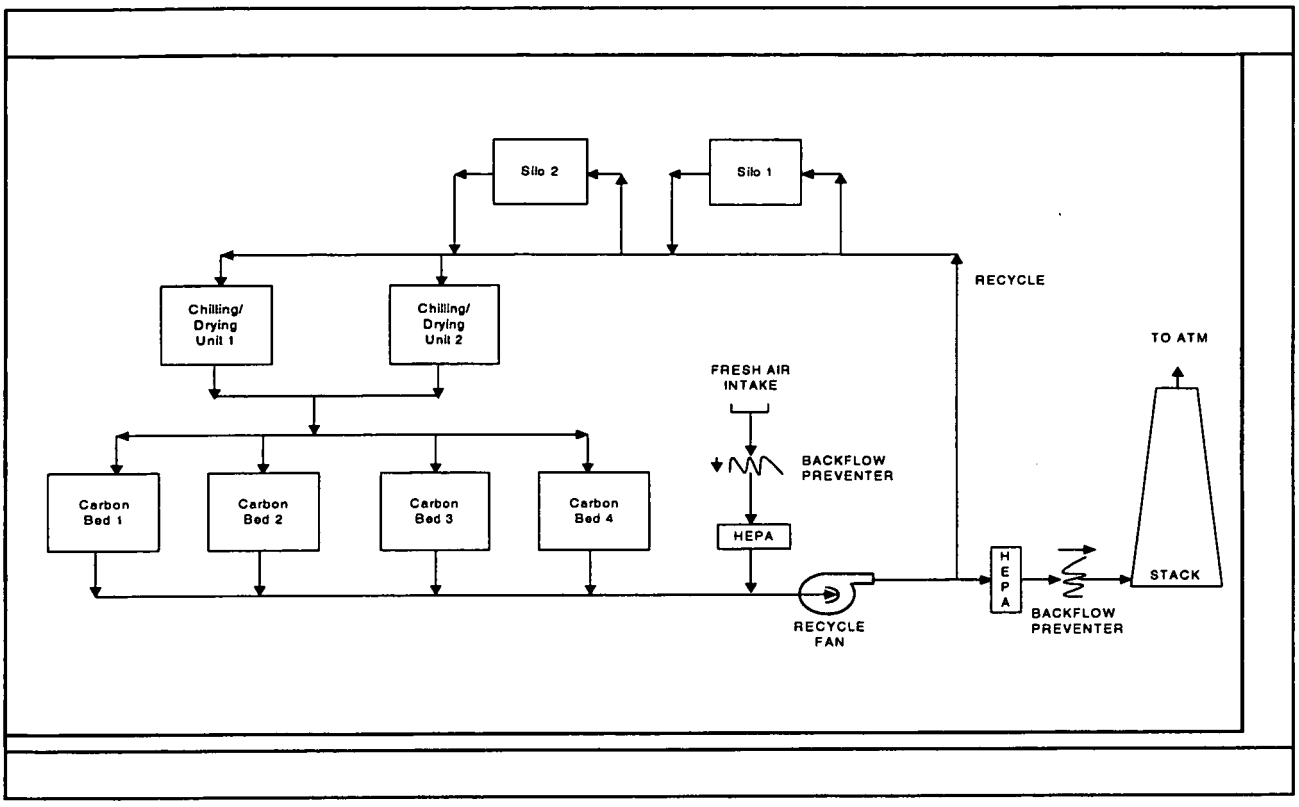
During Phase 1 ventilation air is withdrawn from Silos 1 and 2 and transferred to the RCS for treatment. Figure 3-1 depicts a simplified process flow diagram for RCS Phase 1 operations. The treated ventilation air is returned to the silos for sweep ventilation purposes. The desired pressure conditions are maintained by using an automatically controlled fan and damper system. The RCS will operate in this scheme as necessary to maintain radiation levels in the vicinity of the Silos at levels that will allow safe access for work activities in the silo area. A summary of the RCS Phase 1control functions is presented in Table 3-1.

3.1.1 Pressure Control in Silos 1 and 2 Headspace

The design flow rate for the ventilation of Silos 1 and 2 is based upon exhausting up to 500 cfm from each silo for Phase 1 operations. The design also includes the flexibility to reduce or increase flow from one silo for a short period of time to modify the amount of air exhausted from the other silo in service. This capability may be used during silo penetration activities or during maintenance activities.

The RCS control system is designed to maintain silo pressures between −2 and +.5" WC utilizing a "target operating range" of -2 in. WC to +0.1 in. WC. Pressure conditions outside this target operating range are considered out-of-parameter conditions. The silos are protected from out-of-parameter pressure conditions by two methods: (1) the RCS control system automatically controls the master/slave operation of the supply and suction damper system on each silo along with automatic control of the recirculation fans' operating speed and (2) the silos are provided with a mechanical pressure relief system designed to mitigate emergency over- or under pressurization conditions. These two methods are discussed in further detail below.

Figure 3-1



Positive pressures exceeding +0.1 in. WC design range result in the following actions:

- The silos are automatically isolated from the recirculation fans when the silo pressure reaches +0.1 in. WC.
- The RCS control system automatically terminates the operation of the recirculation fans when the silo pressure reaches +0.2 in. WC.
- Silo pressure relief valves (two on each silo) 12 in. in diameter automatically open when silo pressure reaches + 2 in. WC and automatically reseat when the pressure falls below the set point.
- Negative pressures less than −2 in. WC result in the following:

- Silo pressure relief valves (two on each silo) 12 in. in diameter automatically open when silo pressure reaches −2 in. WC and automatically reseat when the pressure rises above the set point.

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

Under normal operating pressure conditions (range approximately equal to 0 to −1 in. WC), flow from the silos through the silo exhaust damper will be monitored against the desired setpoint for the flow transmitter. The silo supply damper will be set to a percentage of the setpoint flow through the silo exhaust damper. The exhaust stack and make-up air dampers will operate to provide a constant flow to the silos by maintaining a setpoint pressure in the 12-in. fan exhaust header. The setpoint pressure for the header will be influenced based upon the selected flow rate being exhausted from the silos. The pressure differential transmitter will measure the pressure in the exhaust header and will control the make-up air and exhaust dampers to maintain required header pressure. If the exhaust air header pressure reaches the high setpoint, the exhaust stack damper will automatically begin to open to alleviate this condition. When the transmitter detects the low setpoint, the make-up air damper will automatically start to open to allow more air to flow into the RCS to maintain the desired pressure in the exhaust air header.

The flow characteristics for the silo's supply damper at different blade positions (percentage open/closed) will be developed and input into the PLC. This offset flow control method will ensure that the exhaust flow rate from the silos will be greater than the supply flow rate, which will maintain a negative pressure within the silos. Offset flow control will be overridden in the event of pressures outside the operating range, either high or low. If the pressure exceeds the high setpoint or low setpoint for normal operating pressure range, associated opposed blade dampers for silo supply and silo exhaust will be controlled by the silo pressure differential transmitter control loop.

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

When a positive pressure (> 0 in.) is detected in the silo, the silo supply damper will begin to close immediately. If unrelieved pressure outside the operating range remains after complete closure of the silo supply damper, the silo exhaust damper will open until the operating range is recovered. If the pressure reaches or exceeds the high-high setpoint for the pressure differential transmitter (0.20 in. WC), bypass dampers associated with the silo (dependent upon phase of operation) will open fully to aid in pressure relief. With the closing of the silo supply damper, back pressure will elevate the pressure in the fan exhaust air header and will be detected by the pressure differential transmitter, which will open the exhaust stack damper to relieve pressure. This is the same operation as outlined

above for maintaining a constant exhaust air header pressure.

The RCS will be automatically shut down if the pressure inside the silo exceeds 0.2 in. WC In the event of a shutdown of the RCS opposed blade-modulating dampers for silo exhaust and exhaust stack will receive a signal from the PLC to open to 100 percent to allow for diffusion through the RCS to the stack. The make-up air damper and the silo supply damper will receive a signal to close upon system shutdown.

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

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

3.1.2 Radon Control in the Silo Headspace

The objective of RCS Phase 1 is to reduce radon concentration levels inside the silo headspaces to levels that allow safe access to the area immediately around the silos for AWR work activities. At the initiation of Phase 1 operations, ventilation air is passed through Silos 1 and 2 and transferred to the RCS for treatment. The majority of the treated air is then recycled from the RCS back through to the silos to provide continuous headspace ventilation. The primary mode of operation during Phase 1 is based upon ventilating each silo at a rate of 500 scfm; however, the ducting design provides the operator with the flexibility to modify the flow to each silo based upon field conditions. For example, work activities intimately involving Silo 1 may require that the flow be increased to Silo 1 and decreased from Silo 2.

During Phase 1, the RCS suction lines from Silos 1 and 2 will be flexible hoses routed over the berm with a low-point condensate trap. This trap is equipped with a level alarm to notify operations personnel of excess water in the trap. Excess condensate is collected in a container and characterized for discharge to the Advanced Wastewater Treatment facility. A ventilation stream from each silo through an existing opening in the silo risers is exhausted through manual dampers into 6-in. flexible hoses. These hoses connect to two dampers that feed a 12-in. main duct header to the RCS. Upon entering the building, the air is treated through two process trains. After the air is treated, it flows to a 12-in. duct header that supplies the silos. This duct header connects to two dampers that feed back to the flexible hoses routed over the berm, which connect to the silos by manual dampers.

Table 3-1 – RCS Phase I - Control Functions

ALARM	FUNCTION	SET-POINT	RANGE
Low pressure in the silos	Notifies operations of low-pressure condition in the silos. System automatically aligns dampers to pull more air into the silos.	-1 in. WC	0 to –20 inches WC
Low-Low pressure in the silos	Notifies operations of low-pressure condition in the silos. System automatically terminates fan operation and relief valves automatically open.	-2 in. WC	0 to –20 inches WC
High pressure in the silos	Notifies operations of high-pressure condition in the silos. System automatically aligns dampers to pull more air from the silos	+0.1 in. WC	0 to +20 inches WC
High-High pressure in the silos	Notifies operations of high-high pressure condition in the silos. System automatically terminates fan operation	+0.2 in. WC	0 to +20 inches WC
High-High-High pressure in the silos	Notifies operations of high-high pressure condition in the silos. Relief valves open.	+2 in. WC	0 to +20 in. WC
High flow to dehumidification system	Notifies operations of high-flow conditions in drying system. Automatic damping system acts to reduce system flow.	1,000 scfm	0 to 3,000 scfm
Low flow to dehumidification system.	Notifies operations of high-flow conditions in dehumidification system. Automatic damping system acts to increase system flow.	500 scfm	0 to 3,000 scfm
High flow to carbon system.	Notifies operations of high-flow conditions in carbon system. Automatic damping system acts to reduce system flow.	1,000 scfm	0 to 3,000 scfm
High flow to stack from carbon beds	Notifies operations of high-flow conditions to stack. Automatic damping system acts to reduce system flow.	200 scfm	0 to 3,000 scfm
High humidity to carbon beds	Alerts operation to take corrective action.	20% RH	0 to 100% RH
High-High humidity to carbon beds	Initates and alarm and terminates the operation of the recirculation fans.	30% RH	0 to 100% RH
High temperature to carbon beds	Alerts operation to take corrective action.	42°F	0 to 100°F

Table 3-1 – RCS Phase I - Control Functions (Cont'd)

ALARM	FUNCTION	SET-POINT	RANGE
High-High temperature to carbon beds	Alarms and terminates the operation of the recirculation fans.	50°F	0 to 100°F
High radon concentration in silos	Alerts operations to take corrective action	250,000 pCi /L	0 to 1,000,000 pCi/L
High radon concentration in working areas	Alerts operations to take corrective action.	30 pCi /L	0 to 1,000 pCi/L
High flow from stack to atmosphere	Notifies operations of high-flow conditions to stack. Automatic damping system acts to reduce system flow.	10,200 scfm	0 to 20,000 scfm
High radon discharge from stack	System automatically places radon system in recycle low discharge mode.	5,000 pCi /L	0 to 100,000 pCi/L
High-High radon discharge from stack	System automatically terminates RCS fans and discontinues stack discharge.	6,000 pCi /L	0 to 100,000 pCi/L

3.2 PHASE 2 RADON CONTROL DURING SWRS

When hydraulic mining activities begin in the silos, the RCS moves from Phase 1 to Phase 2. During this phase, recirculation air to the silos is discontinued and the ventilation air is pulled into the silos through the three enclosures located on the bridge structures. Figure 3-2 depicts a simplified process flow diagram for Phase 2. The capability to shut off the enclosure louver intakes and place the silo in recirculation mode is still available if needed. While hydraulic mining activities occur, recirculation is not used and all air from the silos is exhausted through the stack except during system upsets. A summary of the RCS Phase 2 control functions is presented in Table 3-2.

The design also includes the flexibility to discontinue flow from one silo for a short period of time to increase the amount of air exhausted from the other silo in service.

In Phase 2, the TTA is connected into the RCS. The flow to the various major TTA components is controlled individually at each component. Air is drawn into the TTA through a single manifold and distributed to the transfer tanks by modulating dampers. The TTA tanks are equipped with pressure/vacuum control valves to let air into the tanks at the vacuum setpoint or to remove air at the pressure setpoint. Flow to and from the TTA tanks is controlled using the same methods as those described for the silos.

Before mining starts, the connections of the rigid ductwork on the bridge to the silo and to the duct header on the pipe rack are connected. To begin Phase 2 operations, airflow is

established through the ductwork on the bridge. The dampers associated with Phase 2 operations are opened and the dampers associated with Phase 1 operation are closed. Once airflow is established through the ductwork on the bridge, the flexible hoses associated with Phase 1 operations are disconnected and removed. A blind flange will be installed over the opening associated with the hose removal to provide additional sealing at the start of Phase 2. At operations, the damper in the supply air duct to the silos begins closing upon opening of the automatic dampers on the equipment enclosures. Inlet air for the silos is generally provided directly through the three enclosures above each silo.

Each enclosure is served by a secondary containment that is attached to the silo penetration by a seal arrangement that avoids placing any load on the silo dome. Each of the three enclosures has an air inlet equipped with a roughing filter, HEPA filter, automatic damper, and flow meter. Access to the enclosures is through air-locked doors that limit additional flow during entry and exit. Flexible seals are used to minimize the free space around equipment passing through the enclosure opening into the silo below. See Table 3-2 for a control summary.

3.3 RADON CONTROL DURING STORAGE

According to the current project schedule, operation of the Silos 1 and 2 Remediation Facility will be initiated prior to completion of Silo Waste Retrieval. Operation of the RCS support concurrent operation is discussed under Phase 3 Operations. If, however, operation of the Silos 1 and 2 Remediation Facility has not yet commenced, when waste retrieval is completed the operation of the RCS moves from Phase 2 to storage phase. During this phase, the RCS ventilates various TTA components as required at a ventilation rate of up to 1000 scfm. Airflow during this phase is controlled using the same methods as those described for Phase 1 and Phase 2.

The RCS has the flexibility to recycle treated air back through the TTA manifold or exhaust it through the stack. During the interim waste storage period, the TTA waste storage tanks are provided a 2-ft layer of water on top of the material for attenuating the release of radon to the TTA headspace. See Table 3-3 for an Interim Storage control summary.

Figure 3-2

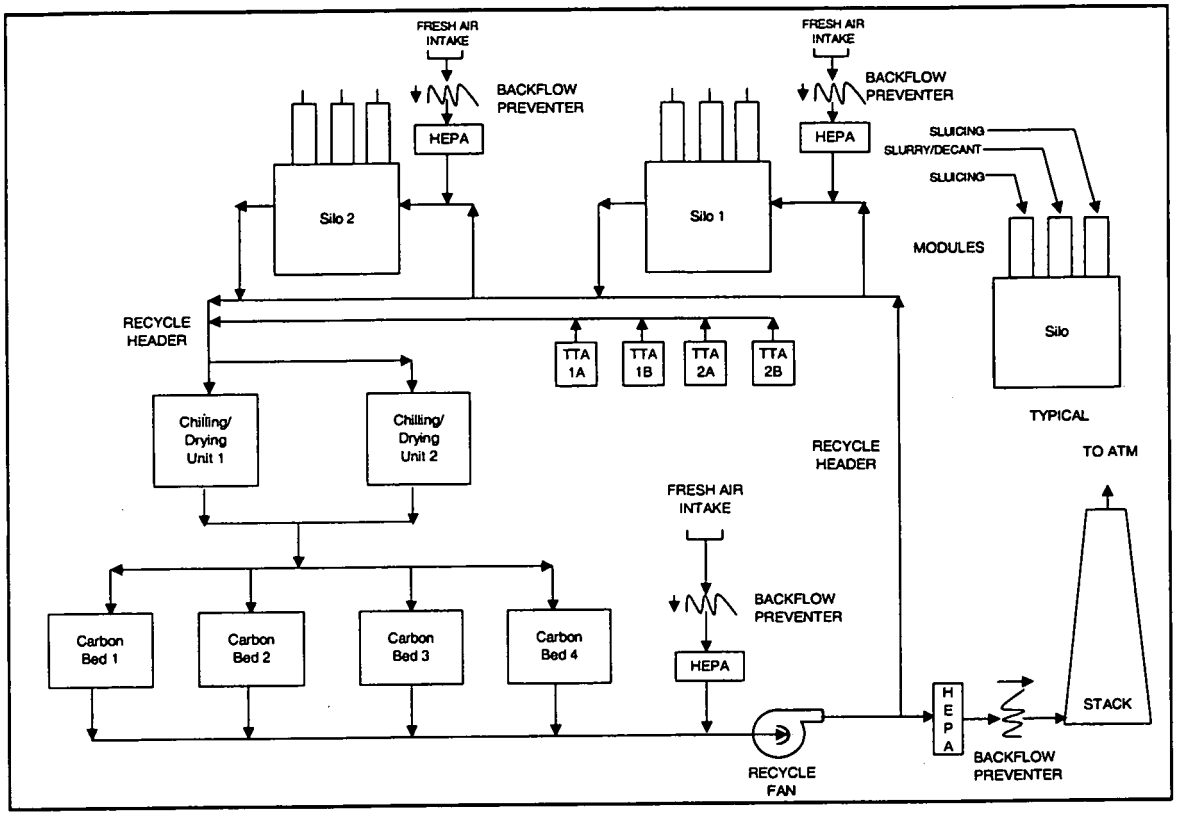

FRESH AIR INTAKE
BACKFLOW PREVENTER
HEPA
Silo 2
FRESH AIR INTAKE
BACKFLOW PREVENTER
HEPA
Silo 1
SLUICING
SLURRY/DECANT
SLUICING
MODULES
Silo
TYPICAL
RECYCLE HEADER
TTA 1A
TTA 1B
TTA 2A
TTA 2B
Chilling/ Drying Unit 1
Chilling/ Drying Unit 2
RECYCLE HEADER
TO ATM
FRESH AIR INTAKE
BACKFLOW PREVENTER
HEPA
Carbon Bed 1
Carbon Bed 2
Carbon Bed 3
Carbon Bed 4
H E P A
STACK
RECYCLE FAN
BACKFLOW PREVENTER

Table 3-2 – RCS Phase 2 Control Functions

ALARM	FUNCTION	SET-POINT	RANGE
Low pressure in the silos/TTA tanks	Notifies operations of low-pressure condition in the silos. System automatically aligns dampers to pull more air into the silos/TTA tanks.	-1 in. WC	0 to –20 in. WC
Low-low pressure in the silos/TTA tanks	Notifies operations of low- pressure condition in the silos/TTA tanks. System automatically terminates fan operation and relief valves.	-2 in. WC	0 to –20 in. WC
High pressure in the silos/TTA tanks	Notifies operations of high- pressure condition in the silos/TTA tanks. System automatically aligns dampers to pull more air from the silos/TTA tanks.	+0.1 in. WC	0 to +20 in. WC
High-high pressure in the silos/TTA tanks	Notifies operations of high-high pressure condition in the silos/TTA tanks. System automatically terminates fan operation.	+0.2 in. WC	0 to +20 in. WC
High-high-high pressure in the silos/TTA tanks	Notifies operations of high-high pressure condition in the silos. Relief valves open.	+2 in. WC	0 to +20 in. WC
High flow to dehumidification system	Notifies operations of high-flow conditions in drying system. Automatic damping system acts to reduce system flow.	1,000 scfm	0 to 3,000 scfm
Low flow to dehumidification system	Notifies operations of high-flow conditions in dehumidification system. Automatic damping system acts to increase system flow.	500 scfm	0 to 3,000 scfm
High flow to carbon system	Notifies operations of high-flow conditions in carbon system. Automatic damping system acts to reduce system flow.	1,000 scfm	0 to 3,000 scfm
High flow to stack from carbon beds	Notifies operations of high-flow conditions to stack. Automatic damping system acts to reduce system flow.	1,000 scfm	0 to 3,000 scfm
High humidity to carbon beds	Alerts operation to take corrective action.	20% RH	0 to 100% RH
High-high humidity to carbon beds	Alarms and terminates the operation of the recirculation fans.	30% RH	0 to 100% RH
High temperature to carbon beds	Alerts operation to take corrective action.	42°F	0 to 100°F
High-high temperature to carbon beds	Alarms and terminates the operation of the recirculation fans.	50°F	0 to 100°F
High radon concentration in silos	Alerts operations to take corrective action.	250,000 pCi/L	0 to 1,000,000 pCi/L

Table 3-2 – RCS Phase 2 Control Functions (Cont'd)

LARM	FUNCTION	SET-POINT	RANGE
High radon concentration in TTA tanks	Alerts operations to take corrective action.	250,000 pCi/L	0 to 1,000,000 pCi/L
High radon concentration in working areas	Alerts operations to take corrective action.	30 pCi/L	0 to 1,000 pCi/L
High flow from stack to atmosphere.	Notifies operations of high-flow conditions to stack. Automatic damping system acts to reduce system flow.	1,000 scfm	0 to 20,000 scfm
High radon discharge from stack	System automatically places radon system in recycle low discharge mode.	5,000 pCi/L	0 to 100,000 pCi/L
High-High radon discharge from stack	System automatically terminates RCS fans and discontinues stack discharge.	6,000 pCi/L	0 to 100,000 pCi/L

Table 3-3 – RCS Storage Control Functions

ALARM	FUNCTION	SET-POINT	RANGE
Low pressure in the TTA tanks	Notifies operations of low-pressure condition in the TTA tanks. System automatically aligns dampers to pull more air into the TTA tanks.	-1 in. WC	0 to –20 in. WC
Low-low pressure in the silos TTA tanks	Notifies operations of low- pressure condition in the TTA tanks. System automatically terminates fan operation and relief valves automatically.	-2 in. WC	0 to –20 in. WC
High pressure in the TTA tanks	Notifies operations of high- pressure condition in the TTA tanks. System automatically aligns dampers to pull more air from the TTA tanks.	+0.1 in. WC	0 to +20 in. WC
High-high pressure in the TTA tanks	Notifies operations of high-high pressure condition in the TTA tanks. System automatically terminates fan operation.	+0.2 in. WC	0 to +20 in. WC
High-high-high pressure in the TTA tanks	Notifies operations of high-high pressure condition in the silos. Relief valves open.	+2 in. WC	0 to +20 in. WC
High flow to dehumidification system	Notifies operations of high-flow conditions in drying system. Automatic damping system acts to reduce system flow.	1,000 scfm	0 to 3,000 scfm
Low flow to dehumidification system	Notifies operations of high-flow conditions in dehumidification system. Automatic damping system acts to increase system flow.	500 scfm	0 to 3,000 scfm

Table 3-3 – RCS Storage Control Functions (Cont'd)

ALARM	FUNCTION	SET-POINT	RANGE
High flow to carbon system	Notifies operations of high-flow conditions in carbon system. Automatic damping system acts to reduce system flow.	1,000 scfm	0 to 3,000 scfm
High flow to stack from carbon beds	Notifies operations of high-flow conditions to stack. Automatic damping system acts to reduce system flow.	200 scfm	0 to 3,000 scfm
High humidity to carbon beds	Alerts operation to take corrective action.	20% RH	0 to 100% RH
High-high humidity to carbon beds	Initiates an alarm and terminates the operation of the recirculation fans	30% RH	0 to 100% RH
High temperature to carbon beds	Alerts operation to take corrective action.	42°F	0 to 100°F
High-high temperature to carbon beds	Alarms and terminates the operation of the recirculation fans.	50°F	0 to 100°F
High radon concentration in TTA tanks	Alerts operations to take corrective action.	250,000 pCi/L	0 to 1,000,000 pCi/L
High radon concentration in working areas	Alerts operations to take corrective action.	30 pCi/L	0 to 1,000 pCi/L
High flow from stack to atmosphere	Notifies operations of high-flow conditions to stack. Automatic damping system acts to reduce system flow.	10,200 scfm	0 to 20,000 scfm
High radon discharge from stack	System automatically places radon system in recycle low discharge mode.	5,000 pCi/L	0 to 100,000pCi/L
High-High radon discharge from stack	System automatically terminates RCS fans and discontinues stack discharge.	6,000 pCi/L	0 to 100,000 pCi/L

3.4 PHASE 3 RADON CONTROL DURING FULL-SCALE REMEDIATION

During Phase 3, the RCS can accommodate a design airflow rate of up to 1,500 CFM from the future full-scale treatment facility and its support facilities. In addition, the design supports an airflow rate of up to 500 CFM from the TTA tanks and SWRS activities. Dampers would again control the balance between these two inputs. Phase 3 is controlled in the same manner as Phase 2, which is discussed in Section 3.2.

3.5 PROCESS CONTROL OF CARBON BEDS

The carbon adsorption system consists of four insulated carbon steel vessels, approximately 16 ft X 11 ft X 11 ft, which contains a total of 160,000 lbs of carbon (40,000 lb/vessel). A 12-in. blind flanged tee and an isolation damper are provided in the ducting system upstream of the carbon beds to allow future expansion of the four-bed

system. The isolation damper is provided to minimize the operational impact of adding carbon beds to the system. Each carbon adsorption vessel is capable of treating up to 500 CFM. Each carbon bed is physically isolated in an individual room.

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

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

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

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

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

In the event a carbon bed needs to be dried to regain carbon bed performance, the RCS has the capability to isolate the individual bed from the others. A take-off stream ranging between 125 and 250 CFM from recirculation is passed through the affected carbon beds by using an induced draft fan. From this fan the drying air stream is transferred to the RCS for treatment in the carbon beds that remain on line or, if the bed has decayed adequately, the capability exists to discharge the drying stream directly through the HEPA filters to the stack.

3.6 EMISSION CONTROL

The treated gas stream flows from the carbon adsorption units to the HEPA filtration units.

Filter housings for the HEPA filters are stainless steel, side access, "bag-in/bag-out" type housings with in-place test sections. The HEPA filtration system uses bag-in and bag-out features to minimize the potential of releases during filter changes. The HEPA filters are designed to pass 1,000 scfm with a 1-in. WC pressure loss. Air from the carbon beds, makeup air, and fan recycle combine before entering the HEPA filters. Differential pressure transmitters monitor differential pressure across each filter. Alarms are annunciated if the low setpoint or high setpoints are exceeded when filter is in service.

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

This configuration allows the flow path of the air to:

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

Quantities of makeup air, fan-recycle air, and stack exhaust are to be based upon maintaining the proper static pressure conditions across the fan to maintain the desired flow path. After exiting the HEPA filters, treated air enters the recirculation fan for redistribution to the silos, TTA tanks, or exhaust through the monitored stack.

Air returned to the silos or the TTA is sent through a duct located on the pipe rack that branches to each of the areas and further branches to the individual silo and tank sources to supply air to each one. The distribution of air being exhausted versus the amount of air being recirculated is controlled by using modulating dampers LVR-20-016, LVR-20-015, and LVR-20-020, which are controlled based upon pressure in the fan discharge line. The pressure in the fan discharge line is affected by the pressure in the silos and TTA tanks, each of which has modulating dampers on their inlets and outlets for pressure and flow control to each vessel.

The carbon steel stack (STK-20-001) is 150 ft high and is approximately 6 ft 4 in. in diameter at the base. The stack tapers to approximately 3 feet at the top. The design flow through the stack during Phase 1 is 12,000 CFM; however, the stack and monitoring systems are designed to accommodate expansion of flow to 13,000 CFM in Phase 3. The stack has connections for a 12-in. RCS process duct and a 34-in. RCS building ventilation duct. The stack is provided with an isokinetic sampling system and a continuous radon

monitor. The isokinetic samples are continuously monitored for radioactivity. Out of parameter conditions detected by the stack monitoring system result in mitigating actions by the RCS control system. These mitigating actions include:

1. Automatic reconfiguration of the RCS ducting system from the discharge mode to the recycle mode during system upsets;

2. Annunciation of an alarm system designed to automatically notify a pre-selected sequence of both on-site and off-site Fernald personnel of upset conditions; and

3. Automatically terminate RCS operations if mitigating action No. 1 has not mitigated the out-of-parameter condition within an acceptable time period.

3- SAMPLING PLAN

-4448

SAMPLING PLAN

FOR THE

SILOS 1 AND 2 ACCELERATED WASTE RETRIEVAL (AWR) PROJECT

August 2002

-4448

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APPENDICES

APPENDIX A	Radiological Criteria for Transfer of Wastewater from the Accelerated Waste Retrieval (AWR) Project to the Advanced Wastewater Treatment (AWWT) Facility
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APPENDIX D	Typical Analytical Methods for Air Emissions Analyses
APPENDIX E	Radon Control System (RCS) Stack Sampling Guideline

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ACRONYM LIST

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ALARA	as low as reasonably achievable
ANSI	American National Standards Institute
ASL	analytical support level
AWR	Accelerated Waste Retrieval
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
FAT&LC	Fernald Atomic Trades & Labor Council
FEMP	Fernald Environmental Management Project
Fluor Fernald	Fluor Fernald, Inc.
FWENC	Foster Wheeler Environmental Corporation
gpd	gallons per day
gpm	gallons per minute
HASL	Health and Safety Laboratory
HASP	Health and Safety Plan
kg/day	kilograms per day
lb/day	pounds per day
LCS	Laboratory Control Sample
MeV	million electronvolts
MSCC	Material Segregation and Containerization Criteria
MS/MSD	Matrix Spike/Matrix Spike Duplicate
NPDES	National Pollutant Discharge Elimination System
OAC	Ohio Administrative Code
pCi/L	picocuries per liter
PM	Project Manager
ppm	parts per million
PWID	Project Waste Identification and Disposition
QA	quality assurance
QA/QC	quality assurance/quality control
QC	quality control
RCS	Radon Control System
SOP	Standard Operating Procedure
TEDE	total effective dose equivalent
TRD	Technical Requirements Document
TSS	total suspended solids
TTA	Transfer Tank Area
WAC	waste acceptance criteria
WL	working levels

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1.0 INTRODUCTION

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

1.1 Background

The source of contamination for the AWR Project is the residues 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, contained in Silos 1 and 2 and the wastewater from the Decant Sump Tank. Accumulated concentration of radon gas in the silo headspaces is reduced through the operation of the Radon Control System (RCS). This system will generate a condensate requiring discharge to the FEMP's Advanced Wastewater Treatment (AWWT) facility.

The Silos 1 and 2 material 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 Sampling Plan. (Note: Wastewater from the Decant Sump Tank will be transferred to the TTA and managed from that point similar to the filtrate. Any excess wastewater generated by AWR waste retrieval operations will be transferred to the Silos 1 and 2 Remediation Facility for utilization in the treatment process. Therefore, the only wastewater to be sent to the AWWT facility from the AWR Project will come from either the RCS condensate tanks or, if the volume of excess wastewater exceeds the needs of the Silos 1 and 2 Remediation facility, from the TTA filtrate tanks).

1.2 Scope and Purpose of Plan

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

- Ensure that the periodic discharge of excess water from the AWR Project is acceptable for transfer to the AWWT facility; and
- Ensure that the air emissions associated with the AWR Project meet the applicable regulatory and FEMP site standards.

1.3 Organization of Plan

This Sampling Plan and its implementation will comply with the *FEMP Sitewide CERCLA Quality Assurance Project Plan* (FD-1000) and applicable local, state, and federal regulatory requirements.

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

- Appendix A — Radiological Criteria for Transfer of Wastewater from the AWR Project to the AWWT Facility
- Appendix B — Summary of Analytical Procedures, Containers, Preservatives, and Holding Time Requirements for Wastewater Samples;
- Appendix C — Wastewater Sample Collection Guideline;
- Appendix D — Typical and Alternative Analytical Methods for Air Emissions Analyses; and
- Appendix E — RCS Stack Sampling Guideline.

The guidelines presented in the appendices relating to sample collection methods will be used in the development of detailed AWR Project procedures. Detailed sampling procedures will be prepared as part of the operational procedures associated with the RCS and Balance of Plant (BOP) operations. Specifically, the sampling/monitoring associated with the condensate tanks, carbon beds, and exhaust stack will be addressed in the RCS Phase 1 and 2 Standard Operating Procedures (SOPs). The sampling of the filtrate storage tank will be addressed in the SOP's for silo waste retrieval.

2.0 DATA QUALITY OBJECTIVES AND QUALITY CONTROL

This section provides an overview of the DQOs and QC elements associated with the AWR Project sampling and analysis efforts.

2.1 DQOs and Intended Use of Acquired Data

As defined by the U.S. Environmental Protection Agency (EPA), DQOs are qualitative and quantitative statements developed to specify the quality of data from field and laboratory data collection activities needed to support specific decisions. The DQOs describe the required quality 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.*

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2.1.1 Wastewater

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

The radiological criteria for transfer of AWR wastewater to the AWWT facility is provided in Appendix A of this Sampling Plan. In addition, several other water quality parameters are to be monitored as identified in Appendix B.

2.1.2 Air Emissions

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

The continuous air monitoring systems, as later described in Sections 3 and 4 of this Sampling Plan, are used to assess RCS operations and process control, as well as to signal the need for corrective actions to prevent onsite or public exposures from air emissions exceeding established limits. These monitoring systems will have alarms that are preset to provide timely warnings to AWR Project operations staff. In addition, the ratio between the radon concentrations measured by the monitors upstream and downstream of the carbon beds 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 the same sense, if the radon concentrations do not exceed the preset alarm level for the stack monitors, then the RCS is functioning within limits and no mitigative actions are required. If the preset stack alarm levels are exceeded, then alarms will sound and indications will be shown on the control panel located in the AWR Project control room, with corresponding mitigation measures and corrective actions implemented accordingly.

In addition to monitoring of the RCS exhaust stack, enhancements have been made to the site-wide Integrated Environmental Monitoring Plan (IEMP) monitoring program to monitor the potential impacts of AWR Project activities. These changes to the IEMP program are addressed in the Silos Project Environmental Monitoring Plan, 40000-PL-0010.

2.2 Elements of Quality Control (QC)

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

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

2.2.1 Laboratory Control Sample (LCS)

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

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

2.2.2 Internal Standards (IS)

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

2.2.3 Method Blank

A method blank is defined as a 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 applicable parameters. The method blank is used to determine the level of laboratory background contamination. Unfavorable method blank results render associated data suspect and require 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 (e.g., water) is fortified, or spiked, with a known concentration of target compounds. The spike solution will consist of the same compounds used for the LCS. The MS/MSD are subjected to the entire analytical procedure in order to indicate both accuracy and precision of the method for the matrix by measuring the percent recovery and the relative percent difference of the two spiked samples. These samples are also used to assess matrix interference effects on the method, as well as to evaluate instrument performance. MS/MSD shall be analyzed for each analytical batch in order to maintain continuous surveillance of acceptable method performance.

2.2.6 Analytical Methods

Analysis of the wastewater and air emissions samples shall comply with methods approved or recognized by the EPA and/or other regulatory agencies. The analytical methods for wastewater and air emissions samples are identified in Appendices B and D, respectively, of this Sampling Plan.

3.0 SAMPLING MEDIA AND SOURCES

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

3.1 Wastewater

Water will be used to hydraulically transport silo residues from the existing silos into the TTA. During this transfer process, water may be added to the sluicing operations or periodically removed. Excess wastewater withdrawn from the sluicing process (via one 7,500-gallon filtrate storage tank) will be transferred the Silos 1 and 2 Remediation facility to be stored for use in the treatment process. Any wastewater from the retrieval process in excess of what can be utilized in the Silos 1 and 2 Remediation facility, and wastewater from the RCS (via two 3,000-gallon condensate tanks) will be eventually transferred to the FEMP AWWT facility.

Two AWR wastewater streams have been identified requiring segregation and transfer to the FEMP AWWT facility, and therefore, requiring characterization. The first wastewater stream is the accumulation of condensate during the operation of the RCS. This condensate is collected in two 3,000-gallon tanks in the RCS Building. The second wastewater stream is excess water from the slurry transfer activities.

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3.1.1 RCS Condensate Tanks

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

3.2 Air Emissions

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

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

3.2.2 Process Monitoring of Radon Concentrations

Carbon bed performance is instrumental in reducing the concentrations of radon in the silo and TTA headspaces, which will reduce emissions of radon to the environment and reduce external exposures to personnel in the immediate area around the silos. 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.

A representative air stream will be diverted through an in-line monitor at one of two locations to measure radon concentrations upstream of the four carbon bed systems. One measurement point is the silo headspace monitors, which will be used in assessing the performance of the

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RCS in the reduction of radon concentrations in the headspaces. The measurement at the second location (after the combination of the silo exhaust, TTA, process, and RCS ducts) serves as a "before" measurement for comparing "before" and "after" concentrations in the assessment of carbon bed performance. A representative air stream must also be diverted through an in-line monitor to measure radon concentrations downstream of the carbon beds. These measurements serve as the "after" concentrations for comparing "before" and "after" concentrations to assess the performance of the carbon beds, and to validate the concentration measured by the exhaust stack radon monitor.

4.0 SAMPLING AND ANALYTICAL METHODS

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

4.1 Wastewater

Both field screening and laboratory analytical methods will be used in determining whether or not wastewater is acceptable for transfer to the AWWT. First, field screening is performed to determine the likelihood of wastewater samples in meeting the radionuclide criteria, and if so determined, will be sent to the laboratory for confirmatory analysis. The laboratory will then perform a two-step confirmation process. The laboratory will first determine if the radionuclide criteria are met. If the radionuclide criteria are met, the lab will conduct the metals and general chemistry analyses. A summary of analytical procedures, containers, preservatives, and holding time requirements for wastewater samples is provided in Appendix B of this Sampling Plan.

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

The design of the AWR Project, more specifically the RCS condensate tanks, includes ports or outlets for the collection of wastewater samples. These ports will be the source of wastewater collected for sampling under this Sampling Plan. Each tank is considered a batch release. Circulation of the condensate tanks is not required since the condensate is free of solids and homogeneous in nature. When one of the tanks is full, the input flow is switched to the other tank. Once analytical results are obtained, and approval is received from AWWT Operations, the tank is transferred as directed.

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

4.1.1 Sample Collection and Field Screening

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For field screening of AWR Project wastewater samples, the samples need to be properly collected (as summarized above and described in the Appendix C guideline) and then analyzed by means of gamma spectroscopy to determine the presence of specific radionuclides, and if present, determine the quantities for each nuclide present. Samples of wastewater (approximately 1 liter or less) will be collected in plastic (or glass) bottles from sampling ports on the RCS condensate tanks and the TTA filtrate storage tank. The outside of the bottles will be cleaned 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. Procedure Ga-01-R of DOE's Environmental Measurements Laboratory (EML) Procedures Manual, HASL-300, will be used for this screening analysis. Gamma spectrum analysis software will be used to estimate the concentration of predominant radionuclides present (e.g., Ra-226, Th-228, etc.). Samples passing the screening analyses should have a high probability of meeting the AWWT criteria.

4.1.2 Radiological Analytical Methods

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

Both typical and alternative analytical methods, or approved equivalents, to be used by the laboratory are presented in Tables 4-1 and 4-2.

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Table 4-1. Typical Analytical Methods for Wastewater Analyses

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

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

Table 4-2. Alternative Analytical Methods for Wastewater Analyses

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

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

4.1.3 Remaining Analytical Methods

Upon confirmation that the analytical data indicates the respective samples meet the AWWT criteria for radionuclides, the laboratory will use the methods prescribed in Table 4-3, or approved equivalents, for the analysis of metals and general chemistry parameters.

Table 4-3. Analytical Methods for Metals and General Chemistry Parameters

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

Notes: [1] *Test Methods for Evaluating Solid Waste Physical/Chemical Methods*, EPA Report Number SW-846 (EPA 1998), specifies test methods and detection limits.

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

4.2 Air Emissions

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

4.2.1 Stack Monitoring

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

The isokinetic sample system consists of the following:

- Sampler head,
- Particulate sampler,
- Sample line,
- Particulate radiation detector,
- Radon detector,
- Sample flow measurement device,
- Sample flow controller,
- Control system,
- Pump, and
- Return line.

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

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

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

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

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

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

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

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

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

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

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

Radon Monitoring

Radon concentrations in the RCS air effluent will be measured in the RCS stack. The type of monitor to be used will be a continuous monitor such as a Pylon CRM-1 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.

A "High" alarm and a "High-High" alarm will be set at the setpoints identified in the Process Control Summary (40710-RP-0020) to ensure notification of elevated concentrations and allow initiation of corrective action as required to maintain specified onsite and fenceline radon concentrations.

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Particulate Monitoring

For particulate monitoring of RCS air effluent, the type of isokinetic sampler to be used in the RCS stack is a Ludlum Model 177-62-1 Beta Monitor, 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 emissions from the particulate material collected.

4.2.2 Radon Process Monitoring

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

The type of monitor to be used downstream of the carbon beds will be a continuous monitor such as a Pylon CRM-1 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. Since this radon process monitoring is real-time in nature and not part of the air emissions monitoring for the RCS stack, it is not specifically addressed by the sampling guideline provided in Appendix E of this Sampling Plan.

5.0 DOCUMENTATION AND RECORDKEEPING

This section provides information regarding the documentation and recordkeeping associated with the sampling efforts for the AWR Project.

5.1 Field Logbook

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

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

5.2 Sample Container Labeling

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

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

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

5.3 Sample Packaging and Shipping

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

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

5.4 Chain-of-Custody (COC)

For samples shipped for analysis, a COC form will be completed by a designated field team member responsible for sample custody and signed off by the receiving laboratory. As a matter of record, a COC will be prepared for samples collected and analyzed onsite and not processed for shipment offsite. Information specified on the COC record will contain the same level of detail as found in the field logbook. COC documentation will be prepared and maintained in accordance with procedure EW-0002, Chain of Custody/Request of Analysis Record for Sample Control.

If samples are known to require rapid turnaround because of project time constraints or analytical concerns (e.g., extraction time or sample retention period limitations, etc.), then the person completing the COC record will note these constraints in the remarks section of the custody record. The relinquishing individual will record shipping data (e.g., air bill number,

organization, time, and date) on the original COC record, which will be transported with the samples to the laboratory and retained in the laboratory's file.

5.5 Records Storage

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

5.6 Analytical Data

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

5.6.1 Wastewater Samples

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

Analytical laboratory audits will be conducted to assess CSL performance. Analytical turn-around times will vary upon request, depending on the specific time requirement for transferring wastewater from the AWR Project facilities to the AWWT. If needed, a 48-hour turn-around time will be requested for analytical results.

5.6.2 Air Emission Samples

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

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

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

6.0 REFERENCES

Table 6-1 provides a list of the applicable FEMP plans and procedures related to this Plan.

Table 6-1. List of Referenced FEMP Plans and Procedures

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

Other references used in the development of this Plan include:

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

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

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

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

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

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

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

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

APPENDICES

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APPENDIX A

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

Parameter	Discharge Limit (pCi/L)[1]
Radionuclide	
Actinium – 227 (Ac-227)	10
Lead – 210 (Pb-210)	30
Polonium – 210 (Po-210)	80
Protactinium – 231 (Pa-231)	10
Radium – 226 (Ra-226)	100
Radium – 228 (Ra-228)	100
Thorium – 228 (Th-228)	400
Thorium – 230 (Th-230)	300
Thorium – 232 (Th-232)	50
Uranium – 234 (U-234)	5 ppm
Uranium – 235/236 (U-235/U-236)	
Uranium – 238 (U-238)	
General Chemistry	
Total suspended solids (TSS)	1,000 ppm

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

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APPENDIX B

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Summary of Analytical Procedures[1], Containers, Preservatives, and Holding Time Requirements for Wastewater Samples

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

Metals				
Parameter	**Analytical Procedure[3]**	**Holding Time**	**Preservative Requirements**	**Number/Type Containers Per Sample**
As	6010B	6-Months	HNO_3 to pH < 2	1-1Liter Plastic or Glass
Ba	6010B	6-Months	HNO_3 to pH < 2	1-1Liter Plastic or Glass[5]
Cd	6010B	6-Months	HNO_3 to pH < 2	1-1Liter Plastic or Glass[5]
Cr	6010B	6-Months	HNO_3 to pH < 2	1-1Liter Plastic or Glass[5]
Fe	6010B	6-Months	HNO_3 to pH < 2	1-1Liter Plastic or Glass[5]
Pb	6010B	6-Months	HNO_3 to pH < 2	1-1Liter Plastic or Glass[5]
Hg	7470A	28-Days	HNO_3 to pH < 2	1-1Liter Plastic or Glass[5]
Se	6010B	6-Months	HNO_3 to pH < 2	1-1Liter Plastic or Glass[5]
Ag	6010B	6-Months	HNO_3 to pH < 2	1-1Liter Plastic or Glass[5]

General Chemistry				
Parameter	**Analytical Procedure[4]**	**Holding Time**	**Preservative Requirements**	**Number/Type Containers Per Sample**
TSS	160.2	7-Days	Cool to 4 °C	1-100 ml Plastic or Glass

Notes:

[1] Other procedures may be utilized consistent with 40 CFR 136.3
[2] Procedures manual of the DOE Environmental Measurements Laboratory (HASL-300)
[3] Standard Methods for the Examination of Water and Wastewater, 14th Edition
[4] Methods for Chemical Analysis of Water and Wastes, EPA-600/4-79-020
[5] Extracted into same sample container as Arsenic.

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APPENDIX C

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Accelerated Waste Retrieval (AWR) Project Sampling and Analysis Guidelines

SUBJECT: WASTEWATER SAMPLE COLLECTION GUIDELINE

I. Scope and Application

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

II. Summary

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

III. Equipment

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

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

IV. Safety

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

V. Procedure Guide

A. RCS Condensate Tanks – Perform the following:

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

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

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

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

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

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

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

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

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

10. Store dedicated purge wastewater container in predetermined location.

11. Characterize and dispose of polyethylene sheeting in accordance with laboratory waste management procedures.

12. Remove area barricades.

13. Process samples per Manual COC Procedures.

VII. Quality Control/Quality Assurance

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

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APPENDIX D

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Typical and Alternative Analytical Methods for Air Emissions Analyses

Typical Analytical Methods for Air Emissions Analyses

Parameter	Analytical Method[1]
Metals	
Pb	7000A[2]
Radionuclide	
Ac – 227	G-01[3], Electrodeposition of Actinides, Mitchell Method
Pb – 210	Pb-01-RC[3], Lead-210 in .....air and water
Ra – 226	Ra-02-RC[3], Radium-226 Emanation Procedure
Th – 230	Th-01-RC[3], Determination of Thorium

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

Alternative Analytical Methods for Air Emissions Analyses

Parameter	Analytical Method[1]
Radionuclide	
Gross alpha	A-01-R[2], Alpha radioassay
Gross beta	Ba-01-R[2], Beta radioassay
Gamma spectrometry	Ga-01-R[2], Gamma radioassay

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

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APPENDIX E

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RADON CONTROL SYSTEM (RCS) STACK SAMPLING GUIDELINE

I. Scope and Application

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

II. Summary

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

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.

III. Equipment

A. Isokinetic sampler;
B. Ludlum Model 177-62-1 Beta Monitor, or equivalent;
C. Filter (pre-weighed); and
D. Flow Rate Recorder.

IV. Safety

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

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V. Procedure Guide

A. RCS Stack – Perform the following:

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

VII. Quality Control/Quality Assurance

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

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4- BERM EXCAVATION PLAN

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BERM EXCAVATION PLAN
ACCELERATED WASTE RETRIEVAL PROJECT

Document No. 40710-PL-0006

May 8, 2002

Revision A

FERNALD
Environmental Management Project

Prepared Under DOE
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ACRONYMS

ALARA	as low as reasonably achievable
AWR	Accelerated Waste Retrieval
BEP	Berm Excavation Plan
D&D	decontamination and demolition
DOE	U.S. Department of Energy
EPA	U.S. Environmental Protection Agency
Fluor Fernald	Fluor Fernald, Inc.
H:V	horizontal to vertical
OEPA	Ohio Environmental Protection Agency
OSDF	Onsite Disposal Facility
SP	stockpile
WAC	waste acceptance criteria
WAO	Waste Acceptance Organization

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 site. This project is located approximately 15 miles northwest of Cincinnati, Ohio, owned by the U.S. Department of Energy (DOE), and managed by Fluor Fernald, Inc. (Fluor Fernald).

This section describes the purpose, scope of work, background, 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. Berm excavation drawings are included in the Appendix.

1.1 PURPOSE

The BEP describes the construction and operational procedures for the excavation and removal of portions of the containment berms associated with the Silos 1 and 2 AWR Project as required to install the Silo Bridge foundations. The BEP emphasizes the excavation methods used to mitigate the impacts on the silos' structural integrity throughout the AWR Project construction and operational activities.

1.2 SCOPE OF WORK

The scope of this BEP addresses only the excavation of portions of the 3:1 horizontal to vertical (H:V) berm surrounding Silos 1 and 2 to allow the Silo Bridge foundation construction and the crane access pad construction. Construction activities include the excavation of berm material for the foundations for the Silo Bridge support structure associated with the removal of waste from the silos. The remainder of the silo berm soils will be left in place until after completion of silo waste retrieval and will be removed as a part of decontamination and demolition (D&D) of the Silos 1 and 2 structures. Excavation and disposition of the remaining berm soil will be addressed in the D&D. A study titled *Evaluation of Berm Height for Silos 1 and 2* dated April 11, 2002, analyzed the silo structural integrity during waste retrieval. This study determined that all of the waste could be removed from within the silos without affecting the structural integrity of the silo walls. The BEP does not include excavation outside of the Silos 1 and 2 areas.

1.3 Background Brief

From 1951 to 1960, DOE produced approximately 6,800 m^3 of K-65 material while processing high-grade uranium ores. Four concrete silos were built to support the uranium process. Silos 1 and 2 store the K-65 material. Silo 3 contains a different type of material and is not in the scope of this project.

Soil berms were placed around Silo 1 and 2 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).

In 1983, the slopes of the berms were revised to incorporate a slope of 3 to 1 (H:V) to mitigate soil erosion.

1.4 RADIOLOGICAL SURVEYS

Existing berm soil sampling data and sampling requirements for berm soil are documented in reference letter number DOE-0455-99, Proposed Phase II Soil Sampling and Analyses within Soil Remediation Area 7. This document, which was approved by U.S. Environmental Protection Agency (EPA) and Ohio Environmental Protection Agency (OEPA), determined that no additional sampling of berm soil is required for waste acceptance criteria (WAC) demonstration. However, to proactively address the potential berm soil contamination from silo leakage, the berm soil and silos will be visually monitored for silo leakage during berm excavation activities as part of the normal, continuous Fluor Fernald Waste Acceptance Organization (WAO) oversight activities.

WAC verification samples will be taken at various points and locations within the berm excavation, beginning with the surface of the berm. These samples will be analyzed for total uranium before beginning excavation in that area. Once analytical results are received, excavation can begin, and the soil can be directly dispositioned to the Onsite Disposal Facility (OSDF) or Stockpile (SP)-7 based upon the analytical results.

If all samples for a specific area yield results below the WAC, the soil from that area will be directly dispositioned to the OSDF. If any of the results exceed the WAC, either the entire area can be excavated and dispositioned to SP-7, or additional physical samples may be taken to further horizontally delineate the area that exceeds WAC before excavation. All of the delineated area that exceeded WAC would then be dispositioned to SP-7, while the remaining portion of the area could be dispositioned to the OSDF.

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

The radiological surveys required for potentially contaminated berm soils will be performed by Health Physics technicians provided by Fluor Fernald. Noncontaminated soil will be loaded into dump trucks and transported to a location designated by Fluor Fernald.

The excavation work performed under the BEP will comply with the requirements of the *Environmental Control Plan* (Document No. 40710-PL-0007). 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.

1.5 GENERAL DESCRIPTION OF EXCAVATION ACTIVITIES

The berm excavation activities will be accomplished in the general manner described in the following paragraphs:

The silo bridge support structures will be located due east and west of each silo. These support structures will require the excavation of berm soils for installation. The area directly adjacent to the silo at the support foundation location will be excavated 3 ft and then sloped at a 1.5:1 (H:V) to a point approximately 15 ft away from the silo. The excavation will be leveled off at this point. Sheet piles will then be driven through the berm material on three sides of the location of the foundation. The berm material will then be removed from within the sheet piles. After the berm soils have been removed from within the sheet piles, the crane access pads will be constructed by performing excavations and fills to the required elevations.

Approximately 7,590 yd^3 of berm soil will be excavated from around Silo 1 and Silo 2. This material must be disposed in an appropriate manner. The crane access pads will require the placement of 1,617 yd^3 of compacted fill imported from off site.

During excavation the primary objectives are (1) to maintain the structural integrity of the silo walls and (2) to maintain as low as reasonably achievable (ALARA) radiation protection for workers.

Excavation equipment includes a Gradall excavator, a small bulldozer, a bucket loader, and a dump truck. The excavator will perform the bulk of the berm removal. Before Phase 1 excavation begins, an Equipment Exclusion Zone will be marked with wooden stakes and flags. The Equipment Exclusion Zone is an area that extends approximately 15 ft from the Silos 1 and 2 walls. No heavy equipment is allowed inside this zone to minimize any impacts of heavy equipment on the silo walls. The Equipment Exclusion Zone for each phase of excavation is shown on Drawings 94X-3900-G-01932 (G6003) and 94X-3900-G-01933 (G6004).

1.6 ENVIRONMENTAL PROTECTION MEASURES

The Contractor shall take all reasonable measures, as described in the contract documents, to protect the environment and the safety of both on-site personnel and the 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.

1.7 MAINTAIN BERM DURING OPERATION

Based on minimizing worker exposure during the Silo Waste Retrieval activities the technical requirement to remove the berm in concert with silo waste retrieval was reviewed. The basis for removing the berm during silo waste retrieval activities was for silo structural integrity. An independent evaluation of the berm loading on the silos during waste retrieval activities was performed and concluded that excavation of the berm material concurrent with silo waste retrieval is not required to protect the silo structural integrity. Therefore, based on this independent evaluation of silo structural integrity and

for ALARA principles, the berm excavation activities during silo waste retrieval activities, have been delayed to the Silo D&D phase.

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 the Appendix.

2.1 GENERAL EXCAVATION ACTIVITIES

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

A heavy-duty erosion mat and seeding will be placed on slopes steeper than 2:1 (H:V) to stabilize the slope and to prevent the formation of rills. 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, to keep open excavation surfaces dry. A crusting agent such as Pine Sap Emulsion will be used for temporary stabilization of exposed cut slopes, as needed.

The existing trench drain and ditch system that currently encloses the Silos 1 and 2 area shall be maintained and used for drainage control during the berm excavation process. Additional stormwater and erosion control information can be seen on the Stormwater Drainage Plan, Doc. No. 40710-PL-0008.

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

2.2 FOUNDATION EXCAVATIONS ADJACENT TO SILOS 1 AND 2

The Contractor shall excavate portions of the berm to construct the foundations required for erection of the Silo Bridge Support Structure foundations [see Drawing 94X-3900-G-01932 (G6003)].

The Silo Bridge Support Structure has two fixed structural foundations per silo to support the structure's weight. Concrete foundations are required for both support structures.

Exclusion zones shall be laid out and flagged in accordance with the drawings. Silt fence will be installed as shown on Drawing 94X-3900-G-01933 (G6004). The Contractor will excavate the berm material to an elevation of 599.0 (3-ft cut) directly adjacent to the silo. A Gradall or similar machine will be used for excavation. The Gradall will reach inside the equipment exclusion zone and remove the silo berm material, excavating as close to the silo wall as possible without damaging the integrity of the silo wall. The excavation will proceed on a 1.5:1 (H:V) to the edge of the Silo Bridge Support Structure foundation and will be leveled off at that elevation. Sheet piling will then be installed to the required depths [see drawing 94X-3900-G-01932 (G6003) for sheet pile locations]. After the sheet piles have been installed the excavation will continue behind

the sheet pile walls until an elevation of 579.0 is reached. The silo bridge foundations will then be formed and installed (See 35H19606-CSK-008 for typical section). This phase will only excavate those berm soils required to install the Silo Bridge foundations.

2.3 CRANE ACCESS EARTHWORK

The crane access earthwork will install the crane access pads and the lay-down area needed to build the silo bridges. The bridges will be built on the ground and then "walked" into place by two cranes located on either side of the silo. The excavation for this phase will consist of removing silo berm material to the south of Silo 1 to construct the bridge lay-down area and to excavate and/or fill two crane access pads [see drawing 94X-3900-G-01933 (G6004)].

The excavation for the lay-down area will begin at an elevation of 599.0 adjacent to the silo and then proceed on a 1.5:1 (H:V) until it reaches the elevation of the lay-down area. The same equipment exclusion zone and berm methodology used for the Silo Bridge Support Structure foundation excavation will apply to the crane access pad and laydown area excavations.

The crane access pads will consist of soil backfill or excavation overlain with a 1-ft layer of stone for drainage. The stone shall be topped with wooden crane mats to provide a level and uniform surface for the crane operation.

During excavation activities, the area will be graded to avoid accumulations of surface water in low areas. Surface runoff will be diverted to the existing surface water collection system.

In addition, a French drain consisting of a trench with a 6-in. perforated pipe surrounded with Ohio Department of Transportation #2 stone will be installed along the inside edge of each crane access pad. This French drain will serve to drain surface runoff and any shallow flow through the silo berm soils. This water will discharge into the existing perimeter silo trench drain system.

APPENDIX

BERM EXCAVATION DRAWINGS

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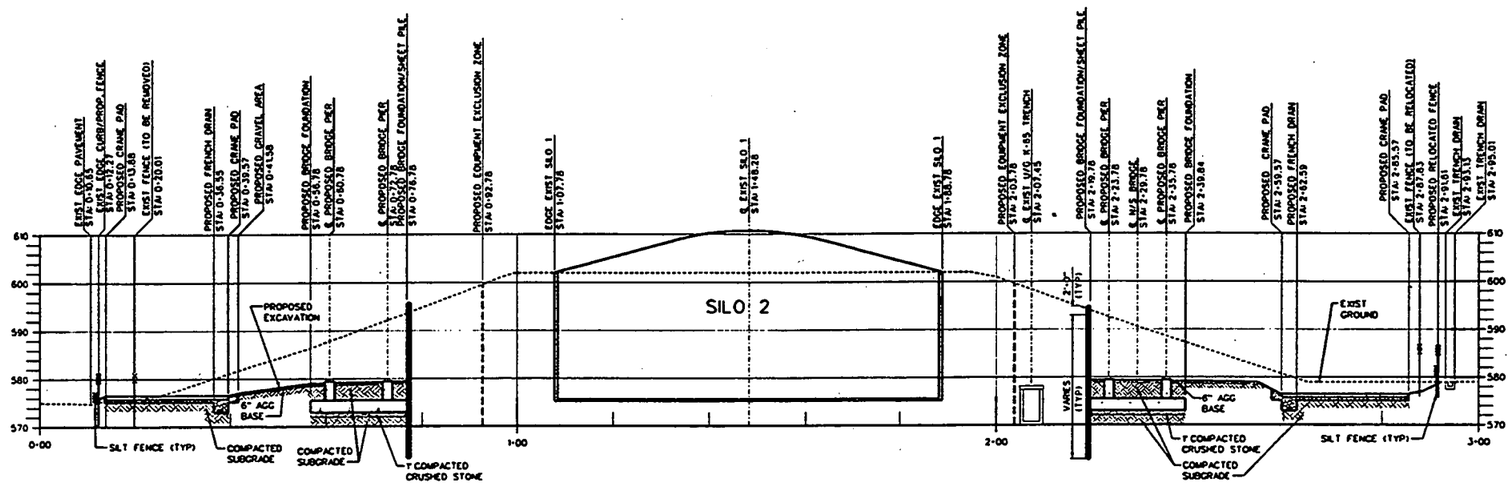

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C	ISSUED FOR REVIEW	8/29/02		
B	ISSUED FOR REVIEW	05/29/02	GM	SH
A	ISSUED FOR REVIEW	05/08/02	GM	SH

INITIALS AND DATE

UNITED STATES
DEPARTMENT OF ENERGY
FERNALD ENVIRONMENTAL MANAGEMENT PROJECT

THIS DRAWING PREPARED BY
JACOBS

PROJECT NAME
AWR OPTIMIZATION

DRAWING TITLE
CIVIL
AWR
TYPICAL CROSS SECTION

DRAWN BY	DATE	TECHNICAL LEAD	DATE	CHECKED BY	DATE
W. MARVIN	05/08/02	F. PARTON	05/08/02	G. MORAR	05/08/02

PLANT/BLDG NO.	FLOOR	SCALE	CLASS
		1" = 10' H&V	U

SUBMITTED FOR 30% ISSUE	SUBMITTED FOR 90% ISSUE	SUBMITTED FOR 90% ISSUE
TECH LEAD	TECH LEAD	TECH LEAD
DATE	DATE	DATE

T.O. NUMBER	PROJECT NO.	DRAWING INDEX CODE NO.	SHEET NO.	REV. NO.
JEG PROJECT NO. 35H19606	FILENAME CSK008.DGN	35H19606-CSK-008	CSK008	C

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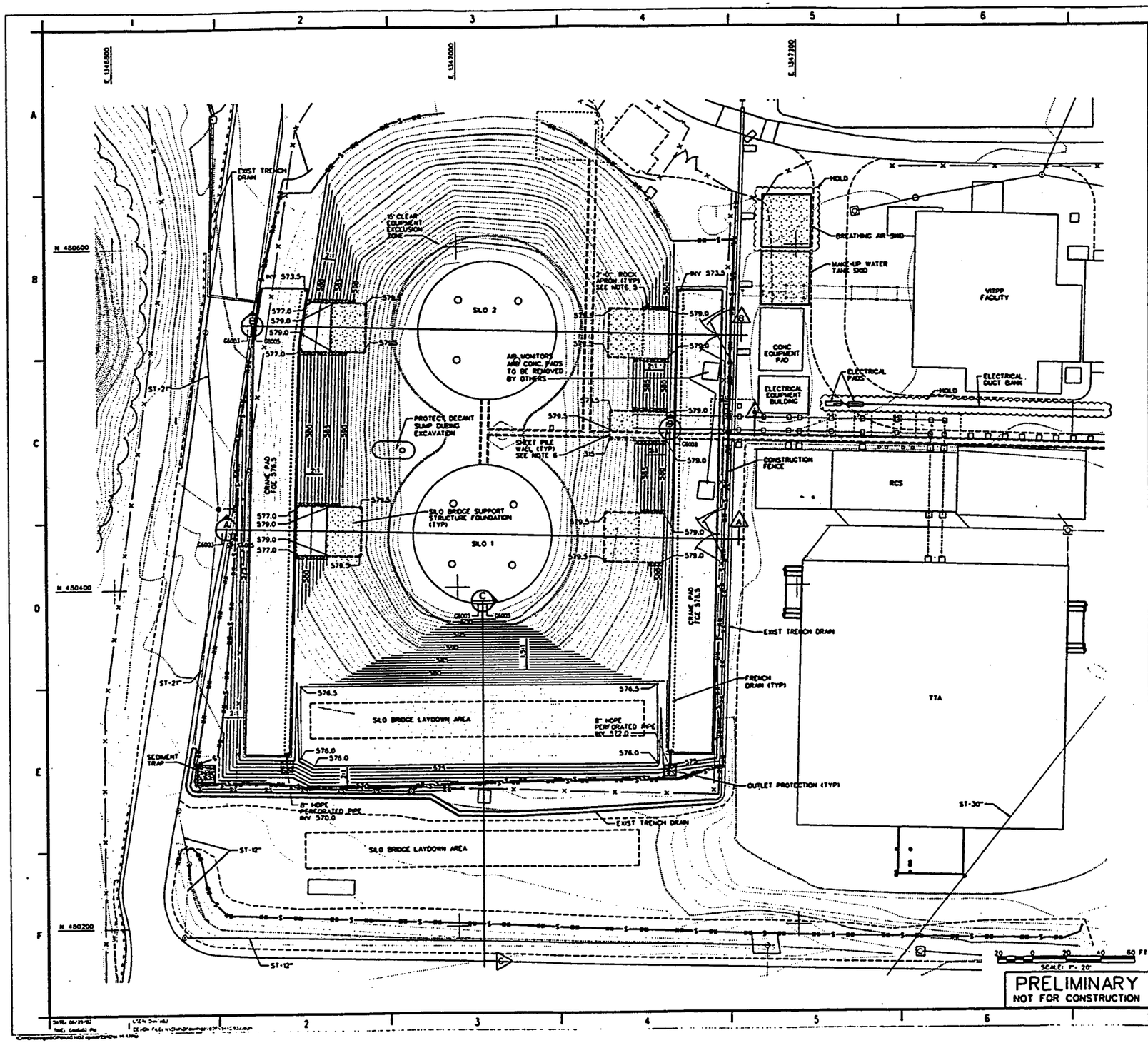

NOTES:

1. FOR GENERAL NOTES, LEGEND AND UTILITY DESIGNATIONS SEE SHEET G6001.
2. ALL CUT SLOPES SHALL BE 1.5:1 UNLESS NOTED OTHERWISE.
3. REMOVE EXISTING K-65 TRENCH AS NECESSARY TO INSTALL FOUNDATIONS. DISPOSE OF TRENCH AS DIRECTED BY CONSTRUCTION MANAGER.
4. FOR STORMWATER AND EROSION CONTROL, SEE SHEET G6004.
5. LAYDOWN A 2'-0" WIDE BY 6" TO 8" THICK LAYER OF TYPE "D" STONE, DIAMETER TO BE NOT LESS THAN 3" AND NO GREATER THAN 8". UNDERLAY WITH GEOTEXTILE FABRIC.
6. FOR SHEET PILE DETAILS, SEE SHEET G6009. FOR SHEET PILE WALL LOCATIONS, SEE SHEET G6002.

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REF DWG NO.	DRAWING TITLE

REV NO	REASON FOR REVISION PURPOSE - DESCRIPTION	DATE	DRN BY	APPR
B	ISSUED FOR REVIEW			
A	ISSUED FOR REVIEW			

UNITED STATES
DEPARTMENT OF ENERGY
FERNALD ENVIRONMENTAL MANAGEMENT PROJECT

THIS DRAWING PREPARED BY
JE JACOBS

PROJECT NAME
AWR BOP OPTIMIZATION

DRAWING TITLE
CIVIL
AWR/BOP
GRADING/EXCAVATION PLAN

Drawn By	DATE	TECHNICAL LEAD	DATE	CHECKED BY	DATE
PLANT/BLDG NO.		PLANT		SCALE 1"=20'	CLASS B
SUBMITTED FOR DOE REVIEW		SUBMITTED FOR DOE REVIEW		SUBMITTED FOR DOE REVIEW	
TECH LEAD		TECH LEAD		TECH LEAD	
DATE		DATE		DATE	

T & MODEL	PROJECT NO.	DRAWING INDEX CODE NO.	SHEET NO.	REV. NO.
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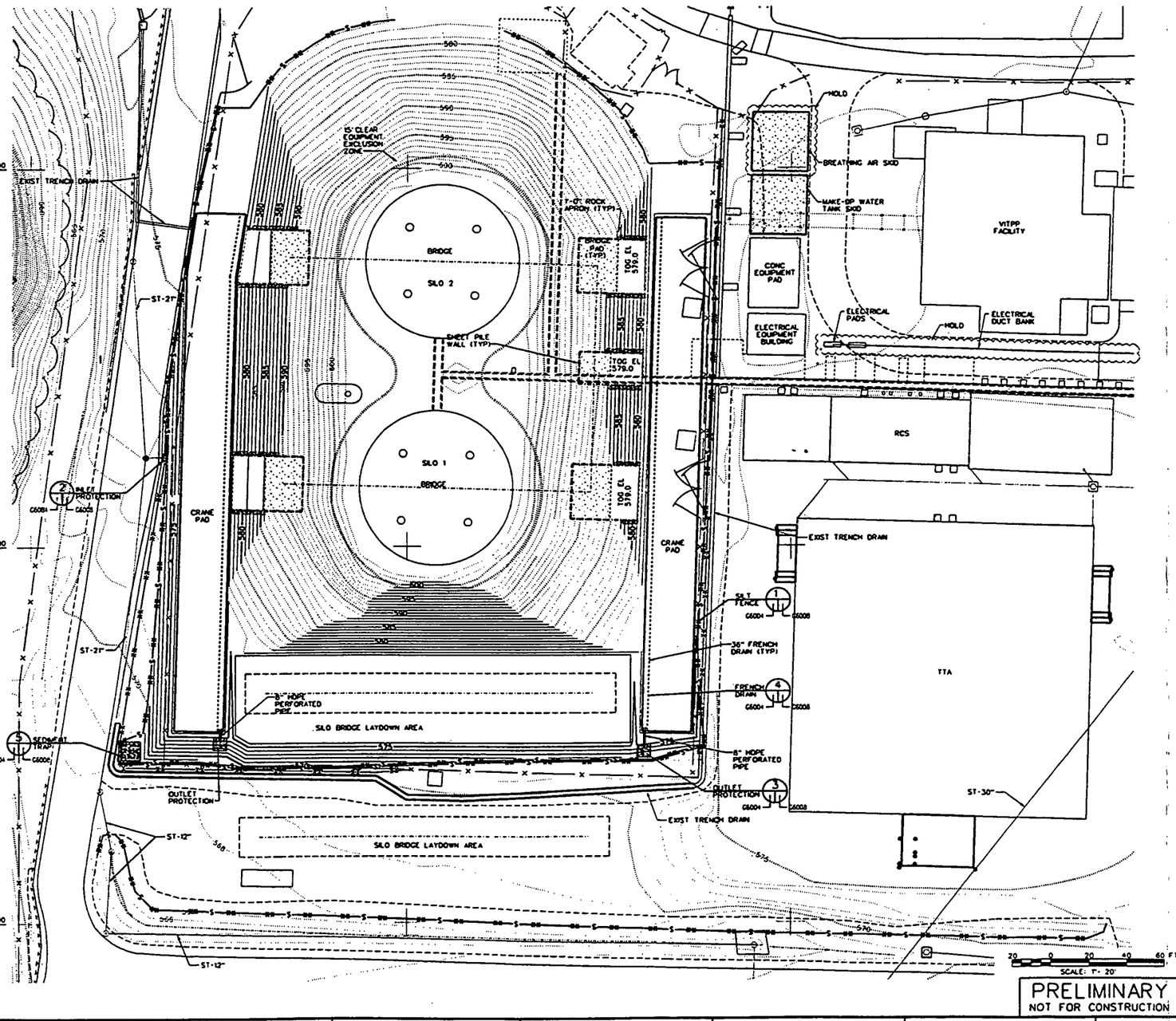

NOTES:

1. FOR GENERAL NOTES, LEGEND AND UTILITY DESIGNATIONS SEE SHEET G6001.
2. ALL CUT SLOPES SHALL BE 1.5:1 UNLESS NOTED OTHERWISE
3. ALL SEDIMENT AND EROSION CONTROL FEATURES SHALL BE INSTALLED AS REQUIRED AND OPERATIONAL PRIOR TO EARTH DISTURBANCE ACTIVITIES.
4. CONTRACTOR SHALL BE RESPONSIBLE FOR REMOVAL OF STORMWATER COLLECTED IN AREAS EXCAVATED BELOW GRADE. ANY DISCHARGE WATER RESULTING FROM PUMPING OF GROUND OR RUNOFF WATER FROM TRENCHES OR OTHER AREAS MUST BE ROUTED THROUGH SEDIMENT CONTROL STRUCTURES AND NOT DISCHARGED DIRECTLY INTO RECEIVING CHANNELS. RUNOFF SHALL BE MANAGED IN ACCORDANCE WITH FEMP STORMWATER POLLUTION PREVENTION PLAN AND TRANSPORTED TO AN ON-SITE LOCATION DETERMINED BY THE OWNER.
5. SILT FENCE LOCATIONS ARE APPROXIMATE. ADD ADDITIONAL SILT FENCE AND/OR ADJUST LOCATION AS NECESSARY TO MEET FIELD CONDITIONS.
6. CONTRACTOR SHALL PROTECT EXISTING CATCH BASINS AND OTHER STORMWATER CONTROLS DURING CONSTRUCTION.

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REV NO	ISSUE OR REVISION PURPOSE - DESCRIPTION	DATE	REV. BY	APR.
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A	ISSUED FOR REVIEW			

DETAILS AND DATE

UNITED STATES DEPARTMENT OF ENERGY
FERNALD ENVIRONMENTAL MANAGEMENT PROJECT

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JE JACOBS

PROJECT NAME
AWR BOP OPTIMIZATION

DRAWING TITLE
CIVIL
AWR/BOP
STORMWATER/EROSION CONTROL PLAN

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TECH LEAD		TECH LEAD		TECH LEAD	
DATE		DATE		DATE	

T.O. NUMBER	PROJECT NO.	DRAWING INDEX CODE NO.	SHEET NO.	REV. NO.
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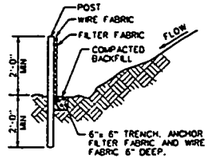

TEMPORARY SILT FENCE (1)
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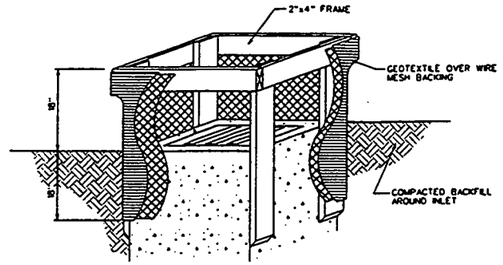
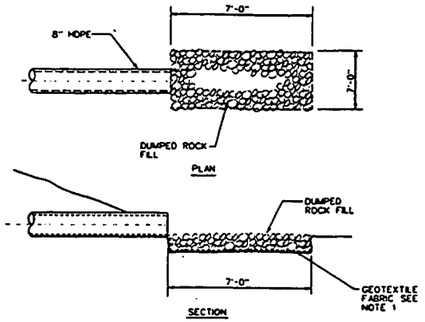
G6004 — G6008



NOTES:

1. INLET PROTECTION SHALL BE CONSTRUCTED EITHER BEFORE UPSLOPE LAND DISTURBANCE BEGINS OR BEFORE THE STORM DRAIN BECOMES OPERATIONAL.
2. THE EARTH AROUND THE INLET SHALL BE EXCAVATED COMPLETELY TO A DEPTH AT LEAST 18 INCHES.
3. THE WOODEN FRAME SHALL BE CONSTRUCTED OF 2"x4" CONSTRUCTION GRADE LUMBER. THE 2"x4" POSTS SHALL BE DRIVEN 18" INTO THE GROUND AT FOUR CORNERS OF THE INLET AND THE TOP PORTION OF 2"x4" FRAME ASSEMBLED USING THE OVERLAP JOINT SHOWN. THE TOP OF THE FRAME SHALL BE AT LEAST 6" BELOW ADJACENT ROADS IF PONDED WATER WOULD POSE A SAFETY HAZARD TO TRAFFIC.
4. WIRE MESH SHALL BE OF SUFFICIENT STRENGTH TO SUPPORT FABRIC WITH WATER FULLY IMPOUNDED AGAINST IT. IT SHALL BE STRETCHED TIGHTLY AROUND THE FRAME AND FASTENED SECURELY TO THE FRAME.
5. GEOTEXTILE SHALL BE STRETCHED TIGHTLY AROUND THE FRAME AND FASTENED SECURELY. IT SHALL EXTEND FROM THE TOP OF THE FRAME TO 18" BELOW THE INLET NOTCH ELEVATION. THE GEOTEXTILE SHALL OVERLAP ACROSS ONE SIDE OF THE INLET SO THE ENDS OF THE CLOTH ARE NOT FASTENED TO THE SAME POST.
6. BACKFILL SHALL BE PLACED AROUND THE INLET IN COMPACTED 6" LAYERS UNTIL THE EARTH IS EVEN WITH NOTCH ELEVATION ON ENDS AND TOP ELEVATION ON SIDES.

INLET PROTECTION (2)
NOT TO SCALE
G6004 — G6008



OUTLET PROTECTION (3)
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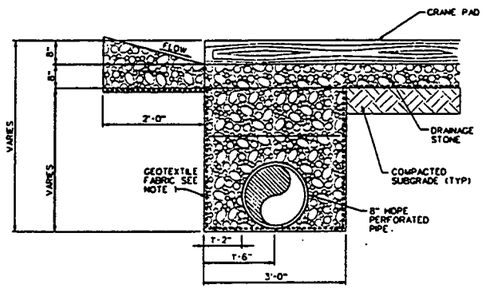
G6004 — G6008



FRENCH DRAIN (4)
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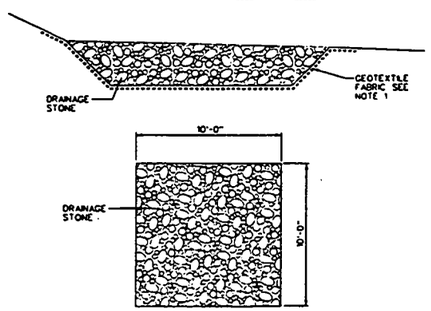
G6002 G6004 — G6008



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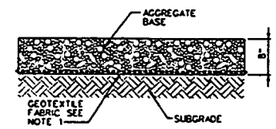
G6004 — G6008



GRAVEL AREA (6)
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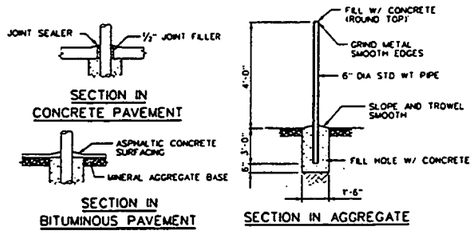
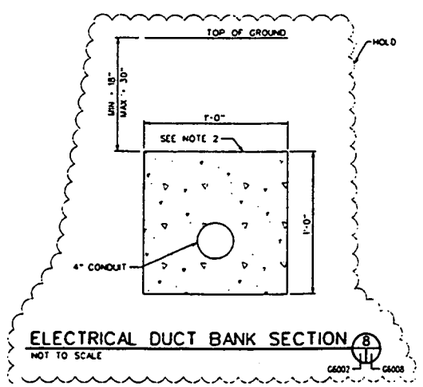
G6002 — G6008



NOTES:

1. BOLLARD TO BE FINISHED WITH A 3-COAT RUSTOLEUM 7600 SERIES ALKYD ENAMEL SYSTEM FOR EXTERNAL FERROUS METAL, OR EQUAL. AS A MINIMUM, THE ENAMEL SYSTEM SHALL BE APPLIED IN ACCORDANCE WITH MANUFACTURER'S WRITTEN INSTRUCTIONS. EXTERIOR TO BE HIGH GLOSS ENAMEL COLOR YELLOW TO MATCH FEDERAL STANDARD 585 CHIP NO. 13538.
2. FOUR BOLLARDS SHALL BE INSTALLED AROUND PIV AS NOTED ON PLAN. PLACE 2 FEET FROM CENTER OF PIV AT 90° CENTER TO CENTER ANGULAR SPACING.
3. CONCRETE TO HAVE A 28-DAY COMPRESSION STRENGTH OF 3000 PSI.

BOLLARD (7)
NOT TO SCALE
G6002 — G6008



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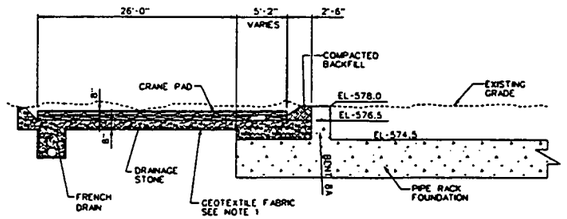
G6002 — G6008



SECTION AT BENT 8A (9)
NOT TO SCALE
G6003 — G6008

NOTES:

1. FOR GEOTEXTILE FABRIC MATERIAL AND WEIGHTS, SEE SPECIFICATION 02714.
2. A 2 INCH WIDE (MINIMUM) ALUMINUM FOIL PLASTIC-BACKED OR DETECTABLE MAGNETIC RED PLASTIC TAPE MANUFACTURED SPECIFICALLY FOR WARNING AND IDENTIFICATION OF BURIED DUCT BANK SHALL BE PLACED DIRECTLY ON TOP OF AND ALONG THE FULL LENGTH OF THE DUCT BANK. IMPRINTED ON IT IN BOLD BLACK LETTERS AND FACING UPWARD, SHALL BE WRITTEN "CAUTION BURIED ELECTRIC CABLE" OR OTHER APPROVED WORDING. TAPE SHALL NOT BE AFFECTED BY MOISTURE OR OTHER SUBSTANCES IN THE TRENCH BACKFILL.

4448

PRELIMINARY
NOT FOR CONSTRUCTION

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A	ISSUED FOR REVIEW			

UNITED STATES
DEPARTMENT OF ENERGY
FERNALD ENVIRONMENTAL MANAGEMENT PROJECT

THIS DRAWING PREPARED BY
JE JACOBS

PROJECT NAME
AWR BOP OPTIMIZATION

DRAWING TITLE
CIVIL
AWR
DETAILS - 1

DRAWN BY	DATE	TECHNICAL LEAD	DATE	CHECKED BY	DATE
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SUBMITTED FOR 30% ISSUE		SUBMITTED FOR 60% ISSUE		SUBMITTED FOR 90% ISSUE	
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DATE		DATE		DATE	

T.O. NUMBER	PROJECT NO.	DRAWING INDEX CODE NO.	SHEET NO.	REV. NO.
N/A	40710			
J.E. PROJECT NO. 3341P006	FILENAME 94X3900G01936.DGN	94X-3900-G-01936	G6008	B

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4443

ENVIRONMENTAL CONTROL PLAN ACCELERATED WASTE RETRIEVAL PROJECT

Document No. 40710-PL-0007
August 29, 2002
Revision 0

FERNALD
Environmental Management Project

Prepared Under DOE
Contract No. DE-AC24-01OH20115

Revision	Prepared by:	Reviewed by:	Approved by:	Date:	Pages Affected:
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B	Frank Parton	Grant Morar	Steven Hungate	May 29, 2002	ALL
0				August 29, 2002	ALL

Revision Sheet			
Revision	**Date**	**Pages Affected**	**Reason for Revision**
A	5/8/02	ALL	ISSUED FOR REVIEW AND APPROVAL
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0	8/29/02	ALL	ISSUED FOR CONSTRUCTION

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000134

ACRONYMS

ARARs	applicable or relevant and appropriate requirements
AWR	Accelerated Waste Retrieval
AWWT	advanced wastewater treatment
BAT	best available technology
DOE	U.S. Department of Energy
ECP	Environmental Control Plan
EPA	Environmental Protection Agency
FEMP	Fernald Environmental Management Project
HEPA	high efficiency particulate air
NFPA	National Fire Protection Association
NPDES	National Pollutant Discharge Elimination System
OEPA	Ohio Environmental Protection Agency
PPDD	Pilot Plant Drainage Ditch
PWID	Project Waste Identification and Disposition
RCRA	Resource Conservation and Recovery Act
RCS	Radon Control System
RD	Remedial Design
TTA	Transfer Tank Area
WPSRC	Waste Pit Area Runoff Control Sump

1.0 INTRODUCTION

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

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

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

Wastewater resulting from AWR Project operations will be recycled to the extent practical to minimize wastewater discharges. When discharge of wastewater is necessary, the wastewater will be utilized by the Silo 1 and 2 treatment facility. However, if the Silo 1 and 2 treatment facility is not available the waste water will be staged, sampled, and discharged to the FEMP Advanced Wastewater Treatment (AWWT) facility in compliance with the FEMP National Pollutant Discharge Elimination System (NPDES) Permit [Ohio Environmental Protection Agency (OEPA) permit No. 1IO0004*FD). Anticipated wastewater streams from the AWR Project are specifically identified in the NPDES permit renewal application submitted to OEPA for approval in May 2002.

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

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

Overall FEMP site environmental monitoring is performed by Fluor Fernald. Project-specific enhancements to the site-wide monitoring programs to address air, direct radiation, and wastewater impacts during the AWR and Silo 3 Projects are documented in the Silos Projects Environmental Monitoring Plan, Document 400000-PL-0010 (Appendix 5.4)

2.0 METHODS AND CONTROLS

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

2.1 AIR EMISSIONS CONTROL

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

- Phase 1: Silos 1 and 2 Headspace Reduction
- Phase 2: Silo Waste Retrieval
- Phase 3: Concurrent Silo Waste Retrieval and Silos 1 and 2 Remediation Facility

Phase 1 operation of the RCS will be established prior to accomplishing initial penetration of the Silo domes. During penetration and modification of the manways, the RCS will be operated to maintain negative pressure in the headspace and assure airflow into the silo through the manways. In this manner, potential emissions to the environment will be directed through the RCS for treatment. The methods to be employed for initial access through the domes of Silos 1 and 2 to complete connections to the RCS and Waste Retrieval Systems will be detailed in the Silo Penetration Plan to be furnished at a later date.

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

The RCS is also designed to provide control and monitoring of emissions from the future Silos 1 and 2 Full-scale Stabilization Facility. The impact of emissions from operation of

the Silos 1 and 2 Full-scale Stabilization Facility will be addressed in detail in the Remedial Design documentation prepared based upon the specific design for that facility.

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

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

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

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

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Radon Control System (RCS)

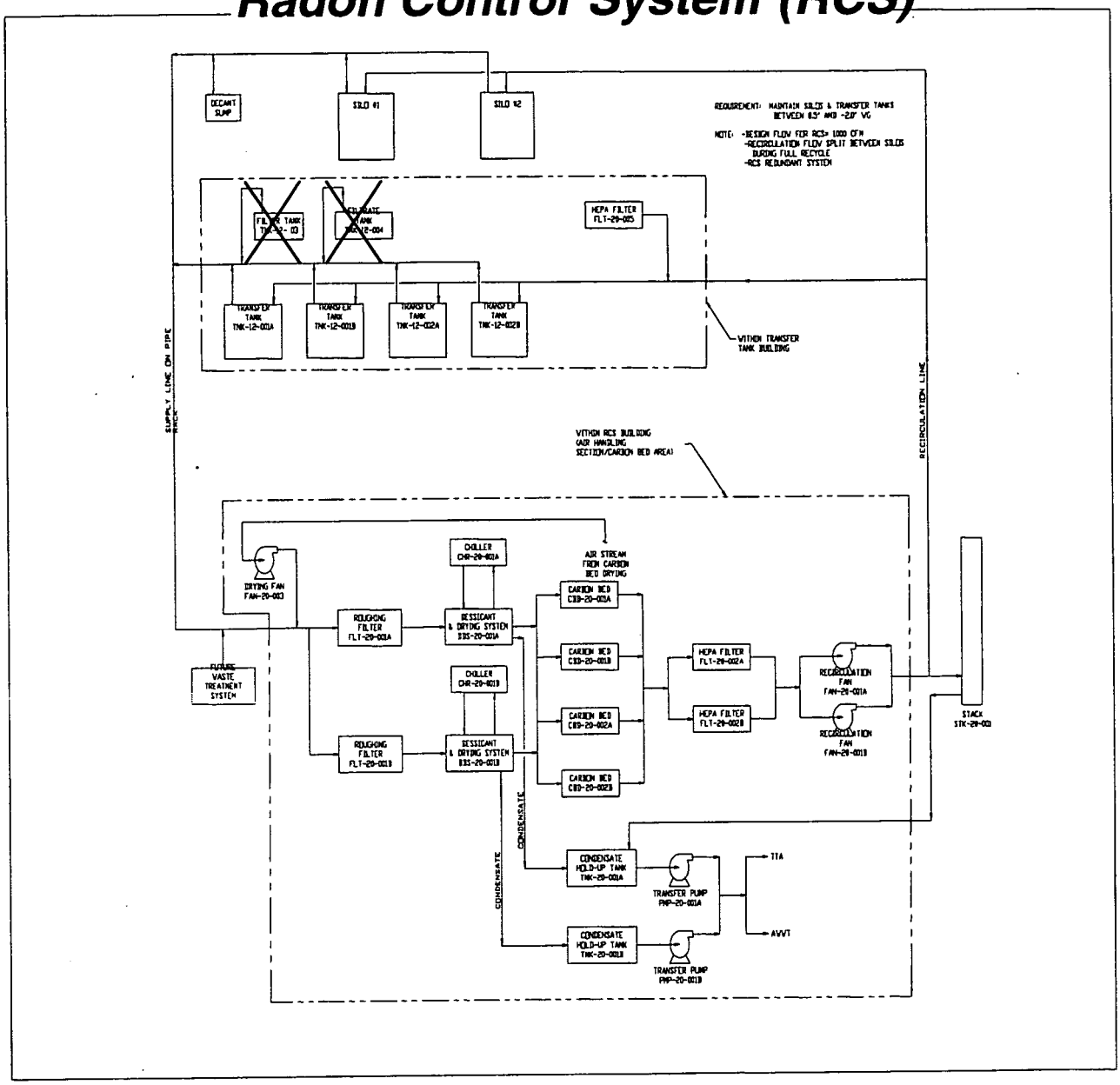

Exhibit 2-1 – RCS schematic

Detailed analysis of radon emissions, including modeling of offsite impact, from material handling and process equipment is described in the Stack Release Considerations for the Radon Control System Performance Calculation (Appendix 5.2). The data from this calculation is summarized below.

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

AWR Project Phase	Stack Exhaust Radon (pCi/L)	On-site Weekly Average Radon (pCi/l)	Fence-line Annual Average Radon (pCi/l)
1. Headspace Reduction (RCS Phase 1)	0.85	6.32E-06	1.89E-06
2. Silo 1 & 2 Retrieval (RCS Phase 2)	977	7.99E-03	2.39E-03
3. Silos 1 and 2 Retrieval and Silos 1 and 2 Remediation Facility Operation Concurrently (RCS Phase 3)	Radon concentration will be calculated after RCS Phase 1 carbon bed efficiency data is available.	Radon concentration will be calculated after RCS Phase 1 carbon bed efficiency data is available.	Radon concentration will be calculated after RCS Phase 1 carbon bed efficiency data is available.

The above data assume a maximum total flow of 1,000 ft^3/minute during RCS Phase 1 operation and 1,000 ft^3/minute during Phase 2 operation. Phase 1 is defined as the period of RCS operation in which the Silo 1 & 2 headspace above the waste is being evacuated prior to mining operations. Phase 2 is defined as the period of RCS operation in which the waste material is transferred from the silos to the TTA tanks. The AWR design provides a bridge over each silo. Each bridge supports a complete waste retrieval system. The AWR is designed to operate with one waste retrieval system online while the other is offline for maintenance. The data above for Phase 3 Operation is based on the following "worst case" assumptions: 1) simultaneous mining of Silo 1 & Silo 2 and 2) Each TTA tank filled to 25% capacity. Note that under these worst case conditions the discharge of the RCS is still well within the required discharge standards.

The current RCS design includes the necessary equipment capacity (fan and duct size, filter capacity) to provide the potential for future expansion to 2,000 ft^3/minute if required to support waste retrieval and treatment facility operation. The need for additional enhancement of the RCS design, such as installation of additional carbon beds, as well as the impact on emissions from the facility, will be evaluated during RCS Phase 1 operation. Details concerning operation at a capacity above 1,000 ft^3/minute, including any necessary modification of the control equipment and impacts on the emission estimates summarized above, will be submitted for EPA and OEPA review and approval prior to initiating operation at the expanded capacity.

Continuous Isokinetic sampling of the stack exhaust for particulate radionuclides shall be performed in compliance with Title 40 of the *Code of Federal Regulations* Part 61, Subpart H, and DOE Order 5400.5, Section IV.6.B. In addition, the stack exhaust is continuously monitored for radon. The monitor consists of a probe assembly and a sampling and

monitoring rack. The probe assembly fits into the stack and has the capability for measuring stack flow and for withdrawal of an isokinetic sample. The sample rack includes a flow controller that matches the flow rate in the sample nozzle with that in the duct, and a coincidence counter for analyzing the radiation from the sample collected on a filter paper. The air stream flows through the filter paper is directed through a continuous radon monitor that measures the concentration of radon in the stack effluent. Analytical instruments will be provided for separately distinguishing radon daughters from other alpha and beta emitting radionuclides.

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

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

2.2 DUST CONTROL

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

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

As specified by the Fugitive Dust Control Plan, AWR Project field activities will be observed by project personnel for visible emissions. The number of pieces or type of dust suppression equipment in operation controlling visible dust emission in a designated area will not preclude stopping project field activities in that area. Personnel should be on-call

during non-work periods seven days per week, including holidays, to respond to the generation of visible dust during off-hours.

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

2.3 WASTEWATER CONTROL

Water shall be added to the silo waste in order to transfer the waste to the TTA. In addition, liquids condensed from the gas steam generated at the RCS will be transferred to shielded hold-up tanks, held up for up to 40 days for radon decay, and returned to the waste retrieval/transfer system for reuse or pumped to the AWWT.

When discharge of wastewater is necessary, the wastewater will be utilized by the Silo 1 and 2 treatment facility. However, if the Silo 1 and 2 treatment facility is not available the waste water will be staged, sampled, and discharged to the FEMP AWWT facility in compliance with the FEMP NPDES Permit [Ohio Environmental Protection Agency (OEPA) permit No. 1IO0004*FD).

Given the expected characteristics from the AWR operations and the discharge criteria for the AWWT, no wastewater unacceptable for transfer to the AWWT is expected to be generated. If analytical results for a particular batch of wastewater are found to be unacceptable, the batch will be managed on a case-by-case basis at the direction of the AWWT operations. The specific disposition of the wastewater would be dependant upon factors including the amount, and specific characteristics of the batch of wastewater and upon current and planned AWWT operations at the time the AWR wastewater is generated.

Based upon the current design for the AWR Project, data on projected generation of wastewater from both RCS and waste retrieval operations was specifically included in the May 2002 application for renewal of the FEMP NPDES Permit (permit No. 1IO0004*FD).

2.4 STORMWATER CONTROL

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

Existing—An existing perimeter channel collects runoff from the Silo domes and the surrounding berms. The perimeter channel consists of a combination of small rectangular

concrete channels, concrete curb, grates, and pipes. The perimeter channel drains to the Waste Pit Area Runoff Control Sump which was installed as part of Comprehensive Environmental Response, Compensation, and Liability Act Removal Action 2 and is located 1,000 ft west-northwest of the silos. The sump has a capacity of 350,000 gallons. This sump also receives drainage from the waste pits to the north. A 12-in. main leads from the sump into the Bio-Surge Lagoon, which discharges to the AWWT facility.

Areas not surrounded by the perimeter channel ultimately drain to the Pilot Plant Drainage Ditch (PPDD), which runs south of the project area and enters Paddy's Run at NPDES outfall STRM 4005, and drains a total of approximately 78 acres. As illustrated on Drawing No. 94X-3900-G-01932 (G6003), the majority of this area reaches the PPDD via an existing storm water basin at the southeast quadrant of the project area. Two culverts cross the southern perimeter road and discharge stormwater to the PPDD; one culvert crosses the west perimeter road, draining to the Waste Pit Area Runoff Control Sump.

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

AWR Project facility construction and operations activities implemented under this Remedial Design (RD) package will not change or move existing drainage divides. Erosion and siltation in the concrete channels surrounding Silos 1 and 2 will be prevented through erosion and sediment control measures identified in Section 2.5. The perimeter road functions as the outer limit of operations. Rainfall will not directly contact the TTA process area since it is equipped with a roof and gutter system. This water is then discharged into the storm drainage system located just north of the TTA. Therefore, contaminated stormwater from this area is not anticipated.

Stormwater drainage during facility construction and operation (berm excavation and waste retrieval) activities is illustrated on Drawing 94X-3900-G-01932 (G6003). Drainage from the Silo 1 and 2 domes and berms will continue to be collected by the existing trench system and discharged to the Waste Pit Area Runoff Control Sump (WPSRC). Silt fence and sediment traps will be utilized to prevent silt buildup in the trench system. The trench will be included in the erosion and sediment control inspections to provide additional assurance that it has not become obstructed.

2.4.1 Spill Prevention Control And Countermeasures

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

1. Silo failure during retrieval

2. Failure of one of the TTA tanks

3. Failure of the Slurry Transfer Line during retrieval

The potential impact of a failure at Silo 1 and 2 during retrieval is minimized by the design of the retrieval operation and by maintenance of the existing drainage system. First, the water flows to and from the silos during retrieval will be closely controlled to minimize the inventory of water in the silo and to assure that the addition of water is stopped immediately upon a silo failure. Second, as will be outlined in the *Berm Excavation Plan* (RD Package Section 4.0), a majority of the berm material will be left in place, providing containment of any material potentially released due to failure of the Silo wall. Maintaining the majority of the berm will assure containment of any water that would penetrate the Silo wall during waste retrieval.

As described in the Berm Excavation Plan, the berm material will be visually monitored for moisture and potential silo leaks during excavation to assess if the berm soil has been potentially contaminated by K-65 slurry/supernate. This potentially contaminated material will be sampled and appropriately dispositioned. Finally, as described in Section 2.3, drainage patterns and runoff controls will be maintained such that any release that was to escape the silo would be contained and directed to the WPSRC sump.

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

The transfer pipe used to transfer the silo material from the Silo Waste Retrieval System to the TTA utilizes double-walled pipe to minimize the risk of pipe failure, the amount of material potentially released in the event of a pipe failure, the amount of material potentially released in the event of a pipe failure would be limited to the inventory contained in the line—approximately 250 gallons, thus minimizing the likelihood that the release would drain beyond the project area. The area underneath the transfer line drains to the southeast stormwater basin. A concrete diversion berm will be installed to prevent drainage to the south directly into the PPDD.

The design and construction of hazardous material storage tanks (e.g., fuel tanks and chemical tanks) and secondary containment will conform to the certified for construction drawings and specifications. Tanks are to be located away from heavy traffic and protected with bollards as necessary. Containers five gallons in size (minimum) are

required to be labeled with the appropriate Hazardous Identification Label (diamond) as identified in the National Fire Protection Association (NFPA) Code NFPA-704.

Heavy equipment and mechanical equipment are to be maintained in good repair so as to minimize the release of engine, transmission, or other oils; engine coolants; or hydraulic fluids. Idle equipment is to be parked as far away from drainage channels as practical. A drip pan can be used under equipment that is leaking, with immediate action taken to repair the equipment or remove it from the FEMP site.

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

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

2.4.2 Inspections And Recordkeeping

Inspections of the site will be performed during excavation activities to confirm compliance with best management practices on a weekly basis, or within 24 hours of a rainfall event exceeding 0.5 in. within a 24-hour period. Items to be inspected include, but are not limited to, the following:

Conditions of erosion controls, such as:

- Silt fences,
- Drainage ways,
- Gully formation,
- Areas needing seeding or reseeding, and
- Access roads.

General housekeeping on-site;

Evidence of silt build-up or obstruction of the Silos 1 and 2 perimeter trench;

Evidence of poor fueling practices or leaking fuel tanks;

Evidence of leaks from other tanks or equipment; and

Stormwater channels inspected for oil sheen, debris, siltation, or other disturbance.

Evidence of silt build-up or obstruction of the Silos 1 and 2 perimeter trench

A written record of the inspection, including all notifications and deficiencies, is to be kept and available 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 or disturbed areas. These controls are to be installed prior to the initiation of excavation in the affected areas. These controls are based on standards specified in the FEMP Stormwater Pollution Prevention Plan and the Ohio Department of Natural Resources Rainwater and Land Development Manual, and were detailed in the AWR Project Site Preparation Package approved in May 2000. The measures outlined in the AWR Site Preparation Package to lessen the environmental impact due to erosion are to be taken during AWR Project Construction include:

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

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

- Silt fence surrounding the excavation area to prevent sediment runoff into the perimeter trench
- Sediment traps at the southwest and southeast corner of Silo 1
- Maintenance of the Silos perimeter trench to assure it remains free of obstruction

Control of berm excavation is detailed in the *Berm Excavation Plan* (RD Package Section 4.0).

2.6 DECANT SUMP TANK WASTE WATER MANAGEMENT

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

During the AWR Project, retrieval of the material from Silos 1 and 2, and excavation of berm material, have the potential to impact the rate of liquid accumulation in the Decant Sump Tank.

In order to provide enhanced protection from release of liquid from the Decant Sump Tank, the procedures and process controls for the waste retrieval operation incorporate additional steps to provide protection from releases from the decant sump tank. These steps include continuous monitoring of the liquid level and rate of infiltration into the sump tank, and alarm set-points to initiate appropriate corrective action (removal of liquid from the tank, adjustment, or shutdown of waste retrieval, etc.). These measures are discussed in greater detail in the Process Description (RD Package Section 2.1)

2.7 SECONDARY WASTE MANAGEMENT

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

The management of secondary waste, is described in detail in the *Waste Handling Work Plan* for the AWR Project (Appendix 5.1 of this ECP). All secondary waste will be segregated, characterized, packaged, and dispositioned in accordance with site procedures. Based upon the Final Design, a Project Waste Identification and Disposition (PWID) Report will be prepared in accordance with procedure EW-1021, *Preparation of the Project Waste Identification and Disposition (PWID) Report.* The PWID will document the anticipated waste streams, generation rates, and Fluor Fernald-approved disposition for secondary waste resulting from AWR operations. Data on tracking of secondary waste

generated will be utilized to update of the appropriate inventory database. As waste is generated, the volumes of each waste stream will be tracked against the PWID, and the PWID will be updated as necessary due to any changes from the initial estimates.

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

ARAR COMPLIANCE
MATRIX

APPENDIX 5.1

ARAR COMPLIANCE MATRIX

AWR Project 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 Process Description document and Section 2.1, Air Emissions Control, of this ECP for additional information.
Radon-222 Emissions (radon flux)	40 CFR 61 Subpart Q No source at a Department of Energy facility may emit more than 20 pCi/m^{2}s as an average for the entire source into the air. Source is defined as "any building, structure, pile, impoundment, or area used for interim storage or disposal..."	Short-term staging of the Silo material while remedial actions are in process does not constitute interim storage for the purposes of NESHAP Subpart Q; therefore, the TTA tanks do not qualify as a 'source'.	N/A	N/A
Radon-222 Emissions (fenceline)	10CFR 834 (proposed) – maximum annual average fenceline radon concentration may not exceed 0.5 pCi/l above background	Radon emissions from the AWR Project must not contribute to fenceline radon concentrations in excess of this limit.	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. A continuous radon monitor is installed downstream of the particulate sampler, with results fed back to the AWR Control Room for readout and recording. Dispersion modeling of expected maximum emissions from the RCS predicts a maximum annual average fenceline impact of 0.019 pCi/l	See sections on the Radon Control System (RCS) and the Heating, Ventilating, and Air Conditioning (HVAC) Systems of the Process Description document and Section 2.1, Air Emissions Control, of this ECP for additional information.

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AWR Project 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.	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.	See above discussion of radon emissions	See sections on the Radon Control System (RCS) and the Heating, Ventilating, and Air Conditioning (HVAC) Systems of the Process Description document 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. Excess wastewater will be transferred to the Silos 1 and 2 Remediation facility for storage pending either use in the Silos 1 and 2 treatment process, or sampling and batch transfer to the AWWT for treatment and discharge in compliance with the NPDES permit. Expected wastewater generation from the AWR project is specifically reflected in the NPDES permit renewal Application submitted to the OEPA in May 2002. 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 Process Description document, as well as Sections 2.3 and 2.4 of this ECP for additional information.

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AWR Project 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
Ohio Water Quality Standards "Five Freedoms" for Surface Water	OAC 3745-1-04. All surface waters of the state shall be free from: ▯ Objectionable suspended solids; ▯ Floating debris, oil and scum; ▯ Materials that create a nuisance; ▯ Toxic, harmful or lethal substances; and ▯ Nutrients that create nuisance growth.	Requires compliance with the FEMP NPDES permit.	See above discussion relating to control of wastewater and storm water discharges associated with the AWR Project.	See sections on the Storm Water System and the Wastewater System of the Process Description document, as well as Sections 2.3 and 2.4 of this ECP for additional information.
OEPA NPDES Permit No. 1I000004•FD	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.	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.	Wastewater will be transferred to the Silos 1 and 2 Remediation facility for storage pending either use in the Silos 1 and 2 treatment process, or sampling and batch transfer to the AWWT for treatment and discharge in compliance with the NPDES permit. Expected wastewater generation from the AWR project is specifically reflected in the NPDES permit renewal Application submitted to the OEPA in May 2002.	See sections on the Storm Water System and the Wastewater System of the Process Description document, as well as Sections 2.3 and 2.4 of this ECP for additional information.

AWR Project 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
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.	No existing structures or areas potentially used as Indiana Bat roosts are expected to be impacted as part of AWR project activities.	General Arrangement and Civil Site Plan drawings
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.	DOE letter OH-0582-98, "Approval of NEPA Supplement Analysis for Proposed Silos 1 and 2 Accelerated Waste Retrieval Project at Fernald," dated March 3, 1998
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.	N/A

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AWR Project 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
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.	All of the intrusive work for the AWR Project takes place within the perimeter of the already-developed Silos Project area. 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.	N/A
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. The AWR Project incorporates Erosion and stormwater controls in accordance with the FEMP SWPPP.	See Section 2.4 of this ECP for additional information.

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AWR Project 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. <u>Best Management Practices</u>: 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 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.	Environmental Control Plan
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 would be applicable to any test borings and wells that might be installed and/or closed as part of these remedial alternatives.	No test holes or monitoring wells are to be installed or closed as part of the AWR project.	N/A

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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).	The materials in Silos 1 and 2 are specifically exempt from the applicability of RCRA requirements. However, these procedures are relevant and appropriate to the management of Silo 1 and 2 Material and any secondary wastes that exhibit hazardous waste characteristics 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.	N/A
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 to the management of Silo 1 and 2 Material and any secondary wastes that exhibit hazardous waste characteristics 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. No hazardous waste requiring off-site transportation for treatment, storage or disposal is expected to be generated as pert of the AWR project.	N/A

AWR Project 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 pre-vent 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 materials in Silos 1 and 2 are specifically exempt from the applicability of RCRA requirements. However, these procedures are relevant and appropriate to the management of Silo 1 and 2 Material and any secondary wastes that exhibit hazardous waste characteristics Secondary 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 are relevant and appropriate 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. Security is provided the FEMP site security program, and inspections performed, as appropriate, of processing systems while attention to ALARA principles is applied to all appropriate AWR Project activities.	Waste Handling Work Plan.

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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 re-lease of hazardous waste to air, soil, or surface water which might threat-en 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.	The relevant and appropriate RCRA TSD facility have been incorporated into the AWR design drawings and specifications, as well as operating and maintenance procedures. 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.	Health and Safety Controls document (RD Package Section 6)

AWR Project 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 materials in Silos 1 and 2 are specifically exempt from the applicability of RCRA requirements. However, these procedures are relevant and appropriate to the management of Silo 1 and 2 Material and any secondary wastes that exhibit hazardous waste characteristics Wastes removed from this operable unit which exhibits a hazardous characteristic must be treated, stored, or disposed in accordance with TSD facility standards.	Relevant and Appropriate requirements for emergency preparedness and prevention have 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.	Health and Safety Controls document (RD Package Section 6)

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AWR Project 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	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 materials in Silos 1 and 2 are specifically exempt from the applicability of RCRA requirements. However, these procedures are relevant and appropriate to the management of Silo 1 and 2 Material and any secondary wastes that exhibit hazardous waste characteristics	Equipment or items used in performance of work that require decontamination are cleaned per approved plans. TTA is not closed as part of this scope of work.	Decontamination wastes are described in the AWR Project Waste Handling Work Plan.

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AWR Project 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 to the management of Silo 1 and 2 Material and any secondary wastes that exhibit hazardous waste characteristics 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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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 materials in Silos 1 and 2 are specifically exempt from the applicability of RCRA requirements. However, these procedures are relevant and appropriate to the management of Silo 1 and 2 Material and any secondary wastes that exhibit hazardous waste characteristics 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.	Process Description Document
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.

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AWR Project 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
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 materials in Silos 1 and 2 are specifically exempt from the applicability of RCRA requirements. However, these procedures are relevant and appropriate to the management of Silo 1 and 2 Material and any secondary wastes that exhibit hazardous waste characteristics 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.	N/A
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 materials in Silos 1 and 2 are specifically exempt from the applicability of RCRA requirements. However, these procedures are relevant and appropriate to the management of Silo 1 and 2 Material and any secondary wastes that exhibit hazardous waste characteristics During the process of remediation, waste materials might require temporary management for the purpose of staging or treating material.	No CAMU's nor temporary units are utilized as part of the AWR Project	N/A

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AWR Project 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. 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 man-age wastes containing free liquids.	The materials in Silos 1 and 2 are specifically exempt from the applicability of RCRA requirements. However, these procedures are relevant and appropriate to the management of Silo 1 and 2 Material and any secondary wastes that exhibit hazardous waste characteristics	No Containment Buildings, as defined under this regulation, are utilized as part of the AWR project	N/A

AWR Project 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. 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 above 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 Radon Control System (RCS) and the Heating, Ventilating, and Air Conditioning (HVAC) Systems of the Process Description document and Section 2.1, Air Emissions Control, of this ECP for additional information.
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.	Environmental Control plan
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. RM-0047 contains the BAT determination for the FEMP site, including the applicable emission standards.	See Section 2.2, Dust Control, of this ECP

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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.	Section 2.1, Air Emissions Control, of the ECP

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AWR Project 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.	N/A
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.	Section 2.1, Air Emissions Control, of the ECP
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.	No air toxics are expected to be generated as part of the AWR project	N/A

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5.2- RCS PERFORMANCE CALCULATION

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APPENDIX 5.2

RADON CONTROL SYSTEM PERFORMANCE CALCULATION

JACOBS	Calculation No: 35H19606-00-PR-003	Page 1 of 32
	Rev. No.: B	Revision Date: 8/29/02
Calculation Cover Sheet	Previous Revision Date: 5/13/02	Current Revision Date: 8/29/02
Issuing Department: *Oak Ridge Design Engineering*	Supersedes: *N/A*	
Client: Fluor Fernald Inc. Project Title: Accelerated Waste Retrieval Project Number: 35H19606 System: 20	Engineering Discipline: Process Engineering	

Calculation Title: RCS Phase 2 Material Balance

Purpose:

The purpose of this calculation is to support the material balance associated with Phase 2 operations of the RCS.

Prepared by: Ken Rickett Date: 08/29/02

Checked by: Ken Eger Date: 08/29/02

Engineering Manager: Ken Cruikshank Date: 08/29/02

Revision History:

Pages Affected By Revision	Revised/ Added/ Deleted	Description of Revision
All	New	Issued
All	Revised	Reapportionment of Air Flow to RCS

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RCS PERFORMANCE CALCULATION

I. CRITERIA

A. Purpose of Calculation

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

B. Functional Requirements

The RCS will provide ventilation of Silos 1 & 2 and the Transfer Tank Area (TTA) vessels for Phase 2. The RCS will chill the ventilation stream to improve radon adsorption and must adsorb radon from the gas stream. The RCS will have the capability of recycling treated gas to all of the source vessels listed above.

II. APPLICABLE CODES AND STANDARDS

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

Table 1: Ambient Air Limitations (Reference 1a)

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

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

III. METHODOLOGY

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

The methodology employed in this calculation is to:

- Evaluate performance of ^{222}Rn adsorption by carbon bed
- Evaluate ^{222}Rn sources and gas concentration during Phase 2 operations where mining is performed in both Silo 1 and Silo 2 and all TTA tanks are ventilated
- Evaluate ^{222}Rn in condensates
- Evaluate ^{222}Rn stack emissions and their consequences

IV. ASSUMPTIONS

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

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

Table 2: Vessel Gas Rates (acfm) to RCS

Phase	Silo 1	Silo 2	TTA 1A	TTA 1B	TTA 2A	TTA2B	FWTF
1	250	250	0	0	0	0	0
2	375	375	62.5	62.5	62.5	62.5	0

5. Building ventilation to the stack is 9310 acfm at 75°F and 100%RH
6. Condensate will collect for 20 days, decay for 15 days, and be discharged or reused in the process.
7. Filled and filling TTA tanks will have 2 ft of water on top of settled solids for shielding and ^{222}Rn reduction.
8. Internal diameters of the silos and TTA tanks are 80 ft and 66 ft, respectively.
9. In Phase 1, 90% of the treated gas will be recirculated to the silos. Normally, treated gas will not be recirculated to the silos or TTA tanks undergoing mining during Phase 2.
10. Exposed surface areas of the silo waste material being mined will be 1.5 times the cross-section of the silo.
11. For this mass balance, all exhaust air from the silos and TTA tanks will be exhausted to the stack to provide the most conservative estimate for exposure levels in Phase 2.
12. Steady state radon concentrations will be equivalent for Silo 1 and Silo 2 since they will both be mined alternately during the same time period.
13. Steady state radon concentrations will be equivalent for all TTA tanks since they are filled evenly throughout the mining operations from both silos.
14. The Future Waste Treatment Facility (FWTF) is not online during Phases 1 and 2.
15. No water cover will be maintained on residues of a silo undergoing mining.
16. On-site worker exposure limit is at a distance of 100 m from the stack, center of plume, under winds of 0.5 m/s, and fumigation conditions with an inversion lid of 200 ft.
17. Stack height is 150 ft; stack discharge diameter is 3 ft.
18. Radon daughter concentration leaving the carbon bed is negligible.
19. Negligible heat transfer from heats of adsorption will occur across the carbon bed. The pressure in the silos associated with radon release within the silo headspace is not significant.
20. The solubility difference of radon in water between atmospheric pressure and 2" wg will not be significant.

V. CALCULATIONS

A. Carbon Bed ^{222}Rn Adsorption

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

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

where:

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

1. Dynamic Adsorption Coefficient, K_a

a) K_a as a Function of Temperature

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

Table 3: Temperature Dependence of K_a			
T (°C)	K_a (L/g)	T (°C)	K_a (L/g)
0	16.5	15	9.0
5	13.6	20	6.8
10	11.7	24	6.1
Reference State: 15% RH, atm. pressure			

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

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

Where:

T	=	Temperature, Kelvin
b_i	=	Regression coefficients b_1 = 1,030.4; b_2 = -895,870; b_3 = 2.9501E8; b_4 = -2.485E10

Assumption 2 requires chiller gas product at 40°F

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

Applying EQN 2:

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

b) K_a as a Function of Gas Stream Humidity

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

This function is expressed as:

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

where:

$K_a'(T,RH)$	=	Adsorption coefficient at T and RH
$K_a(T,15)$	=	Adsorption coefficient at T and RH = 15%
RH	=	Relative humidity, operational
RH_0	=	Relative humidity, standard state selection

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

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

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

<u>K_a will be limited to a value of 13 in this calculation.</u> This value was determined based upon using 160,000 pounds of new purchased carbon (<u>K_a = 13.1</u>). These values of <u>K_a</u> were determined based upon testing performed by Barnebey-Sutcliffe and are found in Reference 18. **The above analysis was included in the calculation for information purposes.**

2. Gas Rate Adjustment for Chiller Operation

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

Table 4: Operating Stream Conditions

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

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

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

and volume on exit is:

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

For conditions of Table 4:

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

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

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

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

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

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

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

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

3. Condensate Removal of ^{222}Rn

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

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

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

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

where:

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

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

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

And the activity carried by the inlet gas is:

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

Thus, the activity carried by the gas exiting the chiller/dryer is:

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

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

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

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

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

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

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

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

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

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

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

4. Carbon Bed Efficiency

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

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

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

where:

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

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

Table 5: Carbon Bed Efficiency with Chilled Gas Rate

Q_{in} (ft^3/min)	Q_{out} (ft^3/min) EQN5	F (L/min)	η EQN 16
250	227.06	6,429.7	1
500	454.13	12,859.4	0.999903
750	681.19	19,289.1	0.997883
1000	908.25	25,719	0.99013

5. Application of Chiller and Carbon Bed Analysis

Example Calculation:

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

Table 6: Source Terms and Ventilation		
Vessel	Q (ft^3/min) [Table 2]	$C_{222Rn,air}$ (pCi/L)
Silo 1	250	252,292
Silo 2	250	249,715
Sum	500	
Average		251,003

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

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

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

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

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

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

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

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

∴For purposes of hand calculation, recirculation of the treated gas may be neglected.

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

1. Phase 1, Silo Headspace Concentration Reduction

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

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

where:

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

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

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

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

References 8 and 9 provide:

Table 7: Silo Headspace Concentrations and Volumes

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

Substituting Table 7 values into EQN 19:

$$E_{Silo1} = \frac{18.2\text{E}6\ \text{pCi}}{\text{L}} \cdot 0.79\text{E}6\text{L} \cdot \frac{1.26\text{E}-4}{\text{min}} = 1.8101\ \text{E}9 \frac{\text{pCi}}{\text{min}}$$

$$E_{Silo2} = \frac{11.3\text{E}6\ \text{pCi}}{\text{L}} \cdot 1.27\text{E}6\text{L} \cdot \frac{1.26\text{E}-4}{\text{min}} = 1.8067\ \text{E}9 \frac{\text{pCi}}{\text{min}}$$

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

Table 8: Time Dependent Phase 1 Silo Headspace ^{222}Rn		
t (min)	Silo 1 C_t (pCi/L)	Silo 2 C_t (pCi/L)
10	1.66E+07	1.07E+07
100	7.49E+06	6.50E+06
500	443,686	889,913
1,000	254,333	286,805
1,440	252,329	252,739
7,200	252,292	249,715
14,400	252,292	249,715

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

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

2. Phase 2, Silo Mining and TTA Storage

   a) TTA Tank Emissions

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

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

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

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

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

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

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

where:

C_{222Ra}	=	Concentration of ^{222}Ra in the solids, pCi/g
A	=	Area of solid surface, vessel cross-section, m^2
depth	=	height of water on top of tailings, inches and a conversion of seconds/minute is required.

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

Table 9: Silo Waste ^{226}Ra Content (95% CI)

Silo	^{226}Ra (pCi/g)
1	477,000
2	263,000

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

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

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

Looking ahead to Silo 2 waste materials:

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

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

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

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

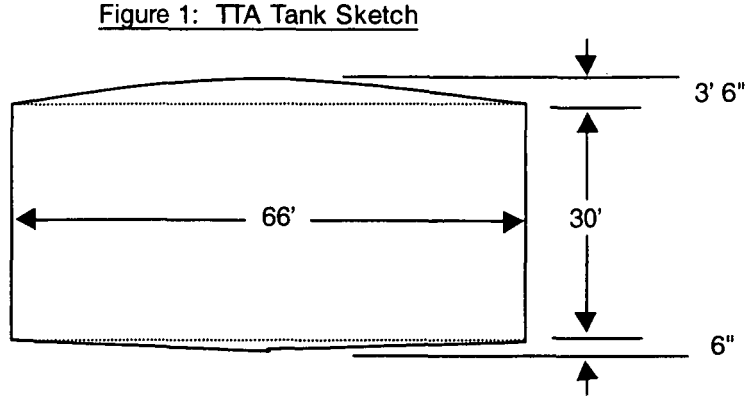
where variables are defined as above, but V varies with the extent of fill of the tank.

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

The volume of the dome is:

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

Figure 1: TTA Tank Sketch



The volume of the cone bottom is:

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

The volume of the sidewall area is:

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

The initial volume of each TTA tank is:

$$V_{Init} = V_{Dome} + V_{Cone} + V_{Upright} = 3.007\,E\,6\,\text{L} \qquad \textbf{(EQN 26)}$$

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

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

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

Table 10: TTA Tank ^{222}Rn Concentrations

V (L)	C (pCi ^{222}Rn/L)	
	Silo 1 Waste	Silo 2 Waste
3.00E+06	454,742	250,728
2.50E+06	468,474	258,299
2.00E+06	483,061	266,342
1.50E+06	498,585	274,901
1.00E+06	515,141	284,029
500,000	532,833	293,785
375,400	537,433	296,321
350,000	**538,381**	**296,843**

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

Since the wastes from Silo 1 and Silo 2 are now being mixed, the higher and more conservative concentration yielded for Silo 1 waste is used for all of the TTA tanks in the material balance for Phase 2.

b) Silo 1 Emissions During Mining

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

$$E_{Silo1,2} = C_{222Ra} \cdot E'' \cdot A' [=] \frac{\text{pCi}}{\text{min}} \qquad \textbf{(EQN 28)}$$

where:

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

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

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

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

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

Table 11: Silo Material Inventories

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

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

V_{Init} = 0.79 E6 L

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

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

Table 12: Silo 1, Phase 2 ^{222}Rn Headspace Concentration	
V(L)	C (pCi ^{222}Rn/L)
7.90E+05	1,122,244
1.00E+06	1,119,482
1.147E+06	**1,117,557**
1.50E+06	1,112,962
2.00E+06	1,106,517
2.50E+06	1,100,147
3.00E+06	1,093,849
3.50E+06	1,087,624
4.00E+06	1,081,468
4.40E+06	1,076,594

For conservative purposes, the radon concentration corresponding to V = 1.147 E6 L is chosen. This volume represents the headspace volume when the clay cap is removed. The value of the concentration from the mass balance will be notable to the reviewer as differing from specific values calculated above 1,127,008 vs. 1,117,557); such deviation is because of round off and/or truncation error associated with the hand calculated material balance and the iterative calculations employed in the spreadsheet.

c) Silo 2 Mining

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

V_{Init} = 1.27E+06 L
V_{Final} = 4.428E+06 L.

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

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

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

Applying EQN 22 from V_{init} to V_{final}, the ^{222}Rn headspace concentration varies as tabulated in Table 13. Q is provided in Table 2.

For conservative purposes, the radon concentration of Table 13 corresponding to V = 1.5E6 L is chosen. This volume corresponds to the volume when the clay cap is removed.

Table 13: Silo 2, Phase 2 ^{222}Rn Headspace Concentration	
V(L)	C (pCi ^{222}Rn/L)
1.27E+06	615,294
1.50E+06	**613,646**
2.00E+06	610,092
2.50E+06	606,580
3.00E+06	603,108
4.00E+06	596,281
4.40E+06	593,594

The value found for Silo 1 in §V.B.2.b is assigned to Silo 2 because of the inherent hypothetical nature of the mining operations. This designation for Silo 2 is conservative since the values obtained for Silo 2 are less than those calculated for Silo 1 as demonstrated.

d) Phase 2 Gas Treatment

The composite gas stream in Phase 2, from §§V.B.2.a, V.B.2.b, V.B.2.c, and Table 2 are summarized in Table 14. The combined Table 14 treatment stream to the chiller is found to be 490,753 pCi/L as:

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

Table 14: Phase 2 Gas Streams		
Vessel	Q (ft^3/min)	C (pCi ^{222}Rn/L)
Silo 1	375	1,117,557
Silo 2	375	1,117,557
TTA 1A	62.5	538,381
TTA 1B	62.5	538,381
TTA 2A	62.5	538,381
TTA 2B	62.5	538,381
Total	1000	972,763

The chiller outlet and carbon bed inlet concentration is:

$$EQN\,15 \Rightarrow C_{222Rn,Out,2} = 1.1010 \cdot 972{,}763 \frac{\text{pCi}}{\text{L}} = 1{,}071{,}012 \frac{\text{pCi}}{\text{L}}$$

Applying treatment efficiency from Table 5 and EQN 17:

$$C_{o,2} = 1{,}071{,}012\frac{\text{pCi}}{\text{L}} \cdot (1 - 0.9901) = 10{,}571\frac{\text{pCi}}{\text{L}}$$

The value of the concentration entering the carbon bed from the mass balance will be notable to the reviewer as differing from specific values calculated above; such deviation is because of round off and/or truncation error associated with the hand calculated material balance and the iterative calculations employed in the spreadsheet.

During Phase 2, the TTA vessels will be filled and will exhibit headspace concentrations of ^{222}Rn of 538,381 pCi/L (see §V.B.2.b, Table 10).

3. Summary of ^{222}Rn Source and Concentration Calculations

Gas stream rates and concentrations are collected in Table 15. Carbon Bed effluents are collected in Table 16.

Table 15: Gas Stream Rates and Concentrations

Vessel	Silo 1	Silo 2	TTA 1A	TTA 1B	TTA 2A	TTA 2B	FWTF	Sum
Phase	Gas Stream Rates (ft^3/min) (before chiller)							
1	250	250	0	0	0	0	0	500
2	375	375	62.5	62.5	62.5	62.5	0	1000
Phase	Gas Stream ^{222}Rn (pCi/L) (before chiller)							
1	252,292	249,715	0	0	0	0	0	251,146
2	1,117,557	1,117,557	538,381	538,381	538,381	538,381	538,381	972,763

Table 16: Carbon Bed Effluents

Phase	Q_{out} (ft^3/min)	C_{out} (pCi ^{222}Rn/L)
1	454	159
2	908	10,571

C. Condensate ^{222}Rn Concentrations

Sections V.A.2 and V.A.3 provide for calculation of the quantity and activity of condensates from the chiller. Given the continuous nature of collection, short half-life of ^{222}Rn, and the (See Assumption 6) time of aggregation and decay, the majority of the radon will have decayed at the time of discharge.

During the time of collection, the rate of change of ^{222}Rn in the condensate is:

$$dA = (Q_{COND} \cdot C_{COND})dt - \lambda A dt \qquad \textbf{(EQN 30)}$$

Integrating this equation over t = 0 to t_1 with the boundary condition that A = 0 at t = 0,

$$A_{t_1} = \frac{Q_{COND} \cdot C_{COND}}{\lambda} - e^{\left(\lambda \cdot t_1 - \ln\left(\frac{Q_{COND} \cdot C_{COND}}{\lambda}\right)\right)} \qquad \textbf{(EQN 31)}$$

where:

t_1	=	End of condensate collection interval, hr
A_{t1}	=	Activity in condensate collected by time t_1, pCi
Q_{COND}	=	Condensate collection rate, L/hr
C_{COND}	=	Condensate activity at collection, pCi/L
λ	=	^{222}Rn decay constant, 7.5536E-3/hr

Following the period of condensate collection, the collected activity will simply decay until the condensate is discharged such that

$$A_{t_2} = A_{t_1} \cdot e^{-\lambda(t_2 - t_1)} = \left(\frac{Q_{COND} \cdot C_{COND}}{\lambda} - e^{\left(\lambda \cdot t_1 - \ln\left(\frac{Q_{COND} \cdot C_{COND}}{\lambda}\right)\right)}\right) \cdot e^{-\lambda(t_2 - t_1)}$$

(EQN 32)

As EQN 32 is linear with respect to the product ($Q_{COND} \cong C_{COND}$) one may assume a unit value for this product (1 pCi/hr) whereupon the activity is a simple product. For Assumption 6 durations of t_1 = 20 days (480 hours) and t_2 = 35 days (840 hours), the activity in the collected condensate at the time of discharge is:

$$A_d = 8.4948\,\text{hr} \cdot \left(Q_{COND} \cdot C_{COND}\,\frac{\text{pCi}}{\text{hr}}\right)[=]\ \text{pCi} \qquad \textbf{(EQN 33)}$$

where:

A_d	=	^{222}Rn activity in discharged condensate, pCi

The meaning of EQN 33 is that over the 20 days of collection of unit ^{222}Rn activities and 15 days of decay, 8.4948 pCi of ^{222}Rn activity remain to be discharged with the collected condensate assuming that the collection rate was 1 pCi/hr.

The decayed activity of the condensate is evaluated using EQNs 8 and 9 => Q_{COND}; EQN 10 => C_{COND} (as collected); Q is total Q_{COND} over 20 days (See Assumption 6); EQN 33 => A_d. The concentration $C_{Discharge} = A_d/Q$. The results of these calculations, using Table 4 and Table 15 input are provided in Table 17.

Table 17: Discharge Condensate ^{222}Rn Concentration							
Phase	Q_{in} (ft^3/min)	C_{in} (pCi/L)	Q_{Cond} (L/min)	C_{Cond} (pCi/L)	A_d (pCi)	Q (L)	$C_{Discharge}$ (pCi/L)
1	500	251,146	0.2950	138,124	2.077E+07	8,497	2,443.9
2	1,000	334,520	0.5900	184,044	5.535E+07	16,993	3,257.1

Check Calculation of ^{222}Rn Equilibrium Coefficient

Reference 7 provides the Henry's Law coefficient (K) of ^{222}Rn as 2,260 atm.

Basis: 1 Ci ^{222}Rn/L in the gas

$$SpA = \frac{\ln(2)}{t_{1/2}} \cdot \frac{N_{Avg}}{MW} \cdot \frac{Ci \cdot s}{3.7E10 dis} = 153{,}841.7 \frac{Ci}{g}$$

Gas Phase Pressure:

$$P = \frac{1Ci}{L} \cdot \frac{g}{153{,}841.7Ci} \cdot \frac{mol}{222g} \cdot \frac{22.4L \cdot atm}{mol} = 6.558747E-7\,atm$$

Henry's Law: P = K X (X = liquid phase concentration)

$$\therefore X = \frac{6.558747E-7\,atm}{2260\,atm} = 2.9021E-10 = \frac{n\,(atoms)\,solute}{n\,(molecule)\,solvent}$$

For 1 liter of water:

$$n\,(molecule)\,solvent = 1L \cdot \frac{1000g}{L} \cdot \frac{mol}{18.0152\,g} \cdot \frac{6.02252E23\ molecule}{mol} = 3.343021E25\,molecules$$

$$n^{222Rn} = X \cdot n\,(molecule)\,solvent = (2.9021E-10) \cdot (3.343021E25) = 9.7101784E15\,atoms$$

$$\therefore \frac{Ci\,^{222}Rn/L\,water}{Ci\,^{222}Rn/L\,air} = \frac{9.7101784E15\,atoms}{L} \cdot \frac{mol}{6.02252E23\,atoms} \cdot \frac{222\,g}{mol} \cdot \frac{153{,}841.7\,Ci}{g} = 0.5501744$$

D. Consequences of ^{222}Rn Stack Emissions

Evaluations of this section are intended to provide the transforms necessary to evaluate process releases of ^{222}Rn in relation to stated limits described in Table 1.

4. General Exposure Evaluation

The consequences of ^{222}Rn stack release from the RCS is a function of the:

- Activity and flow rate from the RCS to the stack,
- Building ventilation entering the stack,
- Height and exit diameter of the stack, and
- Gaseous dispersion.

The total stack flow rate is:

$$Q_{stack} = Q_{bld} + Q_{RCS} \; [=] \; \frac{m^3}{s} \qquad \textbf{(EQN 34)}$$

Where:

Q_{stack} = Stack effluent rate, m^3/s
Q_{bld} = Building ventilation rate, m^3/s
Q_{RCS} = RCS discharge to the stack, m^3/s

Under most conditions of operation, Q_{RCS} is a fraction of the gas leaving the carbon beds as that flow, and its ^{222}Rn concentration, will be modified by makeup air and return of air to the silos or TTA vessels.

As the active vessels and equipment are operated under partial vacuum, the building gas radon concentration may be neglected and the stack ^{222}Rn concentration expressed as:

$$C_{stack} = \frac{C_{RCS} \cdot Q_{RCS}}{Q_{stack}} \; [=] \; \frac{pCi}{m^3} \qquad \textbf{(EQN 35)}$$

The ^{222}Rn atmospheric concentration at a point of exposure is:

$$C_{atm} = C_{stack} \cdot Q_{stack} \cdot \chi/Q \; [=] \; \frac{pCi}{m^3} \qquad \textbf{(EQN 36)}$$

Where:

C_{atm} = Ground level atmospheric concentration at a given point, pCi/m^3
χ/Q = Atmospheric dispersion coefficient for a specified weather condition, distance, and direction, s/m^3

With the determination of appropriate χ/Q values, atmospheric concentrations at points of exposure may be evaluated and compared to limits of Table 1.

5. Definition of Limits

As defined in Table 1, the off-site exposure limit is 0.5 pCi ^{222}Rn/L at a range of 350 m. On-site exposure limits are in terms of "Working Levels" (WL). Reference 11 provides that:

> *Working Level (WL) is any combination of short-lived radon daughters (for radon-222: polonium-218, lead-214, bismuth-214, and polonium-214...) in 1 liter of air that will result in the ultimate emission of 1.3×10^5 MeV of potential alpha particle energy.*

To appropriately describe WL units to a comparison of EQN 36 results, WL must be converted to an equivalent expression of ^{222}Rn concentration.

Application of the WL definition was presaged within Reference 12 to describe that the worker exposure hazard primarily lies in the concentration of the radon daughters in the air, rather than simply of the radon, because of inhalation and body uptake of the solid daughters. As described in Reference 12, and because of gaseous filtration in the RCS, a filtered gas stream is no longer in equilibrium between ^{222}Rn and its daughters. By Assumption 19, the daughters can be considered negligible immediately following treatment and one must determine the activity of the daughters at any later time of exposure due to their ingrowth.

Applying the commercial program RADDECAY (Grove Engineering, Reference 13) to a chosen unit release of 1 Ci of ^{222}Rn with a decay time of 200 seconds (Assumption 17, distance/velocity), the daughter alpha energy attributed by such a release may be determined as in Table 18.

Table 18: Daughter Alpha Energy Per Initial Ci ^{222}Rn (200s decay)

Unit	Isotope						Ref.
	^{222}Rn	^{218}Po	^{214}Pb	^{214}Bi	^{214}Po	Total	
Ci at t=200s	0.99958	0.53106	0.024985	0.0010026	0.0010024		13
SpA (Ci/g)	1.54E+05	2.83E+08	3.28E+07	4.46E+07	3.21E+14		3
MW	222	218	214	214	214		3
g	6.50E-06	1.88E-09	7.62E-10	2.25E-11	3.12E-18		
atoms	1.76E+16	5.19E+12	2.14E+12	6.33E+10	8.78E+03		
Daughter Alpha (MeV/atom)		13.6898014	7.689801	7.688462	7.688462		14
Daughter Alpha (MeV/Ci ^{222}Rn Initial)		7.10E+13	1.65E+13	4.86E+11	6.75E+04	8.80E+13	

As developed in Table 18, with regard to Reference 11, a gas stream with a concentration of 1 Ci ^{222}Rn/L at release (and at the release point) will result in a 200 s alpha potential of:

$$WL = \frac{\alpha(\text{MeV/Ci/L Initial})}{1.3\text{E5 MeV/WL}} = \frac{8.8\text{E13}}{1.3\text{E5}} = \frac{6.769\text{E8 WL}}{\text{Ci }^{222}\text{Rn Initial/L}} \qquad \textbf{(EQN 37)}$$

The atmospheric concentrations corresponding to the WL limits of Table 1 may be derived as:

$$C_{atm,0.2WL} = \frac{0.2\,WL}{\left(\dfrac{6.769\text{E8 WL}}{\text{Ci }^{222}\text{Rn Initial/L}}\right)} \cdot \frac{10^{12}\,\text{pCi}}{\text{Ci}} = 295.5\,\frac{\text{pCi}}{\text{L}} \qquad \textbf{(EQN 38)}$$

and

$$C_{atm,0.02WL} = \frac{0.02\,WL}{\left(\dfrac{6.769\text{E8 WL}}{\text{Ci }^{222}\text{Rn Initial/L}}\right)} \cdot \frac{10^{12}\,\text{pCi}}{\text{Ci}} = 29.55\,\frac{\text{pCi}}{\text{L}} \qquad \textbf{(EQN 39)}$$

With these transformations, Table 1 values may be expressed as represented in Table 19.

Table 19: Ambient Air Limitations

Location	Distance (m)	Limit
Off-Site	350	0.5 pCi ^{222}Rn/L
On-Site	100	295.5 pCi ^{222}Rn/L, instantaneous
On-Site	100	29.55 pCi ^{222}Rn/L, weekly average

6. On-Site Dispersion Coefficients

On-site consequences and compliance with the limits of Table 19 require that χ/Q values be developed for application in EQN 34. The atmospheric conditions for instantaneous exposure limits (See Assumption 17) for this analysis are those of an inversion engendered fumigation (Pasquille Class G – very stable).

Reference 15 provides χ/Q for fumigation as:

$$\chi/Q = \frac{EXP\left[\frac{-y^2}{2\sigma_{y,G}^2}\right]}{(2\pi)^{1/2} \cdot H\,\sigma_{y,G} \cdot \bar{u}} \quad [=] \quad \frac{s}{m^3} \qquad \textbf{(EQN 40)}$$

Where:

y	=	crosswind distance, y = 0 at center of plume, m
$\sigma_{y,G}$	=	Horizontal dispersion parameter, Class G, m
H	=	Height of inversion lid, m
u	=	mean inverse wind speed, m/s

Table 11.3.3 of Reference 15 provides that $\sigma_{y,G}$. 2/3 $\sigma_{y,F}$. Figure 11.3-3 (See Ref. 15) provides $\sigma_{y,F}$ versus distance, wherein $\sigma_{y,F}$ (100m) = 4m. Thus,

$$\sigma_{y,G} = \frac{2}{3}\sigma_{y,F} = \frac{2}{3}(4m) = \frac{8}{3}m \qquad \textbf{(EQN 41)}$$

Substituting y = 0, u = 0.5 m/s, and H = 200 ft (See Assumption 17) and $\sigma_{y,G}$ into EQN 40:

$$\chi/Q_{Onsite,inst.} = \frac{EXP\left[\frac{-(0)^2}{2\left(8/3\right)^2}\right]}{(2\pi)^{1/2} \cdot \left(200\text{ft} \cdot \frac{0.3048\text{m}}{\text{ft}}\right)\left(8/3\,\text{m}\right)\left(\frac{0.5\text{m}}{\text{s}}\right)} = 4.9082\text{E}-03\frac{s}{m^3}$$

This result may be applied before establishment of actual gas rates and concentrations to determine allowed release rates by reforming EQN 36 as:

$$C_{stack} \cdot Q_{stack} = \frac{C_{atm}\left(\frac{\text{pCi}}{\text{L}}\right)}{\chi/Q\left(\frac{\text{s}}{\text{m}^3}\right) \cdot \left(\frac{\text{m}^3}{1000\text{L}}\right)} \quad [=] \quad \frac{\text{pCi}}{\text{s}} \qquad \textbf{(EQN 42)}$$

Application of EQN 42 for instantaneous release and on-site exposure limits yields:

$$\left(C_{stack} \cdot Q_{stack}\right)_{0.2WL} = 6.020\,E7\,\text{pCi/s}$$

Weekly average limits for on-site workers may be established based upon a χ/Q applicable to such exposure. For the purposes of weekly average exposures, the atmospheric conditions for this analysis are those of a Table meteorology (Pasquille Class F).

Reference 16 (SCREEN 3 model) provides the capability to evaluate low-level hourly exposure to contaminants released to the atmosphere. Application of the Screen3 model (see Ref. 16) with the input parameters of Table 18 results in a hourly χ/Q of :

$$\chi/Q_{On-site,hourly} = \frac{54.89\frac{\mu g}{m^3}}{1\frac{g}{s}\cdot 10^6\frac{\mu g}{g}} = 5.489E-05\frac{s}{m^3} \qquad \textbf{(EQN 43)}$$

Table 20: Silos 1 & 2 AWR Screen3 Model Inputs	
Simple Terrain Inputs	Input Value
Source Type	Point
Emission Rate (g/s)	1.000
Stack Height (m)	45.72
Stack Inside Diameter (m)	0.6096
Stack Exit Velocity (m/s)	1.6170
Stack Gas Exit Temperature (K)	293.0
Ambient Air Temperature (K)	293.0
Receptor Height (m)	0.0000
Urbal/Rural Option	Rural
Building Height (m)	18.29
Minimum Horizontal Building Dimension (m)	48.77
Maximum Horizontal Building Dimension (m)	48.77

The value of the parameter inputs into the SCREEN 3 model will be notable to the reviewer as differing from specific values of flow and stack inside diameter used in the succeeding sections of the calculation; such deviation is related to the use of the conservative χ/Q preliminarily utilized in the SCREEN 3 model originally to define the needed stack height for the RCS. The stack diameter and flowrate through the stack changed because the building ventilation was added to the RCS flow out the stack. The revisions resulted in a factor of five increase in the stack flowrate. The original χ/Q value was retained and used since the use of the revised parameters would result in a lower dispersion coefficient, χ/Q which would yield lower onsite weekly average concentrations and the concentration calculated is already three to four orders of magnitude below the allowable limit.

To consider weekly averaged exposures, one must adjust the hourly dispersion factor to address the site meteorological joint frequency distribution. Equations D and H of Table 11.3.1.1 (see Ref. 15) provide instantaneous and long-term sector-averaged expressions of χ/Q from elevated sources. The ratio of these equations provides a factor to account for the varying wind conditions as:

$$\frac{\chi/Q_{\text{Long-term,sector-avg}}}{\chi/Q_{\text{Instantaneous}}} = \sqrt{\frac{2}{\pi}} \cdot \sigma_{y,F} \cdot \frac{0.01f}{2\left(x/n\right)} = 0.03064 \qquad \textbf{(EQN 44)}$$

Where:

f	=	sector frequency, maximum = 12% (see Ref. 1e)
x	=	distance, 100 m
n	=	wind sectors (16)
σ	=	4 for 100 meters (Reference 15, Figure 11.3.3)

The appropriate weekly χ/Q for weekly average exposures may be evaluated from EQNs 43 and 44 as:

$$\chi/Q_{Onsite,weekly} = \chi/Q_{hourly} \cdot 0.03064 = 1.68E-06 \frac{s}{m^3} \qquad \textbf{(EQN 45)}$$

Application of EQN 42 for weekly average release and on-site exposure limits yields:

$$\left(C_{stack} \cdot Q_{stack}\right)_{0.02WL} = 1.757E+09\,\text{pCi/s}$$

This section's results are applied to design basis gas streams in §V.D.5, below.

7. Off-Site Dispersion Coefficients

Reference 17 (CAP88-PC model) provides the capability to evaluate low-level chronic exposure to radionuclides released to the atmosphere.

Application of CAP88-PC for the Fernald Silos AWR Project with the Table 21 inputs results in a matrix of χ/Q values for varied directions and distances provided in Table 22.

From Table 22, the greatest χ/Q is chosen to represent the direction and distance of the greatest off-site dose consequence. Thus, χ/Q for off-site application in EQN 36 is $\chi/Q_{off\text{-}site}$ = 5.020 E-07 s/m^3.

Table 21: CAP88-PC Inputs	
Run Options	Individual type; create χ/Q table
Met. Data	Wind File 93814 (Covington, Greater Cincinnati)
Source Data	Stack, 45.72 m (150 ft); 0.93 m (3 ft) diameter; momentum plume rise at 6.18 m/s (~8,600 ft^3/min)
Agri. Data	Rural, default
Nuclide Data	Rn-222, 1 Ci/yr

Table 22: Off-Site CAP88-PC χ/Q Results (s/m^3)

Dir	Distance (meters)					
	250	350	500	700	750	1500
N	2.253E-07	3.019E-07	3.831E-07	4.453E-07	4.507E-07	3.352E-07
NNW	1.430E-07	1.768E-07	1.961E-07	2.054E-07	2.047E-07	1.412E-07
NW	1.108E-07	1.394E-07	1.575E-07	1.663E-07	1.660E-07	1.147E-07
WNW	1.379E-07	1.740E-07	1.913E-07	1.963E-07	1.947E-07	1.303E-07
W	2.512E-07	3.092E-07	3.312E-07	3.325E-07	3.289E-07	2.162E-07
WSW	1.641E-07	2.066E-07	2.221E-07	2.203E-07	2.172E-07	1.393E-07
SW	1.665E-07	1.989E-07	2.134E-07	2.182E-07	2.165E-07	1.434E-07
SSW	1.363E-07	1.701E-07	1.907E-07	2.009E-07	2.001E-07	1.351E-07
S	2.156E-07	2.832E-07	3.433E-07	3.830E-07	3.847E-07	2.708E-07
SSE	1.348E-07	1.650E-07	1.866E-07	1.976E-07	1.968E-07	1.313E-07
SE	1.282E-07	1.660E-07	2.072E-07	2.364E-07	2.377E-07	1.647E-07
ESE	1.737E-07	2.248E-07	2.808E-07	3.180E-07	3.191E-07	2.151E-07
E	2.577E-07	3.414E-07	4.224E-07	4.724E-07	4.734E-07	3.208E-07
ENE	2.009E-07	2.666E-07	3.149E-07	3.375E-07	3.363E-07	2.255E-07
NE	2.391E-07	3.541E-07	4.508E-07	5.010E-07	**5.020E-07**	3.503E-07
NNE	2.088E-07	2.961E-07	3.913E-07	4.619E-07	4.681E-07	3.530E-07
Max	2.577E-07	3.541E-07	4.508E-07	5.010E-07	**5.020E-07**	3.530E-07
Max. Dir.	NNE	NE	NE	NE	NE	NNE

8. Design Basis Emission Consequences

Application of EQNs 34, 35, and 36 yield the results of Table 23, a comparison of operating conditions with regulatory requirements.

Table 23: Silos 1 & 2 AWR Design Basis Exposure, ^{222}Rn

Exposure Basis					On-Site (instant.)	On-Site (weekly avg.)	Off-Site
Limit (pCi ^{222}Rn/L)					295.5	29.55	0.5
χ/Q (s/m^3)					4.91E-03	1.68E-06	5.020E-07
RCS Phase	C_{RCS} (pCi/L)	Q_{RCS} (ft^3/min)	Q_{stack} (ft^3/min)	C_{stack} (pCi/L)	C_{atm} (pCi/L)		
1	159	50	9,360	0.85	0.018	6.32E-06	1.89E-06
2	10,076	1,000	10,310	977.00	23.333	7.99E-03	2.39E-03

Assumption 5 provided that the RCS building ventilation will be 9310 ft^3/min. Table 23 results and limits demonstrate compliance with allowable emissions of ^{222}Rn regarding worker and public exposure.

As noted earlier in this calculation, minor differences for concentrations within this calculation are a result of round off and/or truncation error.

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APPENDIX 5.3

STORMWATER DRAINAGE PLAN

4448

STORMWATER DRAINAGE PLAN
ACCELERATED WASTE RETRIEVAL PROJECT

Document No. 40710-PL-0008

May 29, 2002

Revision B

FERNALD
Environmental Management Project

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A	Frank Parton	Grant Morar	Stephen Hungate	May 8, 2002	ALL
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Revision Sheet

4448

Revision	Date	Pages Affected	Reason for Revision
B	5/29/02	ALL	Fluor Fernald Comments

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ACRONYMS

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AWR	Accelerated Waste Retrieval
AWWT	advanced wastewater treatment
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
NPDES	National Pollutant Discharge Elimination System
PPDD	Pilot Plant Drainage Ditch

1.0 INTRODUCTION

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The purpose of this Stormwater Drainage Plan is to provide a stormwater and erosion/sediment control master plan for the Silos projects. The Stormwater Drainage Plan includes all Silos 1 and 2 projects, the Silo 3 project, and the Accelerated Waste Retrieval (AWR) project. The Overall Stormwater Plan and the Overall Drainage Discharge Plan (Sketch No. CSK-001 and CSK-002) present a pictorial view of the Silos area and the proposed drainage patterns. A more detailed view of the individual areas can be seen on sketches CSK-003 thru CSK-007. Actual drainage calculations, drainage design and erosion and sediment control will be accomplished within the project packages.

The objective of each of the project packages is to maintain or improve the drainage runoff and erosion and sediment controls within the Silos area. Erosion control features such as the use of silt fencing, sediment traps and routing of water through existing stormwater basins will be employed to minimize stormwater and erosion effects to the Pilot Plant Drainage Ditch (PPDD) and Paddy's Run.

1.1 SILOS 1 AND 2 PROJECT

There are several design packages under the Silos 1 and 2 Project, they are:

- Silos 1 and 2 Remediation Facility Package,
- Silos 1 and 2 Remediation Facility Foundation Excavation Package,
- Silos 1 and 2 Warehouse Site Package,
- Silos 1 and 2 Trailer Relocation Package,
- Silos 1 and 2 Railroad Package, and
- Silos 1 and 2 Drainage Modifications Package.

The following paragraphs describe the existing and proposed stormwater control measures at the Silos 1 and 2 Remediation Facility Project sites to ensure the proper management of stormwater. The areas can also be seen on sketches CSK-003 Through CSK-005.

Existing—The Silos 1 and 2 Remediation Facility Project area is contained within two drainage watersheds. The areas north of the existing K-65 trench generally drain to the north and flow through a series of ditches and pipes to an existing 30 in. pipe. The inlet of the 30 in. pipe is located just south of the Bio-Surge Lagoon and north of 2nd Street. A portion of the area where the proposed warehouse facility will be located flows through a series of ditches and pipes to the 30 in. pipe. A small area of the warehouse site drains by pipe north under 2nd Street and discharges into a ditch along 2nd Street. The water in this ditch is collected in a concrete sump and pumped to the Bio-Surge Lagoon for small rain events. When the water in this ditch reaches a certain depth it flows by gravity through a pipe to a ditch that leads to the 30 in. pipe. The 30 in. pipe flows south traversing the Silos 1 and 2 Remediation Facility site and discharges directly into the PPDD.

Areas to the south of the existing K-65 trench drain to the south through a series of existing ditches, pipes and other drainage structures. This water eventually reaches the existing stormwater basin located in the southeast quadrant of the site and then

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discharges into the PPDD, which discharges through National Pollutant Discharge Elimination System (NPDES) outfall STRM 4005 into Paddy's Run. Portions of the existing K-65 trench will be removed in the future. The area will be backfilled and graded as a high point to ensure the drainage divides will remain as they are now.

Proposed— Control measures will be employed during implementation of Silos 1 and 2 Project construction activities to assure that impacts to natural resources in the Paddy's Run corridor are minimized. The areas south of the K-65 ditch will continue to drain to the existing stormwater basin located in the southeast quadrant of the site. The area north of the K-65 trench disturbed by the Silos 1 and 2 Warehouse Facility will now drain to the south through a series of ditches and pipes and discharge into the same existing stormwater basin. The remainder of the areas north of the K-65 trench will continue to drain to the north into the 30 in. pipe. The Stormwater Management Calculation (35H19603-31B-C-003) prepared as a part of the Silos 1 and 2 Project evaluates the existing conditions and of the stormwater basin and then routes the proposed runoff through the basin. The calculation concludes the stormwater basin will successfully route this water through the basin with basically the same discharge as the existing conditions.

The majority of the area north of the existing K-65 trench disturbed by the Trailer Relocation Project will continue to drain to the north through the existing ditches and pipes and eventually flow to the existing 30 in. pipe. The remaining small portion (southeast corner) will be collected by a catch basin and flow by pipe into the drainage system leading to the existing Stormwater Drainage Basin.

1.2 AWR PROJECT

As described in the AWR Project Site Preparation Package, previously submitted and approved, the AWR Project area is contained within two drainage watersheds. The following paragraphs describe the existing and proposed stormwater control measures at the AWR Project site to ensure the segregation and proper management of uncontaminated and contaminated stormwater.

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

Areas not surrounded by the perimeter channel ultimately drain to the PPDD, which runs south of the project area and enters Paddy's Run at NPDES outfall STRM 4005. As illustrated on Drawing No. CSK-006, the majority of this area reaches the PPDD via an existing storm water basin at the southeast quadrant of the project area. Two culverts cross the southern perimeter road and discharge stormwater to the PPDD; one culvert crosses the west perimeter road, draining to the Waste Pit Area Runoff Control Sump.

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

AWR Project facility construction and operations activities implemented under this Remedial Design package will not change or move existing drainage divides. Erosion and siltation in the concrete channels surrounding Silos 1 and 2 will be prevented through erosion and sediment control measures identified in Section 2.5. The perimeter road functions as the outer limit of operations. Rainfall will not directly contact the Transfer Tank Area process area since it is equipped with a roof and gutter system. Therefore, contaminated stormwater from this area is not anticipated.

Stormwater drainage during facility construction and operation (berm excavation and waste retrieval) activities is illustrated on Drawing CSK-006. Drainage patterns will be maintained to provide segregation of potentially contaminated (e.g. silo berm area) stormwater from clean stormwater. Drainage from the Silo 1 and 2 domes and berms will continue to be collected by the existing trench system and discharged to the Waste Pit Area Runoff Control Sump. As detailed on drawing CSK-006, silt fence and sediment traps will be utilized to prevent silt buildup in the trench system. The trench will be included in the erosion and sediment control inspections to provide additional assurance that it has not become obstructed. In addition, to provide protection in the unlikely event of a leak from the slurry pipeline, controls are designed so the area under the slurry line drains to the Stormwater Basin located southeast of the AWR project area.

1.3 SILO 3 PROJECT

The following paragraphs describe the existing and proposed stormwater control measures at the Silo 3 Project site to ensure the proper management of stormwater. The Silo 3 area can be seen on drawing CSK-007.

Existing—The stormwater management facilities for the Silo 3 area were approved and constructed under a previous project. These facilities consist of a series of catch basins and pipes that collect run-off from the Interim Storage Area concrete pad and route this runoff north through an existing stormwater basin which discharges to the Waste Pit Area Runoff Control Sump which was installed as part of CERCLA Removal Action 2 and is located 1,000 ft west-northwest of the silos. The sump has a capacity of 350,000 gallons. This sump also receives drainage from the waste pits to the north. A 12-in. main leads from the sump into the Bio-Surge Lagoon, which discharges to the AWWT facility. The runoff from the areas to the west of Silo 3 and around Silo 4 are collected in ditches and routed to the existing pipe system under the ISA pad. The Silo 3 Drainage Calculation (35H19605-31B-C-005) was prepared as a part of the Silo 3 Project. This calculation compares the existing drainage runoff to the proposed runoff from the

Silo 3 Project. The calculation concludes that the existing drainage facilities are adequately sized to accommodate the proposed Silo 3 Project without any adverse effects to off-site areas. The updated drainage plan for Silo 3 will be submitted with the revised Silo 3 RD package.

1.4 CONCLUSIONS

The AWR Project will maintain the existing drainage patterns previously submitted and approved. The potentially contaminated runoff from the silo berms will continue to be collected in the existing Silos 1 and 2 trench drain and be routed to the Waste Pit Sump. The runoff from the areas south of the existing Silos 1 and 2 site will be collected in catch basins and pipes and routed directly to the PPDD.

The Silo 3 Project will also maintain the drainage patterns previously submitted and approved. The majority of the runoff will be collected on the ISA pad. The remainder of the runoff will be collected by ditches and routed to the piping running under the ISA pad. All of this water will be routed to the Waste Pit Sump.

The Silos 1 and 2 Remediation Facility Project (all packages) will for the most part continue to maintain the previously approved drainage patterns. The only exception is the majority of the warehouse area and a small portion of the Trailer Relocation area will now be collected and routed to the existing Stormwater Basin located in the southeast quadrant of the site.

The areas north of the existing K-65 trench that are not being disturbed by any of the Silos projects will continue to drain to the north and be routed by a series of pipes and ditches to the existing 30 in. pipe. This water will flow through the 30 in. pipe to the PPDD.

Each of the Silos projects will utilize erosion and sediment controls that will minimize the impacts to the PPDD and Paddy's Run. These controls will include silt fence, sediment traps, inlet protection and other controls to maintain or improve the erosion and sediment protection previously submitted and approved.

The following table describes the expected discharge to each of the receiving structures.

Discharge Receiving Structure	Contributing Drainage Area (SF)	Runoff Coefficient of Drainage	Maximum Flow of Stormwater (CFS)	Reference Calculation
Stormwater Basin	329,532	0.55	30.9	35H19603-31B-C-003
Waste Pit Sump	257,757	0.40	16.9	35H19606-31B-C-001
PPDD	49,753	0.50	4.3	35H19606-31B-C-001
30 inch pipe	162,940	0.55	15.4	35H19606-31B-C-001

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1.5 REFERENCES

1. Rainwater and Land Development (Standards for Stormwater Management, Land Development and Urban Protection), Second Edition, January 1996, Ohio Department of Natural Resources.

2. Construction and Material Specifications, January 1997, Ohio Department of Transportation.

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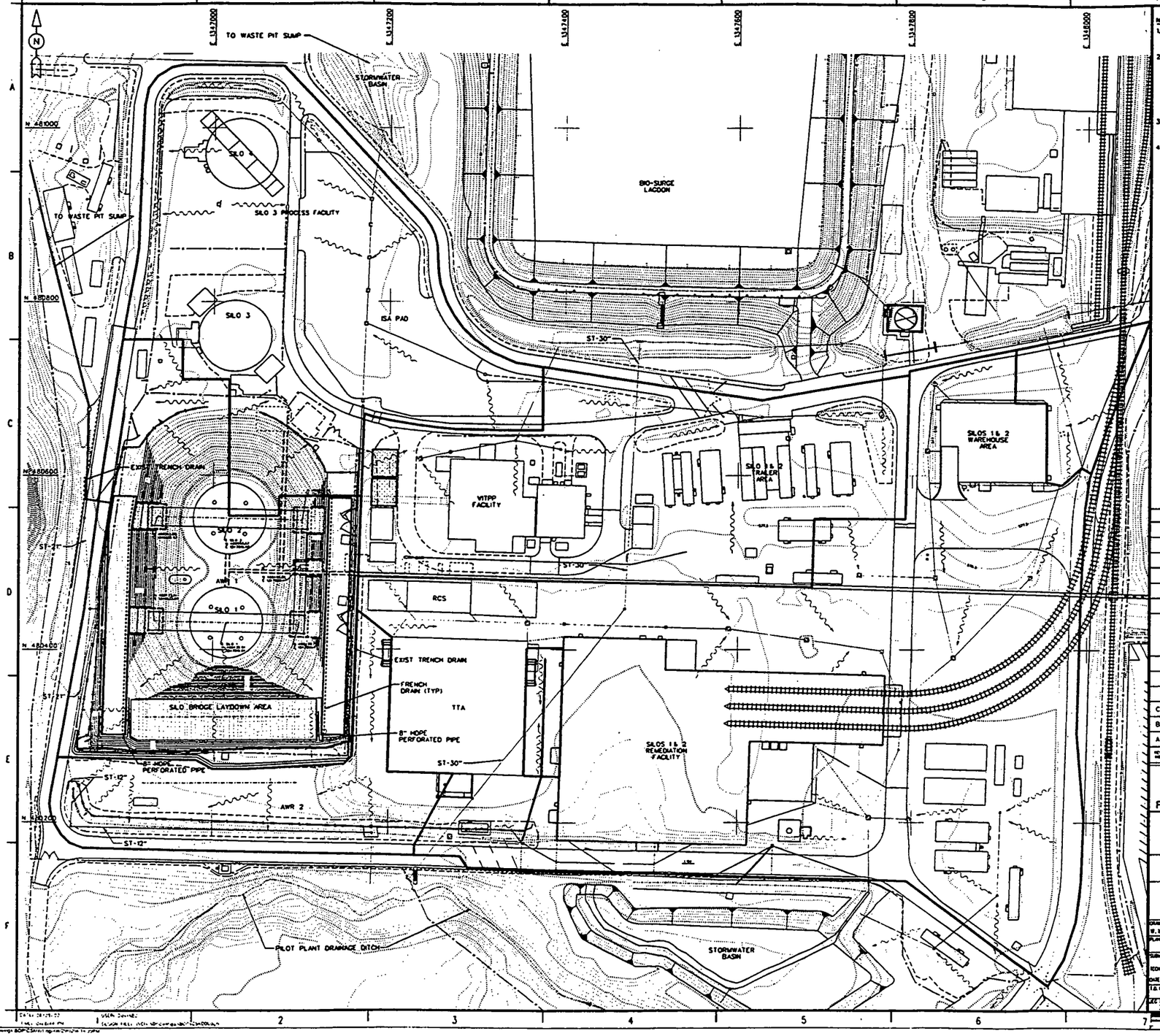
APPENDIX A
STORMWATER DRAINAGE SKETCHES



NOTES:

1. ALL SEDIMENT AND EROSION CONTROL FEATURES SHALL BE INSTALLED AS REQUIRED AND OPERATIONAL PRIOR TO EARTH DISTURBANCE ACTIVITIES.
2. CONTRACTOR SHALL BE RESPONSIBLE FOR REMOVAL OF STORMWATER COLLECTED IN AREAS EXCAVATED BELOW GRADE. ANY DISCHARGE WATER RESULTING FROM PUMPING OF GROUND OR RUNOFF WATER FROM TRENCHES OR OTHER AREAS MUST BE ROUTED THROUGH SEDIMENTATION CONTROL STRUCTURES AND NOT DISCHARGED DIRECTLY INTO RECEIVING CHANNELS. RUNOFF SHALL BE MANAGED IN ACCORDANCE WITH FEMP STORMWATER POLLUTION PREVENTION PLAN AND TRANSPORTED TO AN ON-SITE LOCATION DETERMINED BY THE OWNER.
3. SILT FENCE LOCATIONS SHOWN ARE APPROXIMATE. ADD ADDITIONAL SILT FENCE AND/OR ADJUST LOCATION AS NECESSARY TO MEET FIELD CONDITIONS.
4. CONTRACTOR SHALL PROTECT EXISTING CATCH BASINS AND OTHER STORMWATER CONTROLS DURING CONSTRUCTION.

FLOW ARROW

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PRELIMINARY
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REF DWG NO.	DRAWING TITLE

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SCALE: 1" = 40'

REV NO	ISSUE OR REVISION PURPOSE - DESCRIPTION	DATE	REV BY	APPR
C	ISSUED FOR REVIEW	8/29/02		
B	ISSUED FOR REVIEW	05/29/02	GM	SH
A	ISSUED FOR REVIEW	05/08/02	GM	SH

INITIALS AND DATE

UNITED STATES
DEPARTMENT OF ENERGY
FERNALD ENVIRONMENTAL MANAGEMENT PROJECT

THIS DRAWING PREPARED BY
JE JACOBS

PROJECT NAME
AWR OPTIMIZATION

DRAWING TITLE
CIVIL
AWR
OVERALL STORMWATER PLAN

DRAWN BY	DATE	TECHNICAL LEAD	DATE	CHECKED BY	DATE
W. MARVIN	05/08/02	F.PARTON	05/08/02	C. MORAR	05/08/02

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SUBMITTED FOR 30x ISSUE	SUBMITTED FOR 60x ISSUE	SUBMITTED FOR 90x ISSUE
TECH LEAD	TECH LEAD	TECH LEAD
DATE	DATE	DATE

T.D. NUMBER	PROJECT NO.	DRAWING INDEX CODE NO.	SHEET NO.	REV NO.
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SEC PROJECT NO.	FILENAME
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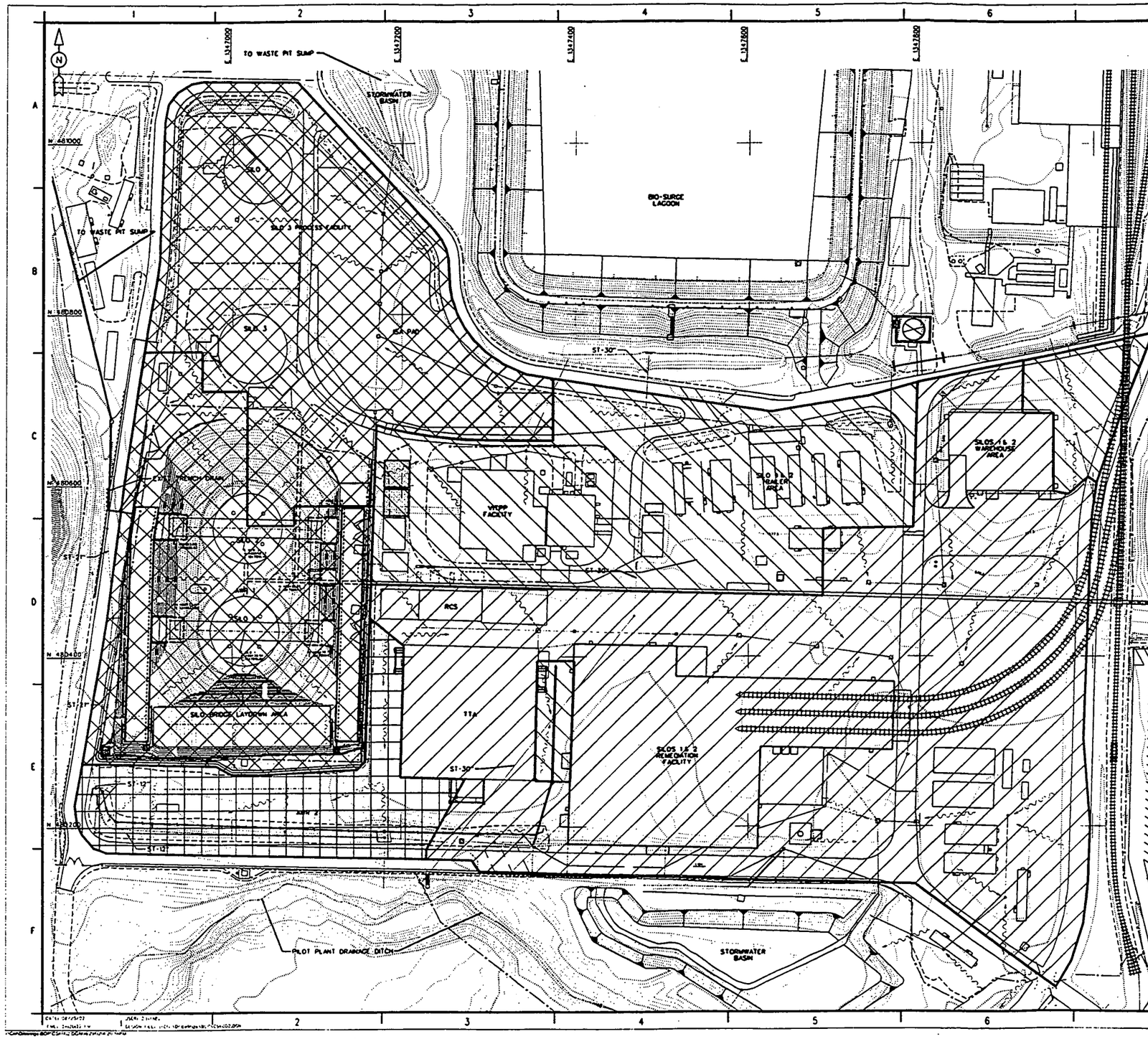

DRAINAGE AREA DISCHARGE LEGEND

- STORMWATER BASIN SOUTHEAST QUADRANT
- EXIST ST-30" TO PILOT PLANT DRAINAGE DITCH
- WASTE PIT SUMP
- PILOT PLANT DRAINAGE DITCH

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AWR OPTIMIZATION

DRAWING TITLE
CIVIL
AWR
OVERALL DRAINAGE DISCHARGE PLAN

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W. MARVIN	05/08/02	F. PARTON	05/08/02	C. MORAR	05/08/02

PLANT/BLDG NO.	FLOOR	SCALE	CLASS
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SUBMITTED FOR 60x ISSUE — TECH LEAD — DATE
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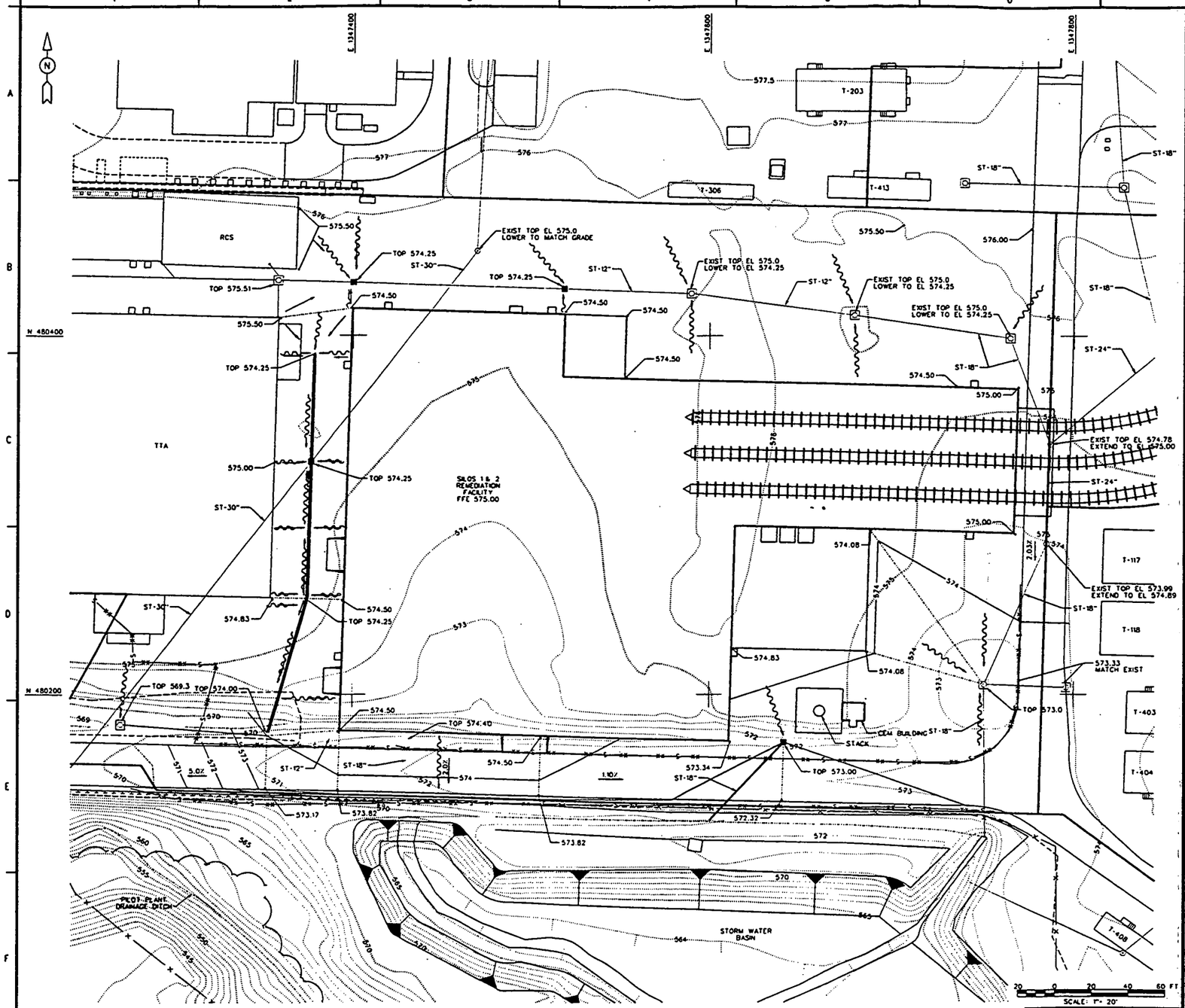

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PROJECT NAME
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CIVIL
REMEDIATION FACILITY AREA
STORMWATER DRAINAGE AND EROSION CONTROL PLAN

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W. MARVIN	05/08/02	F. PARTON	05/08/02	C. MORAN	05/08/02

PLANT/BLDG. NO.	FLOOR	SCALE	CLASS
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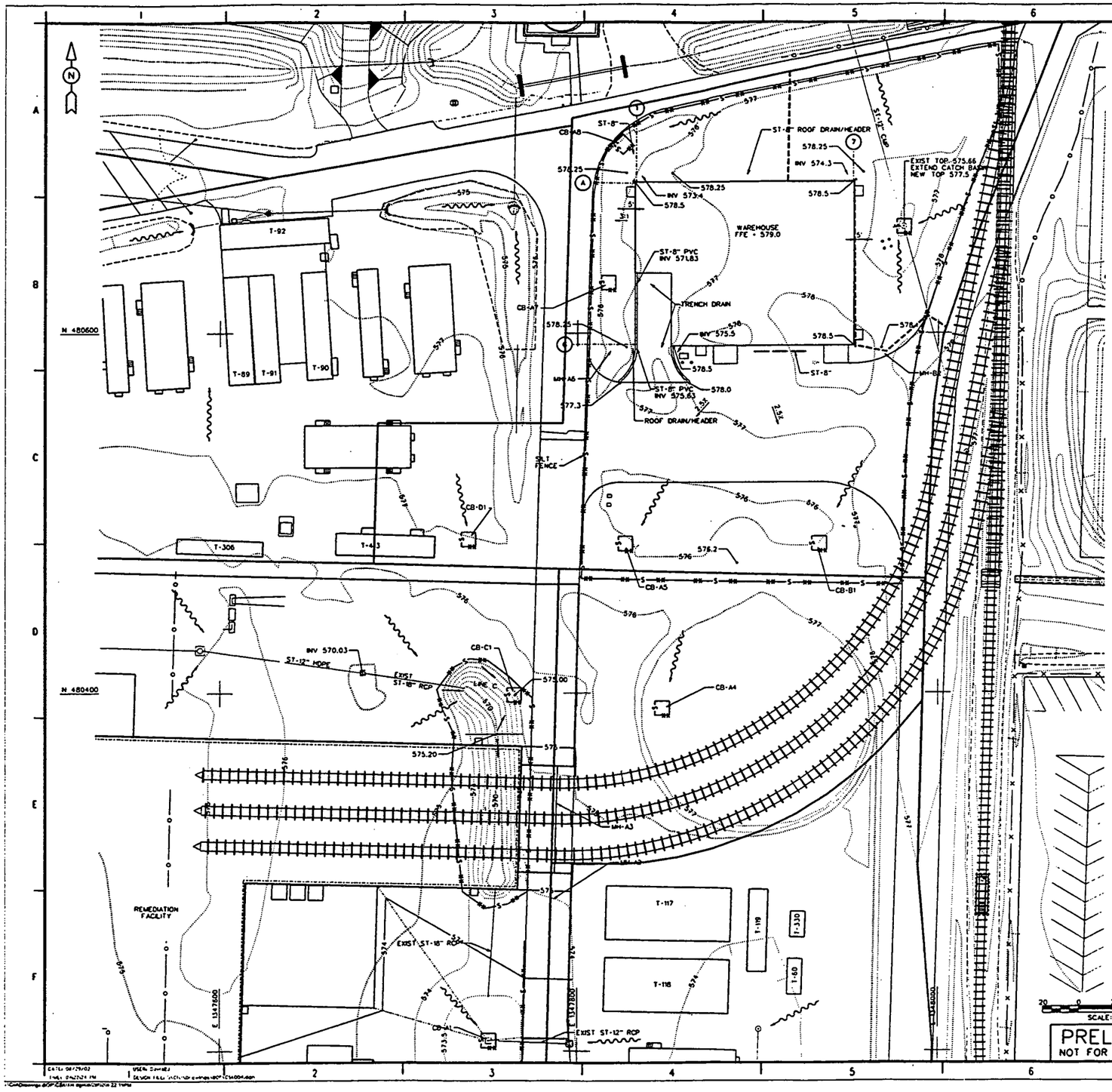

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CIVIL
WAREHOUSE SITE
STORMWATER DRAINAGE AND EROSION CONTROL PLAN

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W. MARVIN	05/08/02	F. PARTON	05/08/02	C. MORAR	05/08/02

PLANT/BLDG NO.	FLOOR	SCALE	CLASS
		1"=20'	U

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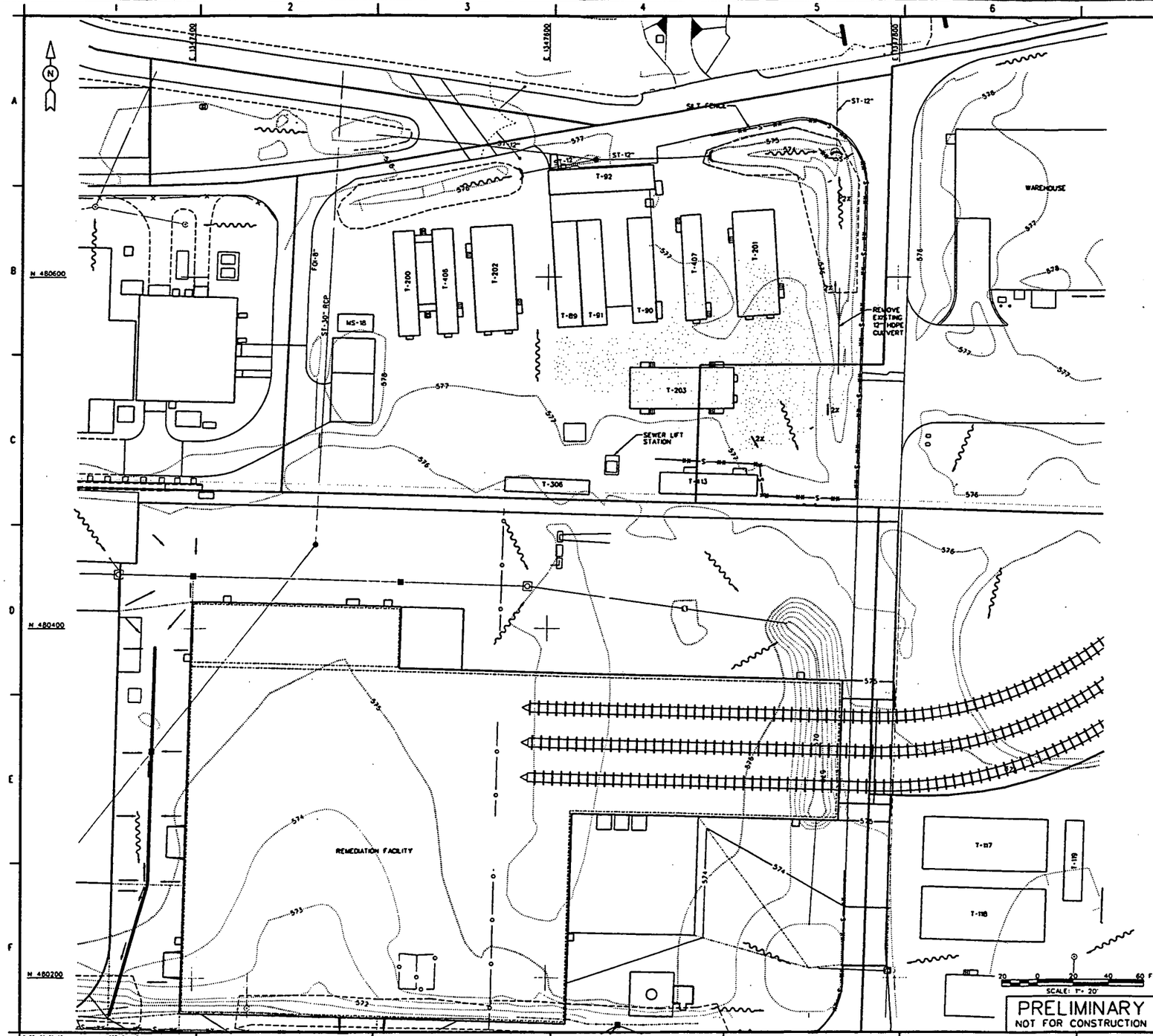

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AWR OPTIMIZATION

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CIVIL
T-92 TRAILER RELOCATION AREA
STORMWATER DRAINAGE AND EROSION CONTROL PLAN

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W. MARVIN	05/08/02	F. PARTON	05/08/02	G. MORAR	05/08/02

PLANT/BLDG NO. | FLOOR | SCALE 1"=20' | CLASS U

SUBMITTED FOR 30% ISSUE — TECH LEAD — DATE
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SUBMITTED FOR 90% ISSUE — TECH LEAD — DATE

T.A. NUMBER N/A | PROJECT NO. 40710 | DRAWING INDEX CODE NO. 35H19606-CSK-005 | SHEET NO. CSK-005 | REV. NO. C

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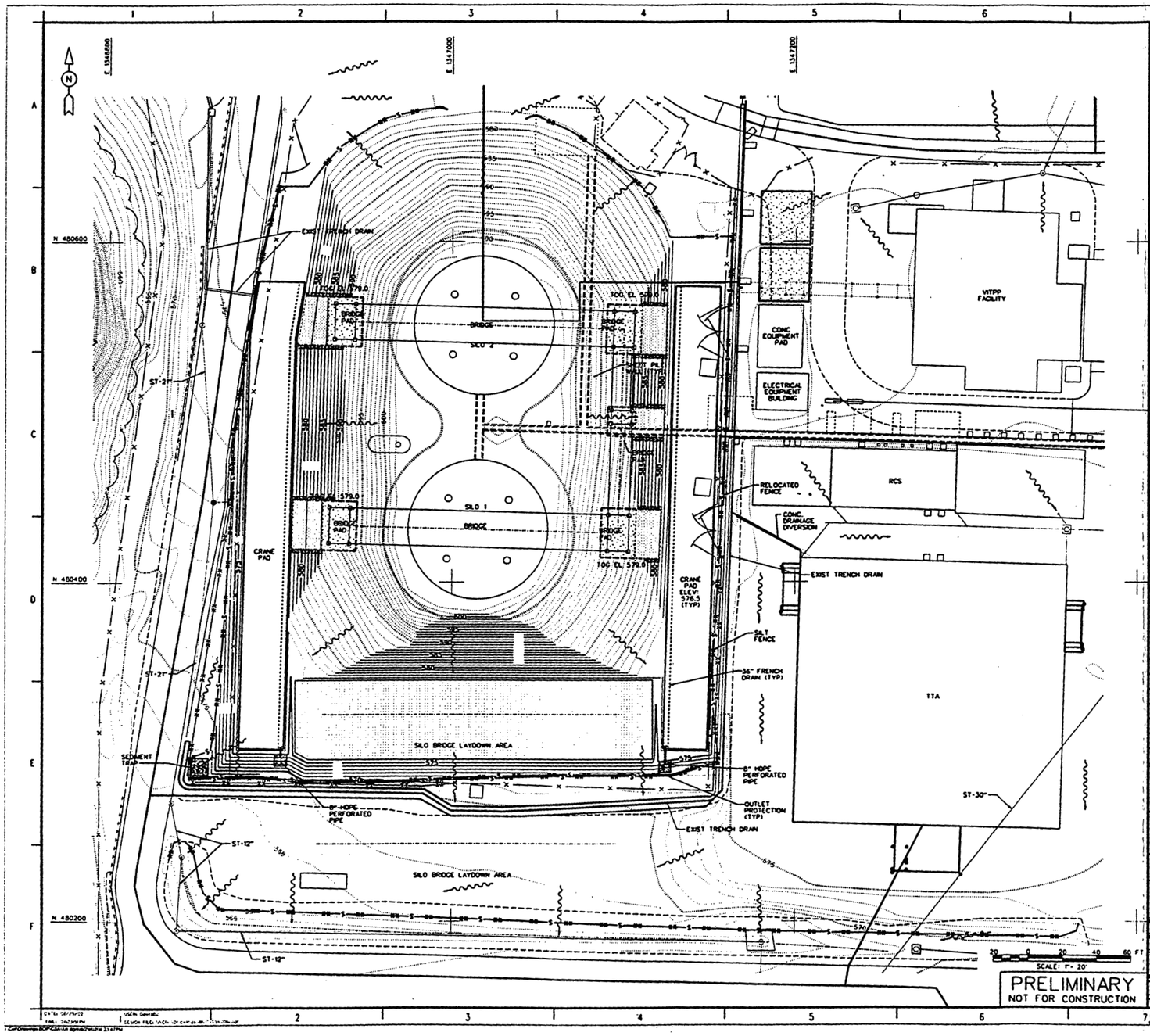

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PROJECT NAME
AWR OPTIMIZATION

DRAWING TITLE
CIVIL
AWR
STORMWATER DRAINAGE AND EROSION CONTROL PLAN

DRAWN BY	DATE	TECHNICAL LEAD	DATE	CHECKED BY	DATE
W. MARVIN	05/08/02	F. PARTON	05/08/02	C. MORAR	05/08/02

PLANT/BLDG NO. | FLOOR | SCALE 1"=20' | CLASS U

SUBMITTED FOR 35% ISSUE | SUBMITTED FOR 60% ISSUE | SUBMITTED FOR 90% ISSUE
TECH LEAD | TECH LEAD | TECH LEAD
DATE | DATE | DATE

T.D. NUMBER N/A | PROJECT NO. 40710 | DRAWING INDEX CODE NO. 35H19606-CSK-006 | SHEET NO. CSK-006 | REV. NO. C

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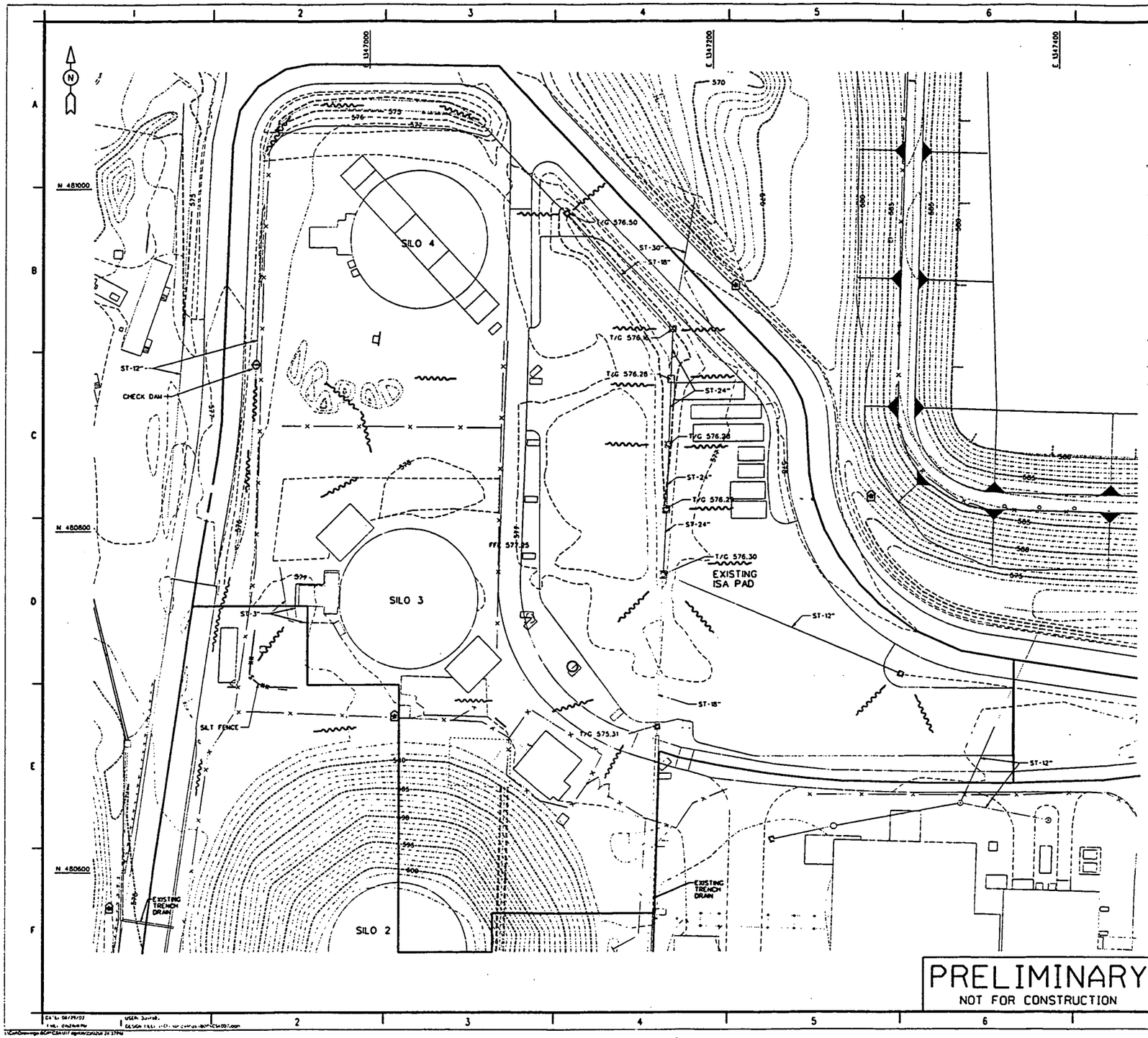

PRELIMINARY
NOT FOR CONSTRUCTION

NOTES:

1. ALL SEDIMENT AND EROSION CONTROL FEATURES SHALL BE INSTALLED AS REQUIRED AND OPERATIONAL PRIOR TO EARTH DISTURBANCE ACTIVITIES.
2. CONTRACTOR SHALL BE RESPONSIBLE FOR REMOVAL OF STORMWATER COLLECTED IN AREAS EXCAVATED BELOW GRADE. ANY DISCHARGE WATER RESULTING FROM PUMPING OF GROUND OR RUNOFF WATER FROM TRENCHES OR OTHER AREAS MUST BE ROUTED THROUGH SEDIMENTATION CONTROL STRUCTURES AND NOT DISCHARGED DIRECTLY INTO RECEIVING CHANNELS. RUNOFF SHALL BE MANAGED IN ACCORDANCE WITH FEMP STORMWATER POLLUTION PREVENTION PLAN AND TRANSPORTED TO AN ON-SITE LOCATION DETERMINED BY THE OWNER.
3. SILT FENCE LOCATIONS SHOWN ARE APPROXIMATE. ADD ADDITIONAL SILT FENCE AND/OR ADJUST LOCATION AS NECESSARY TO MEET FIELD CONDITIONS.
4. CONTRACTOR SHALL PROTECT EXISTING CATCH BASINS AND OTHER STORMWATER CONTROLS DURING CONSTRUCTION.

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REF DWG NO.	DRAWING TITLE

SCALE: 1"= 20'

REV NO	REVISION PURPOSE - DESCRIPTION	DATE	REV. BY	APPR.
C	ISSUED FOR REVIEW	8/29/02		
B	ISSUED FOR REVIEW	05/29/02	GM	SH
A	ISSUED FOR REVIEW	05/08/02	GM	SH

UNITED STATES
DEPARTMENT OF ENERGY
FERNALD ENVIRONMENTAL MANAGEMENT PROJECT

THIS DRAWING PREPARED BY
JE JACOBS

PROJECT NAME
AWR OPTIMIZATION

DRAWING TITLE
CIVIL
SILO 3 AREA
STORMWATER DRAINAGE AND EROSION CONTROL PLAN

DRAWN BY	DATE	TECHNICAL LEAD	DATE	CHECKED BY	DATE
PLANT-WIDE NO.		FLOOR		SCALE 1"=20'	CLASS U

SUBMITTED FOR 30% ISSUE	SUBMITTED FOR 60% ISSUE	SUBMITTED FOR 90% ISSUE
TECH LEAD	TECH LEAD	TECH LEAD
DATE	DATE	DATE

T.O. NUMBER	PROJECT NO.	DRAWING INDEX CODE NO.	SHEET NO.	REV. NO.
N/A	40710	35H19606-CSK-007	CSK-007	C

J.E. PROJECT NO. 35H19606 | FILENAME CSK007.DGN

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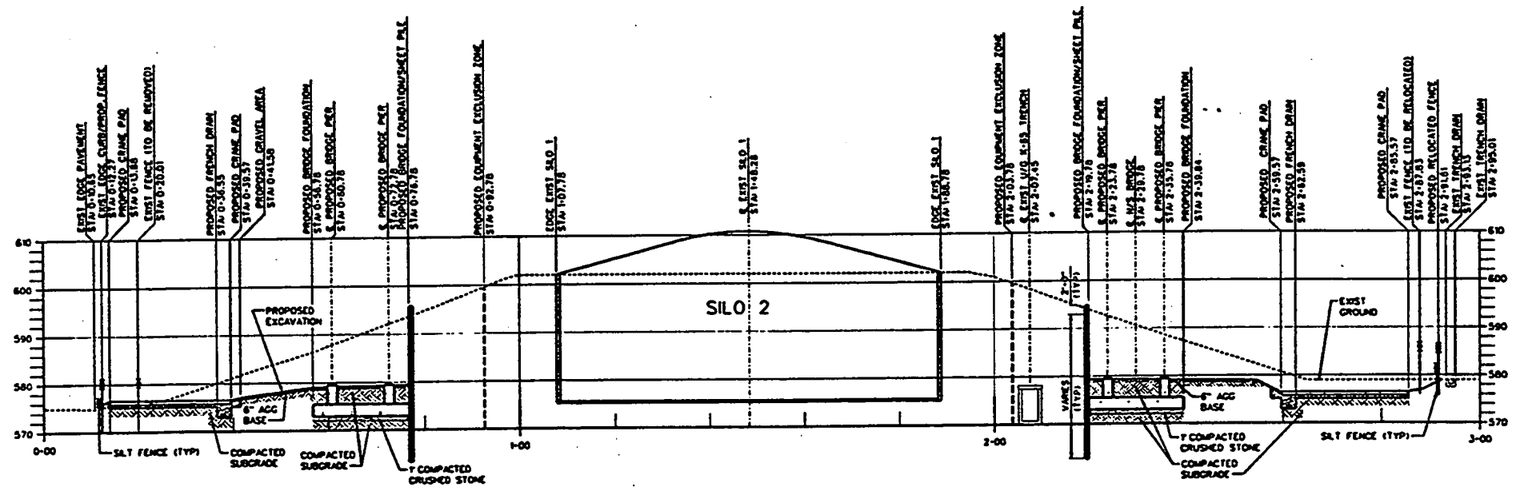

REF DWG NO.	DRAWING TITLE

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C	ISSUED FOR REVIEW	6/29/02		
B	ISSUED FOR REVIEW	05/29/02	GM	SH
A	ISSUED FOR REVIEW	05/08/02	GM	SH

UNITED STATES
DEPARTMENT OF ENERGY
FERNALD ENVIRONMENTAL MANAGEMENT PROJECT

THIS DRAWING PREPARED BY
JACOBS

PROJECT NAME
AWR OPTIMIZATION

DRAWING TITLE
CIVIL
AWR
TYPICAL CROSS SECTION

DRAWN BY	DATE	TECHNICAL LEAD	DATE	CHECKED BY	DATE
W. MARVIN	05/08/02	F. PARTON	05/08/02	C. MORAR	05/08/02

PLANNING NO.	FLOOR	SCALE	CLASS
		1" = 10' H&V	U

SUBMITTED FOR 30% ISSUE	SUBMITTED FOR 60% ISSUE	SUBMITTED FOR 90% ISSUE
TECH LEAD	TECH LEAD	TECH LEAD
DATE	DATE	DATE

T.A. NUMBER	PROJECT NO.	DRAWING INDEX CODE NO.	SHEET NO.	REV. NO.
JCS PROJECT NO. 35H19606	FILENAME CSK008.DGN	35H19606-CSK-008	CSK008	C

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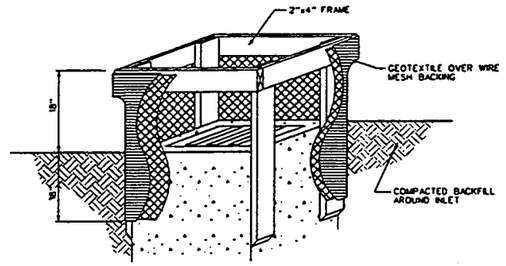
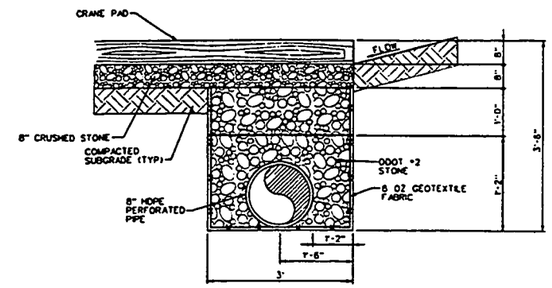


NOTES:

1. INLET PROTECTION SHALL BE CONSTRUCTED EITHER BEFORE UPSLOPE LAND DISTURBANCE BEGINS OR BEFORE THE STORM DRAIN BECOMES OPERATIONAL.
2. THE EARTH AROUND THE INLET SHALL BE EXCAVATED COMPLETELY TO A DEPTH AT LEAST 18 INCHES.
3. THE WOODEN FRAME SHALL BE CONSTRUCTED OF 2"x4" CONSTRUCTION GRADE LUMBER. THE 2"x4" POSTS SHALL BE DRIVEN 18" INTO THE GROUND AT FOUR CORNERS OF THE INLET AND THE TOP PORTION OF 2"x4" FRAME ASSEMBLED USING THE OVERLAP JOINT SHOWN. THE TOP OF THE FRAME SHALL BE AT LEAST 6" BELOW ADJACENT ROADS IF PONDED WATER WOULD POSE A SAFETY HAZARD TO TRAFFIC.
4. WIRE MESH SHALL BE OF SUFFICIENT STRENGTH TO SUPPORT FABRIC WITH WATER FULLY IMPOUNDED AGAINST IT. IT SHALL BE STRETCHED TIGHTLY AROUND THE FRAME AND FASTENED SECURELY TO THE FRAME.
5. GEOTEXTILE SHALL BE STRETCHED TIGHTLY AROUND THE FRAME AND FASTENED SECURELY. IT SHALL EXTEND FROM THE TOP OF THE FRAME TO 18" BELOW THE INLET NOTCH ELEVATION. THE GEOTEXTILE SHALL OVERLAP ACROSS ONE SIDE OF THE INLET SO THE ENDS OF THE CLOTH ARE NOT FASTENED TO THE SAME POST.
6. BACKFILL SHALL BE PLACED AROUND THE INLET IN COMPACTED 6" LAYERS UNTIL THE EARTH IS EVEN WITH NOTCH ELEVATION ON ENDS AND TOP ELEVATION ON SIDES.

INLET PROTECTION

NOT TO SCALE



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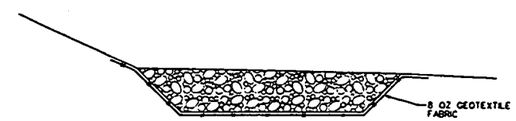

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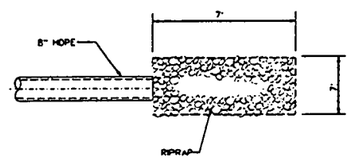

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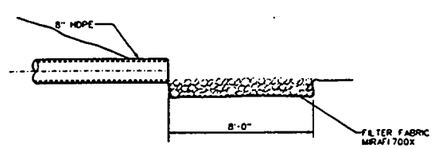
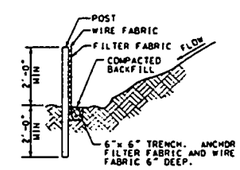


SECTION A-A

CULVERT OUTLET PROTECTION

(NOT TO SCALE)



TEMPORARY SILT FENCE

(NOT TO SCALE)

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REF DWG NO.	DRAWING TITLE

REV NO	ISSUE OR REVISION PURPOSE - DESCRIPTION	DATE	REV BY	APPD
B	ISSUED FOR REVIEW	8/29/02		
A	ISSUED FOR REVIEW	05/29/02		

DETAILS AND DATE

UNITED STATES
DEPARTMENT OF ENERGY
FERNALD ENVIRONMENTAL MANAGEMENT PROJECT

THIS DRAWING PREPARED BY
JE JACOBS

PROJECT NAME
SILOS 1 AND 2

DRAWING TITLE
CIVIL
AWR/BOP
DETAILS - 1

DRAWN BY	DATE	REVIEWED BY	DATE	CHECKED BY	DATE
PLANT-WIDE NO.		FLOOR		SCALE NONE	CLASS U
SUBMITTED FOR 30% ISSUE		SUBMITTED FOR 60% ISSUE		SUBMITTED FOR 90% ISSUE	
TECH LEAD		TECH LEAD		TECH LEAD	
DATE		DATE		DATE	

T.O. NUMBER	PROJECT NO.	DRAWING INDEX CODE NO.	SHEET NO.	REV. NO.
N/A	40710	35H19606-CSK-009	CSK009	B
J.E. PROJECT NO. 35H19606	FILENAME CSK009.DGN			

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APPENDIX 5.4

WASTE HANDLING WORK PLAN

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WASTE HANDLING WORK PLAN

FOR THE

SILOS 1 AND 2 ACCELERATED WASTE RETRIEVAL (AWR) PROJECT

May 29, 2002

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ACRONYMS

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AEA	Atomic Energy Act
AWR	Accelerated Waste Retrieval
AWWT	Advanced Waste Water Treatment System
BMP	Best Management Practice
CFR	Code of Federal Regulations
D&D	Decontamination and Decommissioning
DOE	U.S. Department of Energy
DOT	U.S. Department of Transportation
EPA	U.S. Environmental Protection Agency
FEMP	Fernald Environmental Management Project
Fluor Fernald	Fluor Fernald, Inc.
HP	Health Physics
MSCC	Material Segregation and Containerization Criteria
O&M	operation and maintenance
OSDF	Onsite Disposal Facility
PPE	personal protective equipment
PWID	Project Waste Identification and Disposition Report
RCRA	Resource Conservation and Recovery Act
RCS	Radon Control System
SP	Stockpile
SWRS	Silos Waste Retrieval System
TLCP	Toxicity Character Leaching Procedure
TTA	Transfer Tank Area
TWRS	Transfer Tank Waste Retrieval System
UN	United Nations
WAC	waste acceptance criteria
WHWP	Waste Handling Work Plan

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1.0 INTRODUCTION

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This Waste Handling Work Plan (WHWP) summarizes activities and compliance requirements associated with the management of wastes generated during construction, testing, and operation and maintenance (O&M) of the Accelerated Waste Retrieval (AWR) Project activities at the U.S. Department of Energy (DOE) Fernald Environmental Management Project (FEMP) site.

1.1 Organization of Plan

Section 1 provides and overview of the WHWP, including background and key assumptions supporting the development of this WHWP. Section 2 summarizes the AWR Project scope of work covered by this WHWP. Section 3 identifies applicable waste streams that will be generated and the anticipated waste characterization. Section 4 addresses the handling, segregation, containerization, and movement of waste containers within the AWR Project construction zone and disposition of the waste streams, both onsite and offsite. Section 5 covers documentation, weighing and labeling of waste containers, and transportation issues associated with waste management.

1.2 Background

The FEMP site, owned by the DOE and managed by Fluor Fernald, is located approximately 30 miles northwest of Cincinnati, Ohio. During 1951 to 1960, DOE produced approximately 6,800 cubic meters of material known as K-65 material from processing high-grade uranium ores. Silos 1 and 2 were erected to provide the storage of the material. The silos material contains radionuclides including radium (the contaminant of concern) and thorium. The silos material is classified as 11(e)(2) by-product material in accordance with the Atomic Energy Act (AEA). Therefore, it is excluded from regulation as a solid or hazardous waste under the Resource Conservation and Recovery Act (RCRA) and Title 40 of the *Code of Federal Regulations* (*CFR*) Part 261.4(a)(4).

1.3 Key Assumptions

Waste management activities and compliance practices summarized in the WHWP are based on the following key assumptions:

- **Definition of AWR Project Construction Zone –** The terms "construction zone" for the AWR Project applies to the following areas: (1) the existing Silos 1 and 2 Area; and (2) areas in close proximity to the Silos 1 and 2 where support facility trailers for construction and O&M activities will be located.

- **Transportation in the AWR Project Construction Zone –** waste will be containerized as required and moved to a temporary location within the construction zone for pickup and transportation to the designated disposal location. Most waste identified for the OSDF or SP-7 will be managed in bulk rather than being containerized. Staging and disposal locations will be determined by Waste Acceptance Organization (WAO) personnel in accordance with site procedures.
- **Equipment Decontamination –** Decontamination of equipment, tools and facility components smaller than 18 feet by 30 feet will be performed in a portable, truck-mounted decontamination facility.

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2.0 SCOPE OF WORK

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This section provides a general overview and summary of approach to waste handling activities associated with the AWR Project.

2.1 General

The AWR Project includes the design, construction, and operation of the Radon Control System (RCS), the Silos Waste Retrieval System (SWRS), the Transfer Tank Area (TTA), and the TTA Waste Retrieval System (TWRS).

2.2 Summary of Approach

The AWR Project will employ demonstrated technology to safely and effectively remove radioactive decay gases, K-65 waste residues and bentonite, and debris from Silos 1 and 2. The major elements planned for the execution of the AWR Project are:

1. Mobilization and construction of RCS, and TTA,
2. Training for and operation of RCS,
3. Construction of SWRS, TTA, and TWRS,
4. Bulk Waste Retrieval Operation at Silos 1 and 2,
5. Decontamination and Decommissioning (D&D) and Demobilization.

During the first phase of operations, the accumulated concentration of radon gas in the silo headspaces will be reduced during the Phase 1 operation of the RCS. Parallel to Phase 1 operation of RCS, construction of a twin bridge structure will be performed. This bridge structure, which will straddle the existing silos, is to provide a work platform that precludes the placement of unnecessary loads on the silo domes or walls during the operations phase. Only upon successful demonstration of the design through Cold Loop Testing, and personnel training using non-hazardous surrogate materials, will retrieval of waste from the silos be initiated.

Retrieval of the waste solids is accomplished remotely using "past practice" sluicing methods supported from a work platform on the pivoting bridge structure. Four new tanks in a shielded structure (i.e., TTA) erected to the east of the silos will receive and store the solids for future disposition. Accumulated radon from these tanks will also be exhausted to the on-line RCS

3.0 WASTE STREAMS

The waste streams for the AWR Project are divided into three categories: (1) Silos 1 and 2 material; (2) secondary waste generated during retrieval and storage of the primary waste; and (3) clean construction waste generated during construction and O&M of the facilities required to retrieve the primary waste. All secondary waste will be segregated, characterized, packaged, and dispositioned in accordance with site procedures. Based upon the Final Design, a Project Waste Identification and Disposition (PWID) Report will be prepared in accordance with procedure EW-1021, *Preparation of the Project Waste Identification and Disposition (PWID) Report.* The PWID will document the anticipated waste streams, generation rates, and disposition for secondary waste resulting from AWR operations. Data on secondary waste

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generated will be collected and utilized for updating of the appropriate inventory database. As waste is generated, the volumes of each waste stream will be tracked against the PWID, and the PWID will be updated as necessary due to any changes from the initial estimates.

Anticipated generation volumes, potential container requirements and proposed disposition methods for each waste stream are summarized in Table 4-1. The final disposition determination (e.g. offsite, OSDF, SP-7) and resulting container requirements will be determined during development and review of the PWID. The containers and disposition methods identified in Table 4-1 will be updated as required based on the approved PWID.

3.1 Primary Waste

This section provides an overview of the various primary waste streams associated with the AWR Project.

3.1.1 K-65 Material

As discussed earlier, Silo 1 and 2 material contains radionuclides, including radium-226 (the contaminant of concern) thorium-230, lead-210, bismuth-210, and polonium-210.

3.1.2 Excavated Soils

The AWR Project requires excavation of berm soils around the silos and excavation required to construct the foundations for the bridge structure. These soils may contain radiological contamination. During excavation, a working soil pile will be configured within the AWR Project construction zone to support hauling and placement of soil. The soil pile will be large enough to support two days of hauling. Necessary samples and radiological surveys of the soil will be taken to support determination of the disposition of the soil. Excavation and management of the berm soil is discussed in detail in the Berm Excavation Plan.

3.2 Secondary Waste

During the execution of the AWR Project, additional secondary waste streams will be generated. Also, wastes may be encountered that are not related to site contamination (e.g., heating or fuel oils, lubrication oils, etc.). The following paragraphs give summary data for each of the waste streams anticipated. The container and disposal methods identified in this section are preliminary, and will be finalized during development and review of the PWID. The approved PWID will document the Fluor Fernald-approved container requirements and disposal method for each secondary waste stream.

3.2.1 Wastewater

Water must be added to the silo waste to mobilize and transfer the waste to the TTA. The design will minimize the volume of wastewater by recycling to TTA. The waste slurry will pass through a settling and decanting phase to minimize water used to transfer waste. Slurry pumped from Silo 1 or 2 will be discharged to one of the four TTA tanks and allowed to settle. The water supplying the sluice nozzles will be pumped from one of the other TTA tanks, which has had sufficient settling time. It is estimated that, upon completion of AWR operations, a maximum of 150,000 gallons of excess wastewater will be discharged to the Silos 1 and 2 Treatment Facility for storage pending use in the treatment process or sampling and discharge to the AWWT. An additional wastewater stream from AWR operations will result from the

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condensate generated by the chillers in the RCS. This condensate will be collected in one of two 3000-gallon condensate tanks, held to allow radon decay, and then sampled and discharged to the AWWT.

Management of this AWR wastewater, including the criteria for discharge to AWWT, is discussed in detail in the Environmental Control Plan.

3.2.2 Personal Protective Equipment

Personal protective equipment (PPE) associated with the AWR Project includes gloves, tyvek suits, coveralls, respirators, and boot covers. The recyclable PPE will be placed in plastic bags and stored in an assigned area in the Health Physics (HP) trailer. The disposable PPE will be placed in plastic bags and stored in a roll-off box (until it is full) located near HP trailer and within a posted radiological area. It is anticipated that the majority of the disposal PPE will be disposed as Category 4 material in the OSDF.

3.2.3 HEPA Filters

The RCS will be equipped with two parallel banks of high-efficiency particulate air (HEPA) filters. The life of the filters is extended by adding a prefilter in front to remove coarse solids. In addition each of the six slurry pump modules, and each of the 12 sluice nozzle modules will be equipped with air inlet filters which will require periodic replacement. The used filters and elements will be placed in plastic bags and will be stored in an appropriate container for disposal.

3.2.4 Petroleum, Oils and Lubricants

This waste stream would be generated as a result of vehicle and equipment maintenance, accidental discharge, or failure of equipment. Liquid residue from this waste will be collected and drummed for disposal or recycling.

3.2.5 Vehicle and Equipment Air, Fuel and Oil Filters

Filters being discarded during routine maintenance of vehicles and equipment will be drained, crushed, and bagged as Category 4 material for disposal at the FEMP Onsite Disposal Facility (OSDF).

3.2.6 Anti-Freeze and Engine Coolant

If generated as a result of spill, accident, or equipment malfunction located on soil or gravel, then the area of the spill is to be over-excavated and stockpiled or hauled to the FEMP OSDF or staged at Stockpile SP-7 for offsite disposal.

3.2.7 Sampling Equipment

Equipment used during process control sampling and sampling of K-65 material, soils, and drum contents will be decontaminated and surveyed for free release. If not releasable, the equipment will be inventoried and staged for disposal as Category 2 or 3 material in the OSDF.

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3.2.8 Decontamination Fluids/Materials

Rinse water from vehicles and equipment decontamination activities and gray water from shower facility will be collected, sampled, and disposed as wastewater as described in Section 3.2.1.

3.2.9 Miscellaneous Waste

Miscellaneous waste includes plastic materials and paper wipes from decontamination trailers. If this waste is contaminated, then it will be stored in a container for disposal as Category 4 material in the OSDF.

3.3 Construction Waste

During construction activities, construction waste will be generated as described below. Each category of the construction waste will be segregated by placing in separate containers or stockpiles. The containers will be locked except when waste is being placed in them. The AWR Project Construction Manager or designee will be responsible for maintaining these containers.

3.3.1 Clean Debris

Clean debris such as concrete waste, and unused aggregate will be stockpiled within the AWR Project construction zone but outside the contaminated area. After confirmation that it meets free release requirements, clean debris will be loaded into roll-off boxes for free release and transport to an approved sanitary landfill.

3.3.2 Scrap Metal

Scrap metal generated during fabrication and erection of the steel structures will be collected and placed in a separate container for a free-release survey. If decontamination is required, then the metal will be undergo a second free-release survey. Once material has successfully passed this survey, it undergo a verification survey. Scrap metal not able to be free released will be size reduced as necessary and staged for disposal as Category 2 material in the OSDF.

3.3.3 Wood/Paper Product

Wood pallets, cardboard boxes, or similar material will be collected and placed in separate containers for a free-release survey. Material not able to be free released will be staged for disposal as Category 4 material in the OSDF.

3.3.4 Silo Cap / Silo Penetration Debris

Debris from removal of the plywood caps over the silo domes, and concrete from making the necessary dome penetrations for the retrieval risers and camera ports will be size reduced as necessary, packaged and shipped off-site for disposal.

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4.0 WASTE HANDLING AND DISPOSITION

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This section of the WHWP summarizes how each of the waste streams described in Section 3 must be segregated, containerized, labeled, accumulated, stored, and disposed.

4.1 Waste Segregation Containerization/Accumulation

Table 4-1 summarizes the waste streams, generation volumes, and proposed container and disposition methods established for the AWR Project. Appropriate containers for each waste category are identified in Table 4-1. The container and disposal methods identified in Table 4-1 are preliminary, and will be finalized during development and review of the PWID. The points of generation for K-65 material and debris are Silos 1 and 2. The point of generation for the wastewater will be the RCS Building and change trailers. The point of generation for the decontamination wastes is the location where the decontamination operations (near the TTA) will be performed. The point of generation for the remaining primary and secondary waste streams will vary across the AWR Project site. The clean construction waste will be maintained outside the contaminated area but within the AWR Project construction zone. The point of generation for sanitary water and gray water will be near the AWR Project support trailers.

Containers or drums used for the primary and secondary waste and the storage area will meet the following criteria:

- Containers will be U.S. Department of Transportation (DOT) United Nations (UN) specification drums (e.g., 1A2 for open-top steel drums).
- Containers will be inspected for leaks at least once each week during the storage period.
- Containers will be "marked" with removable markings that include the contents and date the first amount of material was put into the container.
- Containers will be "marked" with removable markings that include the label: "Caution, contains K-65 debris..."
- Storage area will be delineated and "marked" with a sign indicating the Fluor Fernald-required wording: "Caution, contains K-65 debris...."

Additional Best Management Practices (BMPs) for the drum storage areas containing primary and secondary waste will be employed as follows:

- For drum storage area, the containers will be covered with an anchored poly tarp.
- The drum storage area will have a minimum 6-inch curb to minimize spread of contamination.
- The drums will be on wooden pallets, within a locked, fenced-in area for overnight storage (to prevent unauthorized access).
- A written record will be kept which includes (at a minimum: the number of drums, contents of each drum, and dates placed/removed from the storage area).

TABLE 4-1. AWR PROJECT WASTE HANDLING SUMMARY

TASK NUMBER (SEE DESCRIPTIONS BELOW)	WASTE STREAM / ESTIMATED QUANTITIES	~~Preferred~~ Potential Containers[2]							
		LARGE METAL BOX (TOP LOADER)	SMALL METAL BOX		ISO	DRUM	ROLL-OFF BOX	NO CONTAINERS (BULK)	ANTICIPATED DISPOSITION
			B-12	B-25					
4, 5, 6	K-65 Material (Category C)							X	TTA Tanks
4, 5, 6	K-65 Debris (Category C)					X			Offsite (NTS, etc.)
1, 3, 4, 5	Excavated Soils (Berm Soil) / 7600 cubic yards							X	OSDF Cat. 1
1, 3	Buried Debris			~~X~~				X	OSDF Cat. 2
1, 2, 3, 4, 5, 6, 7	Wastewater (Category C) / 150,000 gallons [1]							X	AWWT
1, 2, 3, 4, 5, 6, 7	PPE / 100 cubic yards	X						X	OSDF Cat. 4
2	Surrogate Waste / 200 cubic yards (includes debris *)						X		Free release
2	Surrogate Debris *							X	Free release
1, 2, 3, 4, 5, 6, 7	Petroleum, oils and Lubricants / 200 gallons (includes ** items)					X		X	Offsite / OSDF
1, 2, 3, 4, 5, 6, 7	Air, Fuel and Oil Filter / **					X			OSDF Cat. 4 or SP-7
1, 2, 3, 4, 5, 6, 7	Anti Freeze /Engine Coolant Spill material **					X			OSDF Cat. 4 or SP-7
4, 5	Fixative Spray Paint Spill material					X			OSDF Cat. 4 or SP-7
1, 2, 3, 4, 5, 6, 7	Sampling Equipment	X						X	Free release or OSDF Cat. 2/3
3, 4, 5, 6, 7	Decontamination Fluids and Material / 15,000 gallons water ,50 cubic yards debris							X	AWWT (fluid) OSDF Cat 4
1, 2, 4, 5, 6, 7	HEPA Filters / 12 cubic yards	X							OSDF / offsite
1, 2, 3, 4, 5, 6, 7	Miscellaneous Waste / 10 cubic yards	~~X~~						X	OSDF Cat. 4
1, 2, 3, 4, 5, 6, 7	Scrap Metal / 300 cubic yards						X		Free release/ OSDF Cat 2
1, 2, 3, 4, 5, 6, 7	Wood Paper Product / 300 cubic yards	~~X~~						X	Free release/ OSDF Cat 4
1, 2, 3, 4, 5, 6, 7	Clean Debris / 110 cubic yards						X		Free release
1, 2, 3, 4, 5, 6, 7	Sanitary Wastewater and Gray Water							X	AWWT

Notes: [1] Potable water used for testing of the TTA tanks will be held for use during FSMS testing and subsequent waste retrieval operations. Approximately 150,000 gallons of excess water will be directed to the AWWT facility at the end of AWR Project operations.

[2] Final container requirements and disposal locations will directed by Fluor Fernald, documented in the approved PWID

TASK NUMBERS AND DESCRIPTIONS

NO.	DESCRIPTION	NO.	DESCRIPTION
1	Mobilization and construction of RCS, FSMS, and TTA	5	Waste Retrieval Operation at Silo 1
2	Training for and operation of FSMS and RCS	6	DWRS Operation
3	Construction of SWRS	7	D&D and Demobilization
4	Waste Retrieval Operation at Silo 2		

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- For RCRA-regulated hazardous wastes, a "Hazardous Waste" label will be used. The label must include: The generator's name, accumulation start date, waste code(s), DOT proper shipping name and DOT Identification number.

- For hazardous wastes (e.g., oils, fuels), all applicable labeling requirements will be satisfied, including assignment of specific waste codes if applicable.

PPE associated with the AWR Project will be accumulated in plastic bags for pickup by Fluor Fernald personnel. Separate bags will be used for cloths, gloves, and booties. Disposable PPE will be placed in roll-off boxes until full.

4.2 Temporary Waste Staging Areas

The temporary waste staging areas are shown on Drawing Number 05FCD014, Miscellaneous Facilities Site Space Allocation. As discussed previously, dumpsters and roll-off boxes containing clean debris will be locked, and loading/unloading will be supervised to prevent accidental disposal of the contaminated waste.

4.3 Spill/Discovery Notification

A release/spill of waste will be properly contained as soon as practical after the release occurs. As a proactive measure, spill response kits and equipment will be available at temporary staging locations, including near the Silos 1 and 2 in the contaminated area, Silo 4 area, and the construction staging area (clean area). (See the *Contingency Plan and Emergency Response*, AWR Project Document No. 624-P621-09, regarding the contents of the spill response kits and type of equipment required).

As a preventive measure, drip pans and other precautionary measures will be employed during routine maintenance of vehicle and equipment. These measures serve to minimize the impact of an oil or lubricant released from vehicles or equipment. If oil or hazardous materials not related to site contamination are discovered (e.g., soils, solvents, etc.), then the Fluor Fernald Project Manager will be notified.

5.0 EQUIPMENT TRANSPORTATION IN THE CONSTRUCTION ZONE

The major pieces of equipment that will be used to move drums and dumpsters and to load or unload stockpiles in the AWR Project construction zone are as follows:

- **Drums** – The drums containing K-65 debris and surrogate debris from silos will be loaded in a trolley on the bridge, lowered down to the ground using a hoist and then moved to the drum storage area by a forklift.

- **Dumpsters** – Clean dumpsters and roll-off boxes will be placed at designated locations only. Fluor Fernald will use special equipment to load and unload waste from these containers.

- **Stockpile** – A backhoe, loader, and dump truck will be used to load and unload excavated material and debris from the stockpile area.

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APPENDIX 5.5

SILOS PROJECTS ENVIRONMENTAL MONITORING PLAN

SILOS PROJECTS

ENVIRONMENTAL MONITORING PLAN
40000-PL-0010

Revision 2

Signature Page

Prepared by:	S. Beckman, Silos Project Environmental Compliance	8/29/02 Date
Reviewed by:	M. Frank, Manager Environmental Monitoring	8/29/02 Date
Approved by:	R. Corradi, Project Director, Silos Project	8/29/02 Date

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RECORD OF ISSUE/REVISIONS

-4448

Issue Authorization Date	Effective Date	PCN No.	Rev. No.	Description
	May 17, 2000		0	Initial issue
	November 1, 2000		1	Minor revision in response to comments on AWR RD package – Monitoring station designations in Sections 3.1.3 and 3.1.4 and Attachment A corrected to agree with new light pole numbers; IEMP reporting clarified in Section 4.
	September 1, 2002		2	Revision to for inclusion in revised Silos Projects Remedial Design Packages

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SILOS PROJECTS

ENVIRONMENTAL MONITORING PLAN
40000-PL-0010

Revision 2

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ACRONYM LIST

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ALARA	As Low As Reasonably Achievable
ARAR	Applicable, Relevant, and Appropriate
ASL	Analytical Support Level
AWR	Accelerated Waste Retrieval
AWWT	Advanced Waste Water Treatment
CERCLA	Comprehensive Environmental Response, Compensation and Liability Act
DOE	Department of Energy
FEMP	Fernald Environmental Management Project
HAMDC	Highest allowable minimal detectable concentration
IEMP	Integrated Environmental Management Plan
ISER	Integrated Site Environmental Report
OU4	Operable Unit 4
pCi	pico curie
SCQ	Sitewide CERCLA Quality assurance plan
TLD	Thermoluminescent Dosimeter
WAC	Waste Acceptance Criteria
WPRAP	Waste Pits Remedial Action Plan

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SILOS PROJECTS ENVIRONMENTAL MONITORING PLAN

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1.0 General

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

2.0 Integrated Environmental Monitoring

The IEMP focuses on monitoring air, direct radiation, groundwater, and surface water to ensure protection of human health and the environment during the conduct of site-wide remediation activities. The IEMP incorporates regulatory requirements for site-wide monitoring, trending, reporting, and it serves as the central reporting mechanism to the regulators and stakeholders for the ongoing emission control/ monitoring activities at the FEMP.

3.0 Project-Specific Environmental Monitoring

Project-specific environmental monitoring requirements are identified in the applicable design documentation for both the Silo 3 Project and the AWR Project (References 1 and 2). These requirements for the Silos 1 and 2 Project will be identified in the RD package for that project. Fluor Fernald Inc. has identified additional enhancements to the existing site monitoring program that are integral to all three projects. As a result, this project-specific environmental monitoring plan documents the additional requirements addressing air, direct radiation, and project wastewater (i.e., slurry wastewater and decontamination wastewater) monitoring within and surrounding specified project boundaries that will be established by Fluor Fernald, Inc. The need and extent of project-specific monitoring has been evaluated based on the following criteria:

- Project complexity, extent of contamination, and scope;
- Applicable, Relevant, and Appropriate Requirements (ARARs) compliance strategy;
- DOE Orders compliance strategy; and,
- Existing monitoring data, modeling, and monitoring programs.

This project-specific environmental monitoring plan considers the location of the projects with respect to other remediation activities [e.g. the Waste Pit Remedial Action Plan (WPRAP) project] and the FEMP boundary. The plan also considers project-specific constraints such as the contaminants of concern; the characteristics of the OU4 wastes; and the material transfer, handling, and storage processes. Project-specific emission modeling of both normal and upset conditions have provided the basis for identifying and instituting process emission controls that are protective to the workers, public, and the environment (References 6 and 7). The effectiveness of the project-specific emission controls will be evaluated through analysis of monitoring results to identify whether increased or altered emission control methods are necessary. Project-specific environmental monitoring summary results will be provided in project completion reports.

3.1 Environmental Radiological Air Emissions Monitoring

Environmental radiological air monitoring for the Silos Projects will consist of three programs: 1) Project-specific stack monitoring programs; 2) the IEMP air monitoring program (primarily property boundary and general site areas) including the environmental radon monitoring network; and 3) the Silos area project-specific air monitoring program (within the Silos project area boundary).

3.1.1 Project-Specific Stack Monitoring Program

The Silo 3 and Silos 1 and 2 AWR Project stack monitoring requirements are described in the RD Packages for the projects. Radiological contaminants represent the primary contaminants of concern, therefore the focus of stack air monitoring will be for radionuclides; however, monitoring for other contaminants of concern will be added, as warranted. Stack monitoring for the Silos 1 and 2 project will be addressed in the Silos 1 and 2 RD Package. All three projects will deploy isokinetic sampling for particulate radionuclides, monitoring, and recording of stack exhaust that is compliant with Title 40 of the Code of Federal Regulations (CFR), Part 61, Subpart H, and DOE Order 5400.5, Section IV.6.B.

Additionally, the stack exhaust will be continuously monitored for radon to verify that emissions are controlled such that fence line radon concentrations remain below 0.5 pCi/L, as an annual average above background. Exhaust Stack radon concentration data from this monitor will be modeled to determine the resulting fenceline radon concentration and verify compliance with the annual average 0.5 pCi/l above background fenceline criterion.

Actual ambient concentrations measured by the fenceline and silo area radon monitors will be used to verify the modeling results. These measurements will be compared to historical baseline data to identify any trends (i.e., increased fenceline concentrations) potentially resulting from Silos Project operations. Data from the background monitors specified in the

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IEMP will be used to determine background concentrations for use in determining the "annual average above-background" concentrations at the fenceline monitors in order to verify that the modeled stack data successfully demonstrate compliance with the annual average 0.5 pCi/l above background fenceline criterion.

3.1.2 The IEMP Air Monitoring Program

The IEMP air monitoring program is an established program that will continue throughout remediation. Within the IEMP air monitoring program, the radiological air particulate monitoring program provides a fenceline monitoring network for assessing the collective site-wide impact of FEMP multiple concurrent remediation activities. This program demonstrates FEMP compliance with all ARARs and provides early warning feedback regarding the cumulative sitewide effectiveness of project-specific emission controls. The radiological air particulate monitoring program is reviewed annually in order to account for changes in remediation projects at the FEMP.

Additionally, within the IEMP air monitoring program, the radon monitoring network has been designed to focus on monitoring Silos 1 and 2 headspaces, environmental radon levels in the vicinity of the silos, as well as radon levels at the site fenceline. In support of the Silo 3 and AWR projects and in anticipation of treatment of Silo1 and 2 material, the IEMP environmental radon monitoring network has been modified as described below, and as summarized in Revision 1 of this plan.

3.1.3 The IEMP Environmental Radon Monitoring Network

During the Silo 3 Project and the AWR Project, remediation activities directed toward the removal, processing, and storage of radon-generating wastes create the potential for the release of radon to the environment. Modifications and additions to the existing IEMP environmental radon monitoring network were implemented in 2000 and early 2001 to accommodate construction activities associated with the AWR Project and to better monitor levels around the Silo 1 and 2 area during the OU4 remediation. Four existing radon monitoring stations near the K-65 Silos were re-located to accommodate construction activities. The monitoring stations were re-located as follows:

- KNW at the K-65 exclusion fence was moved to the western side of the road, re-designated KNW-A.
- KSW at the K-65 exclusion fence was moved to the western side of the road, re-designated KSW-A.
- T28 northeast of the K-65 exclusion fence was moved across the road, in the prevailing wind direction from the K-65 Silos, re-designated T28A.
- KNE at the K-65 exclusion fence was moved approximately 50 feet north of its former location and re-designated KNE-A.

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To better monitor radon levels in the K-65 area, five radon monitoring locations were added to the existing IEMP radon network in 2000. The monitors currently provide additional monitoring of radon levels in the vicinity of the silos and will continue to do so during the Silo 3 and AWR projects and subsequent operations for the Silos 1 and 2 material. The locations and designations for the monitors are:

- North of Silo 2 at the K-65 exclusion fence, designated KNO.
- South of Silo 1 near the new south camera tower, designated KSO.
- East of Silo 4 and in the prevailing wind direction from Silo 3, designated LP2.
- East of the silo project construction area near Trailer #117, designated T117.
- An additional station was selected on the FEMP's west fenceline to supplement the established IEMP monitoring network. The monitor (PR-1) is co-located with the WPTH-2 air particulate monitor, on the western perimeter of the facility.

The detail of the OU4 radon monitoring locations is shown on Dwg. 94X-5500-SK-5527 (Attachment A). The map of the entire IEMP radon monitoring network is shown Attachment B. In order to accommodate construction activities, it may be necessary to re-locate radon monitors. Changes in monitoring locations will be documented and reviewed through the Design Change Notice (DCN) process.

Real-time data from selected fenceline and silos area monitors is available via a secure Internet address (the IEMP Data Information Site). The data will include the date and time of the most recent transmission, location, and latest radon concentration. This data is sent from the monitoring instrumentation without review or validation. Data review and validation will be conducted in a manner consistent with the current methods used under the IEMP radon monitoring program. Monthly radon summary data will also be posted to the IEMP Data Information Site after quarterly data quality reviews are completed.

3.1.4 Project-Specific Air Particulate Monitoring Program

The IEMP air particulate monitoring program, which is based on air monitors located at the FEMP's perimeter fenceline, provides early warning feedback regarding the cumulative sitewide effectiveness of all remediation project emission controls. The OU4 project-specific air particulate monitoring program will provide data that confirms the performance of the projects' emissions controls. In addition to providing confirmatory data, the monitoring program will also provide data to quantify the nature and extent of releases from the projects in the event of an upset condition. The program consists of four high-volume particulate air samplers that are co-located with the radon monitors at the Bio-surge lagoon, LP2, T117, and KNW-A locations shown on Attachment A. These samplers maintain a consistent air sample flow rate between 40 and 50 cubic feet per minute through an 8 by 10-inch filter. In order to accommodate

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construction activities, it may be necessary to re-locate air monitors. Changes in monitoring locations will be documented and reviewed through the Design Change Notice (DCN) process.

The sampling and analysis program will consist of bi-weekly isotopic thorium, radium-226, and total particulate analyses. Results from the isotopic thorium analysis (thorium-228, thorium-230, and thorium-232) will be used to specifically monitor thorium-230, the primary isotope of concern within the Silo 3 residues. The radium-226 analysis will be used to assess the effectiveness of process-control measures during the Silo 3 and AWR projects. Total particulate analysis will be used to determine if the results are indicative of project emissions or reflect the measurement of fugitive emissions from other sources (e.g. dust from construction vehicle traffic). The Project may evaluate the feasibility of changing the sample frequency (from biweekly to weekly or monthly) based upon factors such as historical results, the status of Silos Project activities, results from occupational particulate monitors, and the frequency of other IEMP boundary monitors. Any proposed change to the particulate sample analysis frequency will be documented and reviewed through the DCN process.

Samples will be analyzed according to the requirements for Analytical Support Level (ASL) B in the Sitewide CERCLA Quality (SCQ) assurance plan. The highest allowable minimal detectable concentrations (HAMDCs) for ASL B are 9.0 pCi/filter for isotopic thorium analyses and 4.0 pCi/filter for radium-226 analysis.

3.2 Direct Radiation Monitoring

In addition to airborne emissions, exposure to direct radiation is also a radiological hazard at the FEMP, particularly in the vicinity of Silo 1 and Silo 2. Direct, (penetrating) radiation is emitted from the radioactive materials stored onsite. The largest source of penetrating radiation at the FEMP results from the transformation of radium-bearing materials stored in Silos 1 and 2.

The existing IEMP environmental monitoring network includes five locations that monitor direct radiation levels in the vicinity of Silos 1 and 2. The monitoring is conducted using thermoluminescent dosimeters (TLDs). The monitoring network has been established and the locations were strategically chosen to ensure a monitoring envelope for each radiation source. During the AWR Project, major sources of direct radiation at the FEMP will undergo change. For example, the operation of the Radon Control System (RCS) is expected to result in lower direct radiation levels on top of the silos and elevated direct radiation levels adjacent to the carbon beds. The removal of the berm surrounding Silos 1 and 2 will result in changes to existing radiation shielding. These processes, together with the removal and relocation of the silo wastes to the Transfer Tank Area (TTA) may require modification of the IEMP TLD network to ensure adequate coverage of direct radiation sources.

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The existing IEMP TLD monitoring network will be modified in late 2002 to take into account the pending relocation of the wastes stored in the K-65 silos. As necessary, current TLD locations will be adjusted and new TLD locations added to adequately characterize and monitor the direct radiation in the vicinity of the AWR project and the site fenceline. The following new TLD locations are planned for the Silos area:

- Location 43 located on the western side of the Silos, near the KNW-A radon monitor.
- Location 44 located on the western side of the Silos, near the KSW-A radon monitor.
- Location 45 located on the southern side of the Silos, near the KSO radon monitor
- Location 46 located on the project boundary south on the transfer tank area building
- Location 47 located on the project boundary south of the planned location of the Silos 1 and 2 remediation facility

The silo area direct radiation monitoring locations (TLDs) are shown in Attachment A. Due to project construction activities, it may be necessary to re-locate TLDs. Changes in monitoring locations will be documented and approved through the DCN process

3.3 Wastewater Monitoring

All wastewater from the Silo 3 Project, AWR Project, and Silos 1 and 2 Project will be discharged to the FEMP Advanced Wastewater Treatment (AWWT) facility, after sampling to confirm that it is acceptable for transfer. Expected wastewater streams from Silos Project activities will be appropriately incorporated into the FEMP NPDES permit. Given the expected characteristics of the wastewater, and the discharge criteria for the AWWT, no wastewater unacceptable for transfer to the AWWT is expected to be generated. If analytical results for a particular batch of wastewater are found to be unacceptable, the batch will be managed on a case-by-case basis at the direction of AWWT operations. The specific disposition of the wastewater will be dependant upon factors including the amount, and specific characteristics of the batch of wastewater and upon current and planned AWWT operations at the time the AWR wastewater is generated. Details on the disposition of wastewater from each project are provided in the Environmental Control Plan included in each project's Remedial Design Package.

Groundwater Monitoring

Groundwater monitoring is currently managed by the Aquifer Restoration Project (ARP). The ARP provides the monitoring necessary to identify the effect of FEMP remediation activities. This monitoring is adequate for assessing potential impacts on groundwater quality due to the Silo 3 and AWR projects. In the event that collection of groundwater samples is needed to support the projects (or to assess any incidental releases), ARP managers will be notified to coordinate the appropriate groundwater monitoring activity.

4.0 Reporting

All project-specific environmental monitoring will be reported in Project Completion Reports, which will include a summary of the results generated during the projects. For radon monitoring, the report will identify each of the radon monitoring locations and the minimum, maximum, and average radon levels at each of those locations. For project-specific air particulate monitoring, the report will identify each of the monitoring locations and the minimum, maximum, and average levels of each analyte at each of the locations. For direct radiation monitoring, the report will include TLD locations and a summary of quarterly results.

Data from the radon monitors discussed in Section 3.1.3 will be reported in the IEMP mid-year summary and the Site Environmental Report (SER) in addition to the radon summary data and real-time radon data available through the IEMP Data Information Site. Direct radiation monitoring data from the TLD locations discussed in Section 3.2 will also be reported in these two IEMP reports. In addition, other project-specific data may be reported as necessary in the IEMP mid-year report or SER to explain results that have the potential to impact regulatory compliance limits as measured through the IEMP air monitoring program.

5.0 References

1) Revised Silo 3 Project Remedial Design Package, 40430-RDP-0001, May 2002.
2) Revised Silos 1 and 2 Accelerated Waste Retrieval Project Remedial Design Package, June 2002
3) Environmental Control Plan for the Silos 1 and 2 Accelerated Waste Retrieval Project, 40710-PL-0007, June 2002.
4) Silo 3 Project Environmental Control Plan, 40430-PL-0005, April 2002.
5) Integrated Environmental Monitoring Plan, 2505-WP-0022, Revision 2 January 2001.
6) Preliminary Hazards Analysis Report for Silo 3, RMR-0445-0056-002, Rocky Mountain Remediation Services, January 2000.
7) Preliminary Hazards Analysis report for the Silos 1 and 2 Accelerated Waste Retrieval Project, 624-P622-50, Foster Wheeler Environmental Corporation, January 2000

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Attachment A

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Attachment B

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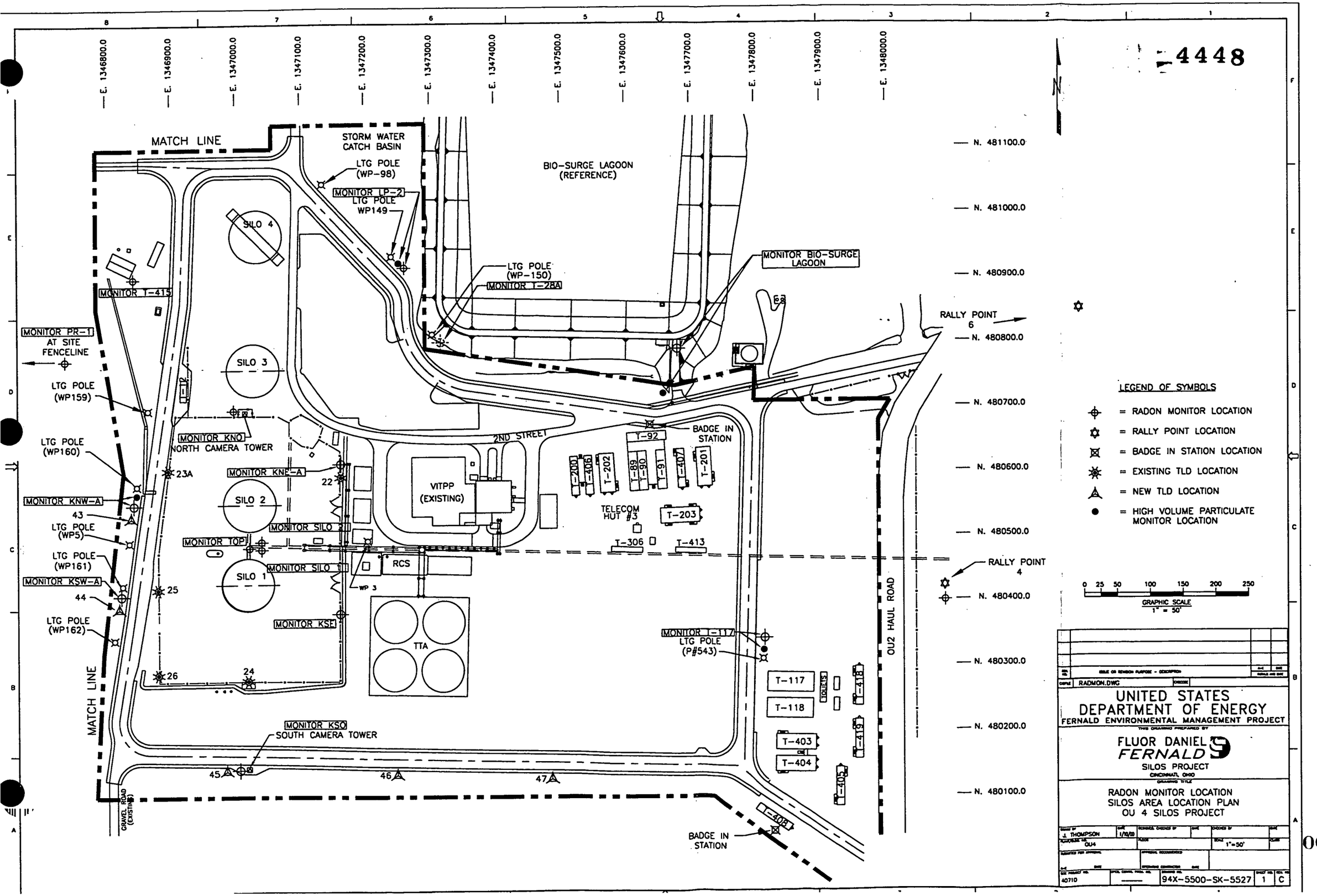
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MATCH LINE
STORM WATER CATCH BASIN
LTG POLE (WP-98)
MONITOR LP-2
LTG POLE WP149
BIO-SURGE LAGOON (REFERENCE)
SILO 4
LTG POLE (WP-150)
MONITOR T-28A
MONITOR BIO-SURGE LAGOON
MONITOR T-415
MONITOR PR-1 AT SITE FENCELINE
SILO 3
LTG POLE (WP159)
RALLY POINT 6
MONITOR KNO NORTH CAMERA TOWER
2ND STREET
BADGE IN STATION
T-92
LTG POLE (WP160)
23A
MONITOR KNE-A
22
VITPP (EXISTING)
T-200
T-406
T-202
T-89
T-90
T-91
T-407
T-201
MONITOR KNW-A
43
SILO 2
TELECOM HUT #3
T-203
LTG POLE (WP5)
MONITOR SILO 2
T-306
T-413
MONITOR TOP
LTG POLE (WP161)
MONITOR SILO 1
RCS
SILO 1
RALLY POINT 4
MONITOR KSW-A
25
WP 3
44
LTG POLE (WP162)
MONITOR KSE
TTA
MONITOR T-117
LTG POLE (P#543)
OU2 HAUL ROAD
26
24
T-117
T-118
T-418
T-419
T-403
T-404
T-405
MATCH LINE
MONITOR KSO SOUTH CAMERA TOWER
45
46
47
GRAVEL ROAD (EXISTING)
T-408
BADGE IN STATION
LEGEND OF SYMBOLS
= RADON MONITOR LOCATION
= RALLY POINT LOCATION
= BADGE IN STATION LOCATION
= EXISTING TLD LOCATION
= NEW TLD LOCATION
= HIGH VOLUME PARTICULATE MONITOR LOCATION
0 25 50 100 150 200 250
GRAPHIC SCALE 1" = 50'
RADMON.DWG
UNITED STATES DEPARTMENT OF ENERGY
FERNALD ENVIRONMENTAL MANAGEMENT PROJECT
FLUOR DANIEL FERNALD
SILOS PROJECT
CINCINNATI, OHIO
RADON MONITOR LOCATION
SILOS AREA LOCATION PLAN
OU 4 SILOS PROJECT
J. THOMPSON
1/10/00
OU4
1"=50'
40710
94X-5500-SK-5527
1
C

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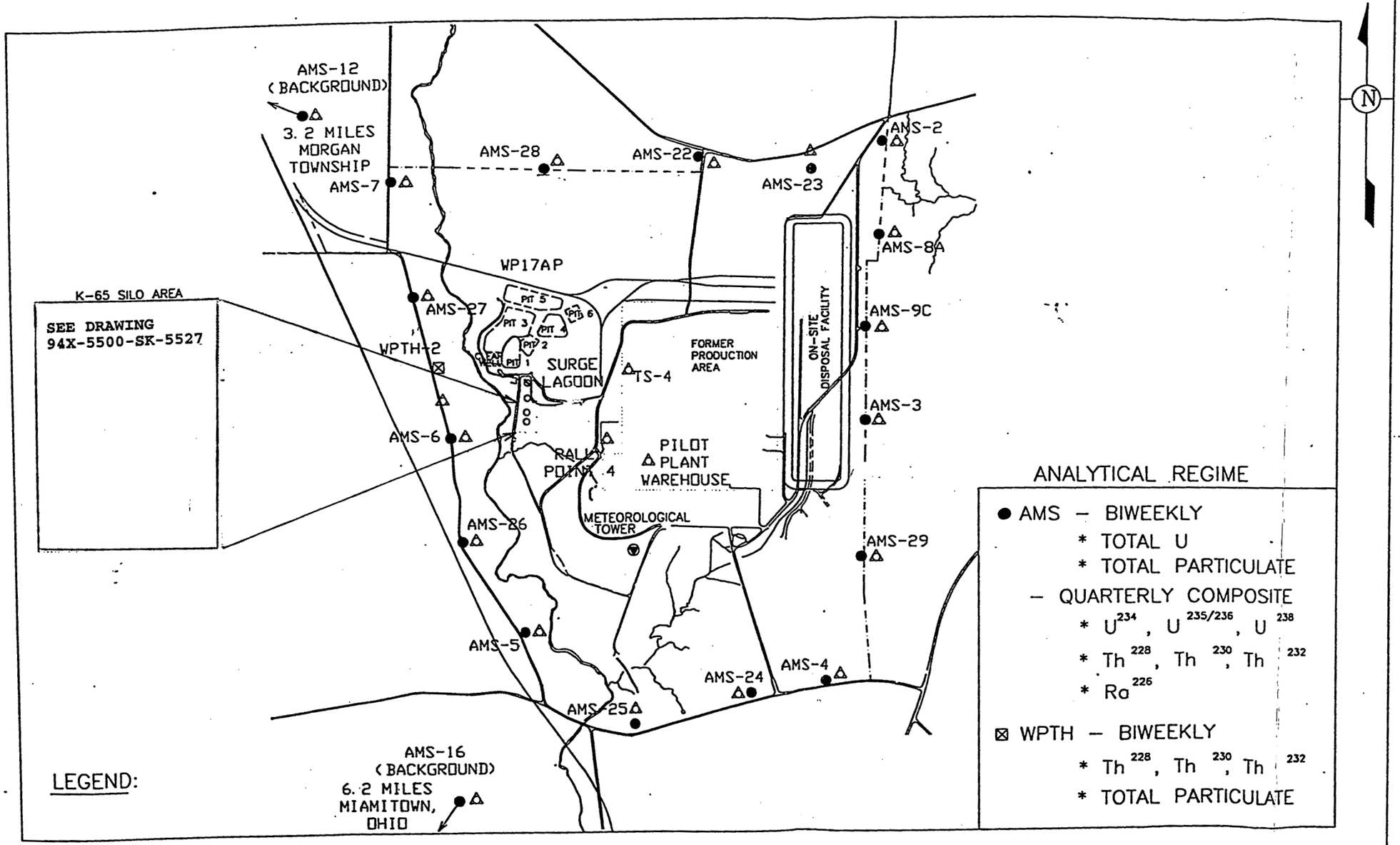
RADIOLOGICAL AIR MONITORING LOCATIONS



Mar. 27, 2000

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LOCATION MAP FOR AIR MONITORING LOCATIONS

6- HEALTH AND SAFETY
CONTROLS

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SILOS PROJECT

Health and Safety Controls

40000-PL-0014

MARCH 2002

FERNALD ENVIRONMENTAL MANAGEMENT PROJECT
FERNALD OHIO
U S DEPARTMENT OF ENERGY

000251

This document has been reviewed and approved by 4448

Project Manager		Date	4/18/02
Health and Safety Manager		Date	4-18-02
Industrial Safety Lead		Date	4/18/02
Industrial Hygiene Lead		Date	4/18/02

1 0 PURPOSE

The Health and Safety Controls portion of the Remedial Design Package is designed to illustrate the planned preventative or mitigative measures to address the occupational hazards identified for the Silos Project The Health and Safety Controls are presented consistent with the Silos Health and Safety Plan The Silos Health and Safety Plan takes into account the specific hazards inherent to the Silos Project site and presents procedures to be followed by Fluor Fernald its subcontractors and all other on site personnel to avoid and if necessary protect against health and/or safety hazards Exhibit 1 0 1 an excerpt from the Silos Health and Safety Plan illustrates the activities associated with the Silos Project and the hazards associated with the activities

The Health and Safety Matrix (Exhibit 1 0 2) lists the occupational hazards as identified in the Silos Project Health and Safety Plan The hazards identified in the Health and Safety Matrix are limited to those considered to be common construction and/or occupational safety hazards These hazards are addressed by the safety programs policies and procedures used to ensure that work is performed safely Some of the health and safety controls used to mitigate the occupational hazards identified are listed in terms of

- Frequency and type of monitoring required
- Personnel Protective Equipment (PPE)
- Training Requirements
- Medical Monitoring Requirements
- Administrative and Engineering Control Measures
- Permit(s)
- Decontamination and Disposal Procedures

The FEMP Emergency Plan PL 3020 describes the emergency management program that responds to potential hazards at the site Potential hazards identified at FEMP include severe weather hazardous and radiological material releases bomb threats vehicle/transportation accidents earthquakes and other events The Emergency Plan identifies the responsible parties to contact in the event of an emergency and details which personnel would respond to the event Specific elements of emergency support procedures are addressed in the Silos Project Health and Safety Plan These elements include communications local emergency support units preparation for medical emergencies first aid for injuries incurred on site record keeping and emergency site evacuation procedures

The health and safety controls will be developed further as the Operations Phase of the Silos Project is further delineated and with the development of activity specific Work Plans Additional occupational hazards and associated mitigative measures may be identified as the project progresses

Exhibit 1.0-1. Occupational Hazards Identified in the Silos Project Health and Safety Plan

- Motor vehicles, heavy equipment and crane operations (cranes, back hoes)
- Cutting and welding
- Overhead hazards
- Material handling (rigging, forklifts)
- Chemical and Radiological hazards
- Energy control (lockout/tagout)
- Silo integrity
- Falling hazards
- Slips and trips
- Heat and cold stress
- Electrical shock
- Lifting and straining
- Excavation and trenching
- Confined space entry

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Exhibit 1.0-2. Health and Safety Contr[illegible]based on the Silos Project Health and Safety Plan

ACTIVITY (TASKS)	HAZARD IDENTIFICATION	FREQUENCY & TYPE OF AIR AND PERSONNEL MONITORING REQUIRED	PERSONAL PROTECTIVE EQUIPMENT	TRAINING REQUIREMENTS	MEDICAL MONITORING & SURVEILLANCE REQUIREMENTS	ADMINISTRATIVE & ENGINEERING CONTROL MEASURES	PERMIT(S)	DECONTAMINATION & DISPOSAL PROCEDURES
1.0 General Project minimum requirements	Work in Silos area Work in construction area	Thermoluminescent Dosimeter (TLD) *Fluor Fernald* Radiological Control Technician (RCT) Periodic Monitoring as required	Steel toed, leather safety boots (ANSI Z41) Hard hat (ANSI Z89.1) Safety glasses w/ rigid side shields (ANSI Z87.1) Leather palm work gloves for sharps, abrasives, hot surfaces or pinch points during use of power hand tools/equipment (The above listed PPE is to protect from dropped objects, overhead hazards, eye injury, and punctures) PPE appropriate to the specific task beyond the standard required PPE will be identified in the Work Plans	General Site Worker Site GET Training Site Worker Training Rad Worker I or II 8 hr. Supervised field experience Construction Rules & Regulations Orientation on the HASP including matrix, and Orientation on Project Specific MSDSs	Medical surveillance exam: baseline, annual, and termination Report all injuries to *Fluor Fernald* Medical Department Baseline, annual, and termination urine sample	Attend a pre-work kickoff/safety meeting Daily job briefing at start of shift, after lunch, and when beginning new tasks *Fluor Fernald* to inspect all equipment prior to entering site Weekly safety meeting held on the first working day of the week Fluor Fernald approved Work Plans	Work Permit Radiological Work Permit (RWP) Site Dome Access Permit if working inside Silos 1 and 2 boundary fence	Personnel and material radiological contamination monitoring as required by Radiological Work Permit
	Work in Contamination Areas (Uranium)	General Area (GA) air sampling by *Fluor Fernald* (Uranium) Breathing Zone air sampling for at least 25% of the workers by *Fluor Fernald*	A minimum of full cloth anti-Cs for hands-on work Full-face respirator with magenta (HEPA cartridges as required by RWP) PAPR as required by RWP	Respirator training and fit-test PAPR Training if PAPRs are worn Rad Worker II 24 hr Supervised field experience	Medical approval for respirator use Initial, every 60 days, and termination urine sample Initial, annual and termination in-vivo exam	Dust suppression technologies (including use of a surfactant) as required by the Radiological Work Permit Visitors who are not Rad Worker II trained are to obtain authorization from the Radiological Control Program Team Coach Fluor Fernald	RWP	Disposal of contaminated material (anti-C, waste, etc) in supplied bags or containers Personnel and material radiological contamination monitoring required to exit Contamination Area

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ACTIVITY (TASKS)	HAZARD IDENTIFICATION	FREQUENCY & TYPE OF AIR AND PERSONNEL MONITORING REQUIRED	PERSONAL PROTECTIVE EQUIPMENT	TRAINING REQUIREMENTS	MEDICAL MONITORING & SURVEILLANCE REQUIREMENTS	ADMINISTRATIVE & ENGINEERING CONTROL MEASURES	PERMIT(S)	DECONTAMINATION & DISPOSAL PROCEDURES
1.0 General Project minimum requirements (continued)	Work in Contamination Areas (Radium)	(Radium) Breathing Zone air sampling for 100% of the workers by Fluor Fernald	Cloth anti-Cs with disposable outer anti-Cs for Radium Contamination Areas Air-supplied hood as required by RWP	Same as Uranium Contamination Area plus Air-supplied hood training, if air-supplied hood is worn	Same as Uranium Contamination Area plus Baseline and incident fecal sampling as required for radium/thorium contamination areas.	Same as Uranium Contamination Area	RWP	Same as Uranium Contamination Area
	Heat Stress	Physiological monitoring Ambient temperature monitoring	Cool vests or cool suits (optional)	Safety meetings concerning signs and symptoms of heat stress	Fluor Fernald Medical approval for working in hot environments	Fluor Fernald-approved heat stress program Work/rest regimen based on physiological monitoring shall be used Cool room, including water		
	Cold Stress	Ambient temperature monitoring	Clothing suitable for cold weather	Safety briefing on cold stress If temperature ≤32°F, special briefing on use of PAPRs in cold weather (if PAPRs are worn)	Fluor Fernald Medical approval for working in cold environments	Fluor Fernald-approved Cold Stress Program Identify a warm-up area(s) to be used Work/rest regimen may be used Use of PAPRs in cold weather is restricted as follows: 0 to 15°F, Time is limited to 15 min. continuous use; and <0°F, Use of PAPRs is prohibited except for emergency use.		
	Eye injury		Safety glasses with rigid side shields (ANSI 287.1)	Worker Awareness Training	Report all injuries to Fluor Fernald Medical Department	Attend a pre-work kickoff/safety meeting. Fluor Fernald Work Plans		
	Overhead hazards		Hardhat (ANSI 298.1)	Worker Awareness Training				
	Dropped Objects		Steel-toed, leather safety boots (ANSI 241)	Worker Awareness Training				

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ACTIVITY (TASKS)	HAZARD IDENTIFICATION	FREQUENCY & TYPE OF AIR AND PERSONNEL MONITORING REQUIRED	PERSONAL PROTECTIVE EQUIPMENT	TRAINING REQUIREMENTS	MEDICAL MONITORING & SURVEILLANCE REQUIREMENTS	ADMINISTRATIVE & ENGINEERING CONTROL MEASURES	PERMIT(S)	DECONTAMINATION & DISPOSAL PROCEDURES
1.0 General Project minimum requirements. (continued)	Elevated work (falls from elevations)		Body harness and lanyard	Training in proper use of fall protection equipment		100% fall protection required for unguarded work locations≥ 6 feet, including work assembling and disassembling scaffold and working from ladders Barricades and post signs in the area(s) below the elevated work Secure lanyard to structure capable of holding 5000 lbs. Quarterly inspection of equipment by the competent person Inspect equipment before use		
	Ladders and scaffolding		See "Elevated Work" above	Competent person for inspection of ladders and scaffolding Scaffold training for users and erectors		Ladders to be secured in place at the top when set up for use Ladders to have current inspection sticker Scaffolding to have current inspection tag		
	Use of a man lift (e.g., JLG, Grove, Scissors)		Safety harness and lanyard (except on scissors-type lifts with top rail, mid rail and toe boards)	Trained operator		All lift units are to be inspected and operated as defined within the manufacture's operation/safety manual Competent person to perform monthly inspections Operators to inspect daily or at the beginning of each shift 100% tie off when in equipment except for Scissors lifts that have top rail, mid rail, and toe boards Barricade around areas of operation Maintain ≥ 10 feet from power lines		

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ACTIVITY (TASKS)	HAZARD IDENTIFICATION	FREQUENCY & TYPE OF AIR AND PERSONNEL MONITORING REQUIRED	PERSONAL PROTECTIVE EQUIPMENT	TRAINING REQUIREMENTS	MEDICAL MONITORING & SURVEILLANCE REQUIREMENTS	ADMINISTRATIVE & ENGINEERING CONTROL MEASURES	PERMIT(S)	DECONTAMINATION & DISPOSAL PROCEDURES
1.0 General Project minimum requirements. (continued)	Silo dome collapse		Safety harness and lanyard			Fluor Fernald approved Work Plans Comply with Technical Safety Requirements for Silo domes of the Preliminary Hazard Analysis Report, Chapter 5, to include: Restrict placement on loads on domes of Silos 1, 2, or 4 so no live load greater than 700 lbs. (including up to three persons). Evaluate modifications in dead loads applied to silos. Equipment loads shall be distributed over the largest area practical. No equipment loads distributed over an area smaller than 3-foot-diameter circle	Dome Access Permit	
	Hoisting/Rigging			Competent person for Hoisting and Rigging Inspection Pre-Work Rigging Orientation Briefing on lifting plan prior to the lift		Comply with DOE Hoisting and Rigging Manual requirements, Chapter 15 Lifting Plan Qualified Rigger verification form for workers Avoid load swing paths over Silo 1, 2, & 3. A Critical Lift Plan shall be required for all lifting of loads over Silos 1, 2 & 3.		
	Hand and power tools		As recommended by the manufacturer	Worker Awareness Training. Review of manufacturer's instructions for use.		Daily inspection of tools prior to use. Remove damaged tools from use and tag as "Do Not Use.		

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ACTIVITY (TASKS)	HAZARD IDENTIFICATION	FREQUENCY & TYPE OF AIR AND PERSONNEL MONITORING REQUIRED	PERSONAL PROTECTIVE EQUIPMENT	TRAINING REQUIREMENTS	MEDICAL MONITORING & SURVEILLANCE REQUIREMENTS	ADMINISTRATIVE & ENGINEERING CONTROL MEASURES	PERMIT(S)	DECONTAMINATION & DISPOSAL PROCEDURES
1.0 General Project minimum requirements (continued)	Weather limitations for outdoor activities					Outdoor activities will be suspended if the following condition(s) occurs(s): Lightning; Heavy persistent rain; Any wind velocity of 25 mph or greater will stop elevated work and crane work; and Any weather condition whose impact is judged to be detrimental by the Fluor Fernald Health and Safety Officer		
	Handling sharp objects/ Punctures/ Pinch Points.		Leather palm gloves		Report all injuries to supervisor and Medical.	Sharp edges will be identified, eliminated, or protected. All hand and power tools will be maintained in safe condition. Guards will be kept in place on all hand/power tools. Alert workers of possible pinch points.		
	Impalement					Protective caps will be placed on the protruding ends of rebar. Sharp edges will be identified, eliminated, or protected		
	Noise	Noise monitoring and/or dosimetry may be conducted to verify compliance with regulations (as required)	Hearing protection required if noise levels ≥ 85 dBA (i.e., when using power tools or heavy equipment) Hearing protection will provide a noise reduction rating capable of maintaining personal exposure below 85 dBA (ear muffs or plugs will be worn as required).	Personnel exposed to an 8-hr TWA of 85 dBA or greater shall be in a Hearing Conservation Program (HCP)	Audiometric evaluation required for employees in Hearing Conservation Program.	Areas and equipment where noise ≥ 85 dBA are to be posted "Hearing Protection Required" Engineer or design out noise whenever possible Time limits or job rotation may be used in conjunction with engineering controls		Store reusable hearing protection in a sanitary manner

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ACTIVITY (TASKS)	HAZARD IDENTIFICATION	FREQUENCY & TYPE OF AIR AND PERSONNEL MONITORING REQUIRED	PERSONAL PROTECTIVE EQUIPMENT	TRAINING REQUIREMENTS	MEDICAL MONITORING & SURVEILLANCE REQUIREMENTS	ADMINISTRATIVE & ENGINEERING CONTROL MEASURES	PERMIT(S)	DECONTAMINATION & DISPOSAL PROCEDURES
1.0 General Project minimum requirements (continued)	Fire (open flame during welding or cutting) See also specific activities for additional requirements when cutting lead painted or contaminated materials		Flame retardant clothing or outer anti-Cs Welder's leathers (when debris contacts clothing) UV eye protection when welding	Fire watch training		Fire extinguisher available near work site Remove combustibles and cover area with fire resistant welding blankets or wet down work area as necessary Maintain a fire watch at least 30 minutes after work is completed Welding screens as needed Ventilation as needed	Open Flame/ Welding Permit Confined Space Evaluation/ Permit if cutting or welding in confined space	
	Vibration from powered hand tools.		Anti-vibration gloves shall be used during extended use of vibrating hand tools more than 2 hours on 1 day or more than 1 hour on consecutive days	Briefing for involved workers on vibration hazards		Personnel shall dress warmly when using power hand tools in cold weather Personnel shall take 10-minute breaks from vibration for each hour a vibrating hand tool is operated		
	Confined Space.	Fluor Fernald performs initial monitoring Fluor Fernald performs continuous monitoring when required	PPE required for entry into permit required, confined spaces	Confined Spaces Training required for entry into permit required confined spaces	Fluor Fernald medical approval for permit required, confined space entry	Work from outside confined space when possible Controls required for entry into permit required confined spaces	Confined Space Evaluation/ Permit	
	Back Injury (Lifting Sprain and Strains)			Must evaluate personnel if required to lift 35-50 lbs. Cannot exceed 50 lbs. without assistance Site personnel will be instructed on proper lifting techniques		Mechanical devices will be utilized to reduce manual handling of materials. Team lifting will be used in lieu of mechanical devices.		

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ACTIVITY (TASKS)	HAZARD IDENTIFICATION	FREQUENCY & TYPE OF AIR AND PERSONNEL MONITORING REQUIRED	PERSONAL PROTECTIVE EQUIPMENT	TRAINING REQUIREMENTS	MEDICAL MONITORING & SURVEILLANCE REQUIREMENTS	ADMINISTRATIVE & ENGINEERING CONTROL MEASURES	PERMIT(S)	DECONTAMINATION & DISPOSAL PROCEDURES
1.0 General Project minimum requirements (continued)	Operation of mobile equipment (e.g., bulldozer, bobcat, forktruck, backhoe) (Property Damage)		Hearing protection required if noise levels ≥ 85 dBA. Orange Vest for nearby employees	Qualified equipment operator		Competent person to inspect equipment before use at FEMP and quarterly Evaluation prior to operation of any mobile equipment of the berms or within 10 feet of the silos. Rollover protection structures Overhead protection Daily inspection of equipment by the operator prior to use. Audible backup alarm and horn No obstructed rear views Barricade the swing radius of equipment Fire extinguisher Seat belts to be worn		
	Penetration of ground or wall penetrations Contact with/ Hitting existing buried utilities.			Site Energy Control Training (OP-0004) for involved workers and supervisors if location of utilities cannot be determined Qualified equipment operator		Review as built drawings Daily Penetration Permit Briefing. Barricade & protect as needed Flag utilities within 10 feet of penetration Lockout and tagout utilities if location of utilities cannot be determined Hand dig within 3 feet of underground utilities	Penetration Lockout/ Tagout	

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ACTIVITY (TASKS)	HAZARD IDENTIFICATION	FREQUENCY & TYPE OF AIR AND PERSONNEL MONITORING REQUIRED	PERSONAL PROTECTIVE EQUIPMENT	TRAINING REQUIREMENTS	MEDICAL MONITORING & SURVEILLANCE REQUIREMENTS	ADMINISTRATIVE & ENGINEERING CONTROL MEASURES	PERMIT(S)	DECONTAMINATION & DISPOSAL PROCEDURES
1.0 General Project minimum requirements (continued)	Connection to site utilities and systems			Site Energy Control Training (OP-0004) for involved workers and supervisors		Verify isolation of utilities and systems Energy isolation plan Lockout/Tagout Specific Equipment Plans	Service Interruption Permit if utilities are disrupted Also see "Ground Penetration/ Excavation/ Radiological Contamination " below	
	Electrical Shock/ Electrocution (Hazardous energy)			Site Energy Control Training (OP-0004) for involved workers and supervisors		All electrical work will be performed by trained/ qualified electricians. All lockout/tagout procedures will be followed as outlined in the HASP and OP-0004. All electrical installation shall comply with National Electrical Safety Codes (NESE), and National Electric Code (NEC). Live parts of wiring or equipment shall be guarded to protect all persons from contact. No energized work will be permitted on live lines/equipment. Electrical tie-ins to existing overhead lines on existing equipment shall require and Energy Isolation Plan and a Service Interruption Permit. Shall maintain a minimum ten (10) feet clearance from overhead lines. Approach distance for qualified employees shall be followed as listed in 10 CFR 1926.416.	Outage Permit if utilities are disrupted	

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ACTIVITY (TASKS)	HAZARD IDENTIFICATION	FREQUENCY & TYPE OF AIR AND PERSONNEL MONITORING REQUIRED	PERSONAL PROTECTIVE EQUIPMENT	TRAINING REQUIREMENTS	MEDICAL MONITORING & SURVEILLANCE REQUIREMENTS	ADMINISTRATIVE & ENGINEERING CONTROL MEASURES	PERMIT(S)	DECONTAMINATION & DISPOSAL PROCEDURES
1.0 General Project minimum requirements (continued)	Electrical Shock/ Electrocution (Hazardous energy) (continued)					Flexible cords shall be elevated GFCI's required Flexible cords shall be UL-listed and rated for hard usage and damp locations Flexible cords shall be protected from vehicle traffic All electric tools shall be inspected for damage prior to use and used in accordance with the manufacturer's guidelines		
	Slip/Trip/Falls		Elevated work will require fall protection (full body harness/lanyard) Steel-toed boots with substantial soles			Daily Inspections for Housekeeping. Work areas and means of access shall be maintained safely and orderly. Maintain clear travel paths. Barricade work areas. Level terrain will be utilized as unloading areas. Elevate electrical cords/welding leads when possible Tripping and poor footing hazards will be repaired as they are discovered or clearly identified. All extension cords, cables and hoses will be run overhead when possible.		

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ACTIVITY (TASKS)	HAZARD IDENTIFICATION	FREQUENCY & TYPE OF AIR AND PERSONNEL MONITORING REQUIRED	PERSONAL PROTECTIVE EQUIPMENT	TRAINING REQUIREMENTS	MEDICAL MONITORING & SURVEILLANCE REQUIREMENTS	ADMINISTRATIVE & ENGINEERING CONTROL MEASURES	PERMIT(S)	DECONTAMINATION & DISPOSAL PROCEDURES
1.0 General Project minimum requirements (continued)	Vehicular Traffic		Orange traffic vests will be worn when working near roadways and equipment.	Qualified equipment operator Worker awareness training		Spotters will be used when backing up trucks and moving equipment in congested areas. Equipment will be equipped with backup alarms Daily vehicle inspections Equipment equipped with horns Flaggers used as needed		

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ACTIVITY (TASKS)	HAZARD IDENTIFICATION	FREQUENCY & TYPE OF AIR AND PERSONNEL MONITORING REQUIRED	PERSONAL PROTECTIVE EQUIPMENT	TRAINING REQUIREMENTS	MEDICAL MONITORING & SURVEILLANCE REQUIREMENTS	ADMINISTRATIVE & ENGINEERING CONTROL MEASURES	PERMIT(S)	DECONTAMINATION & DISPOSAL PROCEDURES
1.0 General Project minimum requirements (continued)	Excavations (Cave in)	Any excavation four feet and deeper will be monitored for oxygen, combustible gases, and toxic atmospheres prior to entry by personnel.		The Excavation Competent Person shall have appropriate training		Daily inspections conducted by the Excavation Competent Person. Stockpiles shall be placed 3 feet or greater from the excavation Any excavation four feet and deeper will be provided with ladders to allow for means of egress in such a way as to require no more than 25 feet lateral travel. The excavated area will be barricaded to prevent field personnel from falling into the trench (when unattended). Protective systems to prevent excavation cave-in will be affected in excavations greater than five feet in depth, or if deemed necessary by a competent person. All trenching shall be in accordance with the provisions of 29 CFR 1926 Subpart P. Smoking or open flames will not be allowed near work areas, if open flames must be used, procedures outlined in the HASP for hot work will be followed. During backfilling operations, warning tape will be laid down to mark buried utilities. HASP and Work Plans	Penetration	

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ACTIVITY (TASKS)	HAZARD IDENTIFICATION	FREQUENCY & TYPE OF AIR AND PERSONNEL MONITORING REQUIRED	PERSONAL PROTECTIVE EQUIPMENT	TRAINING REQUIREMENTS	MEDICAL MONITORING & SURVEILLANCE REQUIREMENTS	ADMINISTRATIVE & ENGINEERING CONTROL MEASURES	PERMIT(S)	DECONTAMINATION & DISPOSAL PROCEDURES
1.0 General Project minimum requirements (continued)	Worker Struck By/ Against/ Between Equipment		Orange traffic vests will be worn when working near roadways and equipment.	Qualified equipment operator. Worker awareness training		Eye contact with operators will be made before approaching equipment. Barricade work areas Use of protective shields or guards on rotating equipment. Equipment will not be approached on blind sides. The lift and swing path will be maintained clear of obstructions. Personnel will maintain a safe distance from the swing radius of the suspended loads. Personnel will understand and review hand signals. All machines will be equipped with backup alarms. Spotters will be used when backing up trucks and moving equipment in confined areas.		
	Spills					Spill and absorbent materials will be readily available. Employees will be instructed as to proper fueling techniques. Fuel nozzle and hose will be secured in holder after use. Fuel caps will be secured after fueling operations.		

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ACTIVITY (TASKS)	HAZARD IDENTIFICATION	FREQUENCY & TYPE OF AIR AND PERSONNEL MONITORING REQUIRED	PERSONAL PROTECTIVE EQUIPMENT	TRAINING REQUIREMENTS	MEDICAL MONITORING & SURVEILLANCE REQUIREMENTS	ADMINISTRATIVE & ENGINEERING CONTROL MEASURES	PERMIT(S)	DECONTAMINATION & DISPOSAL PROCEDURES
1.0 General Project minimum requirements (continued)	Fire/Explosion					All fuel tank/trucks shall be grounded and bonded during fueling operations. Smoking and open flames are not permitted within 50 feet of fueling/greasing areas. Safety Cans (Type II, UL approved) will be used All equipment shall be equipped with 10-lb. ABC type fire extinguishers. 10-lb. ABC type fire extinguishers shall be readily available during fuel/greasing operations.		
	Chemical Exposure	Air monitoring may be conducted to document worker exposure.	Personal Protective Equipment required by Material Safety Data Sheets (MSDSs), Work Plan, and/or FEMP Work Permit	Material Safety Data Sheets shall be reviewed with all workers prior to their starting work. Hazard Communication Training	Inclusion in the appropriate medical surveillance program if required based on exposures.	Chemical overexposures shall be reported to the supervisor and Medical (as necessary). Follow requirements on MSDS Chemical Inventory Hazard Communication	Chemical/ Hazardous Material Work Permit (as required).	Skin will be rinsed with water if contact with chemicals occurs. Portable eyewash and/or safety shower (as required).
	Overhead Utilities					Flag person as appropriate. Walk down of location to familiarize workers. All equipment will stay minimum of ten feet from power lines of 50 kv or less. This minimum distance will be increased as the voltage of the power lines increase Insulate or de-energize lines as needed.		
1.0 General Project minimum requirements (continued)	Dust Exposure	Fugitive dust monitoring as applicable.				Water truck or other wetting device.		

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ACTIVITY (TASKS)	HAZARD IDENTIFICATION	FREQUENCY & TYPE OF AIR AND PERSONNEL MONITORING REQUIRED	PERSONAL PROTECTIVE EQUIPMENT	TRAINING REQUIREMENTS	MEDICAL MONITORING & SURVEILLANCE REQUIREMENTS	ADMINISTRATIVE & ENGINEERING CONTROL MEASURES	PERMIT(S)	DECONTAMINATION & DISPOSAL PROCEDURES
	Compressed Air			Only workers trained in the proper use, storage, and movement of compressed air cylinders shall be allowed to handle them.		Compressed air cylinders shall be appropriately secured, stored and labeled. Compressed air cylinders shall be stored with the protective caps on. Compressed air hose connections shall be secured with wire or chain to prevent whipping if they become separated.		

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ACTIVITY (TASKS)	HAZARD IDENTIFICATION	FREQUENCY & TYPE OF AIR AND PERSONNEL MONITORING REQUIRED	PERSONAL PROTECTIVE EQUIPMENT	TRAINING REQUIREMENTS	MEDICAL MONITORING & SURVEILLANCE REQUIREMENTS	ADMINISTRATIVE & ENGINEERING CONTROL MEASURES	PERMIT(S)	DECONTAMINATION & DISPOSAL PROCEDURES
1.0 General Project minimum requirements (continued)	Crane use			Qualified equipment operator		Mobile cranes and boom trucks shall be inspected by Fluor Fernald's crane inspector prior to entry onto and use at the site. Avoid load swing paths over Silos 1, 2, & 3 A Critical Lift Plan shall be required for all lifting of loads over Silos 1, 2, & 3 Copies of the annual inspection documentation shall be presented to Fluor Fernald 24 hours before delivery of any mobile cranes or boom trucks. Maintenance records shall be presented to Fluor Fernald prior to use of equipment. Daily and monthly inspections of cranes and hoists will be recorded on Fluor Fernald Forms: FS-F-2965, Fluor Fernald Mobile Crane Operator Checklist, FS-F-2423, Fluor Fernald Record of Daily Hoist Check, and FS-F-3948, Fluor Fernald Wire Rope & Hook Condition. Only hooks with latches to bridge the throat opening shall be used. All slings shall have a certificate of proof test to 200% of vertical working load and a manufacturers tag indicating the manufacturers name, wire rope construction and the vertical work load limit. Periodic inspections of structural and mechanical below-the-hook lifting devices shall be conducted referencing Fluor Fernald Form FS-F-2478, Fluor Fernald Lifting Devices, Grabs, & Tongs Checklist	Lift and Critical Lift as applicable	

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ACTIVITY (TASKS)	HAZARD IDENTIFICATION	FREQUENCY & TYPE OF AIR AND PERSONNEL MONITORING REQUIRED	PERSONAL PROTECTIVE EQUIPMENT	TRAINING REQUIREMENTS	MEDICAL MONITORING & SURVEILLANCE REQUIREMENTS	ADMINISTRATIVE & ENGINEERING CONTROL MEASURES	PERMIT(S)	DECONTAMINATION & DISPOSAL PROCEDURES
1.0 General Project minimum requirements (continued)	Biological Hazards (insect stings, plants and snake bites)		Use insect repellent as needed. Gather pants legs and tape closed as needed. Wear a long sleeve shirt as appropriate.	Brief workers on insect, snake and plant hazards		Inspect work areas for potential biological hazards prior to start of activities.		Wash any areas of skin exposed to poisonous plants.
	Concrete Splash		Neoprene or Nitrate gloves for hand protection Rubber pullover boots Long sleeve shirts Splash goggles or face shield and safety glasses	Worker awareness training with review of MSDSs.				Wash any area of body that comes in contact with the wet concrete Follow recommendations of Manufactures MSDS for eye contact. Eyewash stations.
	Metal Fumes (Welding/Torch Work)	Personal Exposure Monitoring based on type of metal being welded, welding rods used, and duration of task.	Respiratory Protection may be required in enclosed or confined spaces.	Worker awareness training with review of MSDSs.	Medical approval for respirators if one is used. Fit Test for respirator	Welding and torch work to be performed in open, well-ventilated areas when possible		Wash hands and face prior to eating and drinking and at end of shift

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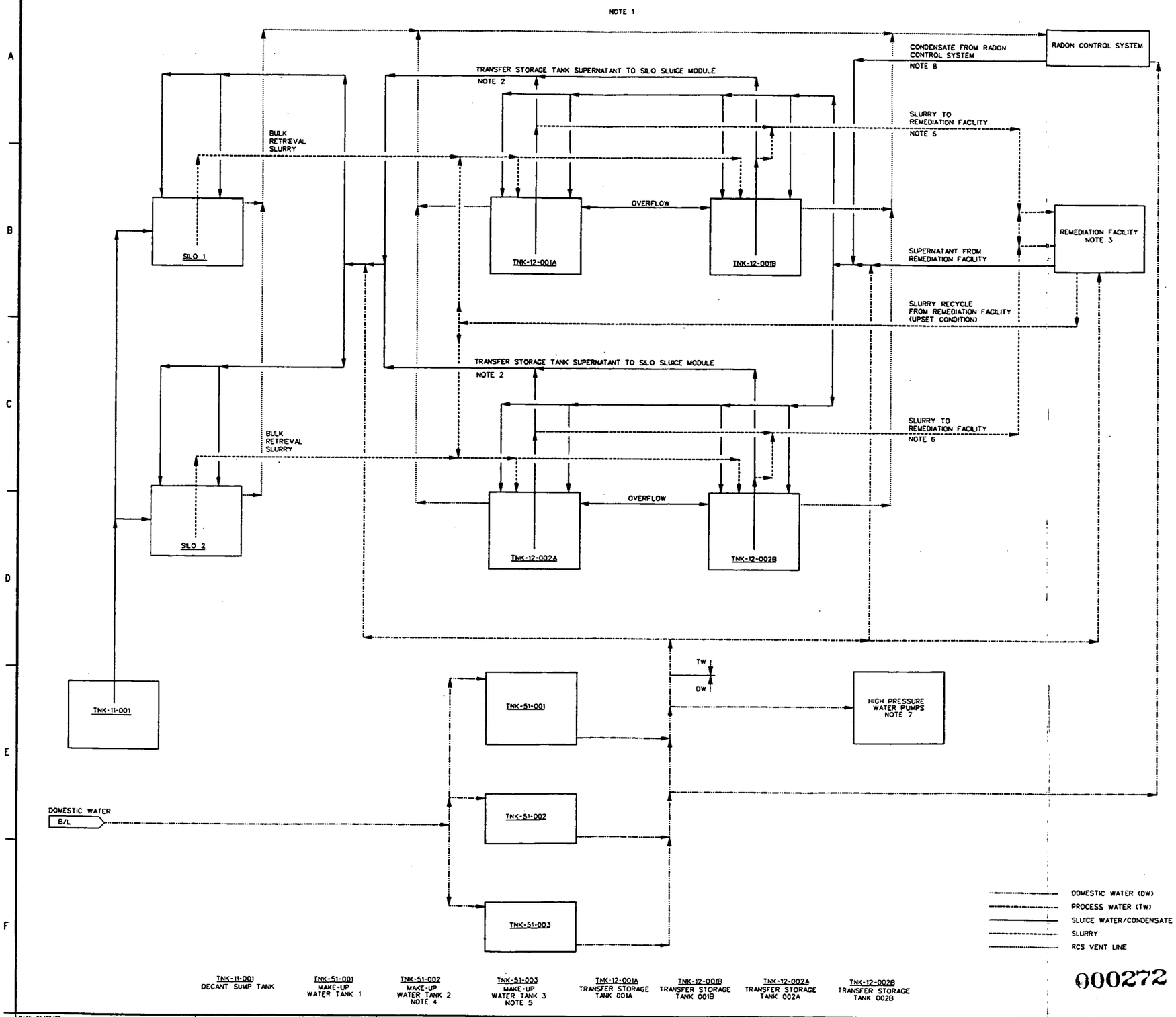
APPENDIX A
PROCESS FLOW DIAGRAMS

AWR Remedial Design Package Drawing List

Appendix A - Process Flow Diagrams

Drawing Number		Revision	Drawing Title
94X-3900-F-	01490	A	FLOW DIAGRAMS, PROCESS FLOW DIAGRAM, PROCESS OVERVIEW
94X-3900-F-	01785	A	FLOW DIAGRAMS, PROCESS FLOW DIAGRAM, COMPRESSED AIR SYSTEM
94X-3900-F-	01493	0	FLOW DIAGRAMS, PROCESS FLOW DIAGRAM, MATERIAL BALANCE TABLE
94X-3900-F-	01476	0	FLOW DIAGRAMS, PROCESS FLOW DIAGRAM, SWRS FOR SILO 1
94X-3900-F-	01477	0	FLOW DIAGRAMS, PROCESS FLOW DIAGRAM, SWRS FOR SILO 2
94X-3900-F-	01478	0	FLOW DIAGRAMS, PROCESS FLOW DIAGRAM, SILO HIGH PRESSURE PUMP SKID
94X-3900-F-	01491	0	FLOW DIAGRAMS, PROCESS FLOW DIAGRAM, SILO SLURRY AND SLUICE WATER DISTRIBUTION
94X-3900-F-	01479	0	FLOW DIAGRAMS, PROCESS FLOW DIAGRAM, TWRS FOR TRANSFER STORAGE TANK 001A
94X-3900-F-	01480	0	FLOW DIAGRAMS, PROCESS FLOW DIAGRAM, TWRS FOR TRANSFER STORAGE TANK 001B
94X-3900-F-	01481	0	FLOW DIAGRAMS, PROCESS FLOW DIAGRAM, TWRS FOR TRANSFER STORAGE TANK 002A
94X-3900-F-	01482	0	FLOW DIAGRAMS, PROCESS FLOW DIAGRAM, TWRS FOR TRANSFER STORAGE TANK 002B
94X-3900-F-	01483	0	FLOW DIAGRAMS, PROCESS FLOW DIAGRAM, TRANSFER STORAGE TANK LEAK DETECTION SUMP
94X-3900-F-	01484	0	FLOW DIAGRAMS, PROCESS FLOW DIAGRAM, DOMESTIC AND PROCESS WATER DISTRIBUTION
94X-3900-F-	01485	0	FLOW DIAGRAMS, PROCESS FLOW DIAGRAM, SLURRY AND SLUICE WATER DISTRIBUTION
94X-3900-F-	01486	0	FLOW DIAGRAMS, PROCESS FLOW DIAGRAM, TWRS HIGH PRESSURE WATER DISTRIBUTION
94X-3900-F-	01487	0	FLOW DIAGRAMS, PROCESS FLOW DIAGRAM, TWRS CONTAINMENT AREA A AND B
94X-3900-F-	01488	0	FLOW DIAGRAMS, PROCESS FLOW DIAGRAM, TRANSFER STORAGE TANK POLYMER SYSTEM
94X-3900-F-	01489	0	RADON CONTROL SYSTEM PROCESS FLOW DIAGRAM MASS BALANCE TABLE (PHASE 1)
20FMD001		5	FLOW DIAGRAMS, PROCESS FLOW DIAGRAM, RCS PHASE 2 MATERIAL BALANCE TABLE
94X-3900-F-	01494	0	FLOW DIAGRAMS, PROCESS FLOW DIAGRAM, RCS PHASE 2 MATERIAL BALANCE TABLE
94X-3900-F-	01495	0	FLOW DIAGRAMS, PROCESS FLOW DIAGRAM, RCS FOR SILO 1 (PHASE 2)
94X-3900-F-	01496	0	FLOW DIAGRAMS, PROCESS FLOW DIAGRAM, RCS FOR SILO 2 (PHASE 2)
94X-3900-F-	01497	0	FLOW DIAGRAMS, PROCESS FLOW DIAGRAM, RCS FOR TRANSFER STORAGE TANKS (PHASE 2)
94X-3900-F-	01498	0	FLOW DIAGRAMS, PROCESS FLOW DIAGRAM, RCS FOR TRANSFER STORAGE TANK MODULES (PHASE 2)
20FMD004		4	RADON CONTROL SYSTEM PROCESS FLOW DIAGRAM SILO 1
20FMD007		4	RADON CONTROL SYSTEM PROCESS FLOW DIAGRAM CARBON BEDS
20FMD008		5	RADON CONTROL SYSTEM PROCESS FLOW DIAGRAM HOLD-UP TANKS AND CONDENSATE
20FMD009		4	RADON CONTROL SYSTEM PROCESS FLOW DIAGRAM DRYERS AND AIR HANDLING
20FMD010		5	RADON CONTROL SYSTEM PROCESS FLOW DIAGRAM HOLD-UP EXHAUST & RECIRC FANS
94X-3900-F-	1492	0	FLOW DIAGRAMS, PROCESS FLOW DIAGRAM, MAKE-UP WATER TANKS
94X-3900-H-	01977	0	HVAC, LEGEND AND GENERAL NOTES, SYMBOLS, ABBREVS., EQUIP. AND SYSTEM DESIGNATORS
94X-3900-H-	01979	0	HVAC, TRANSFER TANK AREA BUILDING, AIRFLOW DIAGRAM
94X-3900-N-	01504	0	INSTRUMENTATION, PIPING AND INSTRUMENTATION DIAGRAM, PIPING, VALVES, AND MISCELLANEOUS, SHEET 1 OF 3
94X-3900-N-	01505	0	INSTRUMENTATION, PIPING AND INSTRUMENTATION DIAGRAM, INSTRUMENTATION, SHEET 2 OF 3
94X-3900-N-	01506	0	INSTRUMENTATION, PIPING AND INSTRUMENTATION DIAGRAM, EQUIPMENT AND MISCELLANEOUS, SHEET 3 OF 3



000272

NOTES:

1. THE PROCESS OVERVIEW PROCESS FLOW DIAGRAM DEPICTS PRIMARY FLOW PATHS AND IS NOT INTENDED TO SHOW ACTUAL PIPING CONFIGURATIONS. FOR EXAMPLE, THE ABILITY TO PUMP CONTENTS OF ONE TRANSFER STORAGE TANK TO ANY OTHER TRANSFER STORAGE TANK EXISTS, BUT IS NOT DEPICTED IN THIS DIAGRAM.
2. SLUICE WATER MAY BE PUMPED FROM ANY ONE OF THE TRANSFER STORAGE TANKS IN DECANT MODE.
3. REFER TO SILOS 1 AND 2 PROJECT.
4. PREVIOUSLY TNK-12-003.
5. PREVIOUSLY TNK-12-004.
6. IT IS ANTICIPATED THAT CONTENTS FROM ONLY ONE TRANSFER STORAGE TANK WILL BE TRANSFERRED TO THE REMEDIATION FACILITY AT A TIME.
7. HIGH PRESSURE PUMPS PROVIDING HIGH PRESSURE WATER FOR DECONTAMINATION EQUIPMENT AND SLURRY PUMP SPRAY RINGS ARE SUPPLIED BY THE DOMESTIC WATER SYSTEM.
8. CONDENSATE IS PUMPED FROM THE RADON CONTROL SYSTEM BUILDING INTO THE VALVE ROOM IN THE TTA BUILDING.

4448

REF DWG NO.	DRAWING TITLE

REV. NO.	ISSUE OR REVISION PURPOSE - DESCRIPTION	DATE	REV. BY	APPR.
0	ISSUED TO CONSTRUCTION	05/29/02	[illegible]	[illegible]

INITIALS AND DATE

UNITED STATES DEPARTMENT OF ENERGY
FERNALD ENVIRONMENTAL MANAGEMENT PROJECT

THIS DRAWING PREPARED BY
JACOBS
125 Broadway Ave.
Oak Ridge, Tennessee 37830
Tel: 865-220-4800
Fax: 865-220-6170

PROJECT NAME
AWR BOP OPTIMIZATION

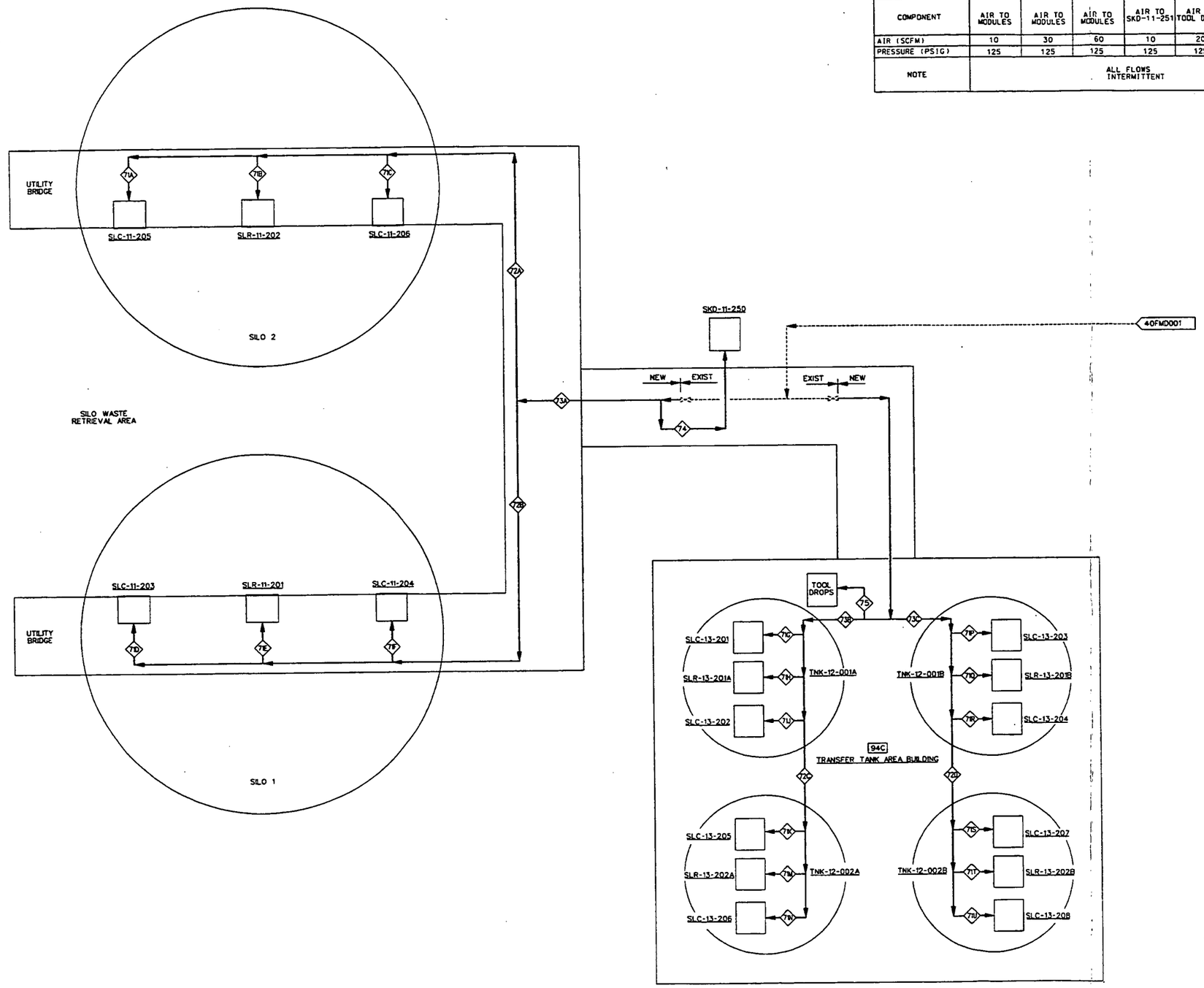
DRAWING TITLE
FLOW DIAGRAMS
PROCESS FLOW DIAGRAM
PROCESS OVERVIEW

DRAWN BY	DATE	TECHNICAL LEAD	DATE	CHECKED BY	DATE
[illegible]	05/29/02	[illegible]	5/30/02	[illegible]	5/29/02
PLANT/BLDG. NO.		FLOOR		SCALE NONE	CLASS U
SUBMITTED FOR 30% ISSUE		SUBMITTED FOR 60% ISSUE		SUBMITTED FOR 90% ISSUE	
TECH LEAD		TECH LEAD		TECH LEAD	
DATE		DATE		DATE	

T.O. NUMBER	PROJECT NO.	DRAWING INDEX CODE NO.	SHEET NO.	REV. NO.
N/A	40710	94X-3900-F-01490	F6000	0
JEC PROJECT NO. 35H19606	FILENAME 94XF1490.DGN			

DATE: 05/29/02
TIME: 01:34:35 PM
USER: h\
DESIGN FILE: h:\proc\PFD'S\94xf1490.dgn

STREAM NUMBER	71A-71U	72A-72D	73A-73C	74	75
COMPONENT	AIR TO MODULES	AIR TO MODULES	AIR TO MODULES	AIR TO SKD-11-251	AIR TO TOOL DROPS
AIR (SCFM)	10	30	60	10	20
PRESSURE (PSIG)	125	125	125	125	125
NOTE	ALL FLOWS INTERMITTENT				



SLC-11-205	SLR-11-202	SLC-11-206	SLC-11-203	SLR-11-201	SLC-11-204	SKD-11-250	TNK-12-001A	SLC-13-201	SLR-13-201A	SLC-13-202	TNK-12-001B	SLC-13-203	SLR-13-201B	SLC-13-204	TNK-12-002A	SLC-13-205	SLR-13-202A	SLC-13-206	TNK-12-002B	SLC-13-207	SLR-13-202B	SLC-13-208
SLUICER MODULE	SLURRY MODULE	SLUICER MODULE	SLUICER MODULE	SLURRY MODULE	SLUICER MODULE	HIGH PRESSURE PUMP SKID	TRANSFER TANK	SLUICER MODULE	SLURRY MODULE	SLUICER MODULE	TRANSFER TANK	SLUICER MODULE	SLURRY MODULE	SLUICER MODULE	TRANSFER TANK	SLUICER MODULE	SLURRY MODULE	SLUICER MODULE	TRANSFER TANK	SLUICER MODULE	SLURRY MODULE	SLUICER MODULE

000273

NOTES:

1. THE PROCESS FLOW DIAGRAM DEPICTS PRIMARY FLOW PATHS AND IS NOT INTENDED TO SHOW ACTUAL PIPING CONFIGURATIONS.

4448

LEGEND

---------- PIPING INSTALLED DURING PHASE 1 CONSTRUCTION

REF DWG NO.	DRAWING TITLE
N6000	PIPING AND INSTRUMENT DIAGRAM, LEGEND SHEET 1
N6001	PIPING AND INSTRUMENT DIAGRAM, LEGEND SHEET 2
N6002	PIPING AND INSTRUMENT DIAGRAM, LEGEND SHEET 3

REV. NO.	ISSUE OR REVISION PURPOSE - DESCRIPTION	DATE	REV. BY	APPR.
0	ISSUED TO CONSTRUCTION	05/28/02		

INITIALS AND DATE

UNITED STATES DEPARTMENT OF ENERGY
FERNALD ENVIRONMENTAL MANAGEMENT PROJECT

THIS DRAWING PREPARED BY

JE JACOBS 125 Broadway Ave., Oak Ridge, Tennessee 37830 Tel: 865-220-9600 Fax: 865-220-6170

PROJECT NAME
AWR BOP OPTIMIZATION

DRAWING TITLE
FLOW DIAGRAMS
PROCESS FLOW DIAGRAM
COMPRESSED AIR SYSTEM

DRAWN BY	DATE	TECHNICAL LEAD	DATE	CHECKED BY	DATE
	05/28/02				05/28/02

PLANT/BLDG. NO. | FLOOR | SCALE: NONE | CLASS: U

SUBMITTED FOR 30% ISSUE — TECH LEAD — DATE
SUBMITTED FOR 60% ISSUE — TECH LEAD — DATE
SUBMITTED FOR 90% ISSUE — TECH LEAD — DATE

T.O. NUMBER	PROJECT NO.	DRAWING INDEX CODE NO.	SHEET NO.	REV. NO.
N/A	40710	94X-3900-F-01785	F6001	0

J.E. PROJECT NO. 35H19606 — FILENAME 94XF1785.DGN

DATE: 05/28/02 TIME: 08:54:49 PM — USER: JRosenbo — DESIGN FILE: h:\Proc\mechanical\drawings\bop\94xf1785.dgn

NOTE 1

STREAM NUMBER	1		2		3		4		5		6		11		12	
STREAM DESCRIPTION	SLURRY FROM SILOS TO TRANSFER STORAGE TANKS (2)		DILUTE POLYMER FROM POLYMER SYSTEM TO SILO SLURRY HEADER (2)		SLURRY FROM REMEDIATION FACILITY TO SILO SLURRY HEADER (2)		SLURRY FROM SILO SLURRY HEADER TO TRANSFER STORAGE TANKS (2)		NEAT POLYMER FROM BOUNDARY LIMITS TO POLYMER SYSTEM		SOLIDS FROM SILOS TO SLURRY PUMPS (2)		SLUICE WATER FROM TRANSFER STORAGE TANKS TO SILOS (2)		SLUICE WATER FROM TTA SLUICE WATER HEADER TO SLUICER MODULE 1 (2)	
	AVERAGE	MAXIMUM	AVERAGE	MAXIMUM	AVERAGE	MAXIMUM	AVERAGE	MAXIMUM	AVERAGE	MAXIMUM	AVERAGE	MAXIMUM	AVERAGE	MAXIMUM	AVERAGE	MAXIMUM
FLOW, GPM	350.0	358.3	1.161	2.378	350.0	NA	351.2	360.7	0.01862	0.03813	25.58	27.23	311.2	322.2	155.6 (3)	322.2 (3)
DAILY THROUGHPUT, GPD	168,000	215,006	557.4	1,427	NA (5)	NA	168,557	215,006 (4)	29.80	76.27	15,350	13,070	149,400	193,350	74,700	193,350
SOLIDS BY WEIGHT, %	15.00	15.00	0.5000	0.5000	15.00	NA	15.00	15.00	30.00	30.00	70.00	70.00	2.750	4.000	2.750	4.000
OPERATIONS, MINS/DAY	480.0	600.0	480.0	600.0	NA (5)	NA	480.0	600.0 (4)	480.0	600.0	600.0	480.0	480.0	600.0	480.0	600.0
SOLIDS TRANSFER, LB/MIN	484.6	496.1	0.04846	0.0992	484.6	NA	484.6	980.8	0.04846	0.09923	387.9	412.9	71.68	108.2	35.84	108.2
SOLIDS TRANSFER, TPD	116.30	148.8	0.01163	0.02977	NA (5)	NA	116.32	148.9 (4)	23.26	59.54	116.37	99.10	17.20	32.46	8.601	32.46
WATER (ONLY) TRANSFER, GPM	329.2	358.3	1.143	2.340	329.2	NA	330.4	360.7	1.143	2.340	19.93	21.22	307.0	316.0	153.5	316.0

STREAM NUMBER	13		15		21		31		32		33		34		35	
STREAM DESCRIPTION	SLUICE WATER FROM TTA SLUICE WATER HEADER TO SLUICER MODULE 2 (2)		SOLIDS FROM TRANSFER STORAGE TANKS TO REMEDIATION FACILITY (6)		SLURRY FROM TRANSFER STORAGE TANKS TO REMEDIATION FACILITY (6)		SLUICE WATER FROM REMEDIATION FACILITY TO TRANSFER STORAGE TANKS (6)		SLUICE WATER FROM SLUICE WATER HEADER TO SLUICER MODULE 1 (6)		SLUICE WATER FROM SLUICE WATER HEADER TO SLUICER MODULE 2 (6)		SLUICE WATER FROM REMEDIATION FACILITY TO SLUICE WATER HEADER (6)		CONDENSATE FROM RCS TO TRANSFER STORAGE TANKS	
	AVERAGE	MAXIMUM	AVERAGE	MAXIMUM	AVERAGE	MAXIMUM	AVERAGE	MAXIMUM	AVERAGE	MAXIMUM	AVERAGE	MAXIMUM	AVERAGE	MAXIMUM	AVERAGE	MAXIMUM
FLOW, GPM	155.6 (3)	322.2 (3)	78.85	78.85	350.0	358.3	304.3	311.6	152.2	311.6	152.2	311.6	193.7	311.6	0.20	0.20
DAILY THROUGHPUT, GPD	74,700	193,350	12,710	19,740	58,390	89,690	49,040	77,990	219,100	448,700	219,100	448,700	31,210	62,410	288	288
SOLIDS BY WEIGHT, %	2.750	4.000	50.00	50.00	15.00	10.00	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0	0
OPERATIONS, MINS/DAY	480.0	600.0	161.1	250.3	161.1	250.3	161.1	250.3	161.1	250.3	161.1	250.3	161.1	250.3	1,440	1,440
SOLIDS TRANSFER, LB/MIN	35.84	108.2	484.6	484.6	484.6	312.0	0.002538	0.002599	0.001269	0.002599	0.001269	0.002599	0.001615	0.003231	0	0
SOLIDS TRANSFER, TPD	8.601	32.46	39.04	60.64	39.04	39.04	0.000204	0.000325	0.0009138	0.001871	0.0009138	0.001871	0.000130	0.000260	0	0
WATER (ONLY) TRANSFER, GPM	153.5	316.0	58.10	58.10	329.2	358.3	304.3	311.6	152.2	311.6	152.2	311.6	193.7	311.6	0.20	0.20

STREAM NUMBER	41		42		43		44		48		49		54		56	
STREAM DESCRIPTION	DOMESTIC WATER FROM BOUNDARY LIMITS TO MAKE-UP WATER TANKS		PROCESS WATER FROM SILO PROCESS WATER HEADER TO SILO HP PUMP SKID		HIGH PRESSURE WATER FROM SILO HP PUMP SKID TO SILO SPRAY HEADER		HIGH PRESSURE WATER FROM SILO HP PUMP SKID TO SLURRY PUMP SPRAY RING		HIGH PRESSURE WATER FROM SILO HP PUMP SKID TO MAKE-UP WATER TANKS		PROCESS WATER FROM PROCESS WATER HEADER TO POLYMER SYSTEM		PROCESS WATER FROM PROCESS WATER HEADER TO REMEDIATION FACILITY		HP WATER FROM PROCESS WATER HEADER TO TWRS HP PUMPS	
	AVERAGE	MAXIMUM	AVERAGE	MAXIMUM	AVERAGE	MAXIMUM	AVERAGE	MAXIMUM	AVERAGE	MAXIMUM	AVERAGE	MAXIMUM	AVERAGE	MAXIMUM	AVERAGE	MAXIMUM
FLOW, GPM	75.9	124.0	40.00	80.00	40.00	40.00	40.00	40.00	0	80.00	1.143	2.340	124.7	129.1	40.00	80.00
DAILY THROUGHPUT, GPD	20,890	33,100	1,320	1,320	1,320	1,320	1,320	1,320	0	1,320	527.6	1,351	20,090	32,300	800.0	800.0
OPERATIONS, MINS/DAY	1,440	1,440	33.00	16.50	33.00	33.00	33.00	33.00	0	16.50	480.0	600.0	161.1	180.0	20.00	10.00

STREAM NUMBER	57		58		59		61		62		63	
STREAM DESCRIPTION	HP WATER FROM TWRS HP HEADER TO TRANSFER STORAGE TANK HP HEADERS		HP WATER FROM TRANSFER STORAGE TANK HP HEADERS TO SPRAY RING HEADERS		HP WATER FROM TRANSFER STORAGE TANK HP HEADERS TO SLURRY/ DECANT MODULES		PROCESS WATER FROM/TO MAKE-UP WATER TANKS		PROCESS WATER FROM MAKE-UP WATER TANKS TO TRANSFER STORAGE TANK HEADER		PROCESS WATER FROM PROCESS WATER HEADER TO TRANSFER STORAGE TANKS	
	AVERAGE	MAXIMUM	AVERAGE	MAXIMUM	AVERAGE	MAXIMUM	AVERAGE	MAXIMUM	AVERAGE	MAXIMUM	AVERAGE	MAXIMUM
FLOW, GPM	40.00	80.00	40.00	40.00	40.00	40.00	45.58	251.4	205.8 (7)	251.4 (7)	34.72	41.67
DAILY THROUGHPUT, GPD	800.0	800.0	400.0	400.0	400.0	400.0	65,632	362,032	22,618 (7)	62,551 (8)	50,000	60,000
OPERATIONS, MINS/DAY	20.00	10.00	10.00	10.00	10.00	10.00	1,440	1,440	1,440	1,440	1,440	1,440

SILO INVENTORY	
SOLIDS, TONS	9,954
WATER, TONS	4,266
TOTAL MASS, TONS	14,220
WATER, GALS	1,023,007
TOTAL, GALS	1,795,544

NOTES:

1. ONLY FLOWRATES ARE INDICATED AS AVERAGE AND MAXIMUM VALUES. ALL OTHER VALUES INDICATED ARE THE RESULT OF CALCULATIONS BASED ON THE FLOWRATE.
2. THE SWRS SYSTEM IS DESIGNED TO OPERATE 8 HOURS PER DAY AVERAGE, 10 HOURS PER DAY MAXIMUM.
3. LOOP TESTS WILL ASSIST IN DETERMINING THE FLOW RATIO BETWEEN THE TWO SLUICERS. HOWEVER, PIPING TO EACH SLUICER WILL BE DESIGNED TO ACCOMMODATE A MAXIMUM OF 100% OF THE TOTAL FLOW.
4. THIS STREAM CONTAINS AN INTERMITTENT SOURCE NOT INCLUDED IN THE DAILY TOTALS.
5. THIS SOURCE IS CONSIDERED INTERMITTENT AND HIGHLY UNLIKELY AND THEREFORE IS NOT INCLUDED IN THE DAILY TOTALS. FLOWRATE IS VARIABLE/INTERMITTENT.
6. THE TWRS SYSTEM IS DESIGNED TO OPERATE 2.7 HOURS PER DAY AVERAGE, 4.2 HOURS PER DAY MAXIMUM.
7. BASED ON ESTIMATES OF SWRS AND TWRS OPERATING SIMULTANEOUSLY.
8. BASED ON ESTIMATES OF SWRS.

-4448

REF DWG NO.	DRAWING TITLE

REV. NO.	ISSUE OR REVISION PURPOSE - DESCRIPTION	DATE	REV. BY	APPR.
0	ISSUED TO CONSTRUCTION	05/29/02		

INITIALS AND DATE

UNITED STATES DEPARTMENT OF ENERGY
FERNALD ENVIRONMENTAL MANAGEMENT PROJECT

THIS DRAWING PREPARED BY

JE JACOBS

PROJECT NAME
AWR BOP OPTIMIZATION

DRAWING TITLE
FLOW DIAGRAMS
PROCESS FLOW DIAGRAMS
MATERIAL BALANCE TABLE

DRAWN BY | DATE | TECHNICAL LEAD | DATE | CHECKED BY | DATE
PLANT/BLDG. NO. | FLOOR | SCALE | CLASS U
SUBMITTED FOR 30% ISSUE | SUBMITTED FOR 60% ISSUE | SUBMITTED FOR 90% ISSUE
TECH LEAD | TECH LEAD | TECH LEAD
DATE | DATE | DATE

T.O. NUMBER N/A | PROJECT NO. 4071D | DRAWING INDEX CODE NO. | SHEET NO. | REV. NO.
J.E. PROJECT NO. 35H19606 | FILENAME 94XF1493.DGN | 94X-3900-F-01493 | F6003 | 0

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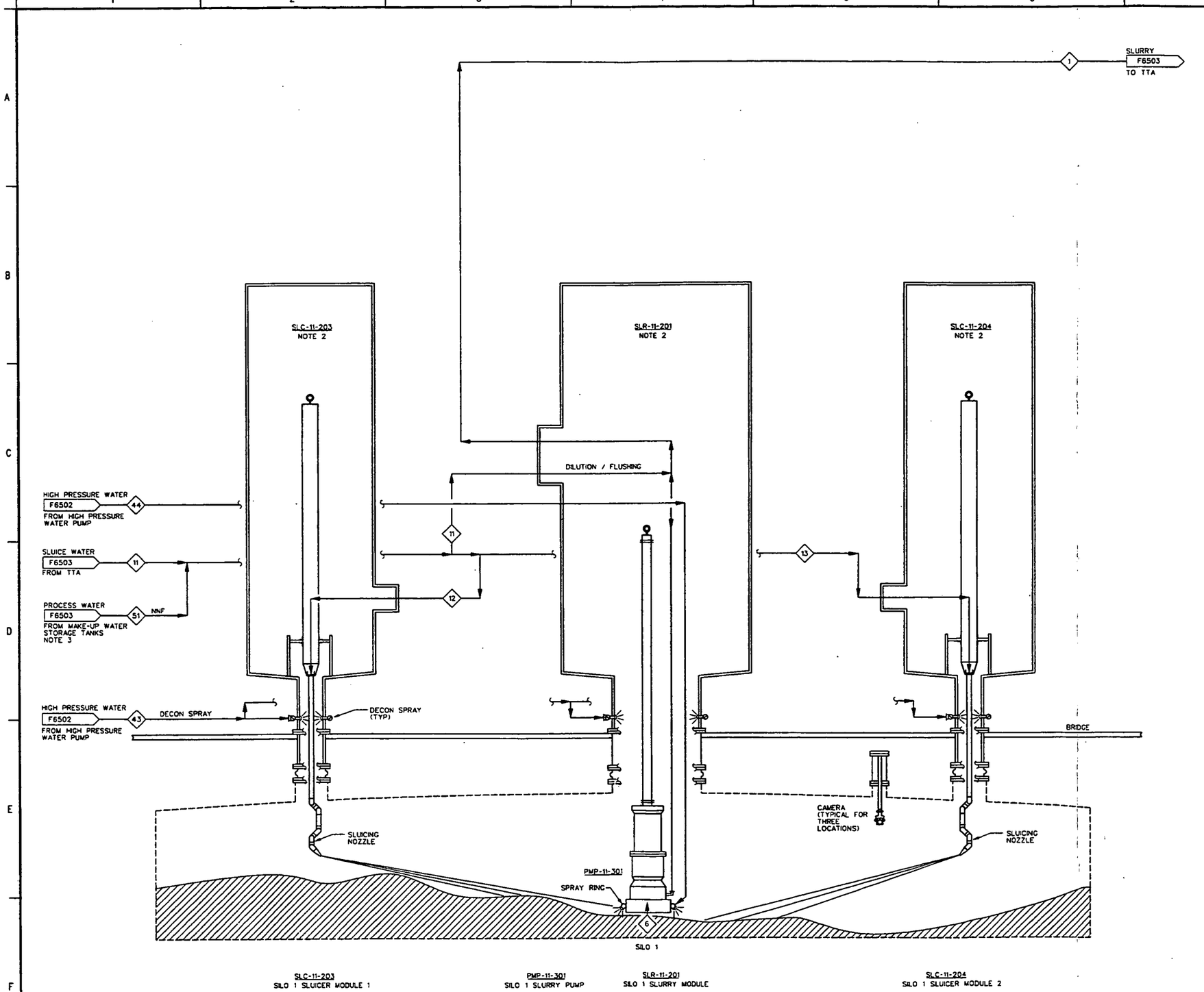

NOTES:

1. STREAM NUMBERS AND FLOWS ARE TYPICAL FOR BOTH SILOS.
2. TPG APPLIED TECHNOLOGY WILL SUPPLY SLUICE AND SLURRY MODULES.
3. PROCESS WATER WILL BE AVAILABLE AS A BACK-UP TO USING SLUICE WATER FOR FLUSHING THE SLURRY LINE FOLLOWING A TRANSFER. IN ADDITION, PROCESS WATER WILL BE AVAILABLE TO BACK FLUSH THE SLURRY/DECANT PUMP.

4448

REF DWG NO.	DRAWING TITLE
F6003	FLOW DIAGRAMS PROCESS FLOW DIAGRAM MATERIAL BALANCE TABLE
N6000	INSTRUMENTATION, PIPING AND INSTRUMENTATION DIAGRAM: PIPING, VALVES AND MISCELLANOUS SHEET 1 OF 3
N6002	INSTRUMENTATION, PIPING AND INSTRUMENTATION DIAGRAM: EQUIPMENT AND MISCELLANOUS SHEET 3 OF 3

REV. NO.	ISSUE OR REVISION PURPOSE - DESCRIPTION	DATE	REV. BY	APPR.
0	ISSUED TO CONSTRUCTION	05/29/02	[signature]	[signature]

INITIALS AND DATE

UNITED STATES DEPARTMENT OF ENERGY
FERNALD ENVIRONMENTAL MANAGEMENT PROJECT

THIS DRAWING PREPARED BY

JACOBS

PROJECT NAME
AWR BOP OPTIMIZATION

DRAWING TITLE
FLOW DIAGRAMS
PROCESS FLOW DIAGRAM
SWRS FOR SILO 1

DRAWN BY	DATE	TECHNICAL LEAD	DATE	CHECKED BY	DATE
[signature]	05/29/02	[signature]	5/29/02	[signature]	5/29/02

PLANT/BLDG. NO.	FLOOR	SCALE	CLASS
		NONE	U

SUBMITTED FOR 30% ISSUE	SUBMITTED FOR 60% ISSUE	SUBMITTED FOR 90% ISSUE
TECH LEAD	TECH LEAD	TECH LEAD
DATE	DATE	DATE

T.O. NUMBER	PROJECT NO.	DRAWING INDEX CODE NO.	SHEET NO.	REV. NO.
N/A	40710	94X-3900-F-01476	F6500	0

JEG PROJECT NO.	FILENAME
35H19606	94XF1476.DGN

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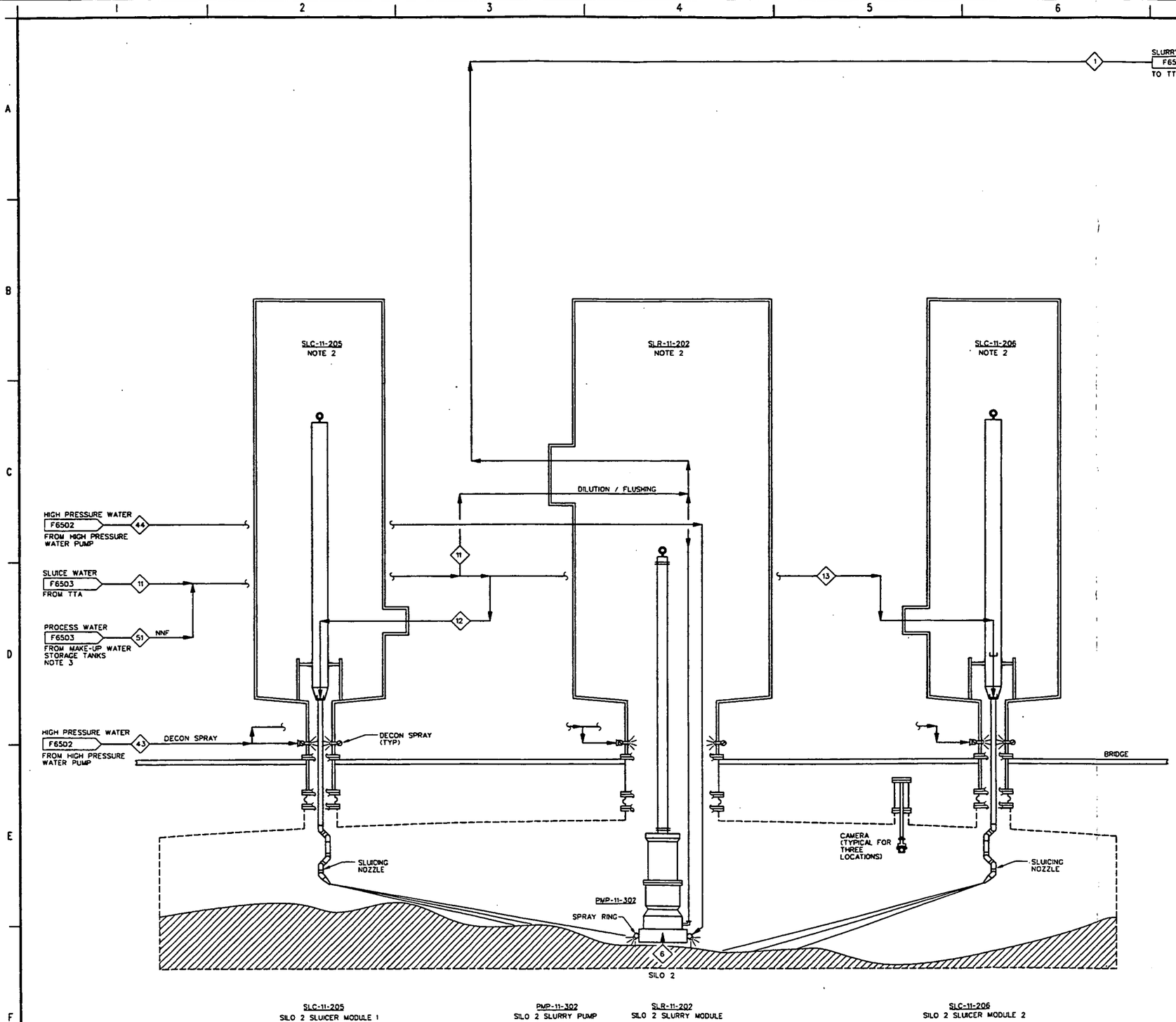

NOTES:

1. STREAM NUMBERS AND FLOWS ARE TYPICAL FOR BOTH SILOS.
2. TPG APPLIED TECHNOLOGY WILL SUPPLY SLUICE AND SLURRY MODULES.
3. PROCESS WATER WILL BE AVAILABLE AS A BACK-UP TO USING SLUICE WATER FOR FLUSHING THE SLURRY LINE FOLLOWING A TRANSFER. IN ADDITION, PROCESS WATER WILL BE AVAILABLE TO BACK FLUSH THE SLURRY/DECANT PUMP.

-4448

REF DWG NO.	DRAWING TITLE
F6003	FLOW DIAGRAMS PROCESS FLOW DIAGRAM MATERIAL BALANCE TABLE
N6000	INSTRUMENTATION, PIPING AND INSTRUMENTATION DIAGRAM: PIPING, VALVES AND MISCELLANOUS SHEET 1 OF 3
N6002	INSTRUMENTATION, PIPING AND INSTRUMENTATION DIAGRAM: EQUIPMENT AND MISCELLANOUS SHEET 3 OF 3

REV. NO.	ISSUE OR REVISION PURPOSE - DESCRIPTION	DATE	REV. BY	APPR.
0	ISSUED TO CONSTRUCTION	05/29/02		

INITIALS AND DATE

UNITED STATES DEPARTMENT OF ENERGY
FERNALD ENVIRONMENTAL MANAGEMENT PROJECT

THIS DRAWING PREPARED BY

JACOBS

PROJECT NAME
AWR BOP OPTIMIZATION

DRAWING TITLE
FLOW DIAGRAMS
PROCESS FLOW DIAGRAM
SWRS FOR SILO 2

DRAWN BY	DATE	TECHNICAL LEAD	DATE	CHECKED BY	DATE
	05/29/02		5/29/02		5/29/02

PLANT/BLDG. NO. | FLOOR | SCALE: NONE | CLASS: U

SUBMITTED FOR 30% ISSUE — TECH LEAD — DATE
SUBMITTED FOR 60% ISSUE — TECH LEAD — DATE
SUBMITTED FOR 90% ISSUE — TECH LEAD — DATE

T.O. NUMBER	PROJECT NO.	DRAWING INDEX CODE NO.	SHEET NO.	REV. NO.
N/A	40710	94X-3900-F-01477	F6501	0

JEG PROJECT NO. 35H19606 | FILENAME 94XF1477.DGN

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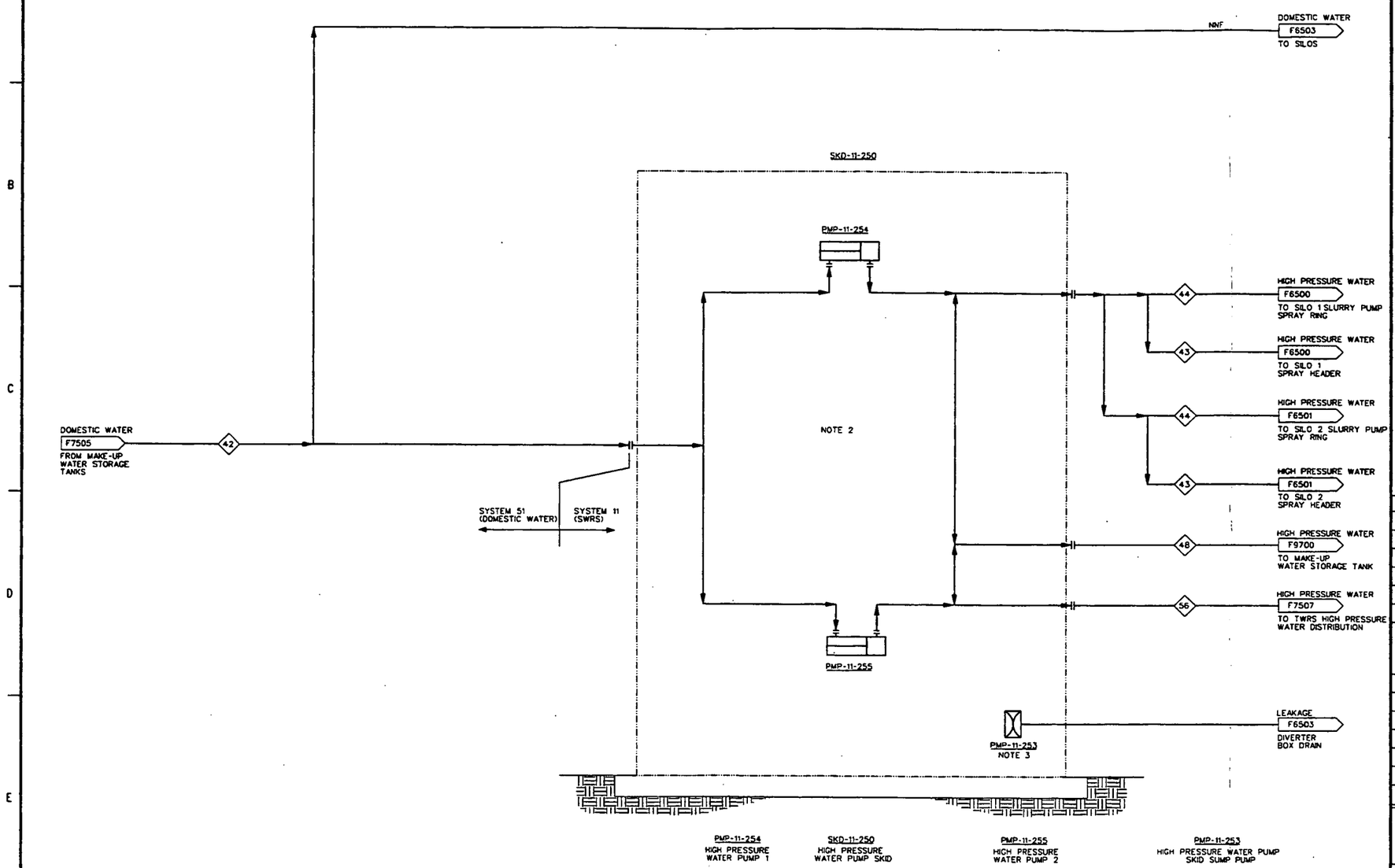
DATE: 05/29/02 TIME: 06:27:27 PM USER: N/A DESIGN FILE: k:\proc\PFD'S\94x1477.dgn



NOTES:

1. STREAM NUMBERS AND FLOWS ARE TYPICAL FOR BOTH SILOS.
2. SEE TPG APPLIED TECHNOLOGY DRAWING 11PMD401 AND 11PMD402 FOR DETAILS OF THIS EQUIPMENT.
3. VERIFY THAT THE ENCLOSURE CONTENTS ARE FREE OF HYDRAULIC FLUID PRIOR TO ACTIVATING PUMP. IF CONTAMINATED, LEAKAGE WILL BE TRANSFERRED INTO DRUMS AND HANDLED ACCORDINGLY.

4448

REF DWG NO.	DRAWING TITLE
F6003	FLOW DIAGRAMS PROCESS FLOW DIAGRAM MATERIAL BALANCE TABLE
N6000	INSTRUMENTATION, PIPING AND INSTRUMENTATION DIAGRAM: PIPING, VALVES AND MISCELLANOUS SHEET 1 OF 3
N6002	INSTRUMENTATION, PIPING AND INSTRUMENTATION DIAGRAM: EQUIPMENT AND MISCELLANOUS SHEET 3 OF 3

REV. NO.	ISSUE OR REVISION PURPOSE - DESCRIPTION	DATE	REV. BY	APPR.
0	ISSUED TO CONSTRUCTION	05/29/02		

INITIALS AND DATE

UNITED STATES DEPARTMENT OF ENERGY
FERNALD ENVIRONMENTAL MANAGEMENT PROJECT

THIS DRAWING PREPARED BY
JACOBS

PROJECT NAME
AWR BOP OPTIMIZATION

DRAWING TITLE
FLOW DIAGRAMS
PROCESS FLOW DIAGRAM
HIGH PRESSURE WATER PUMP SKID

DRAWN BY	DATE	TECHNICAL LEAD	DATE	CHECKED BY	DATE
	5/29/02				5/29/02

PLANT/BLDG. NO. | FLOOR | SCALE: NONE | CLASS: U

SUBMITTED FOR 30% ISSUE — TECH LEAD — DATE
SUBMITTED FOR 60% ISSUE — TECH LEAD — DATE
SUBMITTED FOR 90% ISSUE — TECH LEAD — DATE

T.O. NUMBER	PROJECT NO.	DRAWING INDEX CODE NO.	SHEET NO.	REV. NO.
N/A	4-0710	94X-3900-F-01478	F6502	0

J.E. PROJECT NO. 35H19606 — FILENAME 94XF1478.DGN

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DATE: 05/29/02
TIME: 08:27:50 PM
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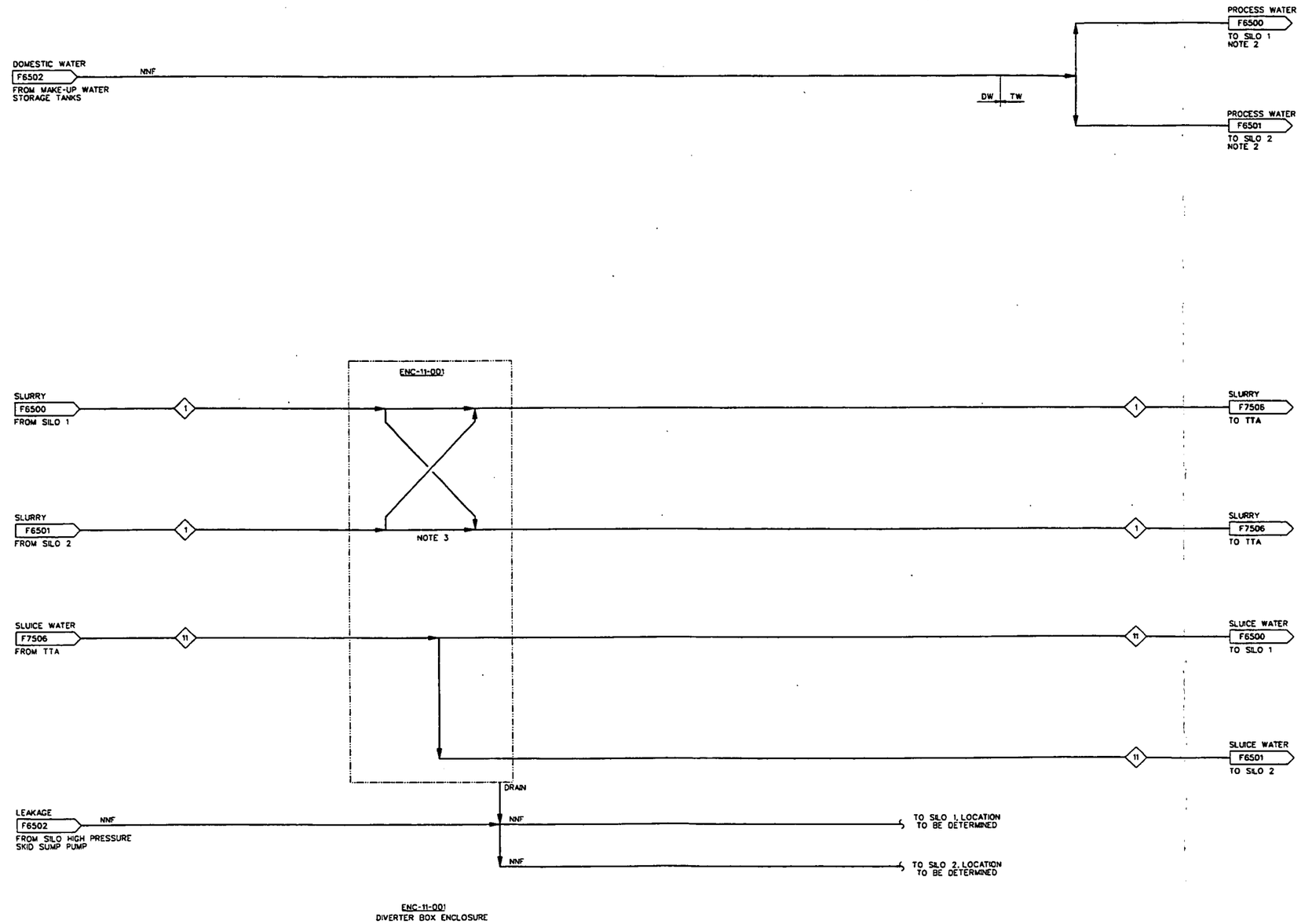

000278

NOTES:

1. STREAM NUMBERS AND FLOWS ARE TYPICAL FOR BOTH SILOS.
2. PROCESS WATER WILL BE AVAILABLE AS A BACK-UP TO USING SLUICE WATER FOR FLUSHING A SLURRY LINE FOLLOWING A TRANSFER.
3. THREE WAY DIVERTER VALVES CONFIGURED AS SHOWN WILL ALLOW SLURRY RETRIEVAL OPERATIONS TO CONTINUE IF ANY ONE OF THE FOUR VALVES FAILS.

4448

REF DWG NO.	DRAWING TITLE
F6003	FLOW DIAGRAMS PROCESS FLOW DIAGRAM MATERIAL BALANCE TABLE
N6000	INSTRUMENTATION, PIPING AND INSTRUMENTATION DIAGRAM: PIPING, VALVES AND MISCELLANOUS SHEET 1 OF 3
N6002	INSTRUMENTATION, PIPING AND INSTRUMENTATION DIAGRAM: EQUIPMENT AND MISCELLANOUS SHEET 3 OF 3

REV. NO.	ISSUE OR REVISION PURPOSE - DESCRIPTION	DATE	REV. BY	APPR
0	ISSUED TO CONSTRUCTION	05/29/02	[illegible]	JWL

INITIALS AND DATE

UNITED STATES DEPARTMENT OF ENERGY
FERNALD ENVIRONMENTAL MANAGEMENT PROJECT

THIS DRAWING PREPARED BY

JACOBS

PROJECT NAME
AWR BOP OPTIMIZATION

DRAWING TITLE
FLOW DIAGRAMS
PROCESS FLOW DIAGRAM
SILO SLURRY AND SLUICE WATER DISTRIBUTION

DRAWN BY	DATE	TECHNICAL LEAD	DATE	CHECKED BY	DATE
[illegible]	05/29/02	[illegible]	5/29/02	[illegible]	5/29/02

PLANT/BLDG. NO.	FLOOR	SCALE	CLASS
		NONE	U

SUBMITTED FOR 30% ISSUE	SUBMITTED FOR 60% ISSUE	SUBMITTED FOR 90% ISSUE
TECH LEAD	TECH LEAD	TECH LEAD
DATE	DATE	DATE

T.O. NUMBER	PROJECT NO.	DRAWING INDEX CODE NO.	SHEET NO.	REV. NO.
N/A	40710	94X-3900-F-01491	F6503	0

JEG PROJECT NO.	FILENAME
35H19606	94XF1491LDGN

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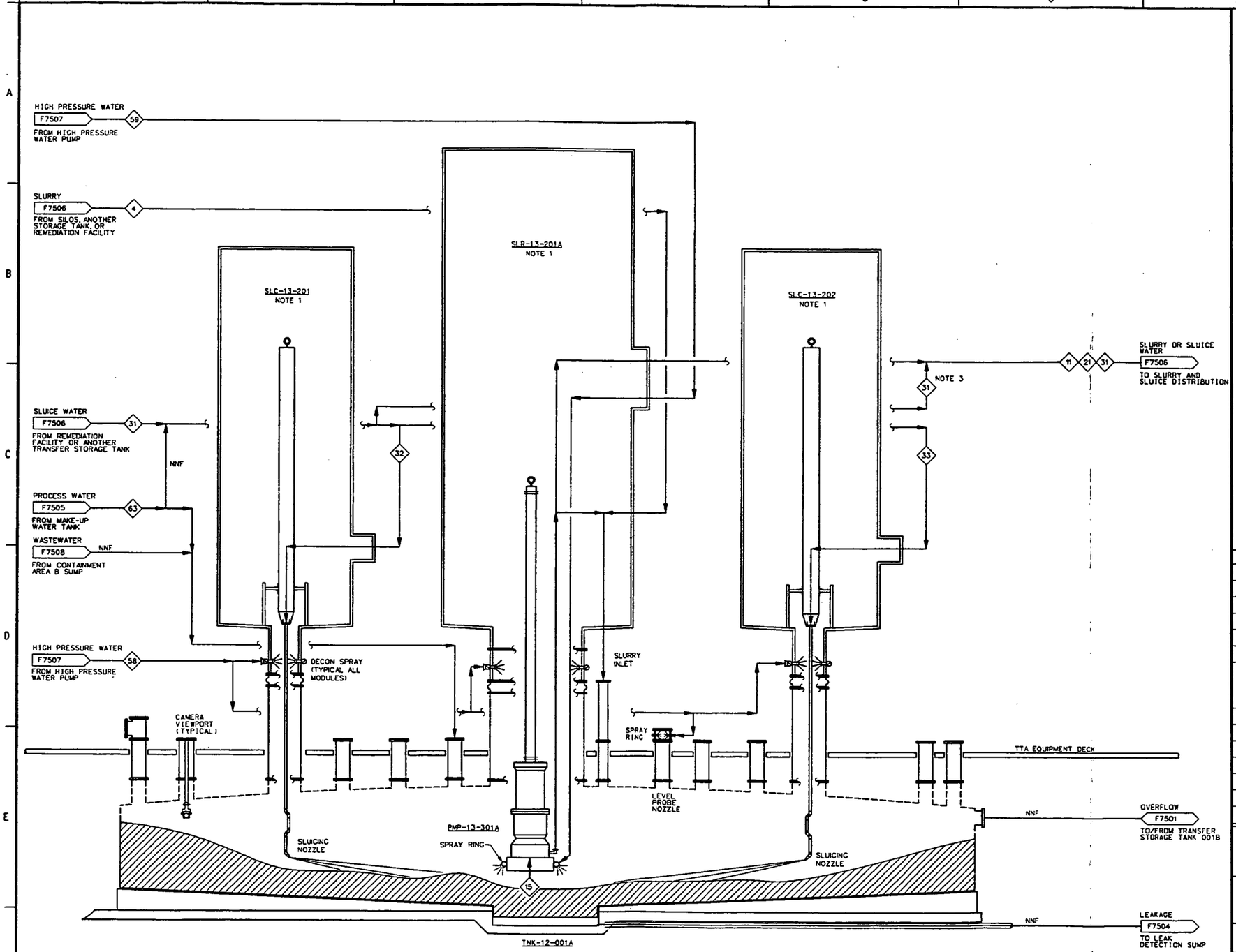

NOTES:

1. TPG APPLIED TECHNOLOGY WILL SUPPLY SLUICE AND SLURRY MODULES.
2. STREAM NUMBERS AND FLOWS ARE TYPICAL FOR ALL TRANSFER STORAGE TANKS.
3. SLUICE WATER WILL BE USED TO FLUSH SLURRY LINES FOLLOWING EACH TRANSFER. PROCESS WATER WILL BE AVAILABLE AS A BACK-UP TO USING SLUICE WATER FOR FLUSHING SLURRY LINE FOLLOWING A TRANSFER. IN ADDITION, PROCESS WATER WILL BE AVAILABLE TO BACK FLUSH THE SLURRY/DECANT PUMP.
4. AT ANY GIVEN TIME, EACH TRANSFER STORAGE TANK MAY OPERATE IN THE SILO WASTE RETRIEVAL SYSTEM (SWRS), TRANSFER STORAGE TANK WASTE RETRIEVAL SYSTEM (TWRS), OR DECANT MODE, BUT NOT MORE THAN ONE MODE SIMULTANEOUSLY.

4448

REF DWG NO.	DRAWING TITLE
F6003	FLOW DIAGRAMS PROCESS FLOW DIAGRAM MATERIAL BALANCE TABLE
N6000	INSTRUMENTATION, PIPING AND INSTRUMENTATION DIAGRAM: PIPING, VALVES AND MISCELLANOUS SHEET 1 OF 3
N6002	INSTRUMENTATION, PIPING AND INSTRUMENTATION DIAGRAM: EQUIPMENT AND MISCELLANOUS SHEET 3 OF 3

REV. NO.	ISSUE OR REVISION PURPOSE - DESCRIPTION	DATE	REV. BY	APPR.
0	ISSUED TO CONSTRUCTION	05/29/02	[illegible]	[illegible]

INITIALS AND DATE

UNITED STATES DEPARTMENT OF ENERGY
FERNALD ENVIRONMENTAL MANAGEMENT PROJECT

THIS DRAWING PREPARED BY

JACOBS

PROJECT NAME

AWR BOP OPTIMIZATION

DRAWING TITLE

FLOW DIAGRAMS
PROCESS FLOW DIAGRAM
TWRS FOR TRANSFER STORAGE TANK 001A

DRAWN BY	DATE	TECHNICAL LEAD	DATE	CHECKED BY	DATE
[illegible]	05/29/02	[illegible]	5/29/02	[illegible]	5/29/02

PLANT/BLDG. NO.	FLOOR	SCALE	CLASS
		NONE	U

SUBMITTED FOR 30% ISSUE	SUBMITTED FOR 60% ISSUE	SUBMITTED FOR 90% ISSUE
TECH LEAD	TECH LEAD	TECH LEAD
DATE	DATE	DATE

T.O. NUMBER	PROJECT NO.	DRAWING INDEX CODE NO.	SHEET NO.	REV. NO.
N/A	40710	94X-3900-F-01479	F7500	0

J.E.G. PROJECT NO.	FILENAME
35H19606	94XF1479.DGN

000279

DATE: 05/29/02
TIME: 06:28:45 PM
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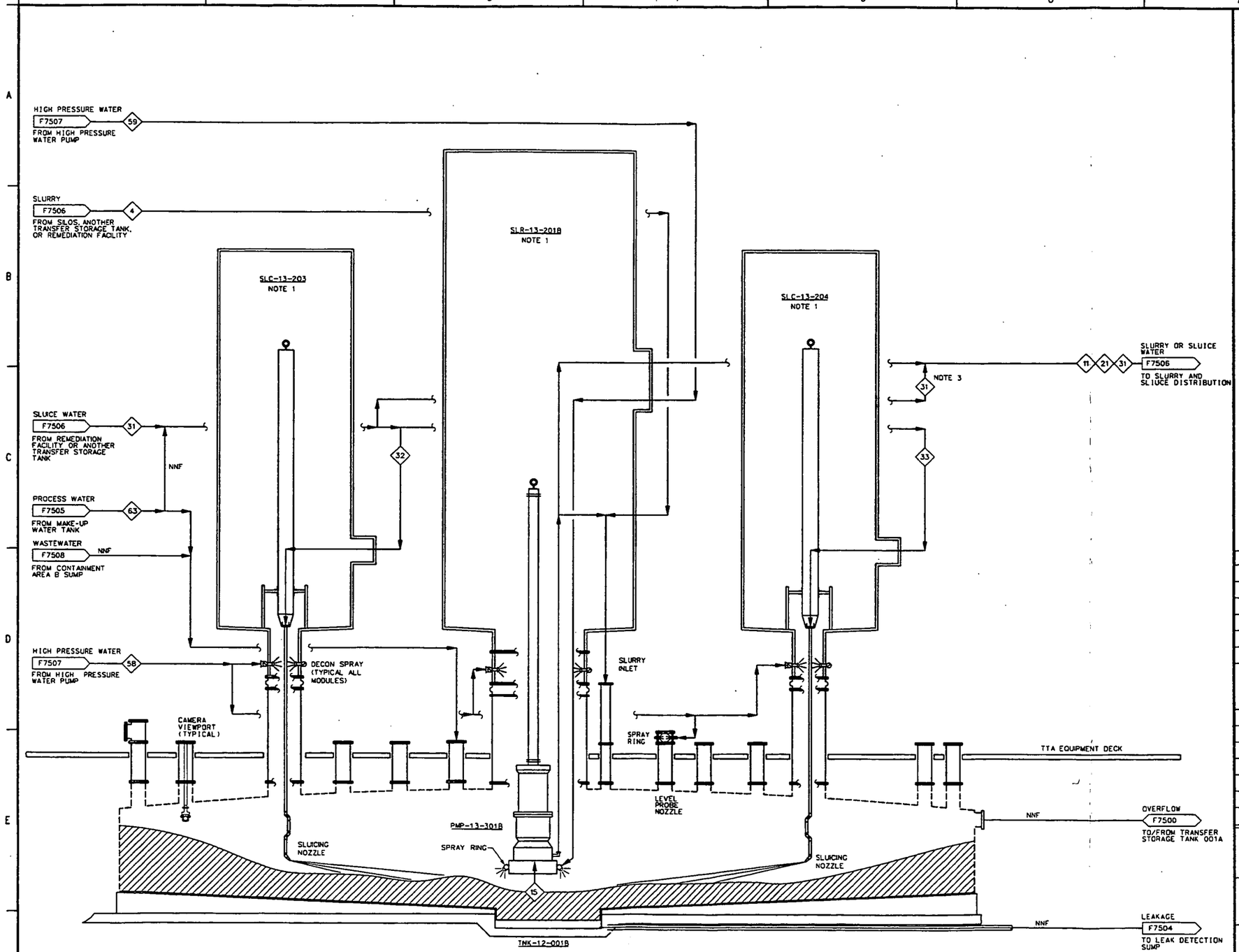
DESIGN FILE: k:\proc\PFD'S\94xf1479.dgn



NOTES:

1. TPG APPLIED TECHNOLOGY WILL SUPPLY SLUICE AND SLURRY MODULES.
2. STREAM NUMBERS AND FLOWS ARE TYPICAL FOR ALL TRANSFER STORAGE TANKS.
3. SLUICE WATER WILL BE USED TO FLUSH SLURRY LINES FOLLOWING EACH TRANSFER. PROCESS WATER WILL BE AVAILABLE AS A BACK-UP TO USING SLUICE WATER FOR FLUSHING SLURRY LINE FOLLOWING A TRANSFER. IN ADDITION, PROCESS WATER WILL BE AVAILABLE TO BACK FLUSH THE SLURRY/DECANT PUMP.
4. AT ANY GIVEN TIME, EACH TRANSFER STORAGE TANK MAY OPERATE IN THE SILO WASTE RETRIEVAL SYSTEM (SWRS), TRANSFER STORAGE TANK WASTE RETRIEVAL SYSTEM (TWRS), OR DECANT MODE, BUT NOT MORE THAN ONE MODE SIMULTANEOUSLY.

4448

REF DWG NO.	DRAWING TITLE
F6003	FLOW DIAGRAMS PROCESS FLOW DIAGRAM MATERIAL BALANCE TABLE
N6000	INSTRUMENTATION, PIPING AND INSTRUMENTATION DIAGRAM: PIPING, VALVES AND MISCELLANOUS SHEET 1 OF 3
N6002	INSTRUMENTATION, PIPING AND INSTRUMENTATION DIAGRAM: EQUIPMENT AND MISCELLANOUS SHEET 3 OF 3

REV. NO.	ISSUE OR REVISION PURPOSE - DESCRIPTION	DATE	REV. BY	APPR.
0	ISSUED TO CONSTRUCTION	05/29/02	[illegible]	[illegible]

INITIALS AND DATE

UNITED STATES DEPARTMENT OF ENERGY
FERNALD ENVIRONMENTAL MANAGEMENT PROJECT

THIS DRAWING PREPARED BY
JACOBS
125 Broadway Ave.
Oak Ridge, Tennessee 37830
Tel: 865-220-6000
Fax: 865-220-6170

PROJECT NAME
AWR BOP OPTIMIZATION

DRAWING TITLE
FLOW DIAGRAMS
PROCESS FLOW DIAGRAM
TWRS FOR TRANSFER STORAGE TANK 001B

DRAWN BY	DATE	TECHNICAL LEAD	DATE	CHECKED BY	DATE
[illegible]	05/29/02	[illegible]	5/29/02	[illegible]	5/29/02

PLANT/BLDG. NO.	FLOOR	SCALE	CLASS
		NONE	U

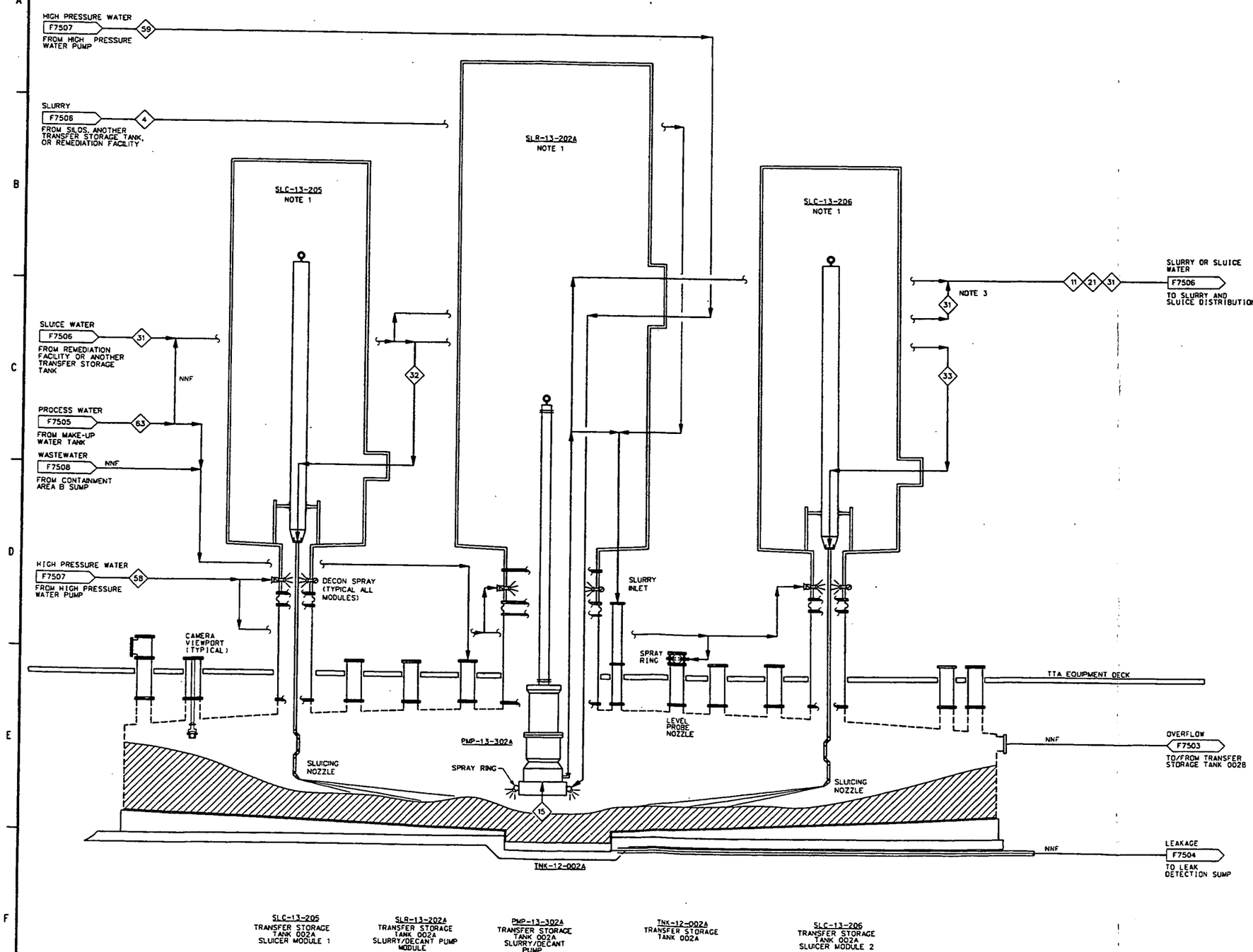
SUBMITTED FOR 30% ISSUE	SUBMITTED FOR 60% ISSUE	SUBMITTED FOR 90% ISSUE
TECH LEAD	TECH LEAD	TECH LEAD
DATE	DATE	DATE

T.O. NUMBER	PROJECT NO.	DRAWING INDEX CODE NO.	SHEET NO.	REV. NO.
N/A	40710	94X-3900-F-01480	F7501	0

JEC PROJECT NO. 35H19606 | FILENAME 94XF1480.DGN

000280

DATE: 05/29/02 TIME: 04:28:46 PM USER: hv\ DESIGN FILE: I:\proo\PFD'S\94xf1480.dgn



NOTES:

1. TPG APPLIED TECHNOLOGY WILL SUPPLY SLUICE AND SLURRY MODULES.
2. STREAM NUMBERS AND FLOWS ARE TYPICAL FOR ALL TRANSFER STORAGE TANKS.
3. SLUICE WATER WILL BE USED TO FLUSH SLURRY LINES FOLLOWING EACH TRANSFER. PROCESS WATER WILL BE AVAILABLE AS A BACK-UP TO USING SLUICE WATER FOR FLUSHING SLURRY LINE FOLLOWING A TRANSFER. IN ADDITION, PROCESS WATER WILL BE AVAILABLE TO BACK FLUSH THE SLURRY/DECANT PUMP.
4. AT ANY GIVEN TIME, EACH TRANSFER STORAGE TANK MAY OPERATE IN THE SILO WASTE RETRIEVAL SYSTEM (SWRS), TRANSFER STORAGE TANK WASTE RETRIEVAL SYSTEM (TWRS), OR DECANT MODE, BUT NOT MORE THAN ONE MODE SIMULTANEOUSLY.

4448

REF DWG NO.	DRAWING TITLE
F6003	FLOW DIAGRAMS PROCESS FLOW DIAGRAM MATERIAL BALANCE TABLE
N6000	INSTRUMENTATION, PIPING AND INSTRUMENTATION DIAGRAM: PIPING, VALVES AND MISCELLANOUS SHEET 1 OF 3
N6002	INSTRUMENTATION, PIPING AND INSTRUMENTATION DIAGRAM: EQUIPMENT AND MISCELLANOUS SHEET 3 OF 3

REV. NO.	ISSUE OR REVISION PURPOSE - DESCRIPTION	DATE	REV. BY	APPR.
0	ISSUED TO CONSTRUCTION	05/29/02	[illegible]	[illegible]

INITIALS AND DATE

UNITED STATES DEPARTMENT OF ENERGY
FERNALD ENVIRONMENTAL MANAGEMENT PROJECT

THIS DRAWING PREPARED BY

JE JACOBS

PROJECT NAME
AWR BOP OPTIMIZATION

DRAWING TITLE
FLOW DIAGRAMS
PROCESS FLOW DIAGRAM
TWRS FOR TRANSFER STORAGE TANK 002A

DRAWN BY	DATE	TECHNICAL LEAD	DATE	CHECKED BY	DATE
[illegible]	05/29/02	[illegible]	5/29/02	[illegible]	5/29/02

PLANT/BLDG. NO.	FLOOR	SCALE	CLASS
		NONE	U

SUBMITTED FOR 30% ISSUE	SUBMITTED FOR 60% ISSUE	SUBMITTED FOR 90% ISSUE
TECH LEAD	TECH LEAD	TECH LEAD
DATE	DATE	DATE

T.O. NUMBER	PROJECT NO.	DRAWING INDEX CODE NO.	SHEET NO.	REV. NO.
N/A	40710	94X-3900-F-01481	F7502	0

JEG PROJECT NO.	FILENAME
35H19606	94XF1481.DGN

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DATE: 05/29/02
TIME: 01:30:13 PM
USER: N/A
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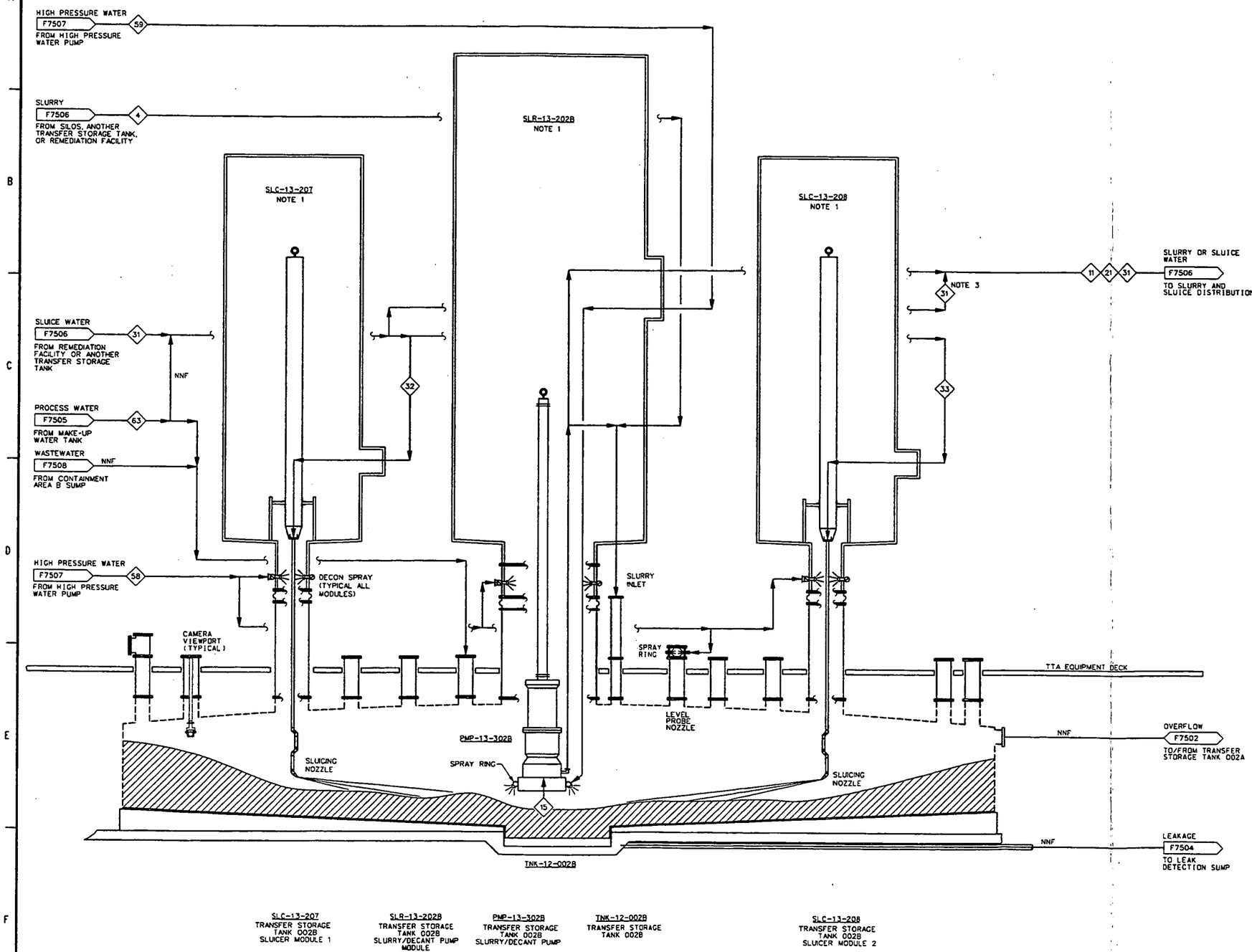

000282

NOTES:

1. TPG APPLIED TECHNOLOGY WILL SUPPLY SLUICE AND SLURRY MODULES.
2. STREAM NUMBERS AND FLOWS ARE TYPICAL FOR ALL TRANSFER STORAGE TANKS.
3. SLUICE WATER WILL BE USED TO FLUSH SLURRY LINES FOLLOWING EACH TRANSFER. PROCESS WATER WILL BE AVAILABLE AS A BACK-UP TO USING SLUICE WATER FOR FLUSHING SLURRY LINE FOLLOWING A TRANSFER. IN ADDITION, PROCESS WATER WILL BE AVAILABLE TO BACK FLUSH THE SLURRY/DECANT PUMP.
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-4448

REF DWG NO.	DRAWING TITLE
F6003	FLOW DIAGRAMS PROCESS FLOW DIAGRAM MATERIAL BALANCE TABLE
N6000	INSTRUMENTATION, PIPING AND INSTRUMENTATION DIAGRAM: PIPING, VALVES AND MISCELLANOUS SHEET 1 OF 3
N6002	INSTRUMENTATION, PIPING AND INSTRUMENTATION DIAGRAM: EQUIPMENT AND MISCELLANOUS SHEET 3 OF 3

REV. NO.	ISSUE OR REVISION PURPOSE - DESCRIPTION	DATE	REV. BY	APPR.
0	ISSUED TO CONSTRUCTION	05/29/02		

INITIALS AND DATE

UNITED STATES DEPARTMENT OF ENERGY
FERNALD ENVIRONMENTAL MANAGEMENT PROJECT

THIS DRAWING PREPARED BY

JACOBS

PROJECT NAME
AWR BOP OPTIMIZATION

DRAWING TITLE
FLOW DIAGRAMS
PROCESS FLOW DIAGRAM
TWRS FOR TRANSFER STORAGE TANK 002B

DRAWN BY	DATE	TECHNICAL LEAD	DATE	CHECKED BY	DATE
	05/29/02		5/29/02		5/29/02

PLANT/BLDG. NO. | FLOOR | SCALE NONE | CLASS U

SUBMITTED FOR 30% ISSUE — TECH LEAD — DATE
SUBMITTED FOR 60% ISSUE — TECH LEAD — DATE
SUBMITTED FOR 90% ISSUE — TECH LEAD — DATE

T.O. NUMBER	PROJECT NO.	DRAWING INDEX CODE NO.	SHEET NO.	REV. NO.
N/A	40710	94X-3900-F-01482	F7503	0

JEG PROJECT NO.	FILENAME
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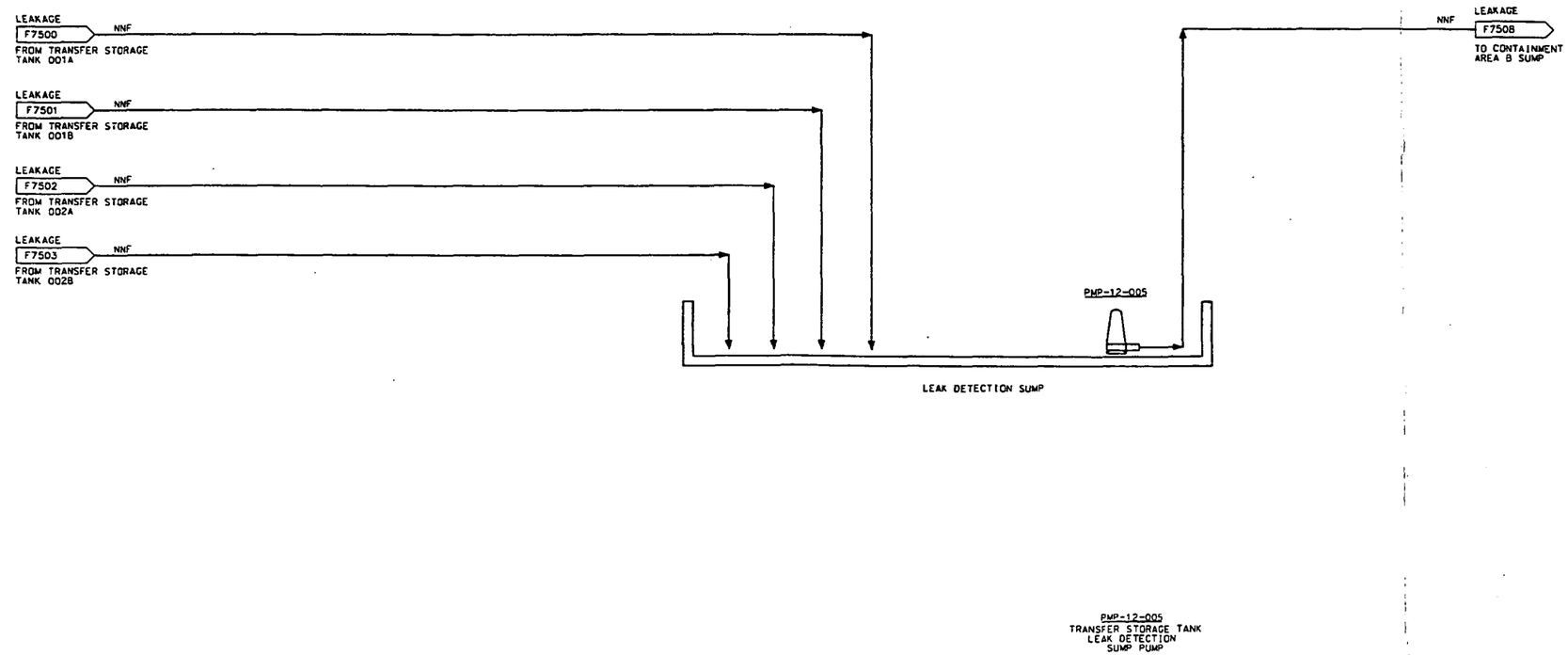
DATE: 05/29/02 TIME: 06:30:41 PM USER: PN DESIGN FILE: I:\proc\PFD'S\94xf1482.dgn



NOTES:

4448

REF DWG NO.	DRAWING TITLE
F6003	FLOW DIAGRAMS PROCESS FLOW DIAGRAM MATERIAL BALANCE TABLE
N6000	INSTRUMENTATION, PIPING AND INSTRUMENTATION DIAGRAM: PIPING, VALVES AND MISCELLANOUS SHEET 1 OF 3
N6002	INSTRUMENTATION, PIPING AND INSTRUMENTATION DIAGRAM: EQUIPMENT AND MISCELLANOUS SHEET 3 OF 3

REV. NO.	ISSUE OR REVISION PURPOSE - DESCRIPTION	DATE	REV. BY	APPR.
0	ISSUED TO CONSTRUCTION	05/29/02	[illegible]	[illegible]

INITIALS AND DATE

UNITED STATES DEPARTMENT OF ENERGY
FERNALD ENVIRONMENTAL MANAGEMENT PROJECT

THIS DRAWING PREPARED BY

JACOBS

PROJECT NAME
AWR BOP OPTIMIZATION

DRAWING TITLE
FLOW DIAGRAMS
PROCESS FLOW DIAGRAM
TRANSFER STORAGE TANK LEAK DETECTION SUMP

DRAWN BY	DATE	TECHNICAL LEAD	DATE	CHECKED BY	DATE
[illegible]	05/29/02	[illegible]	5/29/02	[illegible]	5/29/02

PLANT/BLDG. NO.	FLOOR	SCALE	CLASS
		NONE	U

SUBMITTED FOR 30% ISSUE	SUBMITTED FOR 60% ISSUE	SUBMITTED FOR 90% ISSUE
TECH LEAD	TECH LEAD	TECH LEAD
DATE	DATE	DATE

T.O. NUMBER	PROJECT NO.	DRAWING INDEX CODE NO.	SHEET NO.	REV. NO.
N/A	40710	94X-3900-F-01483	F7504	0

JEC PROJECT NO.	FILENAME
35H19606	94XF1483.DGN

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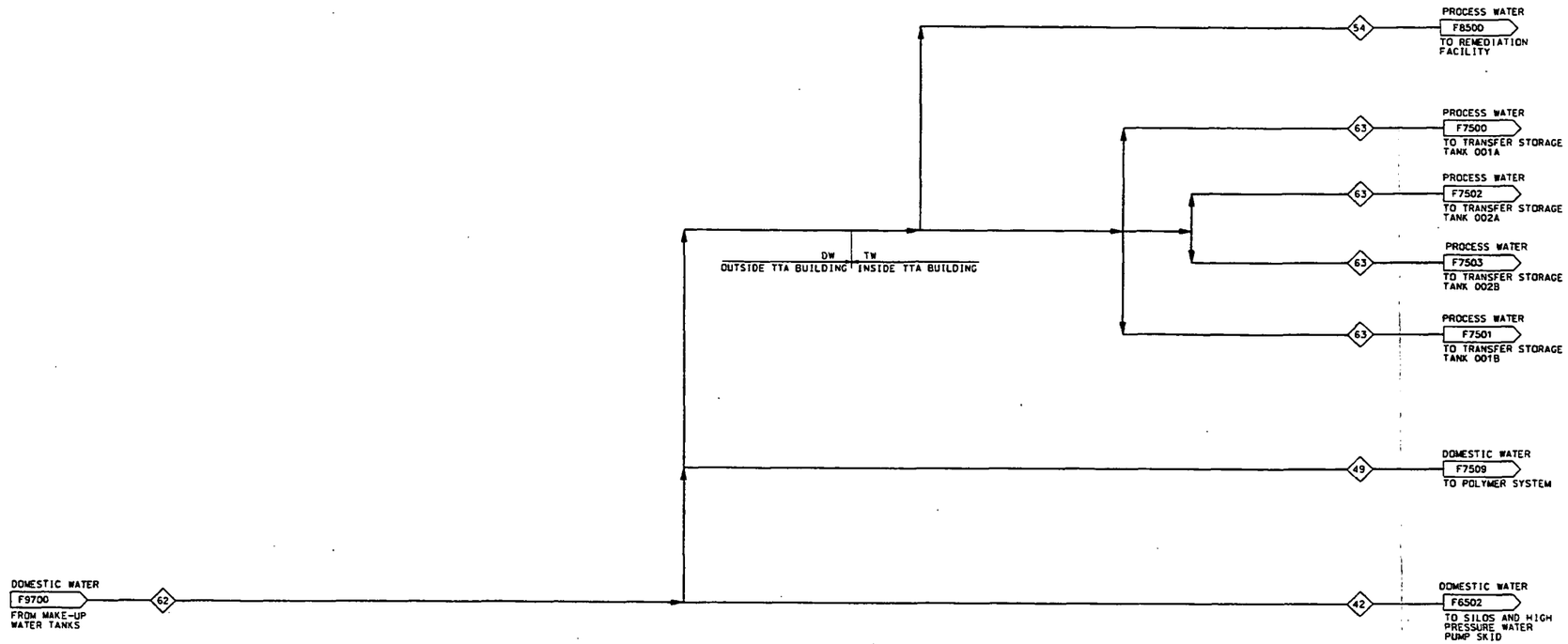

NOTES:

4448

REF DWG NO.	DRAWING TITLE
F6003	FLOW DIAGRAMS PROCESS FLOW DIAGRAM MATERIAL BALANCE TABLE
N6000	INSTRUMENTATION, PIPING AND INSTRUMENTATION DIAGRAM: PIPING, VALVES AND MISCELLANOUS SHEET 1 OF 3
N6002	INSTRUMENTATION, PIPING AND INSTRUMENTATION DIAGRAM: EQUIPMENT AND MISCELLANOUS SHEET 3 OF 3

REV. NO.	ISSUE OR REVISION PURPOSE - DESCRIPTION	DATE	REV. BY	APPR.
0	ISSUED TO CONSTRUCTION	05/29/02	[illegible]	[illegible]

INITIALS AND DATE

UNITED STATES DEPARTMENT OF ENERGY
FERNALD ENVIRONMENTAL MANAGEMENT PROJECT

THIS DRAWING PREPARED BY

JACOBS

PROJECT NAME
AWR BOP OPTIMIZATION

DRAWING TITLE
FLOW DIAGRAMS
PROCESS FLOW DIAGRAM
DOMESTIC AND PROCESS WATER DISTRIBUTION

DRAWN BY	DATE	TECHNICAL LEAD	DATE	CHECKED BY	DATE
[illegible]	05/29/02	[illegible]	5/29/02	[illegible]	5/29/02

PLANT/BLDG. NO. | FLOOR | SCALE: NONE | CLASS: U

SUBMITTED FOR 30% ISSUE — TECH LEAD ____ DATE ____
SUBMITTED FOR 60% ISSUE — TECH LEAD ____ DATE ____
SUBMITTED FOR 90% ISSUE — TECH LEAD ____ DATE ____

T.O. NUMBER	PROJECT NO.	DRAWING INDEX CODE NO.	SHEET NO.	REV. NO.
N/A	40710	94X-3900-F-01484	F7505	0

JEC PROJECT NO. 35H19606 | FILENAME 94XF1484.DGN

000284

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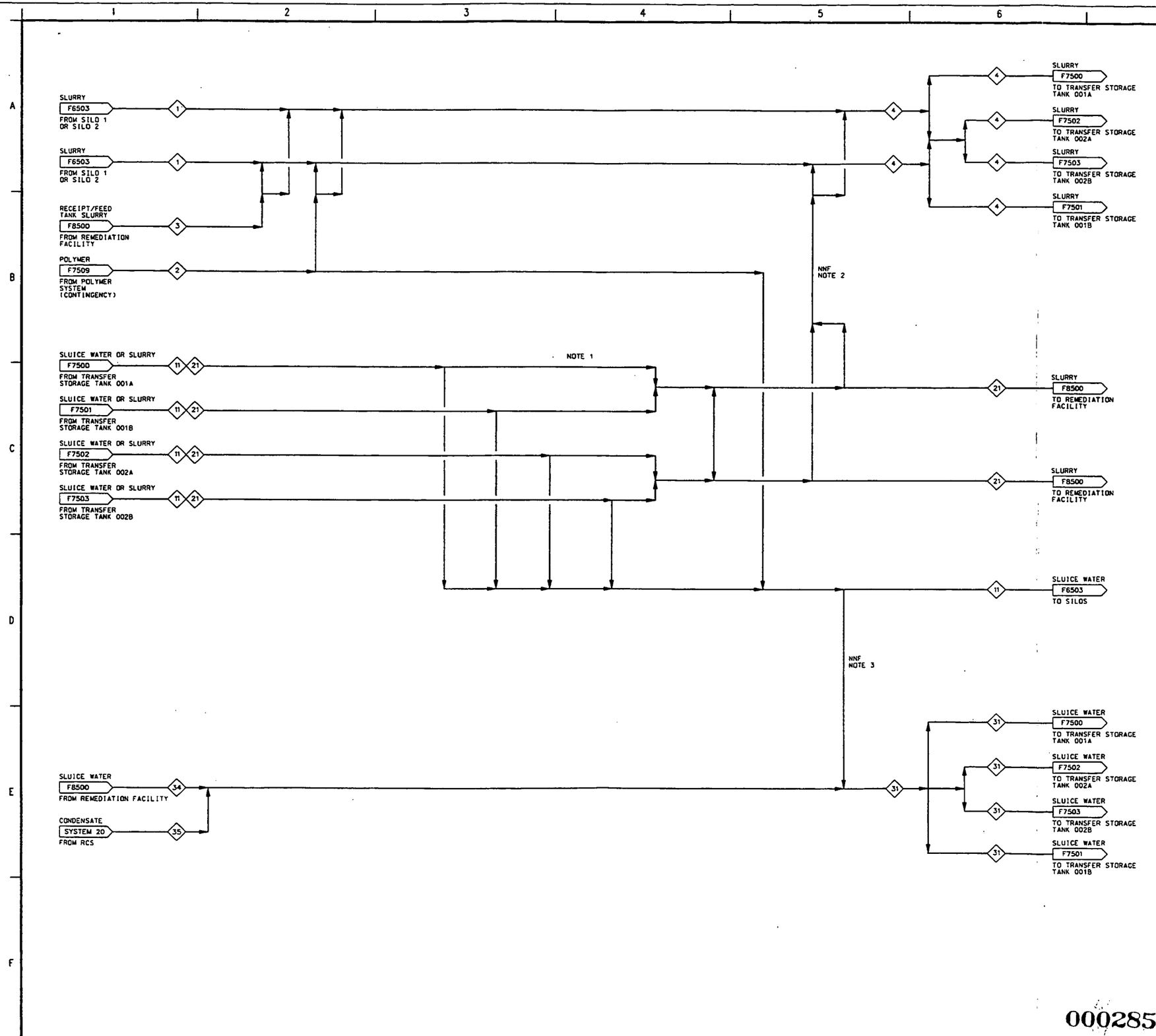

NOTES:

1. SLUICE WATER AND SLURRY DISTRIBUTION FROM THE TRANSFER STORAGE TANKS IS CAPABLE OF SUPPLYING SLURRY FROM ONE OF THE TRANSFER STORAGE TANKS TO THE REMEDIATION FACILITY, WHILE SIMULTANEOUSLY SUPPLYING SLUICE WATER FROM A DIFFERENT TRANSFER STORAGE TANK TO THE SILOS.
2. THE PURPOSE OF THIS CONNECTOR LINE IS TO PROVIDE THE ABILITY TO PUMP SLURRY FROM ONE TRANSFER STORAGE TANK TO A DIFFERENT TRANSFER STORAGE TANK.
3. THE PURPOSE OF THIS CONNECTOR IS TO PROVIDE THE ABILITY TO PUMP SLUICE WATER FROM ONE TRANSFER STORAGE TANK TO A DIFFERENT TRANSFER STORAGE TANK.

4448

REF DWG NO.	DRAWING TITLE
F6003	FLOW DIAGRAMS PROCESS FLOW DIAGRAM MATERIAL BALANCE TABLE
N6000	INSTRUMENTATION, PIPING AND INSTRUMENTATION DIAGRAM: PIPING, VALVES AND MISCELLANOUS SHEET 1 OF 3
N6002	INSTRUMENTATION, PIPING AND INSTRUMENTATION DIAGRAM: EQUIPMENT AND MISCELLANOUS SHEET 3 OF 3

REV. NO.	ISSUE OR REVISION PURPOSE - DESCRIPTION	DATE	REV. BY	APPR.
0	ISSUED TO CONSTRUCTION	05/29/02	[illegible]	[illegible]

INITIALS AND DATE

UNITED STATES DEPARTMENT OF ENERGY
FERNALD ENVIRONMENTAL MANAGEMENT PROJECT

THIS DRAWING PREPARED BY
JACOBS
175 Broadway Ave. Oak Ridge, Tennessee 37830 Tel: 865-220-6800 Fax: 865-220-6170

PROJECT NAME
AWR BOP OPTIMIZATION

DRAWING TITLE
FLOW DIAGRAMS
PROCESS FLOW DIAGRAM
SLURRY AND SLUICE WATER DISTRIBUTION

DRAWN BY	DATE	TECHNICAL LEAD	DATE	CHECKED BY	DATE
[illegible]	05/29/02	[illegible]	5/29/02	[illegible]	5/29/02

PLANT/BLDG. NO.	FLOOR	SCALE	CLASS
		NONE	U

SUBMITTED FOR 30% ISSUE	SUBMITTED FOR 60% ISSUE	SUBMITTED FOR 90% ISSUE
TECH LEAD	TECH LEAD	TECH LEAD
DATE	DATE	DATE

T.O. NUMBER	PROJECT NO.	DRAWING INDEX CODE NO.	SHEET NO.	REV. NO.
N/A	40710	94X-3900-F-01485	F7506	0

JEG PROJECT NO.	FILENAME
35H19606	94XF1485.DGN

000285

DATE: 05/29/02
TIME: 01:32:03 PM
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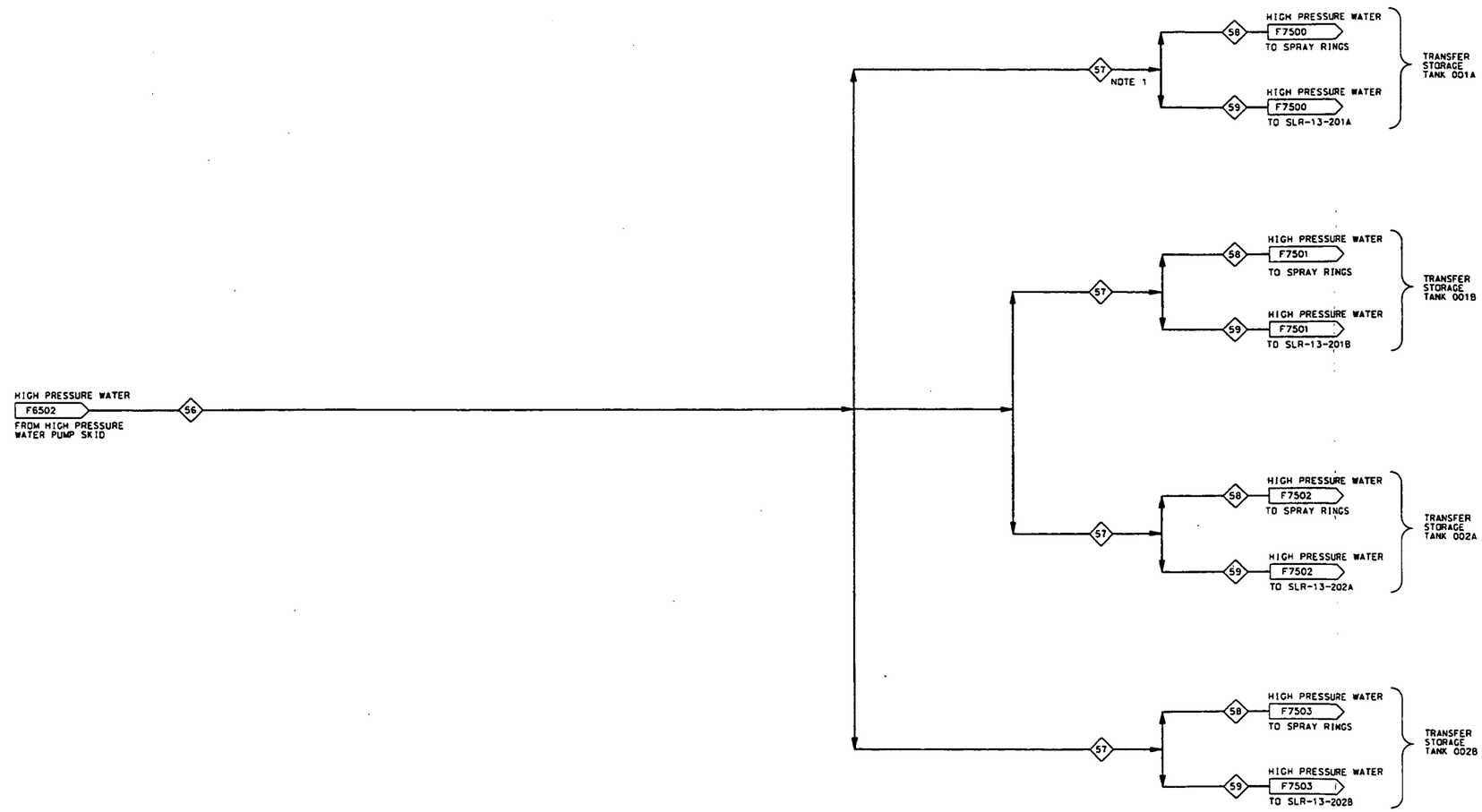

NOTES:

1. HIGH PRESSURE WATER TO EACH OF THE TRANSFER STORAGE TANKS IS USED FOR DECON AND FLUSHING. IT IS ANTICIPATED THAT NORMAL OPERATING CONDITIONS WILL REQUIRE HIGH PRESSURE WATER SUPPLIED TO NO MORE THAN TWO LOCATIONS AT A GIVEN TIME.

4448

REF DWG NO.	DRAWING TITLE
F6003	FLOW DIAGRAMS PROCESS FLOW DIAGRAM MATERIAL BALANCE TABLE
N6000	INSTRUMENTATION, PIPING AND INSTRUMENTATION DIAGRAM: PIPING, VALVES AND MISCELLANOUS SHEET 1 OF 3
N6002	INSTRUMENTATION, PIPING AND INSTRUMENTATION DIAGRAM: EQUIPMENT AND MISCELLANOUS SHEET 3 OF 3

REV. NO.	ISSUE OR REVISION PURPOSE - DESCRIPTION	DATE	REV. BY	APPR.
0	ISSUED TO CONSTRUCTION	05/29/02	[illegible]	[illegible]

INITIALS AND DATE

UNITED STATES DEPARTMENT OF ENERGY
FERNALD ENVIRONMENTAL MANAGEMENT PROJECT

THIS DRAWING PREPARED BY

JE JACOBS

PROJECT NAME
AWR BOP OPTIMIZATION

DRAWING TITLE
FLOW DIAGRAMS
PROCESS FLOW DIAGRAM
TWRS HIGH PRESSURE WATER DISTRIBUTION

DRAWN BY	DATE	TECHNICAL LEAD	DATE	CHECKED BY	DATE
[illegible]	05/29/02	[illegible]	5/29/02	[illegible]	5/29/02

PLANT/BLDG. NO.	FLOOR	SCALE	CLASS
		NONE	U

SUBMITTED FOR 30% ISSUE	SUBMITTED FOR 60% ISSUE	SUBMITTED FOR 90% ISSUE
TECH LEAD	TECH LEAD	TECH LEAD
DATE	DATE	DATE

T.D. NUMBER	PROJECT NO.	DRAWING INDEX CODE NO.	SHEET NO.	REV. NO.
N/A	40710	94X-3900-F-01486	F7507	0

JEG PROJECT NO.	FILENAME
35H19606	94XF1486.DGN

000286

DATE: 05/29/02
TIME: 04:32:36 PM
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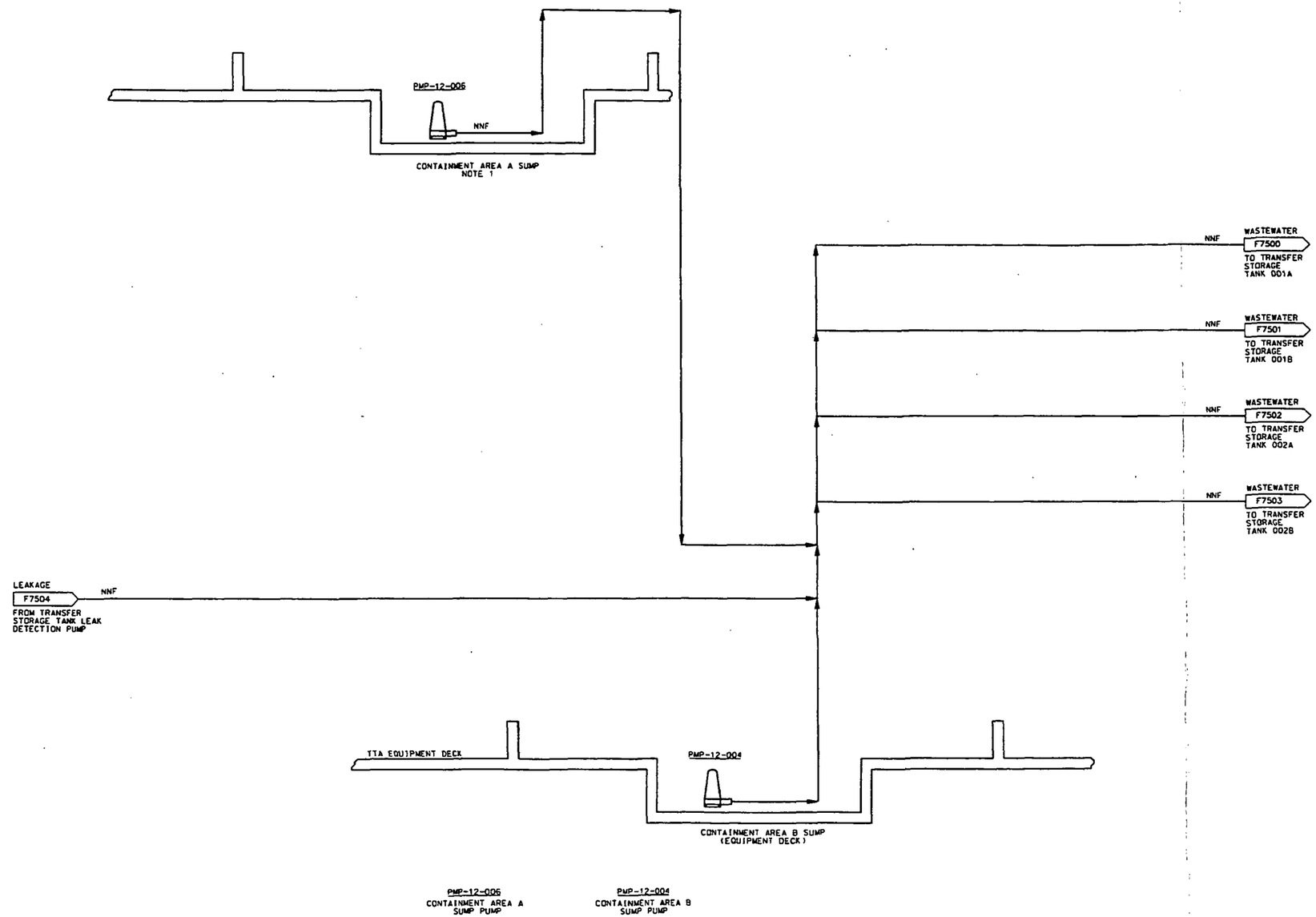

NOTES:

1. CONTAINMENT AREA A SUMP COLLECTS WASTEWATER FROM THE DIVERTER VALVE AREA, WHICH IS INSIDE THE TTA BUILDING.

4448

REF DWG NO.	DRAWING TITLE
F6003	FLOW DIAGRAMS PROCESS FLOW DIAGRAM MATERIAL BALANCE TABLE
N6000	INSTRUMENTATION, PIPING AND INSTRUMENTATION DIAGRAM: PIPING, VALVES AND MISCELLANOUS SHEET 1 OF 3
N6002	INSTRUMENTATION, PIPING AND INSTRUMENTATION DIAGRAM: EQUIPMENT AND MISCELLANOUS SHEET 3 OF 3

REV. NO.	ISSUE OR REVISION PURPOSE - DESCRIPTION	DATE	REV. BY	APPR.
0	ISSUED TO CONSTRUCTION	05/29/02	[illegible]	[illegible]

INITIALS AND DATE

UNITED STATES DEPARTMENT OF ENERGY
FERNALD ENVIRONMENTAL MANAGEMENT PROJECT

THIS DRAWING PREPARED BY

JACOBS

PROJECT NAME
AWR BOP OPTIMIZATION

DRAWING TITLE
FLOW DIAGRAMS
PROCESS FLOW DIAGRAM
TWRS CONTAINMENT AREA A AND B

DRAWN BY	DATE	TECHNICAL LEAD	DATE	CHECKED BY	DATE
[illegible]	05/29/02	[illegible]	5/30/02	[illegible]	5/29/02

PLANT/BLDG. NO.	FLOOR	SCALE	CLASS
		NONE	U

SUBMITTED FOR 30% ISSUE	SUBMITTED FOR 60% ISSUE	SUBMITTED FOR 90% ISSUE
TECH LEAD	TECH LEAD	TECH LEAD
DATE	DATE	DATE

T.O. NUMBER	PROJECT NO.	DRAWING INDEX CODE NO.	SHEET NO.	REV. NO.
N/A	40710	94X-3900-F-01487	F7508	0

JEG PROJECT NO.	FILENAME
35H19606	94XF1487.DGN

000287

DATE: 05/29/02
TIME: 04:33:40 PM
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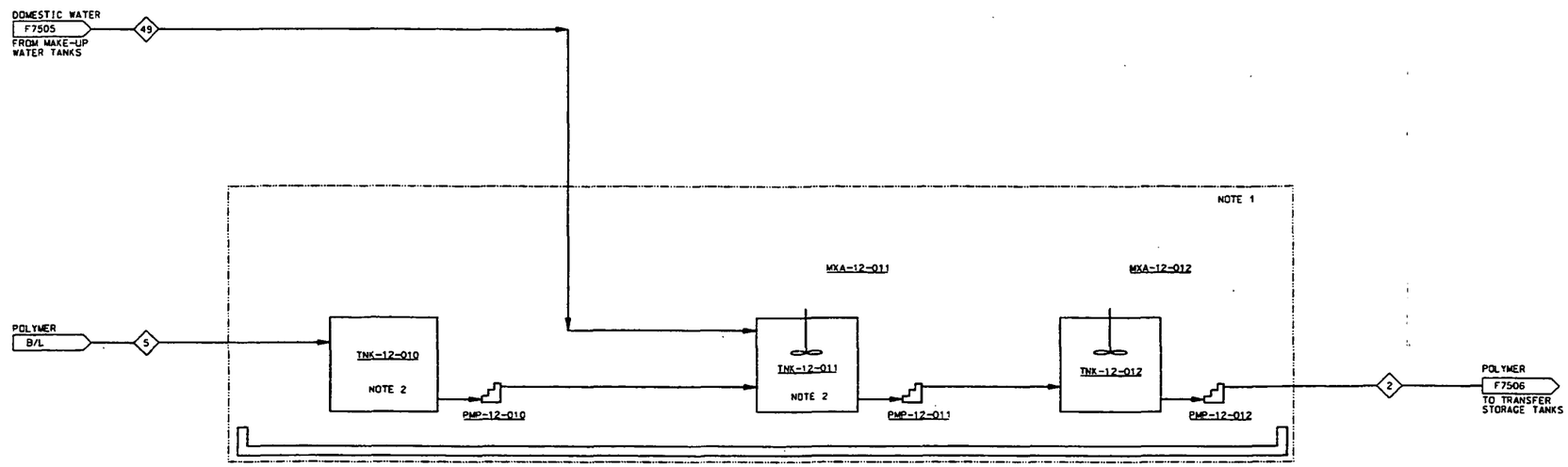

NOTES:

1. THE SKID MOUNTED POLYMER SYSTEM WILL BE A PACKAGE SYSTEM. THE POLYMER SYSTEM WILL BE INCLUDED IN THE AWR SCOPE AS A CONTINGENCY ITEM.
2. BULK POLYMER WILL BE RECEIVED IN RETURNABLE TOTE BINS.

4448

REF DWG NO.	DRAWING TITLE
F6003	FLOW DIAGRAMS PROCESS FLOW DIAGRAM MATERIAL BALANCE TABLE
N6000	INSTRUMENTATION, PIPING AND INSTRUMENTATION DIAGRAM: PIPING, VALVES AND MISCELLANOUS SHEET 1 OF 3
N6002	INSTRUMENTATION, PIPING AND INSTRUMENTATION DIAGRAM: EQUIPMENT AND MISCELLANOUS SHEET 3 OF 3

REV. NO.	ISSUE OR REVISION PURPOSE - DESCRIPTION	DATE	REV. BY	APPR.
0	ISSUED TO CONSTRUCTION	05/29/02	[illegible]	[illegible]

INITIALS AND DATE

UNITED STATES DEPARTMENT OF ENERGY
FERNALD ENVIRONMENTAL MANAGEMENT PROJECT

THIS DRAWING PREPARED BY

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PROJECT NAME
AWR BOP OPTIMIZATION

DRAWING TITLE
FLOW DIAGRAMS
PROCESS FLOW DIAGRAM
TRANSFER STORAGE TANK POLYMER SYSTEM

DRAWN BY	DATE	TECHNICAL LEAD	DATE	CHECKED BY	DATE
[illegible]	05/29/02	[illegible]	5/29/02	[illegible]	5/29/02

PLANT/BLDG. NO.	FLOOR	SCALE	CLASS
		NONE	U

SUBMITTED FOR 30% ISSUE	SUBMITTED FOR 60% ISSUE	SUBMITTED FOR 90% ISSUE
TECH LEAD	TECH LEAD	TECH LEAD
DATE	DATE	DATE

T.O. NUMBER	PROJECT NO.	DRAWING INDEX CODE NO.	SHEET NO.	REV. NO.
N/A	40710	94X-3900-F-01488	F7509	0

JEG PROJECT NO.	FILENAME
35H19606	94XF1488.DGN

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DATE: 05/29/02
TIME: 06:33:37 PM
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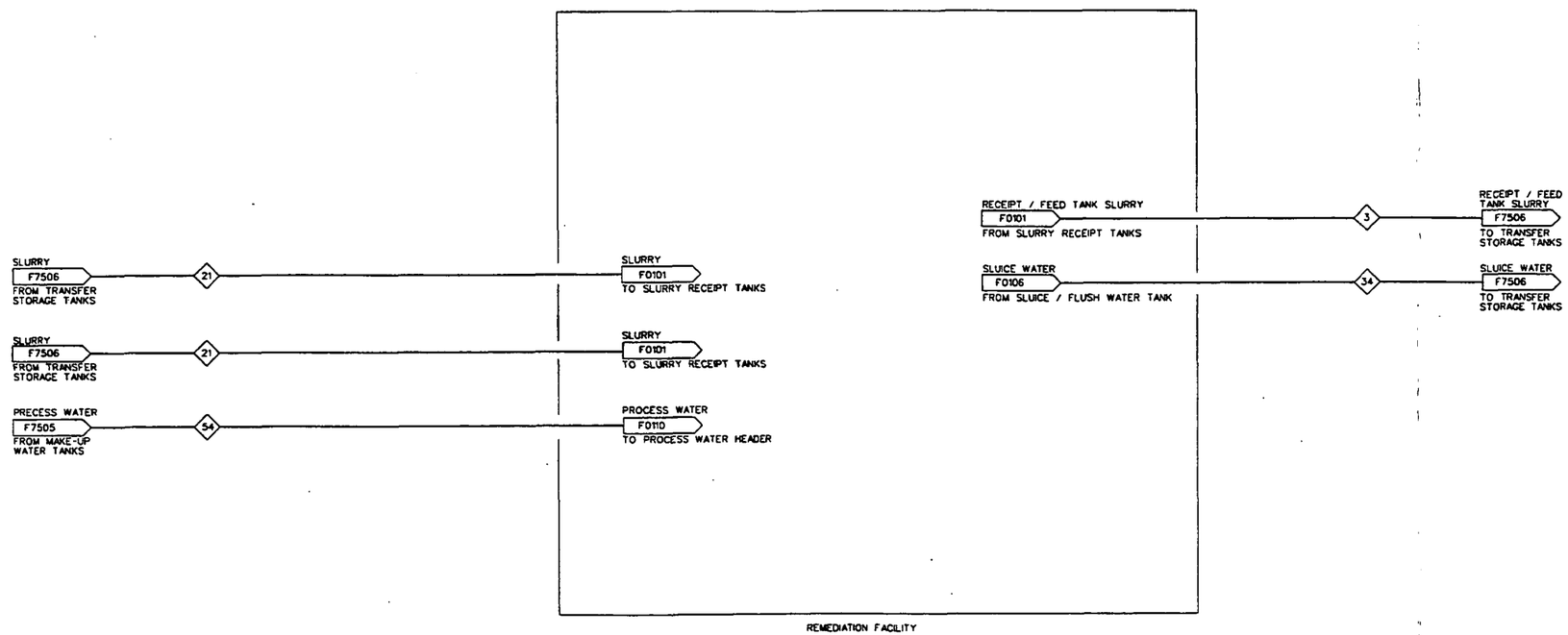
DESIGN FILE: I:\proc\PFD'S\94xf1488.dgn



NOTES:

F4448

REF DWG NO.	DRAWING TITLE
F6003	FLOW DIAGRAMS PROCESS FLOW DIAGRAM MATERIAL BALANCE TABLE
N6000	INSTRUMENTATION, PIPING AND INSTRUMENTATION DIAGRAM: PIPING, VALVES AND MISCELLANOUS SHEET 1 OF 3
N6002	INSTRUMENTATION, PIPING AND INSTRUMENTATION DIAGRAM: EQUIPMENT AND MISCELLANOUS SHEET 3 OF 3
94X-3900-F-01153	FLOW DIAGRAMS PROCESS FLOW DIAGRAM SLURRY RECEIPT TANK SYSTEM
94X-3900-F-01158	FLOW DIAGRAMS PROCESS FLOW DIAGRAM SLUICE/FLUSH WATER SYSTEM

REV. NO.	ISSUE OR REVISION PURPOSE - DESCRIPTION	DATE	REV. BY	APPR.
0	ISSUED TO CONSTRUCTION	05/29/02		

INITIALS AND DATE

UNITED STATES DEPARTMENT OF ENERGY
FERNALD ENVIRONMENTAL MANAGEMENT PROJECT

THIS DRAWING PREPARED BY

JE JACOBS

PROJECT NAME
AWR BOP OPTIMIZATION

DRAWING TITLE
FLOW DIAGRAMS
PROCESS FLOW DIAGRAM
REMEDIATION FACILITY

DRAWN BY	DATE	TECHNICAL LEAD	DATE	CHECKED BY	DATE
	05/29/02		5/29/02		5/29/02

PLANT/BLDG. NO. | FLOOR | SCALE: NONE | CLASS: U

SUBMITTED FOR 30% ISSUE — TECH LEAD — DATE
SUBMITTED FOR 60% ISSUE — TECH LEAD — DATE
SUBMITTED FOR 90% ISSUE — TECH LEAD — DATE

T.O. NUMBER	PROJECT NO.	DRAWING INDEX CODE NO.	SHEET NO.	REV. NO.
N/A	40710			

JEC PROJECT NO.	FILENAME			
35H19606	94XF1489.DGN	94X-3900-F-01489	F8500	0

000289

DATE: 05/29/02
TIME: 06:34:08 PM
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DESIGN FILE: h:\proc\PFD'S\94xf1489.dgn

4448

PHASE 1 – SILO 1 AND SILO 2 HEADSPACE REDUCTION

STREAM NUMBER	1	2	3	4	5	6	6A	7	8	9	9A	10	11	12	13	14	15	16	17	18	19	20
COMPONENT	AIR FLOW FROM SILO 1	AIR FLOW FROM SILO 2		AIR TO DESICCANT DRYERS	AIR TO CARBON BED	AIR FROM CARBON BED	FAN INLET (TREATED GAS + FAN RECYCLE + MAKEUP)	AIR TO SILO 1	AIR TO SILO 2			CONDENSATE TO HOLD-UP TANKS		RCS TO STACK	BUILDING VENT TO STACK	STACK DISCHARGE	FAN RECYCLE FLOW	MAKE-UP AIR	CONDENSATE TO TANKER TRUCK			
AIR (LBS/HR)	1081	1081		2161	2161	2161	2919	976	976			--		210	40219	40436	758	--	--			
WATER (LBS/HR)	20	20		41	2	2	2	1	1			39		0	757	757	0	--	12519			
TOTAL (LBS/HR)	1101	1101		2202	2163	2163	2921	977	977			39		210	40976	41193	758	--	12519			
FLOW (CFM)	250	250		500	454	454	549	225	225			--		50	9310	9360	175	--	--			
FLOW (GPM)	--	--		--	--	--	--	--	--			0.08		--	--	--	--	--	25			
RADON (PICOCURIES/L)	252349	249773		251061	276419	112	112	112	112			138127		112	--	0.596	112	--	2445			
RADON (CURIES/HR)	1.07E-01	1.06E-01		2.13E-01	2.13E-01	8.60E-05	1.23E-04	4.26E-05	4.26E-05			2.44E-06		9.47E-06	--	9.47E-06	3.32E-05	--	1.39E-05			
TEMPERATURE (DEG F)	75	75		75	36	40	51	73	73			40		73	75	75	73	--	--			
PRESSURE (INCHES WC)	--	--		--	--	--	--	--	--			--		--	--	--	--	--	--			
NOTES	RELATIVE HUMIDITY= 100% RADON CONCENTRATION STEADY STATE	RELATIVE HUMIDITY= 100% RADON CONCENTRATION STEADY STATE		FLOW REPRESENTS SILOS 1 AND 2	CHILLER CONDITIONS AIR TO 36°F AND 15% RELATIVE HUMIDITY	RADON REMOVAL BASED ON K=11 AND 4 CARBON BEDS	FLOW IS CARBON BED EXHAUST PLUS FAN RECYCLE FLOW + MAKEUP AIR. INCL. FAN HEAT							VARIABLE FLOW AS REQUIRED TO COMPENSATE FOR IN LEAKAGE	NOTE 2	RELATIVE HUMIDITY= 99.5%	FLOW ENTERS FAN SUCTION AFTER CARBON BEDS	VARIABLE FLOW AS REQUIRED FOR MAKE-UP AIR AND PRESSURE CONTROL	INTERMITTENT FLOW; DISCHARGED AS REQUIRED			

INFORMATION ONLY

[X] A - Conforms to the Subcontract Requirements
[ ] B - Minor Comment - Incorporate and Resubmit
[ ] C - Revise and Resubmit
Sig: B.W. Helmes Date: 5/22/02

NOTES:

1. FOR FLOW DIAGRAMS SEE DRAWINGS 20FMD003, 20FMD004, 20FMD007, 20FMD008, 20FMD009, AND 20FMD010.
2. STREAM 13 FLOW FROM 77FMD002.
3.
4. AIR STREAMS FROM CARBON BED DRYING FAN (FAN-20-003) TO DESICCANT DRYERS OR HEPA FILTERS ARE NOT INCLUDED IN THE MASS BALANCE. THESE FLOW STREAMS ARE NOT PART OF NORMAL OPERATIONS, BUT ARE USED FOR MAINTENANCE ACTIVITIES TO RECLAIM CARBON BED PERFORMANCE.
5. ROUND OFF OF QUANTITIES MAY RESULT IN MINOR DIFFERENCES WITHIN THE MASS BALANCE.

000290

REV	DATE	BY	CHK'D	APRVD	DESCRIPTION/ISSUE
5	5/16/02	BJD	BSM	SWH	REVISED PER DCNS 40710-JEG-147
4	04/25/02	BJD	BSM	SWH	REVISED PER DCNS 40710-JEG-029 & 40710-JEG-117
3	11/10/00	BJD	BAL	KDR	REVISED PER AWR-DCN-M-0002
2	05/15/00	BJD	GCH	KDR	REVISED PER CHANGE PROPOSAL CP-00-001
1	01/03/00	BJD	SWH	KDR	CERTIFIED FOR CONSTRUCTION
0	11/01/99	BJD	KR		PRELIMINARY DESIGN SUBMITTAL

RPE: RPE SEAL NOT REQUIRED FOR JACOBS GENERATED REVISIONS

		DATE
DRAWN BY	B J DAVIS	01/07/00
DESIGNED BY	B J DAVIS	01/07/00
CHECKED BY	S W HUNGATE	01/07/00
APPROVED BY	KENNETH RICKETT	01/07/00
APPROVED BY	JOHN LAWSON	01/07/00

JACOBS PROJECT NO: 35H19606
FERNALD PROJECT NO: 40710
FIRST JACOBS REVISION NO: 4

JACOBS — 123 Broadway Ave., Oak Ridge, Tennessee 37830, Tel 865-220-4000, Fax 865-220-6130

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 TABLE

SIZE: D | SCALE: NONE | DWG. NO. 20FMD001 | REV 5

FILENAME: 20FMD00

PHASE 2

STREAM NUMBER	101	102	103	104	105	106	107	108	109
COMPONENT	AIR FLOW FROM SILO 1	AIR FLOW FROM SILO 2	AIR FLOW FROM TTA	AIR TO CHILLER	AIR TO CARBON BED	TO CONDENSATE TANK	RCS TO STACK	BUILDING VENT TO STACK	AIR TO STACK
AIR (LBS/HR)	1620.75	1620.75	1080.5	4322	4322	---	4322	40.233	44.555
WATER (LBS/HR)	30.52	30.52	20.35	81.40	3.3	78.10	3.3	757.5	760.80
TOTAL. (LBS/HR)	1651.3	1651.3	1100.85	4403.4	4325.3	78.10	4325.3	40.990	45.315.8
FLOW (CFM)	375	375	250	1000	935	---	1000	9310	10.310
FLOW (GPM)	---	---	---	---	---	0.125	---	---	---
RADON (PICOCURIES/L)	1.127.008	1.127.008	545.000	981.506	1.049.739	---	9.815	0	1054
RADON (CURIES/HR)	0.718	0.718	0.231	1.67	1.67	---	0.017	0	0.017
TEMPERATURE (DEG F)	75°F	75°F	75°F	75°F	40°F	---	64°F	75°F	75°F
PRESSURE (INCHES WC)	---	---	---	---	---	---	---	---	---
NOTES	RELATIVE HUMIDITY = 100%	RELATIVE HUMIDITY = 100%	RELATIVE HUMIDITY = 100%	RELATIVE HUMIDITY = 100%	RELATIVE HUMIDITY = 15%	CONDENSATE FROM CHILLING SYSTEM	RELATIVE HUMIDITY = 5.9%	RELATIVE HUMIDITY = 100%	NOTE 2

NOTES:

1. ASSUMPTIONS USED TO GENERATE THE RCS MATERIAL BALANCE AS FOLLOWS:
   a. THE BENTOGROUT LAYER HAS BEEN REMOVED FROM BOTH SILO 1 AND SILO 2.
   b. BOTH SILO 1 AND SILO 2 ARE BEING MINED (ACTIVE SWRS)
   c. ALL FOUR TTA TANKS ARE 25% FILLED WITH K-65 SLURRY.
2. ATMOSPHERIC DISPERSION MODELING INDICATES THAT AT THESE WORST CASE CONDITIONS THE RCS DISCHARGE STREAM IS AT 7% OF THE INSTANTANEOUS ON-SITE STANDARD. 0.03% OF THE ON-SITE WEEKLY STANDARD AND 0.05% OF THE OFF-SITE ANNUAL AVERAGE STANDARD. FOR A MINIMUM SAFETY FACTOR OF 10.0.

4448

REF DWG NO.	DRAWING TITLE
20FMD001	RADON CONTROL SYSTEM PROCESS FLOW DIAGRAM MASS BALANCE TABLES - SHT 1

REV. NO.	ISSUE OR REVISION PURPOSE - DESCRIPTION	DATE	REV. BY	APPR.
0	ISSUED TO CONSTRUCTION	05/29/02	[illegible]	[illegible]

INITIALS AND DATE

UNITED STATES
DEPARTMENT OF ENERGY
FERNALD ENVIRONMENTAL MANAGEMENT PROJECT

THIS DRAWING PREPARED BY
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PROJECT NAME
AWR BOP OPTIMIZATION

DRAWING TITLE
FLOW DIAGRAMS
PROCESS FLOW DIAGRAM
RCS PHASE 2 MATERIAL BALANCE TABLE

DRAWN BY	DATE	TECHNICAL LEAD	DATE	CHECKED BY	DATE
[illegible]	05/29/02	[illegible]	5/30/02	[illegible]	5/30/02

PLANT/BLDG. NO.	FLOOR	SCALE	CLASS
		NONE	U

SUBMITTED FOR 30% ISSUE — TECH LEAD — DATE
SUBMITTED FOR 60% ISSUE — TECH LEAD — DATE
SUBMITTED FOR 90% ISSUE — TECH LEAD — DATE

T.D. NUMBER	PROJECT NO.	DRAWING INDEX CODE NO.	SHEET NO.	REV. NO.
N/A	40710	94X-3900-F-01494	F9500	0

JEG PROJECT NO.	FILENAME
35H19606	94XF1494.DGN

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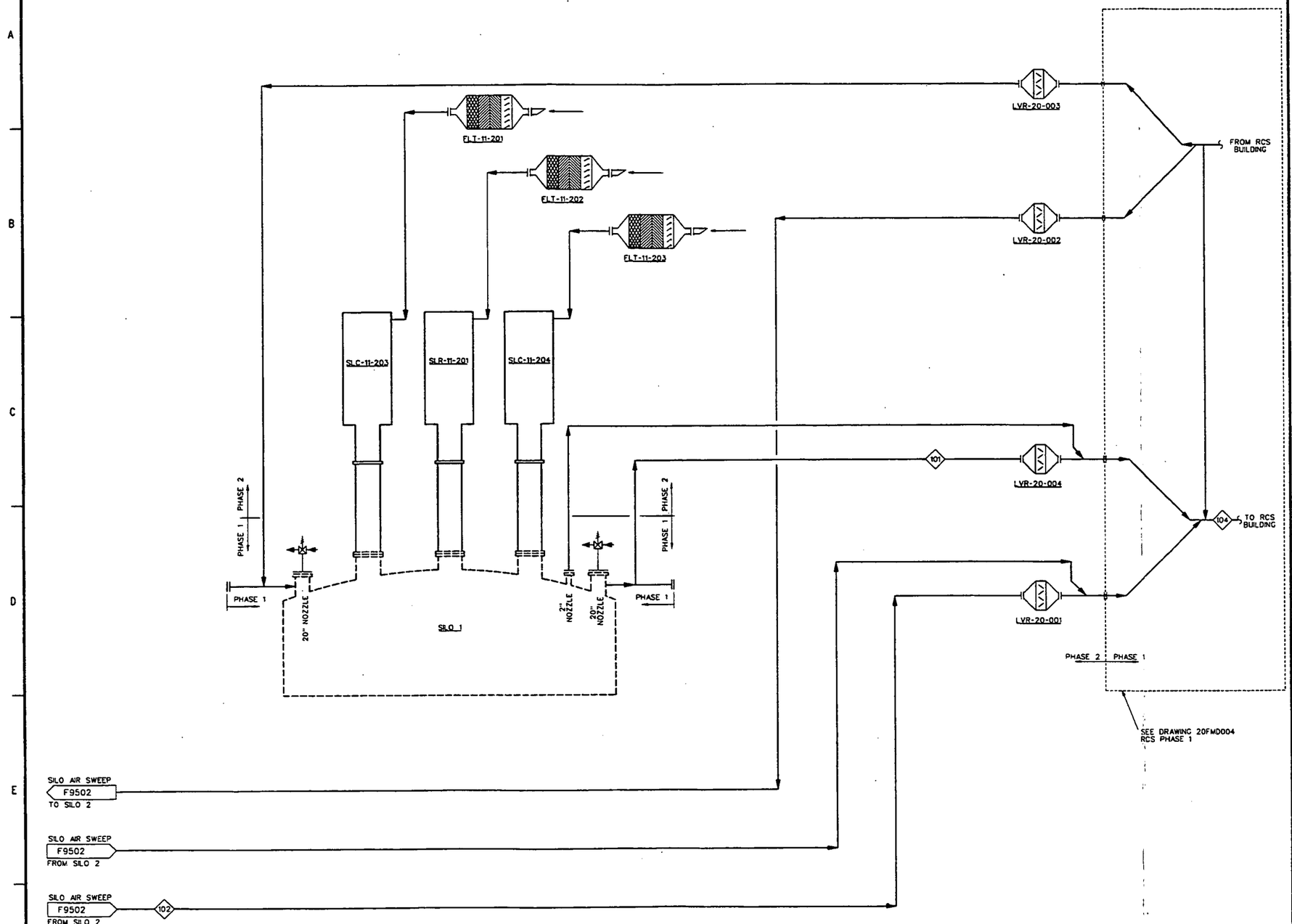

SLC-11-203	SILO 1 SLUICER MODULE 1
SLR-11-201	SILO 1 SLURRY MODULE
SLC-11-204	SILO 1 SLUICER MODULE 2
FLT-11-201	SILO 1 SLUICER MODULE 1 INTAKE FILTER HOUSING
FLT-11-202	SILO 1 SLURRY MODULE INTAKE FILTER HOUSING
FLT-11-203	SILO 1 SLUICER MODULE 2 INTAKE FILTER HOUSING
LVR-20-003	RELOCATE LVR-11-001 TO BRIDGE PHASE 2 OPERATION
LVR-20-004	RELOCATE LVR-11-002 TO BRIDGE PHASE 2 OPERATION
LVR-20-002	RELOCATE LVR-11-003 TO BRIDGE PHASE 2 OPERATION
LVR-20-001	RELOCATE LVR-11-004 TO BRIDGE PHASE 2 OPERATION

000292

NOTES:

4448

REF DWG NO.	DRAWING TITLE
F9500	FLOW DIAGRAMS PROCESS FLOW DIAGRAM MATERIAL BALANCE TABLE
N6000	INSTRUMENTATION, PIPING AND INSTRUMENTATION DIAGRAM: PIPING, VALVES AND MISCELLANOUS SHEET 1 OF 3
N6002	INSTRUMENTATION, PIPING AND INSTRUMENTATION DIAGRAM: EQUIPMENT AND MISCELLANOUS SHEET 3 OF 3

REV. NO.	ISSUE OR REVISION PURPOSE - DESCRIPTION	DATE	REV. BY	APPR.
0	ISSUED TO CONSTRUCTION	05/29/02		

INITIALS AND DATE

UNITED STATES DEPARTMENT OF ENERGY
FERNALD ENVIRONMENTAL MANAGEMENT PROJECT

THIS DRAWING PREPARED BY

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PROJECT NAME
AWR BOP OPTIMIZATION

DRAWING TITLE
FLOW DIAGRAMS
PROCESS FLOW DIAGRAM
RCS FOR SILO 1 (PHASE 2)

DRAWN BY	DATE	TECHNICAL LEAD	DATE	CHECKED BY	DATE
	5/29/02		5/29/02		5/29/02

PLANT/BLDG. NO.	FLOOR	SCALE	CLASS
		NONE	U

SUBMITTED FOR 30% ISSUE	SUBMITTED FOR 60% ISSUE	SUBMITTED FOR 90% ISSUE
TECH LEAD	TECH LEAD	TECH LEAD
DATE	DATE	DATE

T.O. NUMBER	PROJECT NO.	DRAWING INDEX CODE NO.	SHEET NO.	REV. NO.
N/A	40710	94X-3900-F-01495	F9501	0
JE PROJECT NO. 35H19506	FILENAME 94XF1495.DGN			

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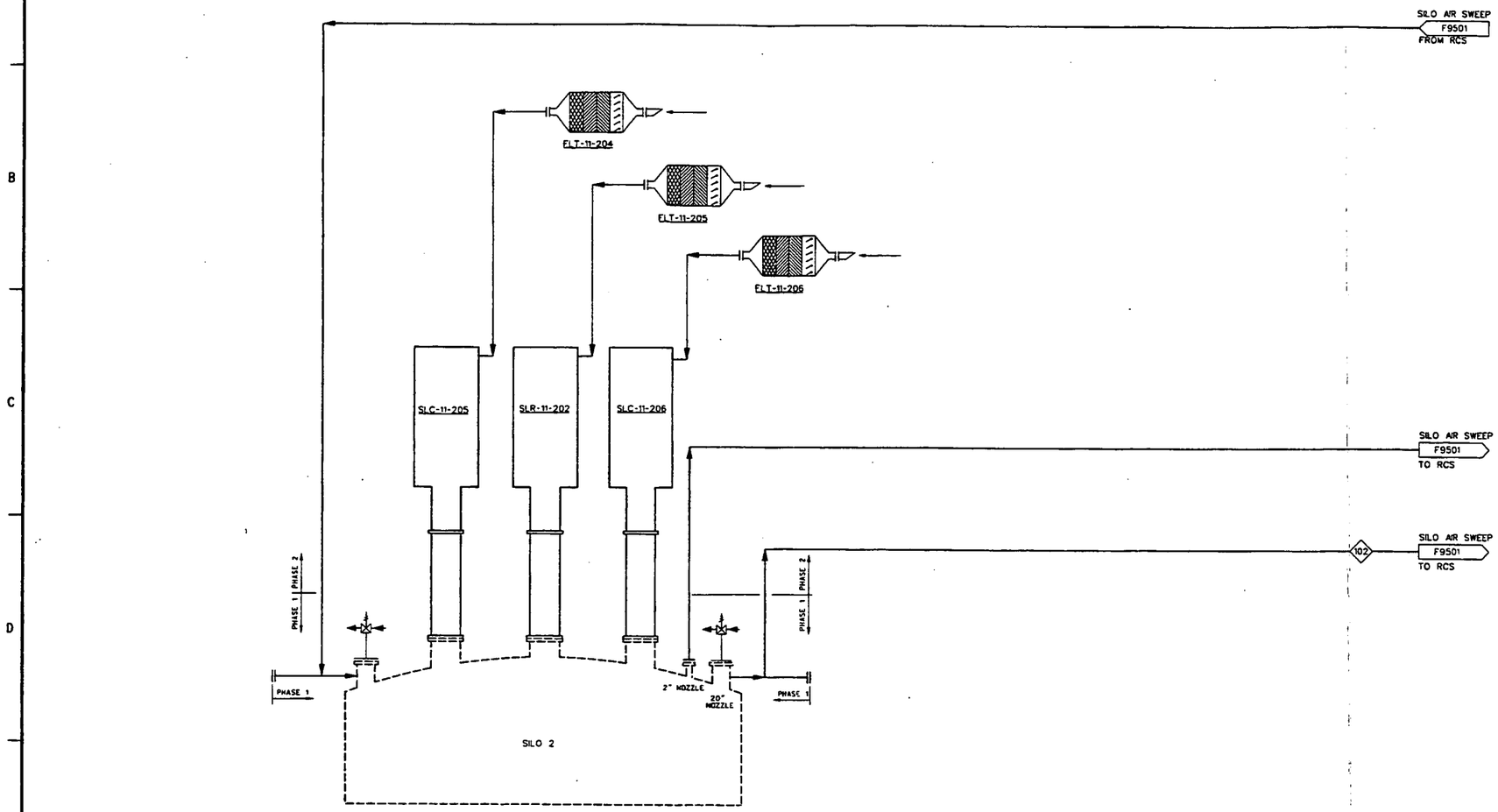

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NOTES:

4448

REF DWG NO.	DRAWING TITLE
F9500	FLOW DIAGRAMS PROCESS FLOW DIAGRAM MATERIAL BALANCE TABLE
N6000	INSTRUMENTATION, PIPING AND INSTRUMENTATION DIAGRAM: PIPING, VALVES AND MISCELLANOUS SHEET 1 OF 3
N6002	INSTRUMENTATION, PIPING AND INSTRUMENTATION DIAGRAM: EQUIPMENT AND MISCELLANOUS SHEET 3 OF 3

REV. NO.	ISSUE OR REVISION PURPOSE - DESCRIPTION	DATE	REV. BY	APPR.
0	ISSUED TO CONSTRUCTION	05/29/02	[illegible]	[illegible]

INITIALS AND DATE

UNITED STATES DEPARTMENT OF ENERGY
FERNALD ENVIRONMENTAL MANAGEMENT PROJECT

THIS DRAWING PREPARED BY

JACOBS

PROJECT NAME
AWR BOP OPTIMIZATION

DRAWING TITLE
FLOW DIAGRAMS
PROCESS FLOW DIAGRAM
RCS FOR SILO 2 (PHASE 2)

DRAWN BY	DATE	TECHNICAL LEAD	DATE	CHECKED BY	DATE
[illegible]	05/29/02	[illegible]	5/29/02	[illegible]	5/29/02

PLANT/BLDG. NO.	FLOOR	SCALE	CLASS
		NONE	U

SUBMITTED FOR 30% ISSUE	SUBMITTED FOR 60% ISSUE	SUBMITTED FOR 90% ISSUE
TECH LEAD	TECH LEAD	TECH LEAD
DATE	DATE	DATE

T.O. NUMBER	PROJECT NO.	DRAWING INDEX CODE NO.	SHEET NO.	REV. NO.
N/A	40710	94X-3900-F-01496	F9502	0

JEG PROJECT NO.	FILENAME
35H19606	94XF1496.DGN

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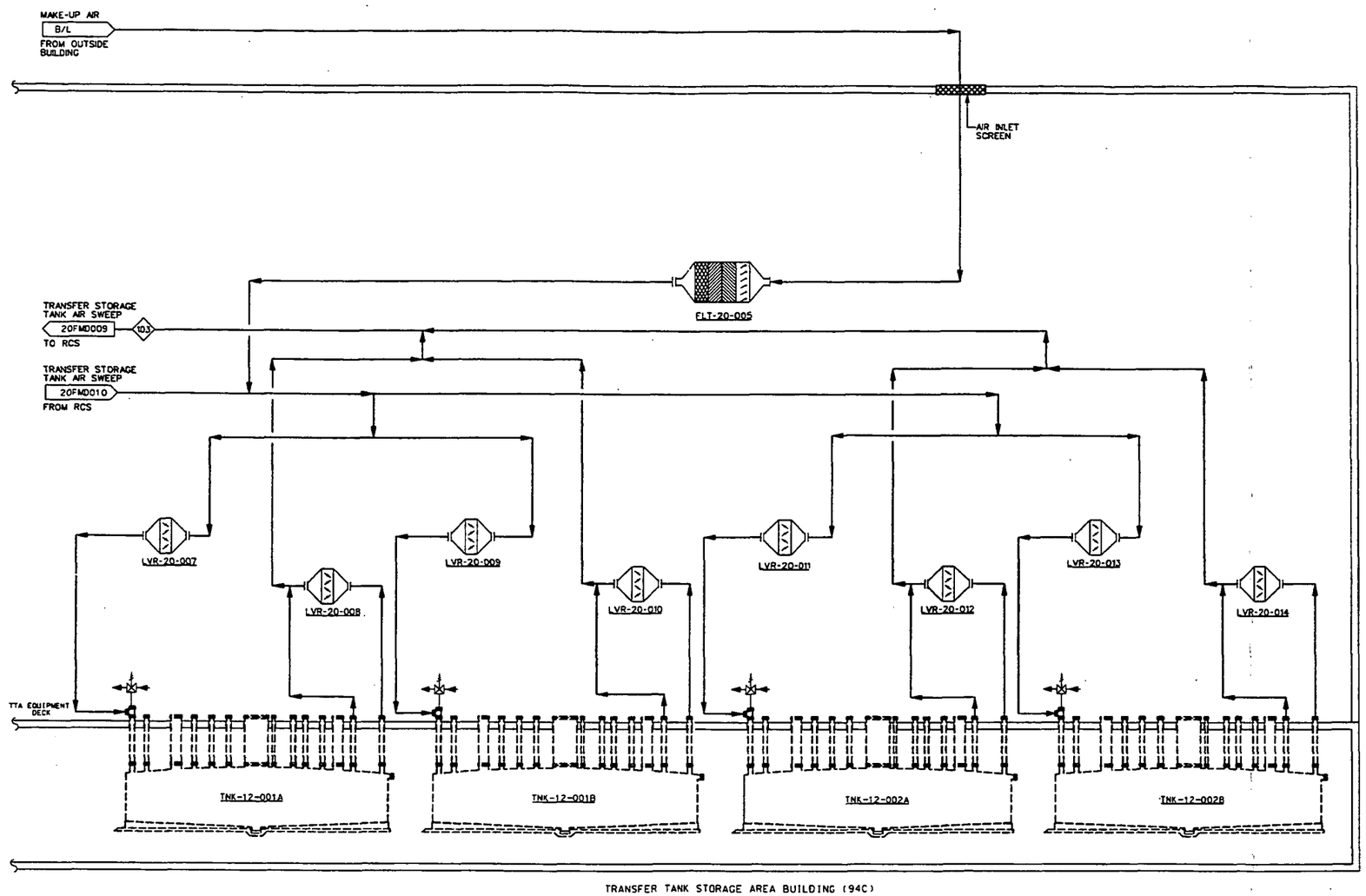

TNK-12-001A TRANSFER STORAGE TANK 001A	LVR-20-007 TRANSFER STORAGE TANK 001A INLET LOUVER	LVR-20-008 TRANSFER STORAGE TANK 001A OUTLET LOUVER	TNK-12-001B TRANSFER STORAGE TANK 001B	LVR-20-009 TRANSFER STORAGE TANK 001B INLET LOUVER	LVR-20-010 TRANSFER STORAGE TANK 001B OUTLET LOUVER	TNK-12-002A TRANSFER STORAGE TANK 002A	LVR-20-011 TRANSFER STORAGE TANK 002A INLET LOUVER	LVR-20-012 TRANSFER STORAGE TANK 002A OUTLET LOUVER	TNK-12-002B TRANSFER STORAGE TANK 002B	LVR-20-013 TRANSFER STORAGE TANK 002B INLET LOUVER	LVR-20-014 TRANSFER STORAGE TANK 002B OUTLET LOUVER

FLT-20-005
TTA RECIRCULATION AIR FILTER HOUSING

000294

NOTES:

4443

REF DWG NO.	DRAWING TITLE
F9500	FLOW DIAGRAMS PROCESS FLOW DIAGRAM MATERIAL BALANCE TABLE
N6000	INSTRUMENTATION, PIPING AND INSTRUMENTATION DIAGRAM: PIPING, VALVES AND MISCELLANOUS SHEET 1 OF 3
N6002	INSTRUMENTATION, PIPING AND INSTRUMENTATION DIAGRAM: EQUIPMENT AND MISCELLANOUS SHEET 3 OF 3

REV. NO.	ISSUE OR REVISION PURPOSE - DESCRIPTION	DATE	REV. BY	APPR.
0	ISSUED TO CONSTRUCTION	05/29/02		

INITIALS AND DATE

UNITED STATES DEPARTMENT OF ENERGY
FERNALD ENVIRONMENTAL MANAGEMENT PROJECT

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PROJECT NAME
AWR BOP OPTIMIZATION

DRAWING TITLE
FLOW DIAGRAMS
PROCESS FLOW DIAGRAM
RCS FOR TRANSFER STORAGE TANKS (PHASE 2)

DRAWN BY	DATE	TECHNICAL LEAD	DATE	CHECKED BY	DATE
	05/29/02				5/29/02

UNIT/BLDG. NO. | FLOOR | SCALE: NONE | CLASS: U

SUBMITTED FOR 30% ISSUE — TECH LEAD — DATE
SUBMITTED FOR 60% ISSUE — TECH LEAD — DATE
SUBMITTED FOR 90% ISSUE — TECH LEAD — DATE

T.O. NUMBER	PROJECT NO.	DRAWING INDEX CODE NO.	SHEET NO.	REV. NO.
N/A	40710	94X-3900-F-01497	F9503	0

JE PROJECT NO. 35H19606 — FILENAME 94XF1497.DGN

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TIME: 04:37:55 PM
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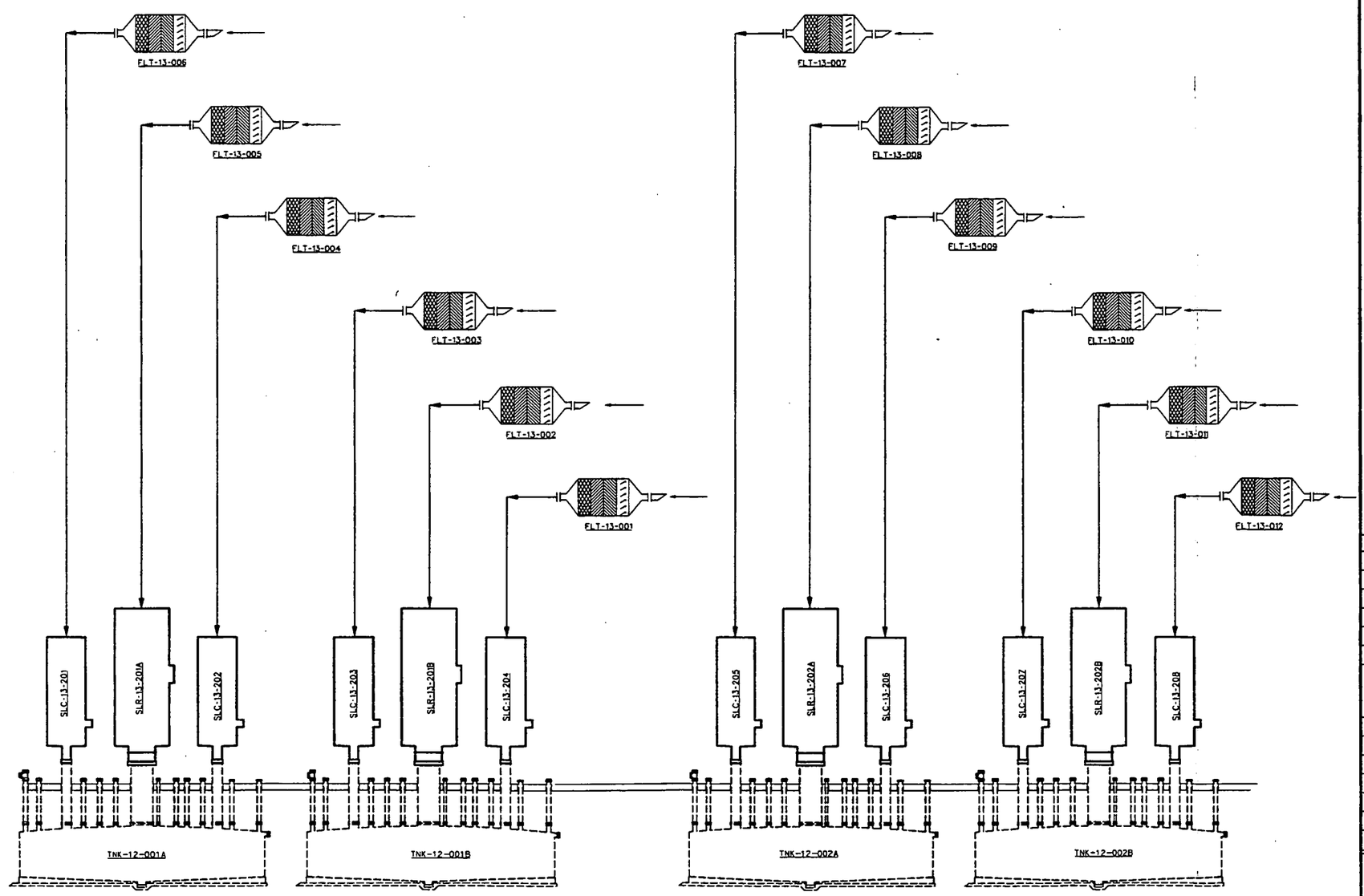


TRANSFER TANK AREA BUILDING (94C)

TNK-12-001A
TRANSFER STORAGE TANK 001A

FLT-13-001 TRANSFER STORAGE TANK 001A SLUICER MODULE 1 INTAKE FILTER HOUSING	FLT-13-002 TRANSFER STORAGE TANK 001A SLURRY/DECANT MODULE INTAKE FILTER HOUSING	FLT-13-003 TRANSFER STORAGE TANK 001A SLUICER MODULE 2 INTAKE FILTER HOUSING
SLC-13-201 TRANSFER STORAGE TANK 001A SLUICER MODULE 1	SLR-13-201A TRANSFER STORAGE TANK 001A SLURRY/DECANT MODULE	SLC-13-202 TRANSFER STORAGE TANK 001A SLUICER MODULE 2

TNK-12-001B
TRANSFER STORAGE TANK 001B

FLT-13-004 TRANSFER STORAGE TANK 001B SLUICER MODULE 1 INTAKE FILTER HOUSING	FLT-13-005 TRANSFER STORAGE TANK 001B SLURRY/DECANT MODULE INTAKE FILTER HOUSING	FLT-13-006 TRANSFER STORAGE TANK 001B SLUICER MODULE 2 INTAKE FILTER HOUSING
SLC-13-203 TRANSFER STORAGE TANK 001B SLUICER MODULE 1	SLR-13-201B TRANSFER STORAGE TANK 001B SLURRY/DECANT MODULE	SLC-13-204 TRANSFER STORAGE TANK 001B SLUICER MODULE 2

TNK-12-002A
TRANSFER STORAGE TANK 002A

FLT-13-007 TRANSFER STORAGE TANK 002A SLUICER MODULE 1 INTAKE FILTER HOUSING	FLT-13-008 TRANSFER STORAGE TANK 002A SLURRY/DECANT MODULE INTAKE FILTER HOUSING	FLT-13-009 TRANSFER STORAGE TANK 002A SLUICER MODULE 2 INTAKE FILTER HOUSING
SLC-13-205 TRANSFER STORAGE TANK 002A SLUICER MODULE 1	SLR-13-202A TRANSFER STORAGE TANK 002A SLURRY/DECANT MODULE	SLC-13-206 TRANSFER STORAGE TANK 002A SLUICER MODULE 2

TNK-12-002B
TRANSFER STORAGE TANK 002B

FLT-13-010 TRANSFER STORAGE TANK 002B SLUICER MODULE 1 INTAKE FILTER HOUSING	FLT-13-011 TRANSFER STORAGE TANK 002B SLURRY/DECANT MODULE INTAKE FILTER HOUSING	FLT-13-012 TRANSFER STORAGE TANK 002B SLUICER MODULE 2 INTAKE FILTER HOUSING
SLC-13-207 TRANSFER STORAGE TANK 002B SLUICER MODULE 1	SLR-13-202B TRANSFER STORAGE TANK 002B SLURRY/DECANT MODULE	SLC-13-208 TRANSFER STORAGE TANK 002B SLUICER MODULE 2

000295

NOTES:

-4448

REF DWG NO.	DRAWING TITLE
F9500	FLOW DIAGRAMS PROCESS FLOW DIAGRAM MATERIAL BALANCE TABLE
N6000	INSTRUMENTATION, PIPING AND INSTRUMENTATION DIAGRAM: PIPING, VALVES AND MISCELLANOUS SHEET 1 OF 3
N6002	INSTRUMENTATION, PIPING AND INSTRUMENTATION DIAGRAM: EQUIPMENT AND MISCELLANOUS SHEET 3 OF 3

REV. NO.	ISSUE OR REVISION PURPOSE - DESCRIPTION	DATE	REV. BY	APPR.
0	ISSUED TO CONSTRUCTION	05/29/02	[signature]	[signature]

INITIALS AND DATE

UNITED STATES DEPARTMENT OF ENERGY
FERNALD ENVIRONMENTAL MANAGEMENT PROJECT

THIS DRAWING PREPARED BY

JACOBS

PROJECT NAME
AWR BOP OPTIMIZATION

DRAWING TITLE
FLOW DIAGRAMS
PROCESS FLOW DIAGRAM
RCS FOR TRANSFER STORAGE TANK MODULES (PHASE 2)

DRAWN BY	DATE	TECHNICAL LEAD	DATE	CHECKED BY	DATE
[signature]	05/29/02	[signature]	5/29/02	[signature]	5/29/02

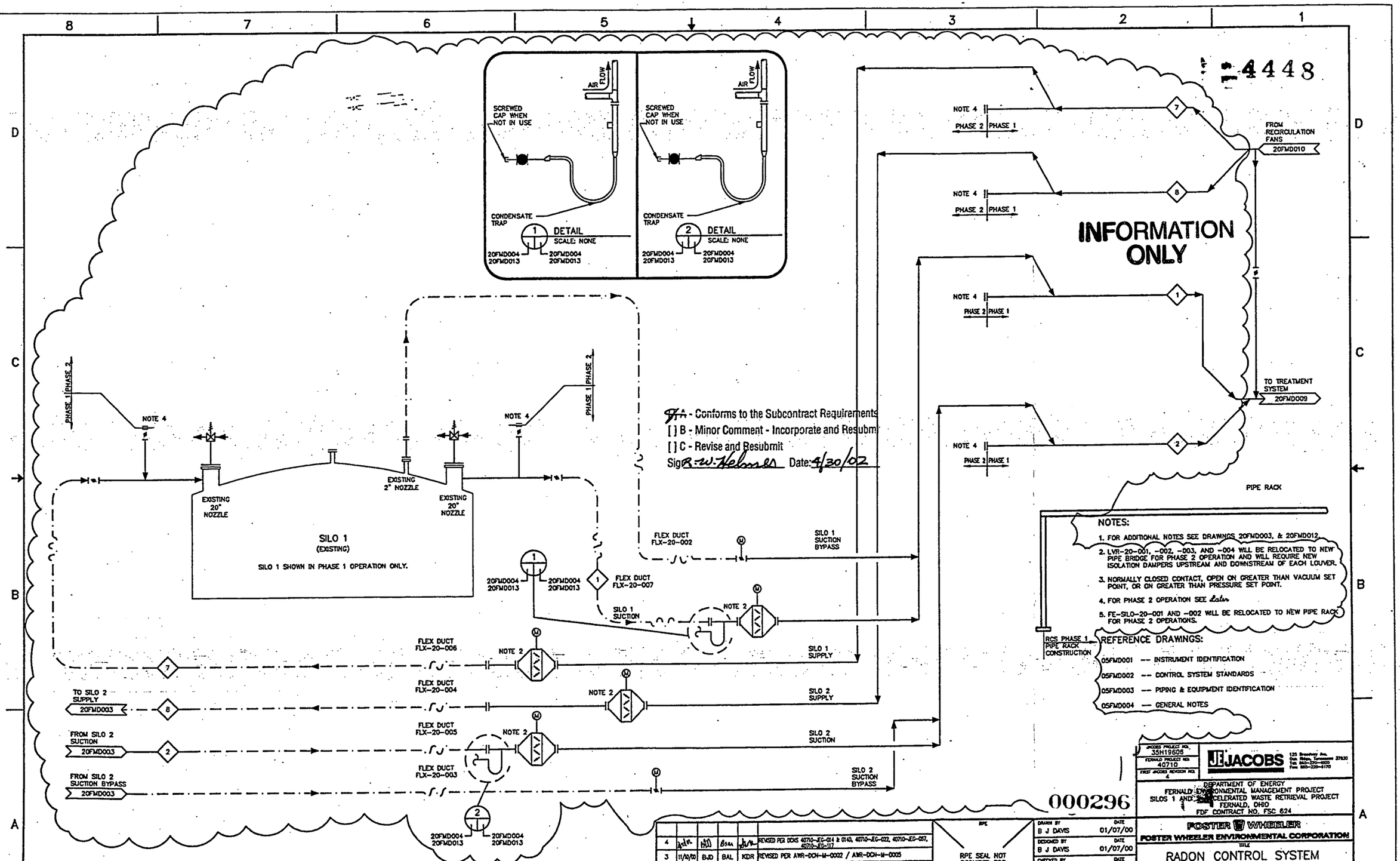
PLANT/BLDG. NO.	FLOOR	SCALE	CLASS
		NONE	U

SUBMITTED FOR 30% ISSUE	SUBMITTED FOR 60% ISSUE	SUBMITTED FOR 90% ISSUE
TECH LEAD	TECH LEAD	TECH LEAD
DATE	DATE	DATE

T.O. NUMBER	PROJECT NO.	DRAWING INDEX CODE NO.	SHEET NO.	REV. NO.
N/A	40710	94X-3900-F-01498	F9504	0

JEC PROJECT NO.	FILENAME
35H19606	94XF1498.DGN

DATE: 05/29/02 TIME: 01:38:28 PM USER: rw\ DESIGN FILE: h:\proc\PFD'S\94xf1498.dgn



A - Conforms to the Subcontract Requirements
[ ] B - Minor Comment - Incorporate and Resubmit
[ ] C - Revise and Resubmit
Sig R.W. Helmes Date: 4/30/02

NOTES:

1. FOR ADDITIONAL NOTES SEE DRAWINGS 20FMD003, & 20FMD012.
2. LVR-20-001, -002, -003, AND -004 WILL BE RELOCATED TO NEW PIPE BRIDGE FOR PHASE 2 OPERATION AND WILL REQUIRE NEW ISOLATION DAMPERS UPSTREAM AND DOWNSTREAM OF EACH LOUVER.
3. NORMALLY CLOSED CONTACT, OPEN ON GREATER THAN VACUUM SET POINT, OR ON GREATER THAN PRESSURE SET POINT.
4. FOR PHASE 2 OPERATION SEE Later
5. FE-SILO-20-001 AND -002 WILL BE RELOCATED TO NEW PIPE RACK FOR PHASE 2 OPERATIONS.

REFERENCE DRAWINGS:

05FMD001 -- INSTRUMENT IDENTIFICATION
05FMD002 -- CONTROL SYSTEM STANDARDS
05FMD003 -- PIPING & EQUIPMENT IDENTIFICATION
05FMD004 -- GENERAL NOTES

000296

REV	DATE	BY	CHK'D	APR'VD	DESCRIPTION/ISSUE
4	[illegible]	[illegible]	[illegible]	[illegible]	REVISED PER DCNS 40710-JEG-014 & 0140, 40710-JEG-022, 40710-JEG-057, 40710-JEG-117
3	11/10/00	BJD	BAL	KDR	REVISED PER AWR-DCN-M-0002 / AWR-DCN-M-0005
2	05/15/00	BJD	GCH	KDR	REVISED PER CHANGE PROPOSAL CP-00-001
1	01/07/00	BJD	SWH	KDR	CERTIFIED FOR CONSTRUCTION
0	01/01/99	BJD	KR		PRELIMINARY DESIGN SUBMITTAL

RPE SEAL NOT REQUIRED FOR JACOBS GENERATED REVISIONS

		DATE
DRAWN BY	B J DAVIS	01/07/00
DESIGNED BY	B J DAVIS	01/07/00
CHECKED BY	S W HUNGATE	01/07/00
APPROVED BY	KENNETH RICKETT	01/07/00
APPROVED BY	JOHN LAWSON	01/07/00

JACOBS PROJECT NO. 35H19606
FERNALD PROJECT NO. 40710
FIRST JACOBS REVISION NO. 4

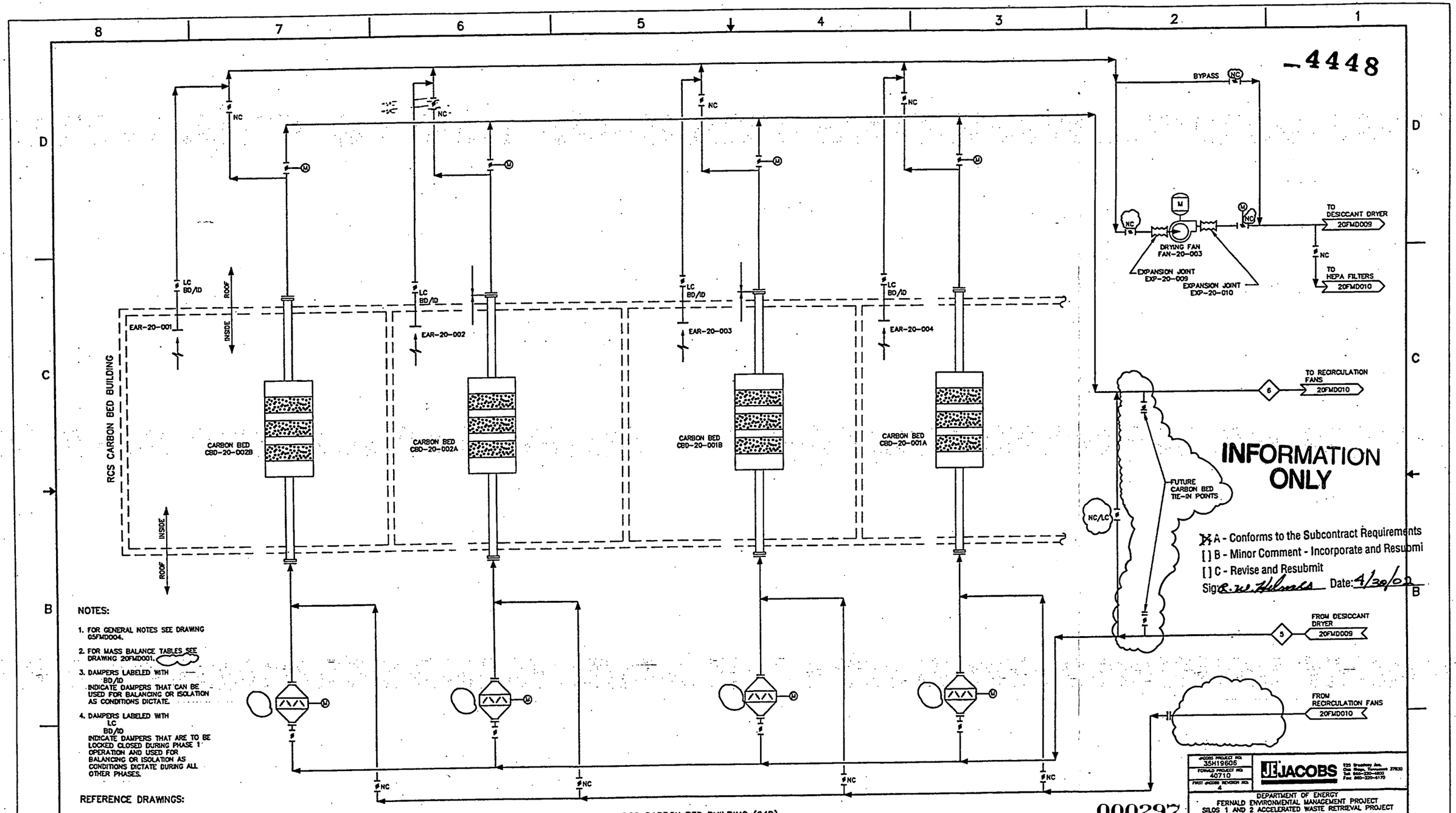
JACOBS
125 Broadway Ave. Oak Ridge, Tennessee 37830 Tel: 865-220-6000 Fax: 865-220-6170

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
RADON CONTROL SYSTEM
PROCESS FLOW DIAGRAM
SILO 1

SIZE D | SCALE: NONE | DWG. NO. 20FMD004 | REV 4



INFORMATION ONLY

[X] A - Conforms to the Subcontract Requirements
[ ] B - Minor Comment - Incorporate and Resubmi
[ ] C - Revise and Resubmit
Sig: R. W. Helmes Date: 4/30/02

NOTES:

1. FOR GENERAL NOTES SEE DRAWING 05FMD004.
2. FOR MASS BALANCE TABLES SEE DRAWING 20FMD001.
3. DAMPERS LABELED WITH BD/ID INDICATE DAMPERS THAT CAN BE USED FOR BALANCING OR ISOLATION AS CONDITIONS DICTATE.
4. DAMPERS LABELED WITH LC BD/ID INDICATE DAMPERS THAT ARE TO BE LOCKED CLOSED DURING PHASE 1 OPERATION AND USED FOR BALANCING OR ISOLATION AS CONDITIONS DICTATE DURING ALL OTHER PHASES.

REFERENCE DRAWINGS:

05FMD001 -- INSTRUMENT IDENTIFICATION
05FMD002 -- CONTROL SYSTEM STANDARDS
05FMD003 -- PIPING & EQUIPMENT IDENTIFICATION
05FMD004 -- GENERAL NOTES

000297

REV	DATE	BY	CHK'D	APR'VD	DESCRIPTION/ISSUE
4	[illegible]	[illegible]	[illegible]	[illegible]	REVISED PER DCNS 40710-JEG-021, 40710-JEG-067, 40710-JEG-115 40710-JEG-117
3	11/10/00	BJD	BAL	KDR	REVISED PER AWR-DCN-M-0002 / AWR-DCN-M-0005
2	05/15/00	BJD	GCH	KDR	REVISED PER CHANGE PROPOSAL CP-00-001
1	01/07/00	BJD	SWH	KDR	CERTIFIED FOR CONSTRUCTION
0	11/01/99	BJD	KR		PRELIMINARY DESIGN SUBMITTAL

RPE SEAL NOT REQUIRED FOR JACOBS GENERATED REVISIONS

		DATE
DRAWN BY	B J DAVIS	01/07/00
DESIGNED BY	B J DAVIS	01/07/00
CHECKED BY	S W HUNGATE	01/07/00
APPROVED BY	KENNETH RICKETT	01/07/00
APPROVED BY	JOHN LAWSON	01/07/00

JACOBS PROJECT NO. 35H19606
FERNALD PROJECT NO. 40710
FIRST JACOBS REVISION NO. 4

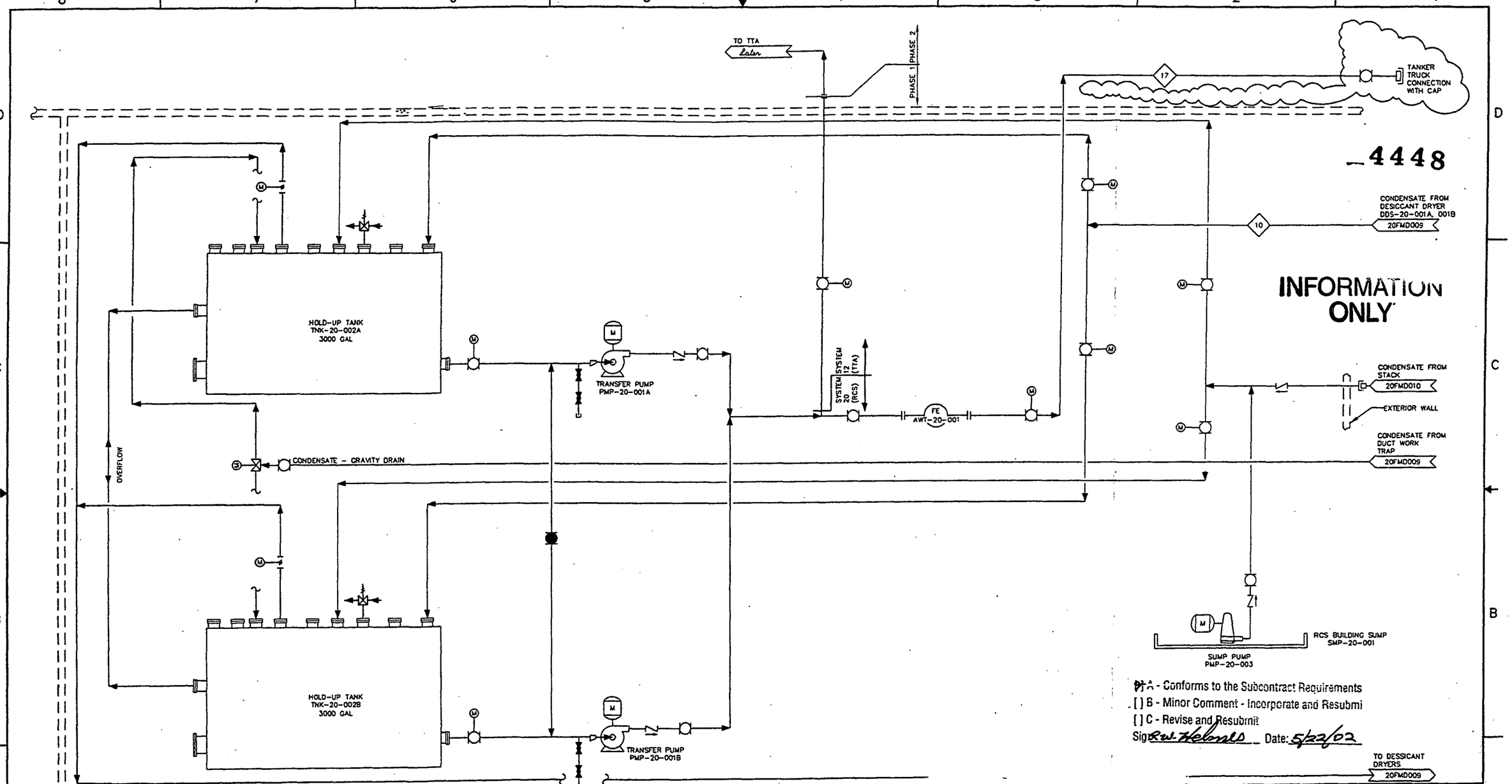
JACOBS
125 Broadway Ave. Oak Ridge, Tennessee 37830 Tel 865-220-4800 Fax 865-220-4170

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 D | SCALE: NONE | DWG. NO. 20FMD007 | REV 4



[X] A - Conforms to the Subcontract Requirements
[ ] B - Minor Comment - Incorporate and Resubmi
[ ] C - Revise and Resubmit
Sig: R.W. Helmes Date: 5/22/02

RCS AIR HANDLING BUILDING (94E)

NOTES:

1. FOR GENERAL NOTES SEE DRAWING 05FMD004.
2. FOR MASS BALANCE TABLES SEE DRAWING 20FMD001.
3. DESICCANT DRYING SYSTEM INCLUDES PRECOOLING COIL, DESICCANT WHEEL, POST-COOLING COIL, CLOSED LOOP REACTIVATION SYSTEM, CONDENSATE COLLECTION TRANSFER SYSTEM, AND INSTRUMENTATION.
4. ALL FLANGE CONNECTIONS FOR CONDENSATE LINES WILL BE COVERED WITH FLANGE SHIELDS. SEE SPECIFICATIONS 15105 & 15120.

REFERENCE DRAWINGS:

05FMD001 -- INSTRUMENT IDENTIFICATION
05FMD002 -- CONTROL SYSTEM STANDARDS
05FMD003 -- PIPING & EQUIPMENT IDENTIFICATION
05FMD004 -- GENERAL NOTES

000298

REV	DATE	BY	CHK'D	APR'VD	DESCRIPTION/ISSUE
5	5/14/02	[illegible]	BSM	SWH	REVISED PER 40710-JEG-147
4	04/25/02	BJD	BSM	SWH	REVISED PER DCNS AWR-DCN-M-0012, 40710-JEG-024, 40710-JEG-093, 40710-JEG-115, 40710-JEG-117
3	11/10/00	BJD	BAL	KDR	REVISED PER AWR-DCN-M-0002 / AWR-DCN-M-0005
2	05/15/00	BJD	GCH	KDR	REVISED PER CHANGE PROPOSAL CP-00-001
1	01/07/00	BJD	SWH	KDR	CERTIFIED FOR CONSTRUCTION
0	11/01/99	BJD	KR		PRELIMINARY DESIGN SUBMITTAL

RPE

RPE SEAL NOT REQUIRED FOR JACOBS GENERATED REVISIONS

		DATE
DRAWN BY	B J DAVIS	01/07/00
DESIGNED BY	B J DAVIS	01/07/00
CHECKED BY	S W HUNGATE	01/07/00
APPROVED BY	KENNETH RICKETT	01/07/00
APPROVED BY	JOHN LAWSON	01/07/00

JACOBS PROJECT NO: 35H19606
FERNALD PROJECT NO: 40710
RST JACOBS REVISION NO: 4

JACOBS
125 Broadway Ave. Oak Ridge, Tennessee 37830 Tel: 865-220-4800 Fax: 865-220-6170

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

FOSTER WHEELER
FOSTER WHEELER ENVIRONMENTAL CORPORATION

TITLE
RADON CONTROL SYSTEM
PROCESS FLOW DIAGRAM
HOLD-UP TANKS & CONDENSATE

SIZE: D | SCALE: NONE | DWG. NO. 20FMD008 | REV 5

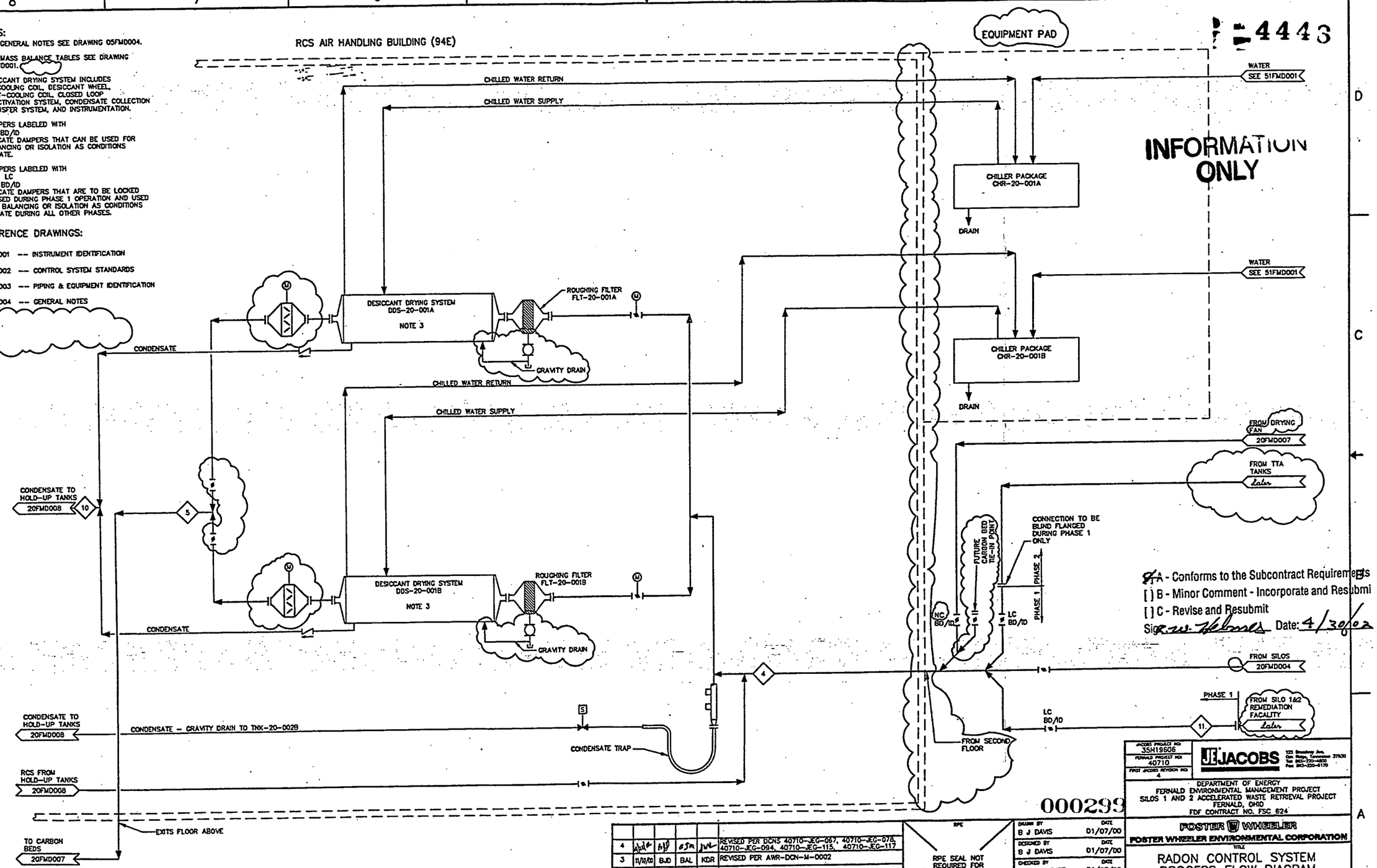
FILENAME: 20FMD008.DWG

NOTES:

1. FOR GENERAL NOTES SEE DRAWING 05FMD004.
2. FOR MASS BALANCE TABLES SEE DRAWING 20FMD001.
3. DESICCANT DRYING SYSTEM INCLUDES PRECOOLING COIL, DESICCANT WHEEL, POST-COOLING COIL, CLOSED LOOP REACTIVATION SYSTEM, CONDENSATE COLLECTION TRANSFER SYSTEM, AND INSTRUMENTATION.
4. DAMPERS LABELED WITH BD/ID INDICATE DAMPERS THAT CAN BE USED FOR BALANCING OR ISOLATION AS CONDITIONS DICTATE.
5. DAMPERS LABELED WITH LC BD/ID INDICATE DAMPERS THAT ARE TO BE LOCKED CLOSED DURING PHASE 1 OPERATION AND USED FOR BALANCING OR ISOLATION AS CONDITIONS DICTATE DURING ALL OTHER PHASES.

REFERENCE DRAWINGS:

05FMD001 -- INSTRUMENT IDENTIFICATION
05FMD002 -- CONTROL SYSTEM STANDARDS
05FMD003 -- PIPING & EQUIPMENT IDENTIFICATION
05FMD004 -- GENERAL NOTES



INFORMATION ONLY

4443

A - Conforms to the Subcontract Requirements
[ ] B - Minor Comment - Incorporate and Resubmi
[ ] C - Revise and Resubmit
Sig R.W. Helmes Date: 4/30/02

000299

REV	DATE	BY	CHK'D	APR'VD	DESCRIPTION/ISSUE
4	[illegible]	[illegible]	[illegible]	[illegible]	REVISED PER DCNS 40710-JEG-067, 40710-JEG-078, 40710-JEG-094, 40710-JEG-115, 40710-JEG-117
3	11/10/00	BJD	BAL	KDR	REVISED PER AWR-DCN-M-0002
2	05/15/00	BJD	GCH	KDR	REVISED PER CHANGE PROPOSAL CP-00-001
1	01/07/00	BJD	SWH	KDR	CERTIFIED FOR CONSTRUCTION
0	01/01/99	BJD	KR		PRELIMINARY DESIGN SUBMITTAL

RPE SEAL NOT REQUIRED FOR JACOBS GENERATED REVISIONS

DRAWN BY	B J DAVIS	DATE 01/07/00
DESIGNED BY	B J DAVIS	DATE 01/07/00
CHECKED BY	S W HUNGATE	DATE 01/07/00
APPROVED BY	KENNETH RICKETT	DATE 01/07/00
APPROVED BY	JOHN LAWSON	DATE 01/07/00

JACOBS PROJECT NO. 35H19606
FERNALD PROJECT NO. 40710
FIRST JACOBS REVISION NO. 4

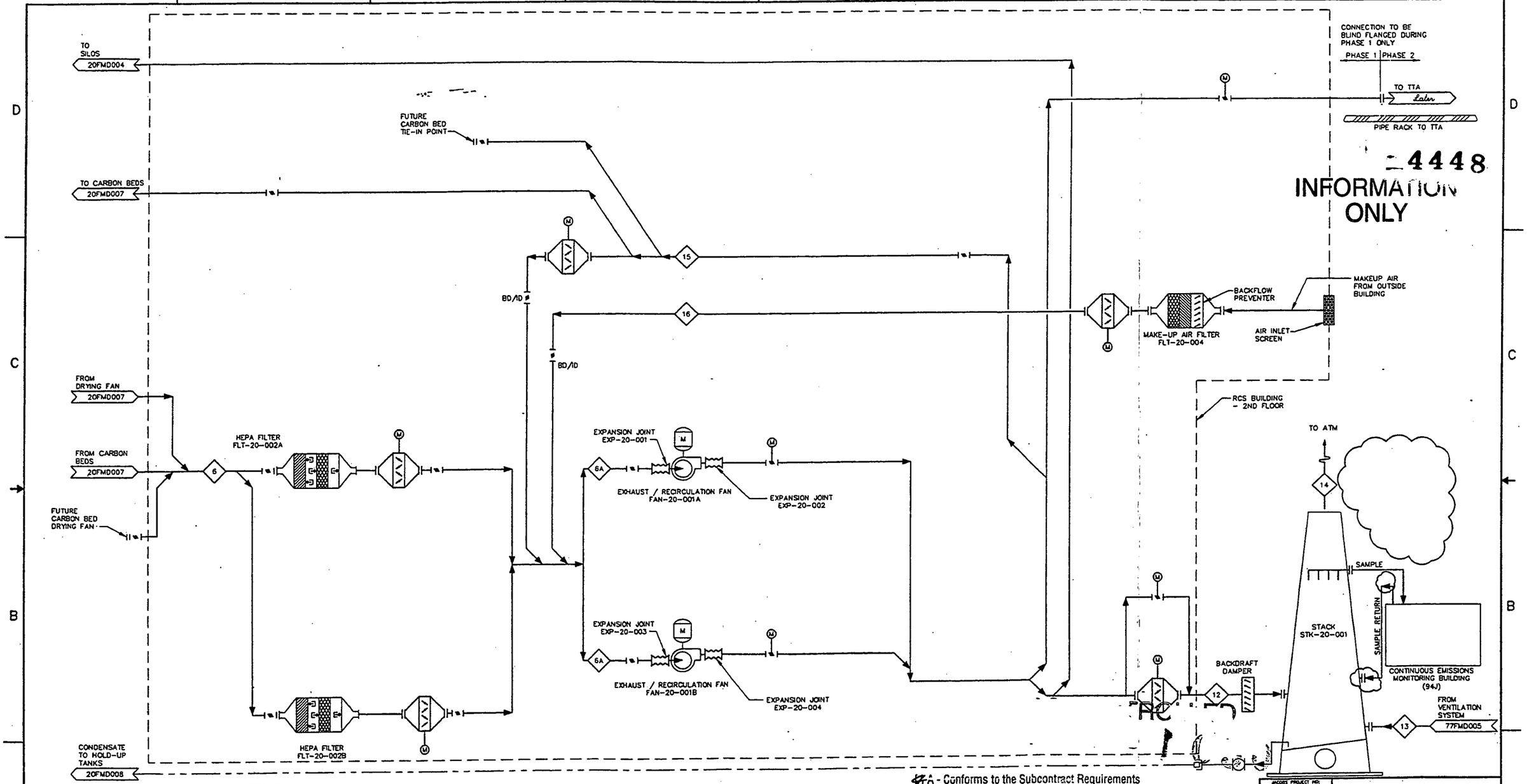
JACOBS
125 Broadway Ave. Oak Ridge, Tennessee 37830 Tel: 865-220-4800 Fax: 865-220-6170

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

FOSTER WHEELER
FOSTER WHEELER ENVIRONMENTAL CORPORATION

TITLE
RADON CONTROL SYSTEM
PROCESS FLOW DIAGRAM
DRYERS & AIR HANDLING

SIZE D | SCALE: NONE | DWG. NO. 20FMD009 | REV 4



REMOVAL OF CONDENSATE FROM STACK WILL BE PERFORMED BY USING A PORTABLE PUMP AND TEMPORARY HOSE BY OPERATIONS IF REQUIRED.

RCS AIR HANDLING BUILDING (94E) – 2ND FLOOR

[X] A - Conforms to the Subcontract Requirements
[ ] B - Minor Comment - Incorporate and Resubmi
[ ] C - Revise and Resubmit
Sig: R.W. Helmes Date: 5/22/02

NOTES:

1. FOR GENERAL NOTES SEE DRAWING 05FMD004.
2. FOR MASS BALANCE TABLES SEE DRAWING 20FMD001.
3. DAMPERS LABELED WITH BD/ID INDICATE DAMPERS THAT CAN BE USED FOR BALANCING OR ISOLATION AS CONDITIONS DICTATE.
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REFERENCE DRAWINGS:

05FMD001 -- INSTRUMENT IDENTIFICATION
05FMD002 -- CONTROL SYSTEM STANDARDS
05FMD003 -- PIPING & EQUIPMENT IDENTIFICATION
05FMD004 -- GENERAL NOTES

REV	DATE	BY	CHK'D	APPR'D	DESCRIPTION/ISSUE
5	5/22/02	BJD	BAS	SWH	REVISED PER DCN 40710-JEG-136
4	04/25/02	BJD	BAS	SWH	REVISED PER DCNS 40710-JEG-067, 40710-JEG-105 40710-JEG-115, 40710-JEG-117
3	11/19/00	BJD	BAL	KDR	REVISED PER AWR-DCN-M-0005
2	05/15/00	BJD	GCH	KDR	REVISED PER CHANGE PROPOSAL CP-00-001
1	03/07/00	BJD	SWH	KDR	CERTIFIED FOR CONSTRUCTION
0	11/01/99	BJD	KR		PRELIMINARY DESIGN SUBMITTAL

RPE

RPE SEAL NOT REQUIRED FOR JACOBS GENERATED REVISIONS

		DATE
DRAWN BY	B J DAVIS	01/07/00
DESIGNED BY	B J DAVIS	01/07/00
CHECKED BY	S W HUNGATE	01/07/00
APPROVED BY	KENNETH RICKETT	01/07/00
APPROVED BY	JOHN LAWSON	01/07/00

000300

JACOBS PROJECT NO. 35H19606
FERNALD PROJECT NO. 40710
FIRST JACOBS REVISION NO. 4

JACOBS 125 Broadway Ave. Oak Ridge, Tennessee 37830 Tel: 865-220-4600 Fax: 865-220-9170

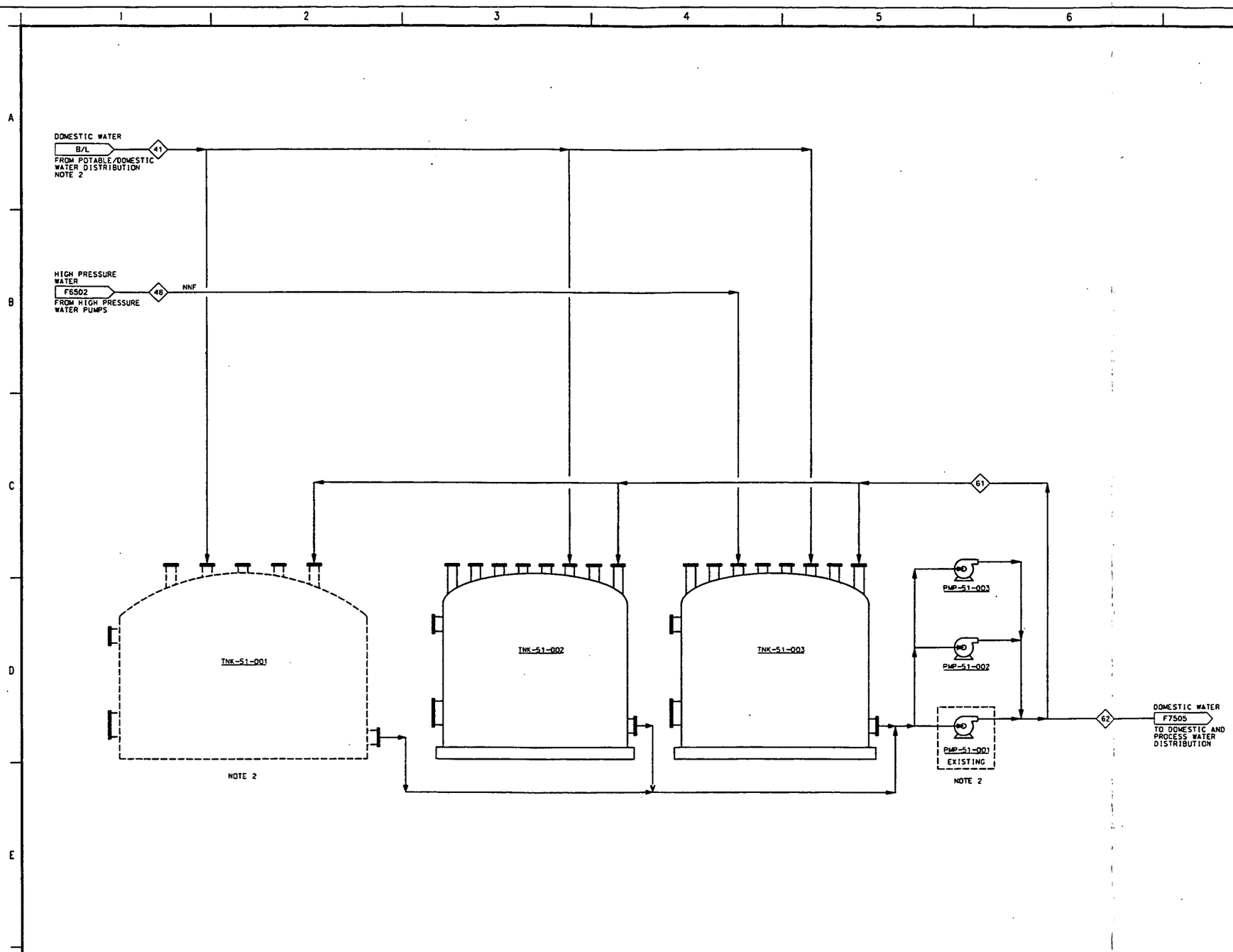
DEPARTMENT OF ENERGY
FERNALD ENVIRONMENTAL MANAGEMENT PROJECT
SILOS 1 AND 2 ACCELERATED WASTE RETRIEVAL PROJECT
FERNALD, OHIO
FDF CONTRACT NO. FSC 624

FOSTER WHEELER
FOSTER WHEELER ENVIRONMENTAL CORPORATION

TITLE
RADON CONTROL SYSTEM
PROCESS FLOW DIAGRAM
EXHAUST & RECIRC FANS

SIZE: D | SCALE: NONE | DWG. NO. 20FMD010 | REV 5

4448



NOTES:

1. MAKE-UP WATER TANKS 2 AND 3 PREVIOUSLY IDENTIFIED AS TNK-12-003 AND TNK-12-004, RESPECTIVELY.
2. REFER TO DRAWING 51FMD003.

4448

REF DWG NO.	DRAWING TITLE
F6003	FLOW DIAGRAMS PROCESS FLOW DIAGRAM MATERIAL BALANCE TABLE
N6000	INSTRUMENTATION, PIPING AND INSTRUMENTATION DIAGRAM: PIPING, VALVES AND MISCELLANOUS SHEET 1 OF 3
N6002	INSTRUMENTATION, PIPING AND INSTRUMENTATION DIAGRAM: EQUIPMENT AND MISCELLANOUS SHEET 3 OF 3
51FMD003	POTABLE/DOMESTIC WATER SYSTEM, PIPING & INSTRUMENT DIAGRAM, MAKE-UP WATER, REV. 4.

REV. NO.	ISSUE OR REVISION PURPOSE - DESCRIPTION	DATE	REV. BY	APPR.
0	ISSUED TO CONSTRUCTION	05/29/02	[illegible]	[illegible]

INITIALS AND DATE

UNITED STATES
DEPARTMENT OF ENERGY
FERNALD ENVIRONMENTAL MANAGEMENT PROJECT

THIS DRAWING PREPARED BY

JACOBS

PROJECT NAME
AWR BOP OPTIMIZATION

DRAWING TITLE
FLOW DIAGRAMS
PROCESS FLOW DIAGRAM
MAKE-UP WATER TANKS

DRAWN BY	DATE	TECHNICAL LEAD	DATE	CHECKED BY	DATE
[illegible]	05/29/02	[illegible]	5/29/02	[illegible]	5/29/02

PLANT/BLDG NO.	FLOOR	SCALE	CLASS
		NONE	U

SUBMITTED FOR 30% ISSUE	SUBMITTED FOR 60% ISSUE	SUBMITTED FOR 90% ISSUE
TECH LEAD	TECH LEAD	TECH LEAD
DATE	DATE	DATE

T.O. NUMBER	PROJECT NO.	DRAWING INDEX CODE NO.	SHEET NO.	REV. NO.
N/A	40710	94X-3900-F-01492	F9700	0

JEG PROJECT NO.	FILENAME
35H19606	94XF1492.DGN

000301

DATE: 05/29/02
TIME: 01:35:29 PM
USER: fw\
DESIGN FILE: b:\proc\PFD'S\94xf1492.dgn

ABBREVIATIONS

AC	ALTERNATING CURRENT
AG	ABOVE GROUND
ASHRAE	AMERICAN SOCIETY OF HEATING, REFRIGERATING, AND AIR CONDITIONING ENGINEERS
ATM	ATMOSPHERE
B/L	BATTERY LIMIT
BTL	BOTTOM TANGENT LINE
BYP	BYPASS
CC	CHEMICAL CLEANOUT
CCTV	CLOSED CIRCUIT TELEVISION
CL	CENTERLINE
CFM	CUBIC FEET PER MINUTE
CO	CLEANOUT
CONN	CONNECTION
CSC	CAR SEAL CLOSED
CSO	CAR SEAL OPEN
CTR	CENTER
DC	DIRECT CURRENT
DCS	DISTRIBUTED CONTROL SYSTEM
DES	DESIGN
DIA	DIAMETER
DP	DESIGN PRESSURE
D/P	DIFFERENTIAL PRESSURE
DRN	DRAIN
DT	DESIGN TEMPERATURE
DWG	DRAWING
(E)	EXISTING
EA	EXHAUST AIR
EL	ELEVATION
ESD	EMERGENCY SHUTDOWN
FOF	FACE OF FLANGE
(F)	FURNISHED
FI	FAIL INDETERMINATE
FLG	FLANGE
FOB	FLAT ON BOTTOM
FOT	FLAT ON TOP
FP	FULL PORT
FRP	FIBERGLASS REINFORCED PLASTIC
FV	FULL VACUUM
GO	GEAR OPERATED
GPM	GALLONS PER MINUTE
GR	GRADE
HC	HOSE CONNECTION
HDR	HEADER
HEPA	HIGH-EFFICIENCY PARTICULATE AIR
HH	HAND HOLE
HOA	HAND/OFF/AUTOMATIC
HP	HORSEPOWER
HPT	HIGH POINT
HT	HEIGHT
HVAC	HEATING, VENTILATING, AIR CONDITIONING
HZ	HERTZ
IA	INSTRUMENT AIR
ISBL	INSIDE BATTERY LIMITS
KW	KILOWATT
LG	LEVEL GAUGE
LP	LOW PRESSURE
LPT	LOW POINT
MAX	MAXIMUM
MCC	MOTOR CONTROL CENTER
MIN	MINIMUM
MOV	MOTOR OPERATED VALVE
MTL	MATERIAL
MW	MANWAY
NNF	NORMALLY NO FLOW
NOZ	NOZZLE
O/C	OPEN/CLOSE
O/O	ON/OFF
OP	OUTPUT
OSBL	OUTSIDE BATTERY LIMITS
OVHD	OVERHEAD
PH	PHASE
PLC	PROGRAMMABLE LOGIC CONTROLLER
PLCS	PLACES
PRESS	PRESSURE
PSIG	POUNDS PER SQUARE INCH, GAUGE
PV	PROCESS VARIABLE
(R)	RELOCATED
REQD	REQUIRED
RTD	RESISTANCE TEMPERATURE DETECTOR
SA	SUPPLY AIR
SC	SAMPLE CONNECTION
SCFM	STANDARD CUBIC FEET PER MINUTE
SCH	SCHEDULE
SD	SHUTDOWN
SG	SPECIFIC GRAVITY
SIS	SAFETY INSTRUMENTED SYSTEM
SO	STEAM OUT
SP	SET POINT
SS	STAINLESS STEEL
S/S	START/STOP
STD	STANDARD
SWRS	SILO WASTE RETRIEVAL SYSTEM
TA	TRANSFER AIR
T/C	THERMOCOUPLE
TDH	TOTAL DIFFERENTIAL HEAD
TEMP	TEMPERATURE
THRD	THREADED
TL	TANGENT LINE
TSO	TIGHT SHUT-OFF
TTA	TRANSFER TANK AREA
T/T	TANGENT-TO-TANGENT
TWRS	TRANSFER STORAGE TANK WASTE RETRIVEAL SYSTEM
TYP	TYPICAL
UG	UNDERGROUND
UPS	UNINTERRUPTIBLE POWER SUPPLY
V	VOLT
VAC	VACUUM
VB	VORTEX BREAKER
VNT	VENT
W/	WITH
W/O	WITHOUT
W%	WEIGHT PERCENT

VALVE SYMBOLS

OPEN — CLOSED

- GATE
- GLOBE
- NEEDLE
- PLUG
- BALL
- PINCH
- BUTTERFLY
- ANGLE
- 3-WAY BALL OR PLUG
- 3-WAY DIVERTER
- 4-WAY
- CHECK
- MANUAL CHECK
- KNIFE
- ROTARY
- BACKFLOW PREVENTER

NORMAL POSITIONS ALL VALVES

NO-INDICATES NORMALLY OPEN
NC-INDICATES NORMALLY CLOSED

LOCKED POSITIONS ALL VALVES

LO-INDICATES LOCKED OPEN
LC-INDICATES LOCKED CLOSED

FAIL POSITIONS ALL VALVES

FO-INDICATES FAIL OPEN
FC-INDICATES FAIL CLOSED
FL-INDICATES FAIL LAST POSITION

VALVE ACTUATORS

- CYLINDER
- DIGITAL
- SOLENOID
- HANDWHEEL
- ROTARY MOTOR (SHOWN TYPICALLY WITH ELECTRIC SIGNAL)
- PRESSURE DIAPHRAGM
- DIAPHRAGM
- SPRING

PIPING FITTINGS

- FLANGE
- SCREWED CAP
- WELDED CAP
- UNION JOINT
- CONCENTRIC (OR GENERIC) REDUCER
- ECCENTRIC REDUCER
- HOSE CONNECTION (FEMALE)
- HOSE CONNECTION (MALE)
- BLIND FLANGE

PIPING LINE SYMBOLS

- PRIMARY (AG & UG)
- SECONDARY / UTILITY (AG & UG)
- JACKETED OR DOUBLE CONTAINMENT

PIPING SPECIALTY ITEMS

- Y-TYPE STRAINER
- CONE STRAINER
- DUPLEX STRAINER
- BASKET STRAINER
- EXPANSION JOINT
- FLEXIBLE CONNECTOR
- ATMOSPHERIC VENT
- FILTER
- TRAP
- PULSATION DAMPENER
- IN-LINE SILENCER
- VENT SILENCER
- REMOVABLE SPOOL (RS)
- FLEXIBLE HOSE
- BREATHER
- VENT COVER
- IN-LINE MIXER
- SIGHT GLASS
- BOOSTER AIR FITTING
- FUNNEL
- SAFETY SHOWER
- CLEANOUT AND PRESSURE TAP
- FILTER REGULATOR LUBRICATOR

LINE IDENTIFICATION

II-JJZZZZ-M-NNN-OO-TT

- TT — HEAT TRACE TYPE (USE ONLY IF REQUIRED)
- OO — INSULATION TYPE (USE ONLY IF REQUIRED)
- NNN — MATERIAL SPECIFICATION
- M — PIPE SIZE (INCHES)
- ZZZZ — LINE SEQUENCE NUMBER
- JJ — SYSTEM NUMBER
- II — LINE SERVICE (SEE BELOW)

LINE SERVICE CODES (II)

CA	--	AIR, COMPRESSED
CND	--	CONDENSATE
DW	--	DOMESTIC WATER
FLW	--	FLUSH WATER
HPW	--	HIGH PRESSURE WATER
MS	--	MISCELLANEOUS SLURRY
POLY	--	POLYMER SOLUTION
RCS	--	RADON CONTROL SYSTEM
SA	--	AIR, BREATHING
SEAL	--	SEAL WATER
SLW	--	SLUICE WATER
SUMP	--	SUMP
TW	--	PROCESS WATER
VA	--	VENTILATION AIR

MISCELLANEOUS

- POINT OF CHANGE IN LINE CLASS, INSULATION REQUIREMENT OR AREA DESIGNATION
- NEW EQUIPMENT
- EXISTING OR INSTALLED EQUIPMENT
- PACKAGED EQUIPMENT LIMITS
- PAGE CONNECTOR
- PAGE CONNECTOR
- PAGE CONNECTOR BIDIRECTIONAL FLOW

NOZZLE IDENTIFICATION

A - 10"

- 10" — NOZZLE SIZE (INCHES)
- A — NOZZLE IDENTIFIER (FROM VESSEL DATA SHEET)

VALVE IDENTIFICATION

AAA-JJ-KKKK

- KKKK — VALVE NUMBER
- JJ — SYSTEM NUMBER
- AAA — VALVE CODE

VALVE CODES (AAA)

AIR OPERATED VALVE	--	AOV
AUTOMATIC RECIRCULATION VALVE	--	ARV
BACK FLOW PREVENTER	--	BFP
CHECK VALVE	--	CKV
DOUBLE CHECK VALVE	--	DCV
DIFFUSER CHECK VALVE	--	DFV
DAMPER (BUTTERFLY)	--	DMP
DIVERTER VALVE	--	DVR
FLOAT OPERATED VALVE	--	FOV
HAND OPERATED VALVE	--	HOV
MOTOR OPERATED VALVE	--	MOV
PRESSURE CONTROL VALVE	--	PCV
PRESSURE SAFETY ELEMENT	--	PSE
PRESSURE SAFETY VALVE	--	PSV
SOLENOID OPERATED VALVE	--	SOV

INSULATION TYPE CODES (OO)

- AS -- ANTI-SWEAT
- CC -- COLD SERVICE INSULATION
- CP -- CONDENSATION CONTROL
- FP -- FIRE PROTECTION INSULATION
- HC -- HEAT CONSERVATION INSULATION
- PF -- PREVENTION FROM FREEZING INSULATION
- PP -- PERSONNEL PROTECTION INSULATION

TRACE TYPE CODES (TT)

- ET -- ELECTRIC TRACED
- CT -- CHILLED FLUID TRACED
- HJ -- HOT FLUID JACKETED
- HT -- HOT FLUID TRACED
- SJ -- STEAM JACKETED
- ST -- STEAM TRACED

SYSTEM NUMBERING

JJ (VALVE IDENTIFICATION)
YY (SEE "EQUIPMENT NUMBER IDENTIFICATION," F6002)

	FACILITIES
00	NOT USED
01	NOT USED
02	NOT USED
03	NOT USED
04	NOT USED
05	MISCELLANEOUS FACILITIES
06	NOT USED
07	NOT USED
08	NOT USED
09	NOT USED
	RETRIEVAL
10	NOT USED
11	SILO WASTE RETRIEVAL SYSTEM
12	TRANSFER TANK SYSTEM
13	TTA WASTE RETRIEVAL SYSTEM
14	NOT USED
	PROCESSING
15	NOT USED
16	NOT USED
17	NOT USED
18	NOT USED
19	NOT USED
20	RADON CONTROL SYSTEM
21	NOT USED
22	NOT USED
	PRODUCT HANDLING
23	NOT USED
24	NOT USED
25	NOT USED
26	NOT USED
27	NOT USED
28	NOT USED
29	NOT USED
	ELECTRICAL
30	HIGH VOLTAGE SYSTEM
31	480 VOLT DISTRIBUTION SYSTEM
32	STANDBY ELECTRICAL SYSTEM
33	UNINTERRUPTIBLE POWER SYSTEM
34	LIGHTING SYSTEM
35	GROUNDING SYSTEM
36	NOT USED
37	NOT USED
38	NOT USED
39	MISCELLANEOUS ELECTRICAL
	UTILITIES AND CHEMICALS
40	PLANT AND INSTRUMENT AIR SYSTEM
41	BREATHING AIR SYSTEM
42	NOT USED
43	NOT USED
44	NOT USED
45	NOT USED
46	NOT USED
47	NOT USED
48	NOT USED
49	NOT USED
	WATER SYSTEMS
50	PROCESS WATER SYSTEM
51	DOMESTIC WATER SYSTEM
52	NOT USED
53	NOT USED
54	NOT USED
55	NOT USED
56	NOT USED
57	NOT USED
58	NOT USED
59	NOT USED
	WASTE SYSTEMS
60	NOT USED
61	SANITARY SEWER SYSTEM
62	SLUICE/FLUSH WATER SYSTEM
63	NOT USED
64	NOT USED
65	NOT USED
66	STORM WATER SYSTEM
67	NOT USED
68	NOT USED
69	NOT USED
	HVAC SYSTEMS
70	NOT USED
71	NOT USED
72	NOT USED
73	NOT USED
74	NOT USED
75	NOT USED
76	NOT USED
77	MISCELLANEOUS FACILITIES HVAC SYSTEM
78	NOT USED
79	NOT USED
	MECHANICAL AND ANALYTICAL SYSTEMS
80	NOT USED
81	NOT USED
82	NOT USED
83	NOT USED
84	NOT USED
85	NOT USED
86	NOT USED
87	NOT USED
88	NOT USED
89	NOT USED
	INFORMATION AND CONTROL SYSTEMS
90	DISTRIBUTED CONTROL SYSTEM
91	NOT USED
92	FIRE DETECTION AND ALARM SYSTEM
93	HEALTH PROTECTION SYSTEM
94	NOT USED
95	NOT USED
96	NOT USED
97	NOT USED
98	NOT USED
99	NOT USED

000302

NOTES:

1. ABBREVIATIONS AND SYMBOLS PRESENTED ON SHEETS N6000, N6001 AND N6002 WILL BE USED FOR BOTH PROCESS FLOW DIAGRAMS AND PIPING AND INSTRUMENTATION DIAGRAMS.

4448

REF DWG NO.	DRAWING TITLE

REV. NO.	ISSUE OR REVISION PURPOSE - DESCRIPTION	DATE	REV. BY	INITIALS AND DATE
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UNITED STATES DEPARTMENT OF ENERGY
FERNALD ENVIRONMENTAL MANAGEMENT PROJEC

THIS DRAWING PREPARED BY
JE JACOBS

PROJECT NAME: AWR BOP OPTIMIZATION

DRAWING TITLE: INSTRUMENTATION
PIPING AND INSTRUMENTATION DIAGRAM
PIPING, VALVES, AND MISCELLANEOUS SHEET 1 OF 3

DRAWN BY — DATE 05/29/02 — TECHNICAL LEAD — DATE 5/29/02 — CHECKED BY — DATE
PLANT/BLDG. NO. — FLOOR — SCALE NONE — CLASS U
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T.O. NUMBER N/A — PROJECT NO. 40710 — DRAWING INDEX CODE NO. 94X-3900-N-01504 — SHEET NO. N6000
JEG PROJECT NO. 35H19606 — FILENAME 94XN1504.DGN

DATE: 05/29/02 TIME: 04:25:40 PM — USER: — DESIGN FILE:

INSTRUMENT FUNCTION SYMBOLS

A	ANALOG	I	CURRENT
B	BINARY	O	ELECTROMAGNETIC, SONIC
D	DIGITAL	P	PNEUMATIC
E	VOLTAGE	R	RESISTANCE (ELECTRICAL)
H	HYDRAULIC		

INSTRUMENT LINE SYMBOLS

——	LINE SUPPLY
—AS—	LINE SUPPLY, AIR
—IA—	LINE SUPPLY AIR, INSTR.
—PA—	LINE SUPPLY AIR, PLANT
—ES—	LINE SUPPLY, ELECTRIC
—GS—	LINE SUPPLY, GAS
—HS—	LINE SUPPLY, HYDRAULIC
—NS—	LINE SUPPLY, NITROGEN
—SS—	LINE SUPPLY, STEAM
—WS—	LINE SUPPLY, WATER
	LINE UNDEFINED SIGNAL
	LINE PNEUMATIC SIGNAL
-----	LINE ELECTRICAL SIGNAL A
	LINE ELECTRICAL SIGNAL B
	LINE HYDRAULIC SIGNAL
	LINE CAPILLARY TUBE
	LINE EM SONIC SIGNAL G
~	LINE EM SONIC SIGNAL NG
	LINE INTERNAL SYSTEM LINK
	LINE MECHANICAL LINK
	LINE PNEUMATIC BINARY
	LINE ELECTRIC BINARY A
	LINE ELECTRIC BINARY B

PRIMARY ELEMENT SYMBOLS (FLOW)

- VIBRATION CONTROL TRANSMITTER ORIFICE
- QUANTITY CONTROL FLOW ORIFICE
- PITOT
- VENTURI
- ANALYSIS VALVE PITOT TUBE
- FLUME
- WEIR
- FI — ROTAMETER
- TURBINE
- POSITIVE DISPLACEMENT
- VORTEX
- TARGET
- NOZZLE
- M — MAGNET
- SONIC
- XX — GENERAL SYMBOL IN-LINE ELEMENT XX = FS, FG, FE, FT
- XXXX — XXXX = MASS, CORIOLIS, THERMAL, ORIFICE IN-LINE FLOW ELEMENT WITH INTEGRAL TRANSMITTER
- XXXX — XXXX = MASS, CORIOLIS, THERMAL... IN-LINE FLOW ELEMENT WITH SEPARATE TRANSMITTER

SELF ACTUATED DEVICES

- PRESSURE REDUCING REGULATOR W/ EXTERNAL TAP
- DIFFERENTIAL PRESSURE REDUCING REGULATOR
- BACK PRESSURE REGULATOR (SELF-CONTAINED)
- BACK PRESSURE REGULATOR W/ EXTERNAL TAP
- PRESSURE RELIEF OR SAFETY VALVE
- VACUUM RELIEF VALVE
- PRESSURE AND VACUUM RELIEF VALVE OR CONSERVATION VENT
- S — PILOT OPERATED RELIEF VALVE
- SAFETY HEAD FOR (EXPLOSION PANEL) PRESSURE RELIEF OR RUPTURE DISC
- SAFETY HEAD FOR VACUUM RELIEF (EXPLOSION PANEL) RUPTURE DISC

MISCELLANEOUS SYMBOLS

- CHEMICAL SEAL/DIAPHRAGM
- UNDEFINED INTERLOCK LOGIC
- DUAL FUNCTION OR INSTRUMENTS SHARING COMMON HOUSING
- PILOT LIGHT OR GAUGE GLASS ILLUMINATOR
- INSTRUMENT WITH LONG TAG NUMBER
- AUDIBLE ALARM
- REMOTE ALARM JACK

GENERAL INSTRUMENT SYMBOLS

LOCATION/ACCESSIBILITY	DISCRETE INSTRUMENTS	SHARED DISPLAY AND CONTROL (DCS)	PLC	DISCRETE HARDWARE INTERLOCK
FIELD MOUNTED 1. FIELD OR LOCALLY MOUNTED. 2. ACCESSIBLE TO AN OPERATOR AT DEVICE	○	□	◇	◇
PRIMARY LOCATION NORMALLY ACCESSIBLE TO AN OPERATOR 1. CENTRAL OR MAIN CONTROL ROOM. 2. FRONT OF MAIN PANEL OR CONSOLE MOUNTED 3. VISIBLE ON VIDEO DISPLAY. 4. ACCESSIBLE TO AN OPERATOR AT DEVICE OR CONSOLE.	⊖	⊟	⊠	
PRIMARY LOCATION NORMALLY INACCESSIBLE TO AN OPERATOR 1. CENTRAL OR MAIN CONTROL ROOM. 2. REAR OF PANEL OR CABINET MOUNTED. 3. NOT VISIBLE ON VIDEO DISPLAY. 4. NOT NORMALLY ACCESSIBLE TO AN OPERATOR AT DEVICE OR CONSOLE.	⊖	⊟	⊠	
AUXILIARY LOCATION NORMALLY ACCESSIBLE TO AN OPERATOR 1. SECONDARY OR LOCAL CONTROL ROOM. 2. FIELD OR LOCAL CONTROL PANEL. 3. FRONT OF SECONDARY OR LOCAL PANEL MOUNTED. 4. VISIBLE ON VIDEO DISPLAY. 5. ACCESSIBLE TO AN OPERATOR AT DEVICE OR CONSOLE.	⊖	⊟	⊠	
AUXILIARY LOCATION NORMALLY INACCESSIBLE TO AN OPERATOR 1. SECONDARY OR LOCAL CONTROL ROOM. 2. FIELD OR LOCAL CONTROL PANEL. 3. REAR OF SECONDARY OR LOCAL PANEL OR CABINET MOUNTED. 4. NOT VISIBLE ON VIDEO DISPLAY. 5. NOT NORMALLY ACCESSIBLE TO AN OPERATOR AT DEVICE OR CONSOLE.	⊖	⊟	⊠	

INSTRUMENT IDENTIFICATION LETTERS

	FIRST LETTER		SUCCEEDING LETTERS		
	MEASURED OR INITIATING VARIABLE	MODIFIER	READOUT OR PASSIVE FUNCTION	OUTPUT FUNCTION	MODIFIER
A	ANALYSIS		ALARM		
B	USER'S CHOICE		USER'S CHOICE	USER'S CHOICE	USER'S CHOICE
C	USER'S CHOICE (TYPICALLY CONDUCTIVITY - ELECTRICAL)		CONTROL		CLOSED
D	USER'S CHOICE (TYPICALLY DENSITY OR SPECIFIC GRAVITY)	DIFFERENTIAL			DIVERT
E	VOLTAGE		SENSOR (PRIMARY ELEMENT)		
F	FLOW RATE	RATIO (FRACTION)			
G	USER'S CHOICE OR GAUGING (DIMENSIONAL)		GLASS, VIEWING DEVICE		
H	HAND				HIGH
I	CURRENT (ELECTRICAL)		INDICATE		
J	POWER	SCAN			
K	TIME, TIME SCHEDULE	TIME RATE OF CHANGE		CONTROL STATION	
L	LEVEL		LIGHT		LOW
M	USER'S CHOICE (TYPICALLY MOISTURE OR HUMIDITY)	MOMENTARY			MIDDLE, INTERMEDIATE
N	CAMERA		USERS CHOICE	USERS CHOICE	USERS CHOICE
O	USER'S CHOICE		ORIFICE, RESTRICTION		OPEN
P	PRESSURE, VACUUM		POINT (TEST) CONNECTION		
Q	QUANTITY OR HEAT DUTY	INTEGRATE, TOTALIZE			
R	RADIATION		RECORD		
S	SPEED, FREQUENCY	SAFETY		SWITCH	
T	TEMPERATURE			TRANSMIT	THROUGH
U	MULTIVARIABLE		MULTIFUNCTION	MULTIFUNCTION	MULTIFUNCTION
V	VIBRATION, MECHANICAL ANALYSIS			VALVE, DAMPER, LOUVER	
W	WEIGHT, FORCE		WELL		
X	UNCLASSIFIED	X AXIS	UNCLASSIFIED	UNCLASSIFIED	UNCLASSIFIED
Y	EVENT, STATE OR PRESENCE	Y AXIS		RELAY, COMPUTE, CONVERT	
Z	POSITION, DIMENSION	Z AXIS		DRIVER, ACTUATOR, UNCLASSIFIED FINAL CONTROL ELEMENT	

NOTES:

1. ABBREVIATIONS AND SYMBOLS PRESENTED ON SHEETS N6000, N6001 AND N6002 WILL BE USED FOR BOTH PROCESS FLOW DIAGRAMS AND PIPING AND INSTRUMENTATION DIAGRAMS.

4448

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UNITED STATES DEPARTMENT OF ENERGY
FERNALD ENVIRONMENTAL MANAGEMENT PROJEC

THIS DRAWING PREPARED BY
JE JACOBS

PROJECT NAME
AWR BOP OPTIMIZATION

DRAWING TITLE
INSTRUMENTATION
PIPING AND INSTRUMENTATION DIAGRAM
INSTRUMENTATION, SHEET 2 OF 3

DRAWN BY	DATE	TECHNICAL LEAD	DATE	CHECKED BY	DATE
	05/29/02				6/6

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TIME: 04:25:48 PM
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EQUIPMENT SYMBOLS

- GEAR PUMP
- DIAPHRAGM PUMP
- CENTRIFUGAL PUMP
- PISTON PUMP
- SUBMERSIBLE SUMP PUMP
- POSITIVE DISPLACEMENT METERING PUMP
- MIXER/AGITATOR
- CENTRIFUGAL FAN NO INLET VANES
- CENTRIFUGAL FAN W/INLET VANE DAMPER
- POSITIVE DISPLACEMENT BLOWER
- CENTRIFUGAL COMPRESSOR
- RECIPROCATING COMPRESSOR
- SCREW COMPRESSOR
- SCREW AND TUBE HEAT EXCHANGER (LOCATE NOZZLES TO REFLECT ACTUAL INTERNAL/EXTERNAL CONFIGURATION)
- AIR COOLED HEAT EXCHANGER
- PLATE AND FRAME EXCHANGER
- STACK
- DUCT HEATER
- OR WEIGH CELL
- SLURRY/DECANT PUMP
- CAMERA AND LIGHT UNIT
- CALIBRATION GAUGE GLASS
- MESH SCREEN
- PNEUMATIC TRANSPORTER
- SCREW CONVEYOR
- BACKDRAFT DAMPER
- LOUVER
- MIXER/BLENDER
- SPRAY NOZZLES
- SPRAY RING
- HAND PUMP
- FLEX HOSE W/MALE QUICK COUPLING
- PRODUCT MIXER WASH WATER CONTAINER WITH FLEX HOSE

DRIVERS

- DIESEL ENGINE
- ELECTRIC MOTOR

FILTERS

- 30% ASHRAE
- 90% ASHRAE
- HEPA
- FILTER HOUSING

EQUIPMENT DESCRIPTION	EQUIPMENT DESIGNATOR (XXX)
ACCUMULATOR	ACC
AIR COMPRESSOR	ACP
AIR DRYER	ADR
AIR HANDLING UNIT	AHU
AIR PREHEATER	APH
AIR RECEIVER TANK	ART
AUTO TRANSFER SWITCH	ATS
BACK DRAFT DAMPER	BKD
BAGHOUSE	BGH
BELT CONVEYOR	BCV
BIN (BULK STORAGE)	BIN
BIN ACTIVATOR	BIA
BLOWER	BLR
BREATHING AIR STATION	BAS
BRIDGE CRANE	BRC
BULK BAG UNLOADING UNIT	BBU
BUCKET ELEVATOR	BEV
CABLE OR HOSE REEL	CBR
CAMERA AND LIGHT UNIT	CAM
CARBON FILTER BED	CFB
CARTRIDGE FILTER	CTF
CHILLER	CHR
CONDENSER	CND
CONTAINER	CON
CONTINUOUS EMISSION MONITORING	CEM
CONTROLLER	CNT
COOLING TOWER	CTW
CRANE/HOIST	CRH
CYCLONE SEPARATOR	CYS
DAMPER (NON-BUTTERFLY)	DPR
DELUMPER	DLM
DESICCANT DRYER SYSTEM	DDS
DIESEL GENERATOR	DGN
DIESEL GENERATOR CONTROL PANEL	DGP
DOUBLE CHECK VALVE	DCV
DOUBLE DUMP VALVE	DDV
DRAG FLIGHT CONVEYOR	DFC
DRUM DUMPER	DDP
DRYER	DRY
DRYER (ROTARY)	DRO
DUCT HEATER	DHT
DUST COLLECTOR	DCL
EDUCTOR	EDR
EJECTOR	EJE
ENCLOSURE	ENC
EVAPORATOR	EVP
EXCAVATOR	EXC
EXHAUST AIR REGISTER	EAR
EXPANSION JOINT	EXP
FAN	FAN
FEEDER	FDR
FILTER	FLT
FILTER PRESS	FLP
FLEXIBLE CONNECTION	FLX
FORK LIFT	FKL
GRAVITY DAMPER	GDM
HEAT EXCHANGER	HTX
HEATER	HTR
HOPPER/BIN	HBN
HYDRAULIC ACTUATOR	HYD
HYDRAULIC SYSTEM SKID	HSS
LIFT TABLE	LFT
LIVE ROLLER CONVEYOR	LRC
LOADING SPOUT	LSR
LOUVER	LVR
MIXER / AGITATOR	MXA
MIXER / BLENDER	MXB
MOTOR	MTR
ORIFICE PLATE	ORF
PACKAGE UNIT	PKU
PANEL (CONTROL)	PNL
PANELBOARD	PNB
PERSONNEL CONTAMINATION MONITOR	PCM
PHASE SEPARATOR	PHS
PRESSURE SAFETY ELEMENT	PSE
PRODUCT WEIGH BIN	PWB
PUMP	PMP

EQUIPMENT DESCRIPTION	EQUIPMENT DESIGNATOR (XXX)
REACTOR	REA
RECEIVER	RVR
ROLLER CONVEYOR	RCV
ROTARY FEEDER	ROF
SAMPLING SYSTEM (GASES)	SSG
SAMPLING SYSTEM (LIQUIDS)	SSL
SAMPLING SYSTEM (SOLIDS)	SSS
SCALE	SCL
SCREW CONVEYOR (METERING)	SCM
SCREW CONVEYOR (TRANSFER)	SCT
SCRUBBER	SCR
SKID	SKD
SLIDE GATE	SRS
SLUICER MODULE	SLC
SLURRY MODULE	SLR
TANK	TNK
STACK	STK
STATIC MIXER	STM
STRAINER	STR
SUMP	SMP
TANK	TNK
TRAP	TRP
UNINTERRUPTIBLE POWER SUPPLY	UPS
UPS BATTERY RACK	UBR
VACUUM BREAKER	VBK
VAPORIZER	VPR
VIBRATOR	VIB
WATER METER PIT	WMP
WATER TREATMENT PLANT (WASTE)	WTP

EQUIPMENT NUMBER IDENTIFICATION

XXX-YY-ZZZ

- ZZZ — EQUIPMENT SEQUENCE NUMBER
- YY — SYSTEM NUMBER (SEE N0001)
- XXX — EQUIPMENT DESIGNATOR

GENERAL NOTES:

1. ALL PROCESS SYSTEM BREAKS OCCUR AT INLET TO VALVE ON TOP OF TANKS, UNLESS OTHERWISE NOTED.
2. ALL BALL VALVES ARE FULL PORT UNLESS OTHERWISE NOTED.
3. CAMERAS LOCATED INSIDE TANKS WILL HAVE WATER AND/OR AIR FLUSHING OF LENSES. DETAILS TO BE DETERMINED LATER.

NOTES:

1. ABBREVIATIONS AND SYMBOLS PRESENTED ON SHEETS N6000, N6001 AND N6002 WILL BE USED FOR BOTH PROCESS FLOW DIAGRAMS AND PIPING AND INSTRUMENTATION DIAGRAMS.

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UNITED STATES DEPARTMENT OF ENERGY
FERNALD ENVIRONMENTAL MANAGEMENT PROJECT

THIS DRAWING PREPARED BY
JE JACOBS

PROJECT NAME
AWR BOP OPTIMIZATION

DRAWING TITLE
INSTRUMENTATION
PIPING AND INSTRUMENTATION DIAGRAM
EQUIPMENT AND MISCELLANEOUS, SHEET 3 OF 3

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HEATING, VENTILATION AND AIR CONDITIONING LEGEND, SYMBOLS AND ABBREVIATIONS

ABBREVIATIONS

ABBREV.	WORD OR TERM
ABV	ABOVE
ACFM	ACTUAL CUBIC FEET PER MINUTE
APPROX	APPROXIMATELY
ATM	ATMOSPHERE
AUTO	AUTOMATIC
BEL	BELOW
BHP	BRAKE HORSEPOWER
BOG	BOTTOM OF GRILLE
BOL	BOTTOM OF LOUVER
BOP	BOTTOM OF PIPE
BOU	BOTTOM OF UNIT
BTUH	BRITISH THERMAL UNITS PER HOUR
BYP	BYPASS
CNTFGL	CENTRIFUGAL
C	COMMON
CAP	CAPACITY
CCW	COUNTERCLOCKWISE
CD	CEILING DIFFUSER
CFH	CUBIC FEET PER HOUR
CFM	CUBIC FEET PER MINUTE
CG	CEILING GRILLE
CL	CENTERLINE
CLG	COOLING
CONC	CONCRETE
CONN	CONNECTION
CS	CARBON STEEL
CTR	CENTER
CV	CHECK VALVE
CW	CLOCKWISE
DB	DRY BULB
DES	DESIGN
DIA	DIAMETER
DISCH	DISCHARGE
DN	DOWN
D/P	DIFFERENTIAL PRESSURE
DRN	DRAIN
DT	DESIGN TEMPERATURE
DWG	DRAWING
EA	EXHAUST AIR
EFF	EFFICIENCY
EG	EXHAUST GRILLE
EL	ELEVATION
ENT	ENTERING
EQUIP	EQUIPMENT
EP	EXPLOSION PROOF
ER	EXHAUST REGISTER
ESD	EMERGENCY SHUTDOWN
EVAC	EVACUATION
EXH	EXHAUST
(F)	FURNISHED
°F	DEGREES FAHRENHEIT
FLG	FLANGE
FLR	FLOOR
FLTR	FILTER
FP	FIRE PROTECTION
FPM	FEET PER MINUTE
FT	FEET
FURN	FURNISHED
FT^2	SQUARE FEET
FT^3	CUBIC FEET
FC	FAIL CLOSED
FO	FAIL OPEN
FL	FAIL LOCKED
FWD CRV	FORWARD CURVED
GAL	GALLON
GALV	GALVANIZED
GPM	GALLONS PER MINUTE
GR	GRADE
H	HIGH
HTG	HEATING
HEPA	HIGH EFFICIENCY PARTICULATE AIR FILTER
HVAC	HEATING, VENTILATION AND AIR CONDITIONING
HD	HEAD
HDR	HEADER
HP	HORSEPOWER
HGT	HEIGHT
HOA	HAND/OFF/AUTOMATIC
HPT	HIGH POINT
HR	HOUR
HZ	HERTZ
INSUL	INSULATION
I.E.	THAT IS
IN	INCH
INSTR	INSTRUMENT
IN WC	INCHES WATER COLUMN
IN WG	INCHES WATER GAUGE
KW	KILOWATT
L	LONG
LG	LEVEL GAUGE
LGTH	LENGTH
LP	LOW PRESSURE
LPT	LOW POINT
MBH	THOUSAND BRITISH THERMAL UNITS PER HOUR
MAX	MAXIMUM
MCC	MOTOR CONTROL CENTER
MW	MANWAY
MIN	MINIMUM
MOV	MOTOR OPERATED VALVE
MTD	MOUNTED
MTG	MOUNTING
MTL	MATERIAL
MFR	MANUFACTURER
NC	NORMALLY CLOSED
NEG	NEGATIVE
NIC	NOT IN CONTRACT
NK	NECK
NO	NORMALLY OPEN
NTS	NOT TO SCALE
OA	OUTSIDE AIR
OBD	OPPOSED BLADE DAMPER
OC	ON CENTER
OD	OUTSIDE DIAMETER
OVHD	OVERHEAD
OP	OUTPUT

ABBREV.	WORD OR TERM
OPNG	OPENING
OPER	OPERATING / OPERATOR
PD	PRESSURE DROP
PENET	PENETRATION
PH	PHASE
PL	PLATE
PLCS	PLACES
PNL	PANEL
PNEU	PNEUMATIC
POC	POINT OF CONNECTION
POS	POSITIVE
PRESS	PRESSURE
PSIG	POUNDS PER SQUARE INCH (GAUGE)
QTY	QUANTITY
R	ROWS
REF	REFERENCE
REQD	REQUIRED
RH	RELATIVE HUMIDITY
RPM	REVOLUTIONS PER MINUTE
SA	SUPPLY AIR
SC	SAMPLE CONNECTION
SCFM	STANDARD CUBIC FEET PER MINUTE
SCH	SCHEDULE
SD	SHUTDOWN
SEC	SECONDARY
SG	SUPPLY GRILLE
SIS	SAFETY INSTRUMENTED SYSTEM
SKID	SKID (VENDOR)
SL	SOUND LINING
SLC	SLUICER
SLR	SLURRY
SPD	SPEED
SP	STATIC PRESSURE
SS	STAINLESS STEEL
STD	STANDARD
SV	SOLENOID VALVE
SW	SWITCH
TA	TRANSFER AIR
TEFC	TOTALLY ENCLOSED FAN COOLED
TEMP	TEMPERATURE
TG	TRANSFER GRILLE
TNK	TANK
TOC	TOP OF CONCRETE
TOS	TOP OF STEEL
TRANSF	TRANSFER
TSP	TOTAL STATIC PRESSURE
TYP	TYPICAL
UC	UNDERCUT DOOR
UG	UNDERGROUND
V	VOLT
VAC	VACUUM
VEL	VELOCITY
VNT	VENT
W	WIDE
WB	WET BULB
W/	WITH
WC	WATER COLUMN
WG	WATER GAUGE
W/O	WITHOUT
WT	WEIGHT
WTR	WATER

SINGLE LINE

- FILTER (30% ASHRAE EFFICIENCY RATING)
- OUTSIDE AIR LOUVER
- FAN
- ELECTRIC UNIT HEATER
- BACKDRAFT DAMPER
- MOTOR OPERATED DAMPER
- PARALLEL BLADE DAMPER
- LEFT OFF PAGE CONNECTOR
- RIGHT OFF PAGE CONNECTOR
- BIDIRECTIONAL CONNECTOR
- SUPPLY AIR FLOW DIRECTION
- EXHAUST OR RETURN AIR FLOW DIRECTION

EQUIPMENT NUMBER IDENTIFICATION

XXX-YY-ZZZZ

- ZZZZ — EQUIPMENT SEQUENCE NUMBER
- YY — SYSTEM NUMBER
- XXX — EQUIPMENT CODE DESIGNATOR

EQUIPMENT DESCRIPTION / EQUIPMENT DESIGNATOR (XXX)

EQUIPMENT DESCRIPTION	EQUIPMENT DESIGNATOR (XXX)
BACKDRAFT DAMPER	BKD
DAMPER (NON-BUTTERFLY)	DPR
ENCLOSURE	ENC
FAN	FAN
FILTER	FLT
HEATER	HTR
LOUVER	LVR
MAIN CIRCUIT BREAKER	MCB
MOTOR	MTR
MOTOR CONTROL CENTER	MCC
MOTOR STARTER PANEL	MSP
PANEL (CONTROL)	PNL
PANELBOARD	PNB
POWER DISTRIBUTION PANEL	PDP
POWER PANEL	PPN
POWER PANEL (INSTRUMENTATION)	PWP

SYSTEM NUMBERING

YY	
	FACILITIES
00	NOT USED
01	NOT USED
02	NOT USED
03	NOT USED
04	NOT USED
05	MISCELLANEOUS FACILITIES
06	NOT USED
07	NOT USED
08	NOT USED
09	NOT USED
	RETRIEVAL
10	NOT USED
11	SILO WASTE RETRIEVAL SYSTEM
12	TRANSFER TANK SYSTEM
13	TTA WASTE RETRIEVAL SYSTEM
14	NOT USED
	PROCESSING
15	NOT USED
16	NOT USED
17	NOT USED
18	NOT USED
19	NOT USED
20	RADON CONTROL SYSTEM
21	NOT USED
22	NOT USED
	PRODUCT HANDLING
23	NOT USED
24	NOT USED
25	NOT USED
26	NOT USED
27	NOT USED
28	NOT USED
29	NOT USED
	ELECTRICAL
30	HIGH VOLTAGE SYSTEM
31	480 VOLT DISTRIBUTION SYSTEM
32	STANDBY ELECTRICAL SYSTEM
33	UNINTERRUPTIBLE POWER SYSTEM
34	LIGHTING SYSTEM
35	GROUNDING SYSTEM
36	NOT USED
37	NOT USED
38	NOT USED
39	MISCELLANEOUS ELECTRICAL
	UTILITIES AND CHEMICALS
40	PLANT AND INSTRUMENT AIR SYSTEM
41	BREATHING AIR SYSTEM
42	NOT USED
43	NOT USED
44	NOT USED
45	NOT USED
46	NOT USED
47	NOT USED
48	NOT USED
49	NOT USED
	WATER SYSTEMS
50	NOT USED
51	POTABLE WATER SYSTEM
52	NOT USED
53	NOT USED
54	NOT USED
55	NOT USED
56	NOT USED
57	NOT USED
58	NOT USED
59	NOT USED
	WASTE SYSTEMS
60	NOT USED
61	SANITARY SEWER SYSTEM
62	NOT USED
63	NOT USED
64	NOT USED
65	NOT USED
66	STORMWATER SYSTEM
67	NOT USED
68	NOT USED
69	NOT USED
	HVAC SYSTEMS
70	NOT USED
71	NOT USED
72	NOT USED
73	NOT USED
74	NOT USED
75	NOT USED
76	NOT USED
77	MISCELLANEOUS FACILITIES HVAC SYSTEM
78	NOT USED
79	NOT USED
	MECHANICAL AND ANALYTICAL SYSTEMS
80	NOT USED
81	NOT USED
82	NOT USED
83	NOT USED
84	NOT USED
85	NOT USED
86	NOT USED
87	NOT USED
88	NOT USED
89	NOT USED
	INFORMATION AND CONTROL SYSTEMS
90	DISTRIBUTED CONTROL SYSTEM
91	NOT USED
92	FIRE DETECTION AND ALARM SYSTEM
93	HEALTH PROTECTION SYSTEM
94	NOT USED
95	NOT USED
96	NOT USED
97	NOT USED
98	NOT USED
99	NOT USED

NOTES:

1. ALL NOTED DUCT DIMENSIONS ARE INSIDE DIMENSIONS UNLESS OTHERWISE NOTED.
2. AIR FLOWS SHOWN IN CUBIC FEET PER MINUTE (CFM) ARE ACTUAL FLOWS (ACFM) AT THE SITE ELEVATION ABOVE SEA LEVEL.
3. ALL EQUIPMENT SUPPORTS, FOUNDATIONS, PADS, WALL OPENINGS OR PENETRATIONS SHALL BE VERIFIED WITH THE ACTUAL EQUIPMENT FOR SIZE AND FIT. THE EQUIPMENT SIZES INDICATED ON THE DRAWINGS HAVE BEEN SELECTED FOR ENGINEERING DESIGN AND SPACE ALLOCATION PURPOSES. THE ACTUAL SIZES MAY VARY DEPENDING ON EQUIPMENT MANUFACTURER.
4. FOR EXPLANATION OF ADDITIONAL ABBREVIATIONS USED SEE ASHRAE HANDBOOK OF FUNDAMENTALS.
5. ALL MOTORS ARE 3 PHASE, 60 HERTZ, 230/460 VOLTS UNLESS OTHERWISE NOTED.

4448

REF DWG NO.	DRAWING TITLE
N6000	PIPING AND INSTRUMENT DIAGRAM, LEGEND SHEET 1
N6001	PIPING AND INSTRUMENT DIAGRAM, LEGEND SHEET 2
N6002	PIPING AND INSTRUMENT DIAGRAM, LEGEND SHEET 3

REV. NO.	ISSUE OR REVISION PURPOSE - DESCRIPTION	DATE	REV. BY	APPR.
0	ISSUED TO CONSTRUCTION	05/29/02		

INITIALS AND DATE

UNITED STATES DEPARTMENT OF ENERGY
FERNALD ENVIRONMENTAL MANAGEMENT PROJECT

THIS DRAWING PREPARED BY
JACOBS

PROJECT NAME
AWR BOP OPTIMIZATION

DRAWING TITLE
HVAC
LEGEND AND GENERAL NOTES
SYMBOLS, ABBREVIATIONS, EQUIPMENT AND SYSTEM DESIGNATORS

DRAWN BY	DATE	TECHNICAL LEAD	DATE	CHECKED BY	DATE

PRINT/BLDG NO. | FLOOR | SCALE: NONE | CLASS: U

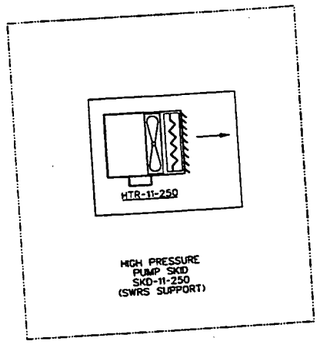
SUBMITTED FOR 30% ISSUE — TECH LEAD — DATE
SUBMITTED FOR 60% ISSUE — TECH LEAD — DATE
SUBMITTED FOR 90% ISSUE — TECH LEAD — DATE

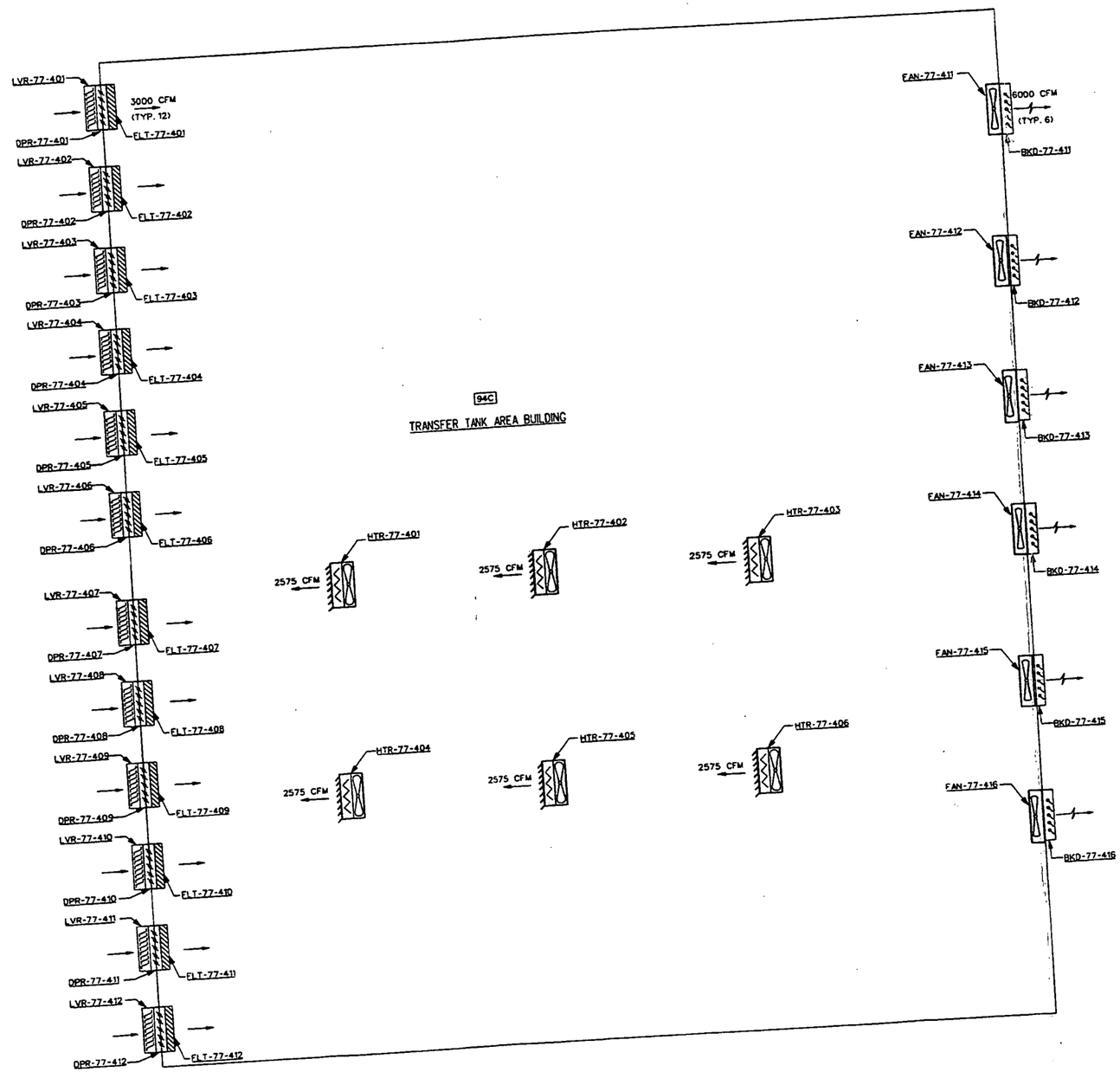
T.O. NUMBER	PROJECT NO.	DRAWING INDEX CODE NO.	SHEET NO.	REV. NO.
N/A	40710	94X-3900-H-01977	H8500	0

JE JACOBS PROJECT NO. 35H19606 — FILENAME 94XH5177.DGN

000305

DATE: 05/28/02 TIME: 04:50PM USER: JRosenbo DESIGN FILE: h:\hvac\Drawings\BOP\94XH5177.DGN





EQUIPMENT TABLE

EQUIPMENT TYPE	EQUIPMENT NUMBER
UNIT HEATER	HTR-11-250
	HTR-77-401
	HTR-77-402
	HTR-77-403
	HTR-77-404
	HTR-77-405
	HTR-77-406
EXHAUST FAN	FAN-77-411
	FAN-77-412
	FAN-77-413
	FAN-77-414
	FAN-77-415
	FAN-77-416
BACKDRAFT DAMPER	BKD-77-411
	BKD-77-412
	BKD-77-413
	BKD-77-414
	BKD-77-415
	BKD-77-416
LOUVER	LVR-77-401
	LVR-77-402
	LVR-77-403
	LVR-77-404
	LVR-77-405
	LVR-77-406
	LVR-77-407
	LVR-77-408
	LVR-77-409
	LVR-77-410
	LVR-77-411
	LVR-77-412
DAMPER	DPR-77-401
	DPR-77-402
	DPR-77-403
	DPR-77-404
	DPR-77-405
	DPR-77-406
	DPR-77-407
	DPR-77-408
	DPR-77-409
	DPR-77-410
	DPR-77-411
	DPR-77-412
FILTER	FLT-77-401
	FLT-77-402
	FLT-77-403
	FLT-77-404
	FLT-77-405
	FLT-77-406
	FLT-77-407
	FLT-77-408
	FLT-77-409
	FLT-77-410
	FLT-77-411
	FLT-77-412

NOTES:

1. DESIGN CONDITIONS:

   OUTSIDE-
   SUMMER - 93°F. DB: 74°F WB
   WINTER - 1°F.

   INSIDE- TTA BUILDING
   SUMMER - 103°F. MAX.
   WINTER - 55°F.

2. FOR EQUIPMENT DETAILS, REFER TO EQUIPMENT LIST. H0710-LST-0002.
3. TPG APPLIED TECHNOLOGY SILOS WASTE RETRIEVAL SYSTEM MODULES ARE PROVIDED WITH RADIANT HEATERS FOR FREEZE PROTECTION.
4. TPG APPLIED TECHNOLOGY EQUIPMENT MODULES ARE PROVIDED VENTILATION BY THE RADON CONTROL SYSTEM (RCS). SEE RCS DRAWINGS FOR DETAILS.

4448

REF DWG NO.	DRAWING TITLE
H8500	HVAC LEGEND AND GENERAL NOTES
H8510	HVAC PIPING AND INSTRUMENT DIAGRAM
N6000	PIPING AND INSTRUMENT DIAGRAM, LEGEND SHEET 1
N6001	PIPING AND INSTRUMENT DIAGRAM, LEGEND SHEET 2
N6002	PIPING AND INSTRUMENT DIAGRAM, LEGEND SHEET 3

REV. NO.	ISSUE OR REVISION PURPOSE - DESCRIPTION	DATE	REV. BY	APR.
0	ISSUED TO CONSTRUCTION	05/29/02		

INITIALS AND DATE

UNITED STATES
DEPARTMENT OF ENERGY
FERNALD ENVIRONMENTAL MANAGEMENT PROJECT

THIS DRAWING PREPARED BY
JACOBS

PROJECT NAME
AWR BOP OPTIMIZATION

DRAWING TITLE
HVAC
TTA BUILDING
AIRFLOW DIAGRAM

DRAWN BY	DATE	TECHNICAL LEAD / DATE	CHECKED BY / DATE
PLANT/BLDG. NO.		FLOOR	SCALE: NONE / CLASS: U
SUBMITTED FOR 30% ISSUE		SUBMITTED FOR 60% ISSUE	SUBMITTED FOR 90% ISSUE
TECH LEAD / DATE		TECH LEAD / DATE	TECH LEAD / DATE
T.O. NUMBER: N/A	PROJECT NO.: 40710	DRAWING INDEX CODE NO.: 94X-3900-H-01979	SHEET NO.: H8505 / REV. NO.: 0
J.E.C. PROJECT NO.: 35H19606	FILENAME: 94XH1979.DGN		

000306

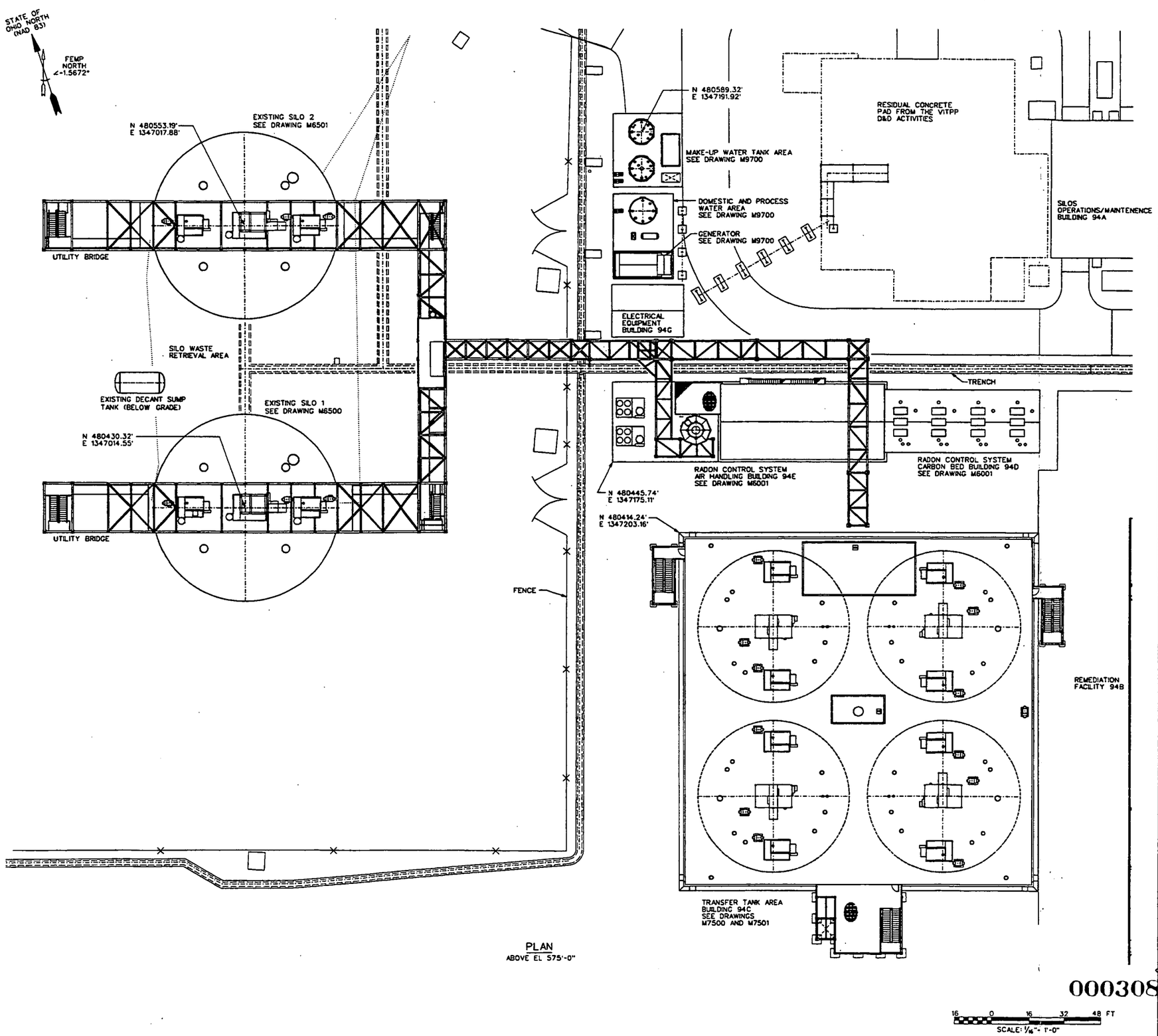
DATE: 05/28/02
TIME: 04:45 PM
USER: JRosenbo
DESIGN FILE: I:\HVAC\Drawings\BOP\94XH1979.DGN

APPENDIX B
GENERAL ARRANGEMENT DRAWINGS

AWR Remedial Design Package Process Drawing List

Appendix B - General Arrangements

Drawing Index Code		Revision	Drawing Title
94X-3900-M-	01833	0	MECHANICAL, GENERAL ARRANGEMENT, OVERALL PLAN
94X-3900-M-	01834	0	MECHANICAL, GENERAL ARRANGEMENT, SILO 1 PLAN
94X-3900-M-	01835	0	MECHANICAL, GENERAL ARRANGEMENT, SILO 2 PLAN
94X-3900-M-	01836	0	MECHANICAL, GENERAL ARRANGEMENT, SILOS 1 AND 2 SECTION
94X-3900-M-	01837	0	MECHANICAL, GENERAL ARRANGEMENT, SILOS AND UTILITY BRIDGE SECTION
94X-3900-M-	01838	0	MECHANICAL, GENERAL ARRANGEMENT, UTILITY BRIDGE AND FACILITY PLAN
94X-3900-M-	01839	0	MECHANICAL, GENERAL ARRANGEMENT, UTILITY BRIDGE AND FACILITY SECTION
94X-3900-M-	01840	0	MECHANICAL, GENERAL ARRANGEMENT, TRANSFER TANK AREA BUILDING - FIRST FLOOR
94X-3900-M-	01841	0	MECHANICAL, GENERAL ARRANGEMENT, TRANSFER TANK AREA BUILDING - EQUIPMENT DECK
94X-3900-M-	01842	0	MECHANICAL, GENERAL ARRANGEMENT, TRANSFER TANK AREA BUILDING SECTION
94X-3900-M-	02367	0	MECHANICAL, GENERAL ARRANGEMENT, TRANSFER TANK AREA BUILDING SECTION
94X-3900-M-	01843	0	MECHANICAL, GENERAL ARRANGEMENT, MAKE-UP WATER TANK AREA PLAN
94X-3900-M-	02368	0	MECHANICAL, GENERAL ARRANGEMENT, MAKE-UP WATER TANK AREA SECTION
N/A	20FMD027	4	RADON CONTROL SYSTEM, GENERAL ARRANGEMENT, 1ST FLOOR
N/A	20FMD028	4	RADON CONTROL SYSTEM, GENERAL ARRANGEMENT, 2ND FLOOR



PLAN
ABOVE EL 575'-0"

000308

NOTES:

4443

REF DWG NO.	DRAWING TITLE
N6000	INSTRUMENTATION, PIPING AND INSTRUMENTATION DIAGRAM PIPING, VALVES AND MISCELLANEOUS, SHEET 1 OF 3
N6001	INSTRUMENTATION, PIPING AND INSTRUMENTATION DIAGRAM INSTRUMENTATION, SHEET 2 OF 3
N6002	INSTRUMENTATION, PIPING AND INSTRUMENTATION DIAGRAM EQUIPMENT AND MISCELLANEOUS, SHEET 3 OF 3

REV. NO.	ISSUE OR REVISION PURPOSE - DESCRIPTION	DATE	REV. BY	APPR.
0	ISSUED TO CONSTRUCTION	05/29/02	JDM	[illegible]

INITIALS AND DATE

UNITED STATES
DEPARTMENT OF ENERGY
FERNALD ENVIRONMENTAL MANAGEMENT PROJECT

THIS DRAWING PREPARED BY
JACOBS
125 Broadway Ave.
Oak Ridge, Tennessee 37830
Tel: 865-220-4600
Fax: 865-220-6170

PROJECT NAME
AWR BOP OPTIMIZATION

DRAWING TITLE
MECHANICAL
GENERAL ARRANGEMENT
OVERALL PLAN

DRAWN BY	DATE	TECHNICAL LEAD	DATE	CHECKED BY	DATE
[illegible]	05/29/02	Michael Malone	5/29/02	J D Nelson	5/29/02

PLANT/BLDG. NO.	FLOOR	SCALE	CLASS
		1/16"=1'-0"	U

SUBMITTED FOR 30% ISSUE	SUBMITTED FOR 60% ISSUE	SUBMITTED FOR 90% ISSUE
TECH LEAD	TECH LEAD	TECH LEAD
DATE	DATE	DATE

T.D. NUMBER	PROJECT NO.	DRAWING INDEX CODE NO.	SHEET NO.	REV. NO.
N/A	40710	94X-3900-M-01833	M6000	0

JEG PROJECT NO.	FILENAME
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TIME: 8:29:29 AM
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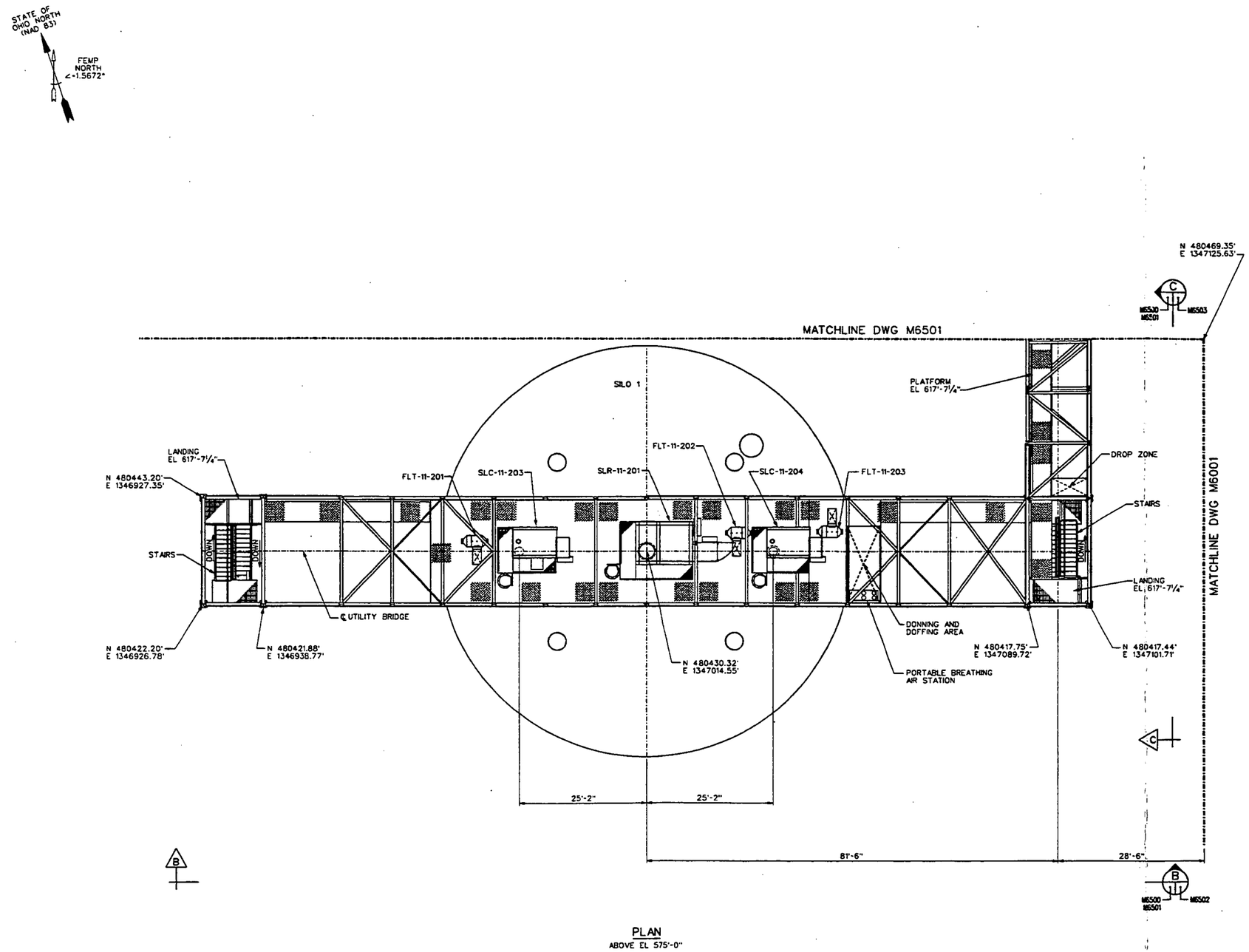
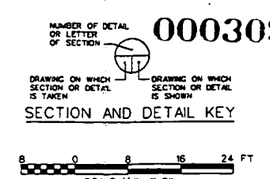


PLAN
ABOVE EL 575'-0"



SECTION AND DETAIL KEY

8 0 8 16 24 FT
SCALE: ⅛"= 1'-0"

000309

NOTES:

4448

REF DWG NO.	DRAWING TITLE
M6000	MECHANICAL, GENERAL ARRANGEMENT OVERALL PLAN
N6000	INSTRUMENTATION, PIPING AND INSTRUMENTATION DIAGRAM PIPING, VALVES AND MISCELLANEOUS, SHEET 1 OF 3
N6001	INSTRUMENTATION, PIPING AND INSTRUMENTATION DIAGRAM INSTRUMENTATION, SHEET 2 OF 3
N6002	INSTRUMENTATION, PIPING AND INSTRUMENTATION DIAGRAM EQUIPMENT AND MISCELLANEOUS, SHEET 3 OF 3

REV. NO.	ISSUE OR REVISION PURPOSE - DESCRIPTION	DATE	REV. BY	APPR
0	ISSUED TO CONSTRUCTION	05/29/02	JJT	JWA

INITIALS AND DATE

UNITED STATES DEPARTMENT OF ENERGY
FERNALD ENVIRONMENTAL MANAGEMENT PROJECT

THIS DRAWING PREPARED BY
JACOBS
125 Broadway Ave. Oak Ridge, Tennessee 37830 Tel: 865-220-4800 Fax: 865-220-6170

PROJECT NAME
AWR BOP OPTIMIZATION

DRAWING TITLE
MECHANICAL
GENERAL ARRANGEMENT
SILO 1 PLAN

DRAWN BY	DATE	TECHNICAL LEAD	DATE	CHECKED BY	DATE
[signature]	05/29/02	[signature]	5/29/02	[signature]	5/29/02
PLANT/BLDG. NO.		FLOOR		SCALE ⅛" = 1'-0"	CLASS U
SUBMITTED FOR 30% ISSUE		SUBMITTED FOR 60% ISSUE		SUBMITTED FOR 90% ISSUE	
TECH LEAD		TECH LEAD		TECH LEAD	
DATE		DATE		DATE	

T.O. NUMBER	PROJECT NO.	DRAWING INDEX CODE NO.	SHEET NO.	REV. NO.
N/A	40710	94X-3900-M-01834	M6500	0

JEG PROJECT NO.	FILENAME
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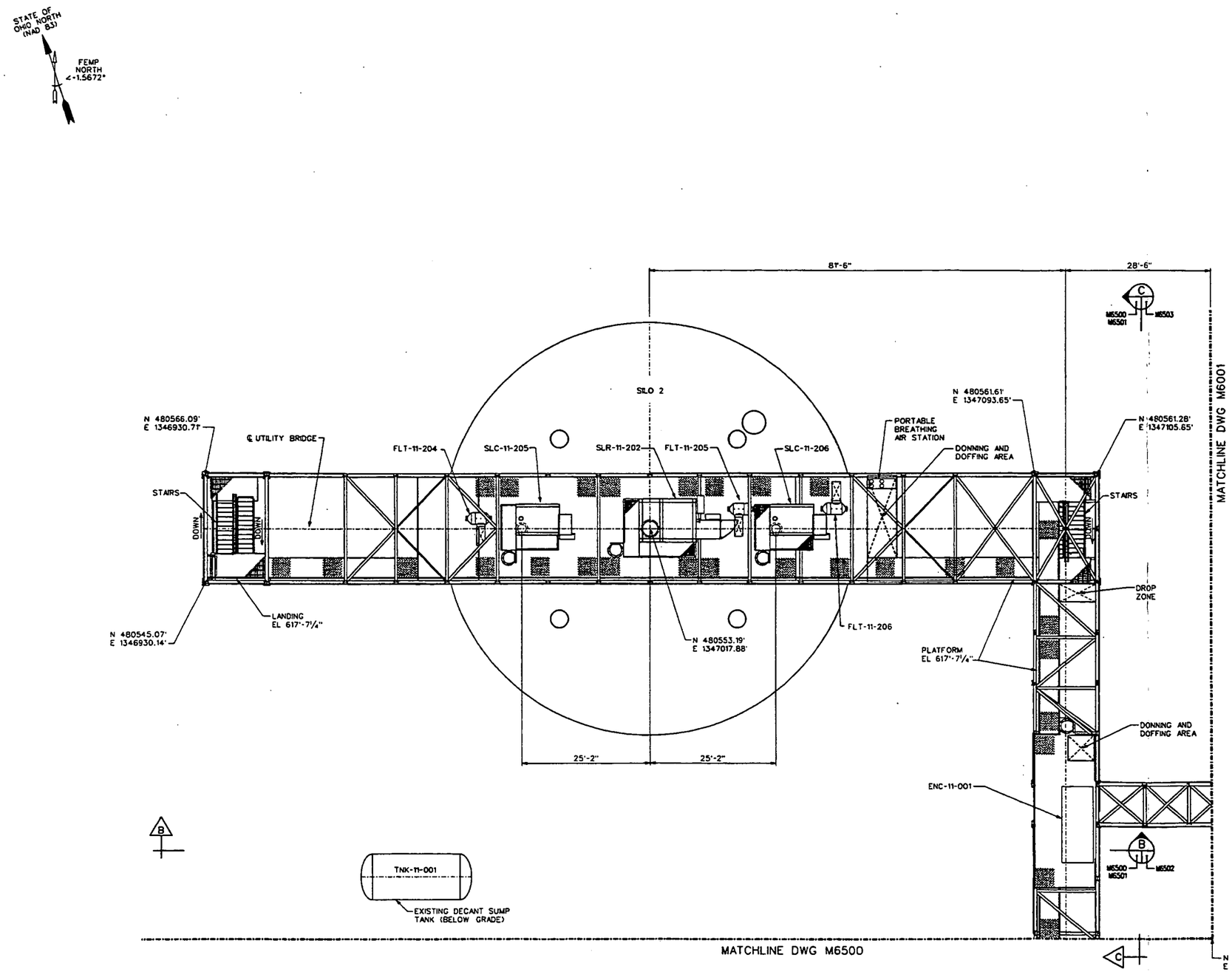

PLAN
ABOVE EL 560'-0"

000310

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

SECTION AND DETAIL KEY

8 0 8 16 24 FT
SCALE: ⅛" = 1'-0"

NOTES:

4448

REF DWG NO.	DRAWING TITLE
M6000	MECHANICAL, GENERAL ARRANGEMENT OVERALL PLAN
N6000	INSTRUMENTATION, PIPING AND INSTRUMENTATION DIAGRAM PIPING, VALVES AND MISCELLANEOUS, SHEET 1 OF 3
N6001	INSTRUMENTATION, PIPING AND INSTRUMENTATION DIAGRAM INSTRUMENTATION, SHEET 2 OF 3
N6002	INSTRUMENTATION, PIPING AND INSTRUMENTATION DIAGRAM EQUIPMENT AND MISCELLANEOUS, SHEET 3 OF 3

REV. NO.	ISSUE OR REVISION PURPOSE - DESCRIPTION	DATE	REV. BY	APPR.
0	ISSUED TO CONSTRUCTION	05/29/02	JDM	JWK

INITIALS AND DATE

UNITED STATES
DEPARTMENT OF ENERGY
FERNALD ENVIRONMENTAL MANAGEMENT PROJECT

THIS DRAWING PREPARED BY
JACOBS
125 Broadway Ave.
Oak Ridge, Tennessee 37830
Tel: 865-220-4800
Fax: 865-220-6170

PROJECT NAME
AWR BOP OPTIMIZATION

DRAWING TITLE
MECHANICAL
GENERAL ARRANGEMENT
SILO 2 PLAN

DRAWN BY	DATE	TECHNICAL LEAD	DATE	CHECKED BY	DATE
[signature]	05/29/02	[signature]	5/29/02	[signature]	5/29/02
PLANT/BLDG. NO.		FLOOR		SCALE ⅛" = 1'-0"	CLASS U
SUBMITTED FOR 30% ISSUE		SUBMITTED FOR 60% ISSUE		SUBMITTED FOR 90% ISSUE	
TECH LEAD		TECH LEAD		TECH LEAD	
DATE		DATE		DATE	

T.O. NUMBER	PROJECT NO.	DRAWING INDEX CODE NO.	SHEET NO.	REV. NO.
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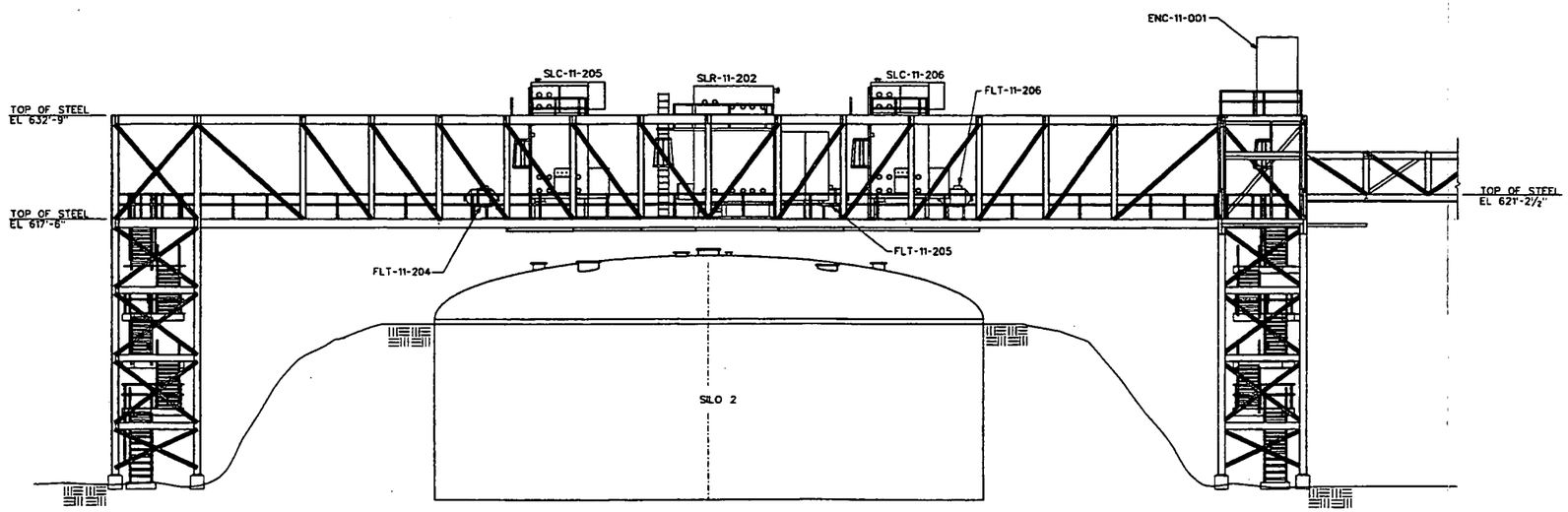

SECTION
LOOKING NORTH
B
M6500
M6501
M6502

SILO 1 SECTION SIMILAR

NOTES:

4448

REF DWG NO.	DRAWING TITLE
M6000	MECHANICAL, GENERAL ARRANGEMENT OVERALL PLAN
N6000	INSTRUMENTATION, PIPING AND INSTRUMENTATION DIAGRAM PIPING, VALVES AND MISCELLANEOUS, SHEET 1 OF 3
N6001	INSTRUMENTATION, PIPING AND INSTRUMENTATION DIAGRAM INSTRUMENTATION, SHEET 2 OF 3
N6002	INSTRUMENTATION, PIPING AND INSTRUMENTATION DIAGRAM EQUIPMENT AND MISCELLANEOUS, SHEET 3 OF 3

REV. NO.	ISSUE OR REVISION PURPOSE - DESCRIPTION	DATE	REV. BY	APPR.
0	ISSUED TO CONSTRUCTION	05/29/02		

INITIALS AND DATE

000311

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

SECTION AND DETAIL KEY

8 0 8 16 24 FT
SCALE: 1/8"= 1'-0"

UNITED STATES DEPARTMENT OF ENERGY
FERNALD ENVIRONMENTAL MANAGEMENT PROJECT

THIS DRAWING PREPARED BY
JACOBS
123 Broadway Ave.
Oak Ridge, Tennessee 37830
Tel: 865-220-4600
Fax: 865-220-6170

PROJECT NAME
AWR BOP OPTIMIZATION

DRAWING TITLE
MECHANICAL
GENERAL ARRANGEMENT
SILOS 1 AND 2 SECTION

DRAWN BY	DATE	TECHNICAL LEAD	DATE	CHECKED BY	DATE
	05/29/02		5/29/02		5/29/02

PLANT/BLDG. NO.	FLOOR	SCALE	CLASS
		1/8"=1'-0"	U

SUBMITTED FOR 30% ISSUE	SUBMITTED FOR 60% ISSUE	SUBMITTED FOR 90% ISSUE
TECH LEAD	TECH LEAD	TECH LEAD
DATE	DATE	DATE

T.O. NUMBER	PROJECT NO.	DRAWING INDEX CODE NO.	SHEET NO.	REV. NO.
N/A	40710	94X-3900-M-01836	M6502	0

JEG PROJECT NO.	FILENAME
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DATE: 05/29/02
TIME: 8:30:49 AM
USER: PK\
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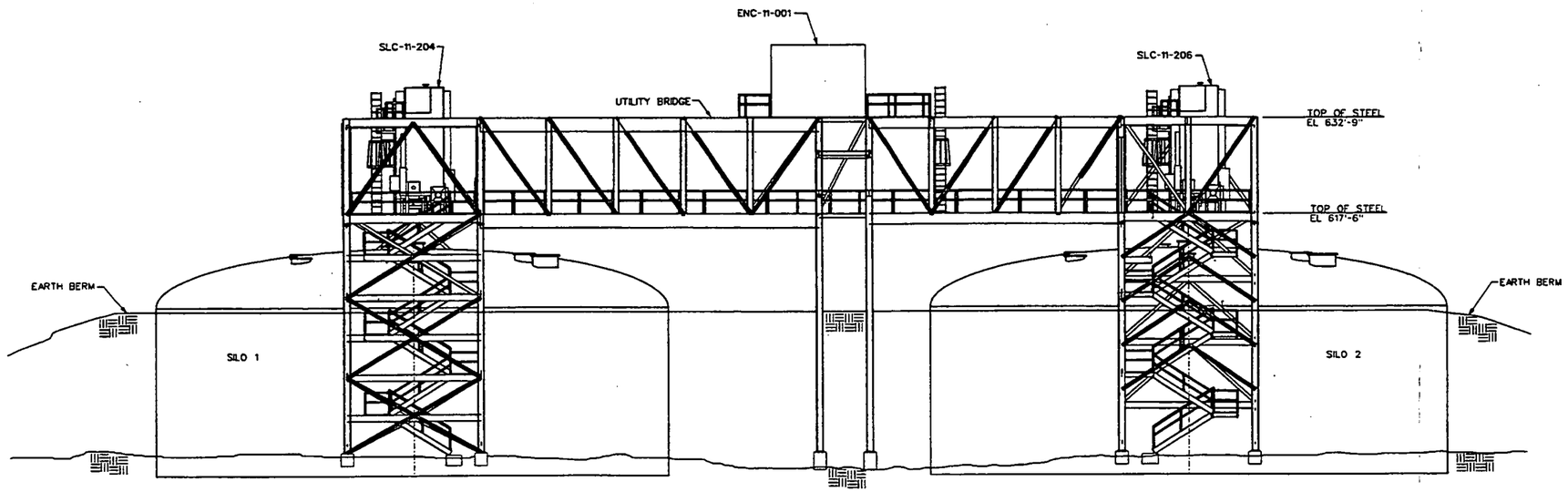

SECTION
LOOKING WEST
M6500 M6501 M6503

000312

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

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SCALE: 1/8" = 1'-0"

NOTES:

4448

REF DWG NO.	DRAWING TITLE
M6000	MECHANICAL, GENERAL ARRANGEMENT OVERALL PLAN
N6000	INSTRUMENTATION, PIPING AND INSTRUMENTATION DIAGRAM PIPING, VALVES AND MISCELLANEOUS, SHEET 1 OF 3
N6001	INSTRUMENTATION, PIPING AND INSTRUMENTATION DIAGRAM INSTRUMENTATION, SHEET 2 OF 3
N6002	INSTRUMENTATION, PIPING AND INSTRUMENTATION DIAGRAM EQUIPMENT AND MISCELLANEOUS, SHEET 3 OF 3

REV. NO.	ISSUE OR REVISION PURPOSE - DESCRIPTION	DATE	REV. BY	APPR.
0	ISSUED TO CONSTRUCTION	05/29/02	[illegible]	[illegible]

INITIALS AND DATE

UNITED STATES DEPARTMENT OF ENERGY
FERNALD ENVIRONMENTAL MANAGEMENT PROJECT

THIS DRAWING PREPARED BY
JACOBS
125 Broadway Ave.
Oak Ridge, Tennessee 37830
Tel: 865-220-6800
Fax: 865-220-6170

PROJECT NAME
AWR BOP OPTIMIZATION

DRAWING TITLE
MECHANICAL
GENERAL ARRANGEMENT
SILOS AND UTILITY BRIDGE SECTION

DRAWN BY	DATE	TECHNICAL LEAD	DATE	CHECKED BY	DATE
[illegible]	05/29/02	[illegible]	5/29/02	[illegible]	5/29/02

PLANT/BLDG. NO.	FLOOR	SCALE	CLASS
		1/8" = 1'-0"	U

SUBMITTED FOR 30% ISSUE	SUBMITTED FOR 60% ISSUE	SUBMITTED FOR 90% ISSUE
TECH LEAD	TECH LEAD	TECH LEAD
DATE	DATE	DATE

T.O. NUMBER	PROJECT NO.	DRAWING INDEX CODE NO.	SHEET NO.	REV. NO.
N/A	40710	94X-3900-M-01837	M6503	0

JEG PROJECT NO.	FILENAME
35H19606	94XM1837.DGN

DATE: 05/29/02
TIME: 10:36:34 AM
USER: hw\
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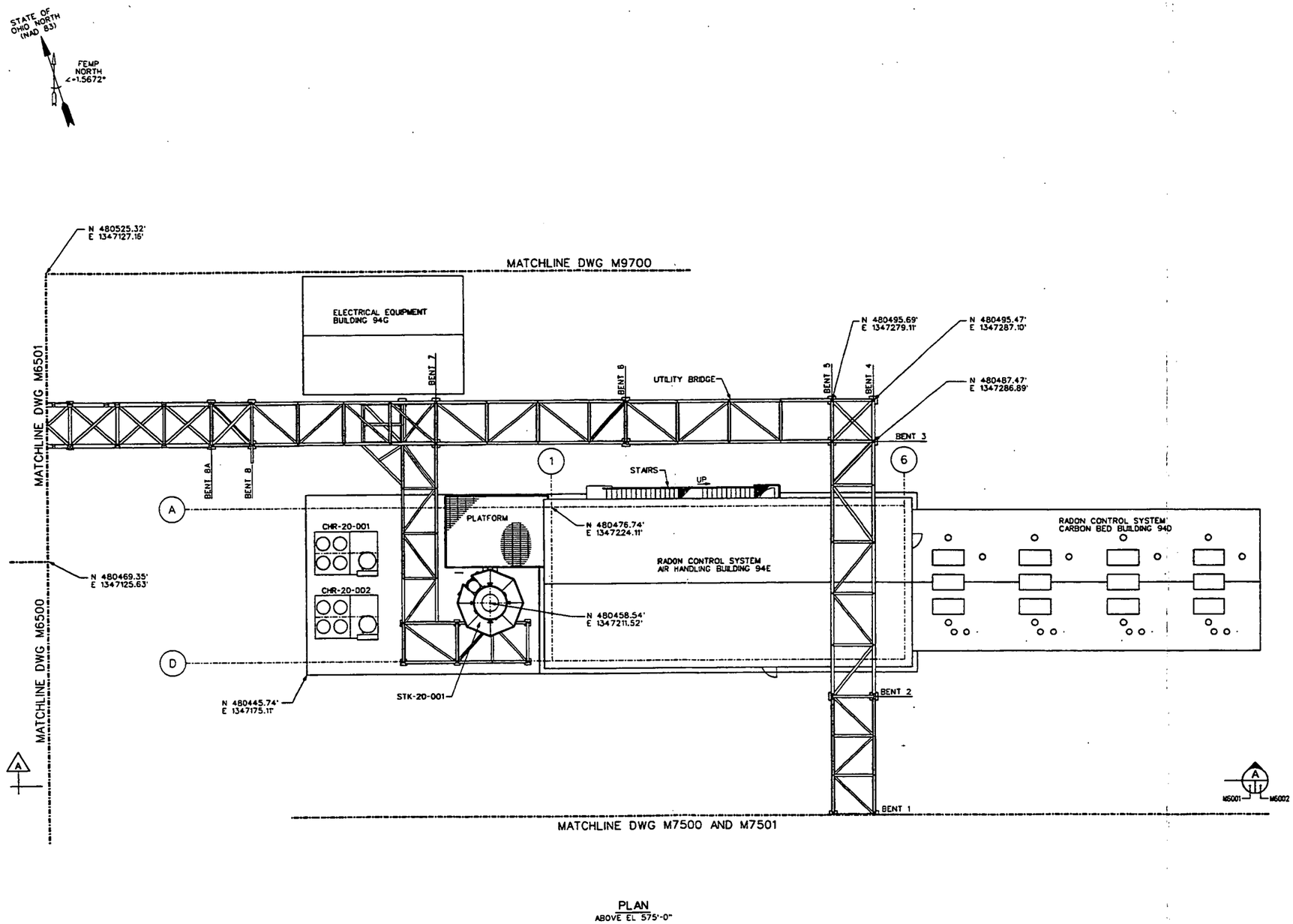


PLAN
ABOVE EL 575'-0"

NOTES:

4448

REF DWG NO.	DRAWING TITLE
M6000	MECHANICAL, GENERAL ARRANGEMENT OVERALL PLAN
N6000	INSTRUMENTATION, PIPING AND INSTRUMENTATION DIAGRAM PIPING, VALVES AND MISCELLANEOUS, SHEET 1 OF 3
N6001	INSTRUMENTATION, PIPING AND INSTRUMENTATION DIAGRAM INSTRUMENTATION, SHEET 2 OF 3
N6002	INSTRUMENTATION, PIPING AND INSTRUMENTATION DIAGRAM EQUIPMENT AND MISCELLANEOUS, SHEET 3 OF 3

REV. NO.	ISSUE OR REVISION PURPOSE - DESCRIPTION	DATE	REV. BY	APPR.
0	ISSUED TO CONSTRUCTION	05/29/02		

INITIALS AND DATE

000313

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

SECTION AND DETAIL KEY

8 0 8 16 24 FT
SCALE: 1/8" = 1'-0"

UNITED STATES DEPARTMENT OF ENERGY
FERNALD ENVIRONMENTAL MANAGEMENT PROJECT

THIS DRAWING PREPARED BY
JACOBS
125 Broadway Ave.
Oak Ridge, Tennessee 37830
Tel: 865-220-4600
Fax: 865-220-6170

PROJECT NAME
AWR BOP OPTIMIZATION

DRAWING TITLE
MECHANICAL
GENERAL ARRANGEMENT
UTILITY BRIDGE AND FACILITY PLAN

DRAWN BY	DATE	TECHNICAL LEAD	DATE	CHECKED BY	DATE
	05/29/02		5/29/02		5/29/02

PLANT/BLDG. NO. | FLOOR | SCALE 1/8" = 1'-0" | CLASS U

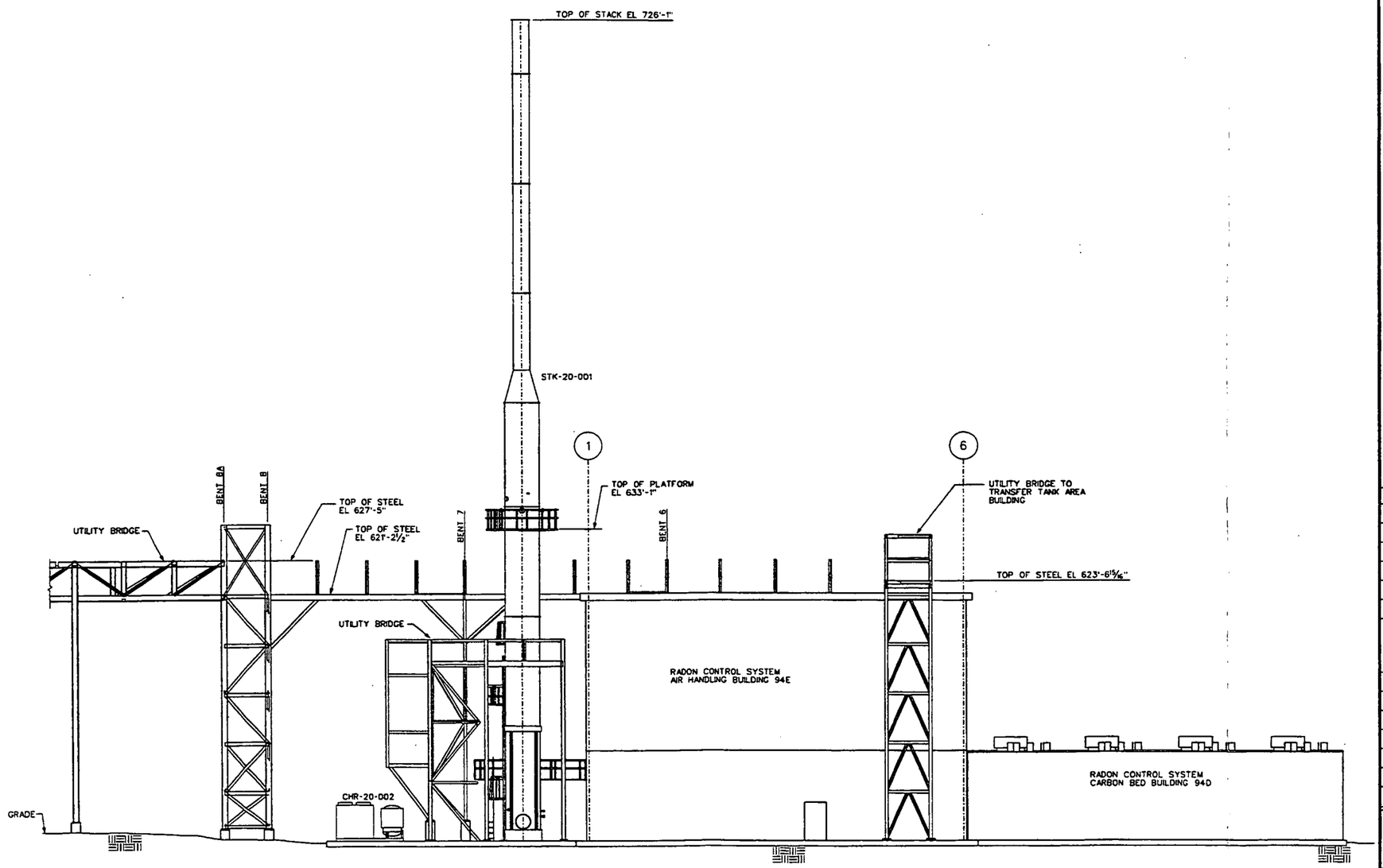
SUBMITTED FOR 30% ISSUE — TECH LEAD — DATE
SUBMITTED FOR 60% ISSUE — TECH LEAD — DATE
SUBMITTED FOR 90% ISSUE — TECH LEAD — DATE

T.O. NUMBER	PROJECT NO.	DRAWING INDEX CODE NO.	SHEET NO.	REV. NO.
N/A	40710	94X-3900-M-01838	M6001	0

JEG PROJECT NO. 35H19606 | FILENAME 94XM1838.DGN

DATE: 05/29/02 TIME: 11:34:48 AM | USER: rw\ DESIGN FILE: J:\Eap\Dwg\94xm1838.dgn

-4448



SECTION
LOOKING NORTH
A
M6001 M6002

000314

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

SECTION AND DETAIL KEY

8 0 8 16 24 FT
SCALE: 1/8" = 1'-0"

REF DWG NO.	DRAWING TITLE
M6000	MECHANICAL, GENERAL ARRANGEMENT OVERALL PLAN
N6000	INSTRUMENTATION, PIPING AND INSTRUMENTATION DIAGRAM PIPING, VALVES AND MISCELLANEOUS, SHEET 1 OF 3
N6001	INSTRUMENTATION, PIPING AND INSTRUMENTATION DIAGRAM INSTRUMENTATION, SHEET 2 OF 3
N6002	INSTRUMENTATION, PIPING AND INSTRUMENTATION DIAGRAM EQUIPMENT AND MISCELLANEOUS, SHEET 3 OF 3

REV. NO.	ISSUE OR REVISION PURPOSE - DESCRIPTION	DATE	REV. BY	APPR.
0	ISSUED TO CONSTRUCTION	05/29/02	JCM	JWH

INITIALS AND DATE

UNITED STATES DEPARTMENT OF ENERGY
FERNALD ENVIRONMENTAL MANAGEMENT PROJECT

THIS DRAWING PREPARED BY
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Fax: 865-220-6170

PROJECT NAME
AWR BOP OPTIMIZATION

DRAWING TITLE
MECHANICAL
GENERAL ARRANGEMENT
UTILITY BRIDGE AND FACILITY SECTION

DRAWN BY	DATE	TECHNICAL LEAD	DATE	CHECKED BY	DATE
Ferri	05/29/02	Michael Hilton	5/29/02	J. D. Nelson	5/29/02

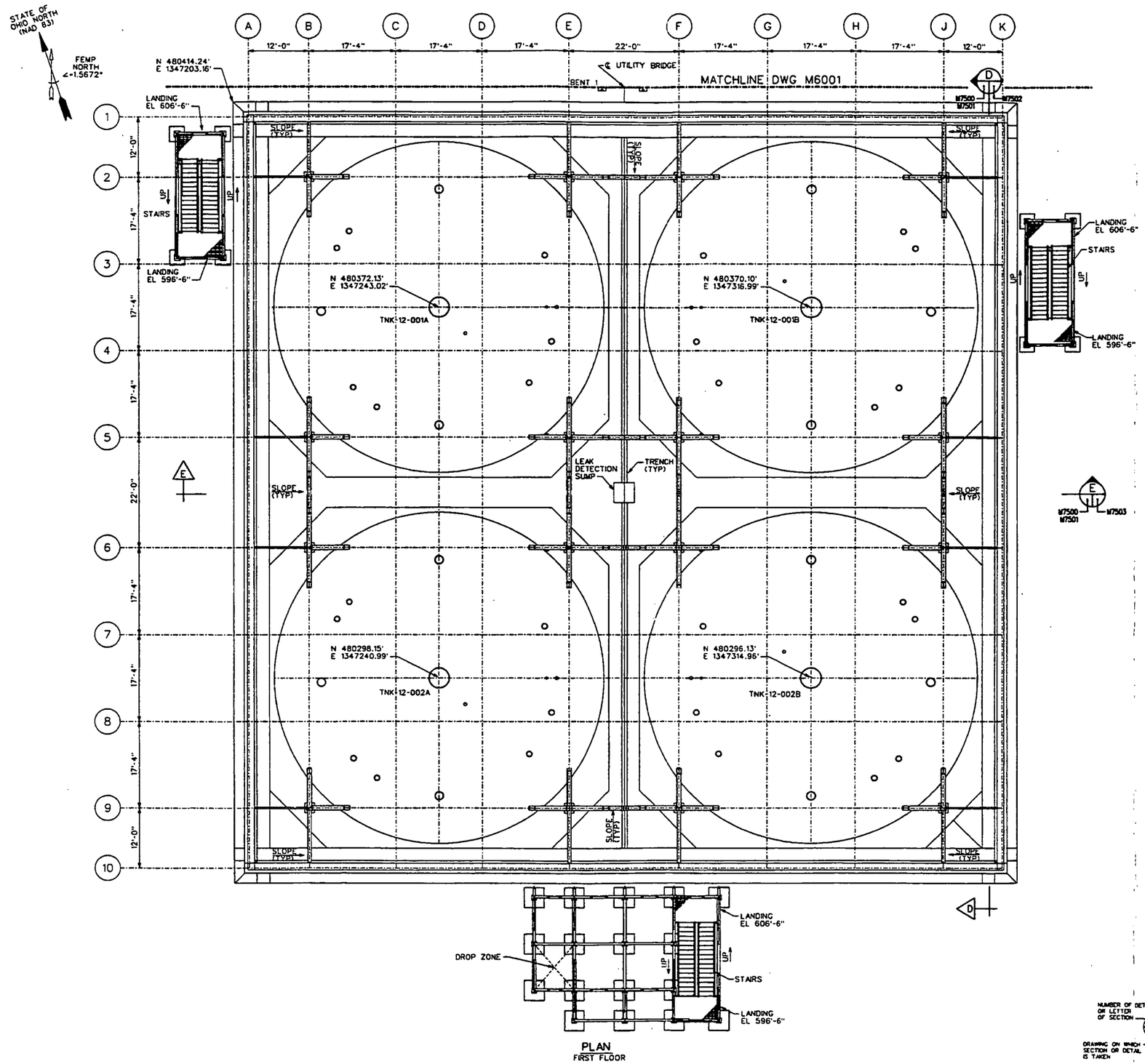
PLANT/BLDG. NO.	FLOOR	SCALE	CLASS
		1/8" = 1'-0"	U

SUBMITTED FOR 30% ISSUE	SUBMITTED FOR 60% ISSUE	SUBMITTED FOR 90% ISSUE
TECH LEAD	TECH LEAD	TECH LEAD
DATE	DATE	DATE

T.D. NUMBER	PROJECT NO.	DRAWING INDEX CODE NO.	SHEET NO.	REV. NO.
N/A	40710	94X-3900-M-01839	M6002	0

JEC PROJECT NO.	FILENAME
35H19606	94XM1839.DGN

DATE: 05/29/02
TIME: 12:28:50 PM
USER: rh\
DESIGN FILE: j:\Eqp\Dwg\94xm1839.dgn



PLAN
FIRST FLOOR

NOTES:

4448

REF DWG NO.	DRAWING TITLE
M6000	MECHANICAL, GENERAL ARRANGEMENT OVERALL PLAN
N6000	INSTRUMENTATION, PIPING AND INSTRUMENTATION DIAGRAM PIPING, VALVES AND MISCELLANEOUS, SHEET 1 OF 3
N6001	INSTRUMENTATION, PIPING AND INSTRUMENTATION DIAGRAM INSTRUMENTATION, SHEET 2 OF 3
N6002	INSTRUMENTATION, PIPING AND INSTRUMENTATION DIAGRAM EQUIPMENT AND MISCELLANEOUS, SHEET 3 OF 3

REV. NO.	ISSUE OR REVISION PURPOSE - DESCRIPTION	DATE	REV. BY	APPR.
0	ISSUED TO CONSTRUCTION	05/29/02	[illegible]	[illegible]

INITIALS AND DATE

000315

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

SECTION AND DETAIL KEY

8 0 8 16 24 FT
SCALE: 1/8"= 1'-0"

UNITED STATES DEPARTMENT OF ENERGY
FERNALD ENVIRONMENTAL MANAGEMENT PROJECT

THIS DRAWING PREPARED BY

JACOBS
125 Broadway Ave.
Oak Ridge, Tennessee 37830
Tel: 863-220-6000
Fax: 863-220-6179

PROJECT NAME
AWR BOP OPTIMIZATION

DRAWING TITLE
MECHANICAL
GENERAL ARRANGEMENT
TRANSFER TANK AREA BUILDING FIRST FLOOR

DRAWN BY	DATE	TECHNICAL LEAD	DATE	CHECKED BY	DATE
[illegible]	05/29/02	[illegible]	5/29/02	[illegible]	5/29/02

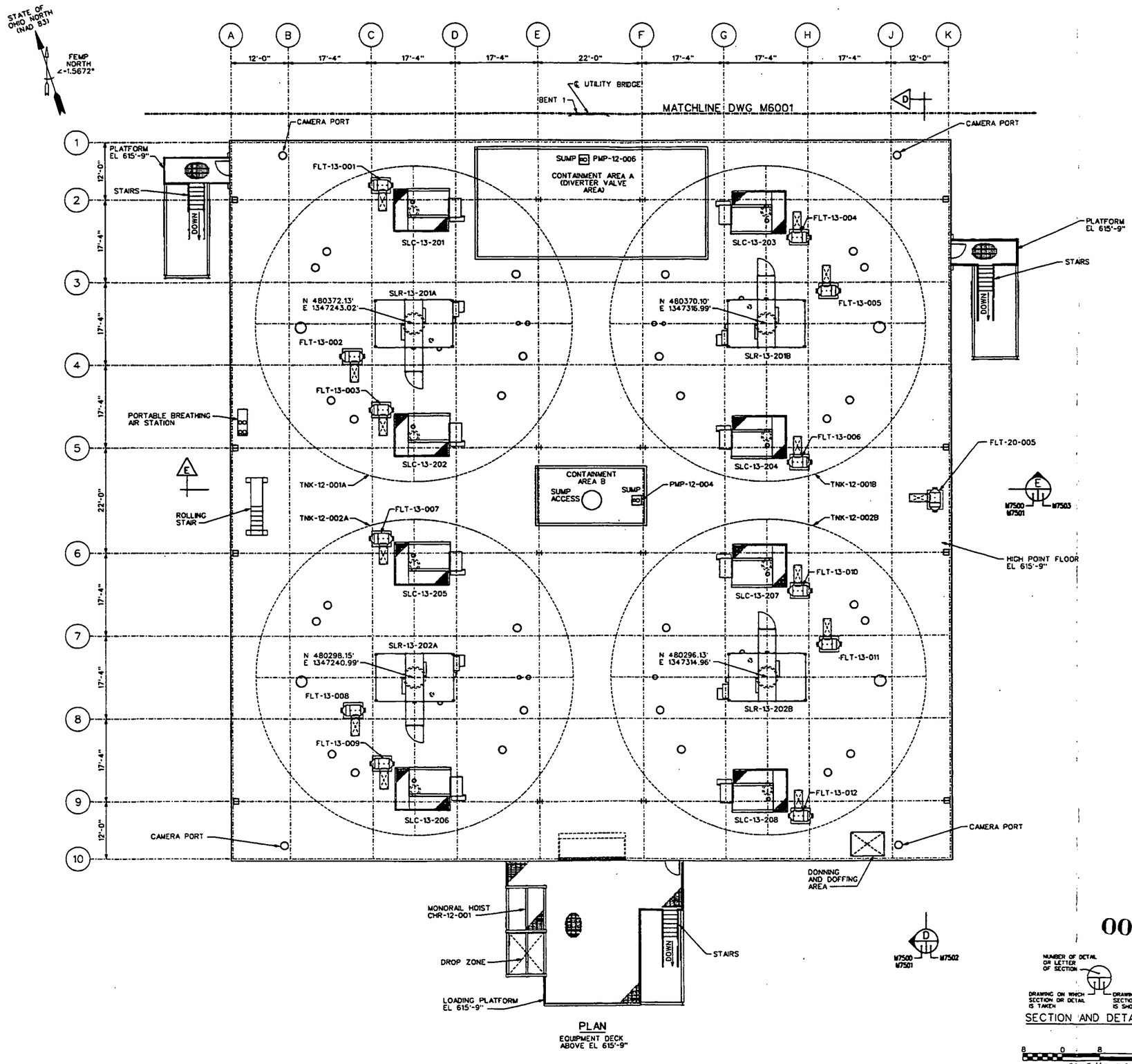
PLANT/BLDG. NO.	FLOOR	SCALE	CLASS
		1/8"=1'-0"	U

SUBMITTED FOR 30% ISSUE	SUBMITTED FOR 60% ISSUE	SUBMITTED FOR 90% ISSUE
TECH LEAD	TECH LEAD	TECH LEAD
DATE	DATE	DATE

T.O. NUMBER	PROJECT NO.	DRAWING INDEX CODE NO.	SHEET NO.	REV. NO.
N/A	40710	94X-3900-M-01840	M7500	0

JEG PROJECT NO.	FILENAME
35H19606	94XM1840.DGN

DATE: 05/29/02
TIME: 11:33:07 AM
USER: hh
DESIGN FILE: J:\Eap\Dwg\94xm1840.dgn



PLAN
EQUIPMENT DECK ABOVE EL 615'-9"

000316

NOTES:

4448

REF DWG NO.	DRAWING TITLE
M6000	MECHANICAL, GENERAL ARRANGEMENT OVERALL PLAN
N6000	INSTRUMENTATION, PIPING AND INSTRUMENTATION DIAGRAM PIPING, VALVES AND MISCELLANEOUS, SHEET 1 OF 3
N6001	INSTRUMENTATION, PIPING AND INSTRUMENTATION DIAGRAM INSTRUMENTATION, SHEET 2 OF 3
N6002	INSTRUMENTATION, PIPING AND INSTRUMENTATION DIAGRAM EQUIPMENT AND MISCELLANEOUS, SHEET 3 OF 3

REV. NO.	ISSUE OR REVISION PURPOSE - DESCRIPTION	DATE	REV. BY	APPR.
0	ISSUED TO CONSTRUCTION	05/29/02	DJM	ML

INITIALS AND DATE

UNITED STATES DEPARTMENT OF ENERGY
FERNALD ENVIRONMENTAL MANAGEMENT PROJECT

THIS DRAWING PREPARED BY
JE JACOBS
125 Broadway Ave., Oak Ridge, Tennessee 37830
Tel: 865-220-4000
Fax: 865-220-6170

PROJECT NAME
AWR BOP OPTIMIZATION

DRAWING TITLE
MECHANICAL
GENERAL ARRANGEMENT
TRANSFER TANK AREA BUILDING EQUIPMENT DECK

DRAWN BY	DATE	TECHNICAL LEAD	DATE	CHECKED BY	DATE
[illegible]	05/29/02	[illegible]	5/29/02	[illegible]	5/29/02

PLANT/BLDG. NO.	FLOOR	SCALE	CLASS
		1/8" = 1'-0"	U

SUBMITTED FOR 30% ISSUE	SUBMITTED FOR 60% ISSUE	SUBMITTED FOR 90% ISSUE
TECH LEAD	TECH LEAD	TECH LEAD
DATE	DATE	DATE

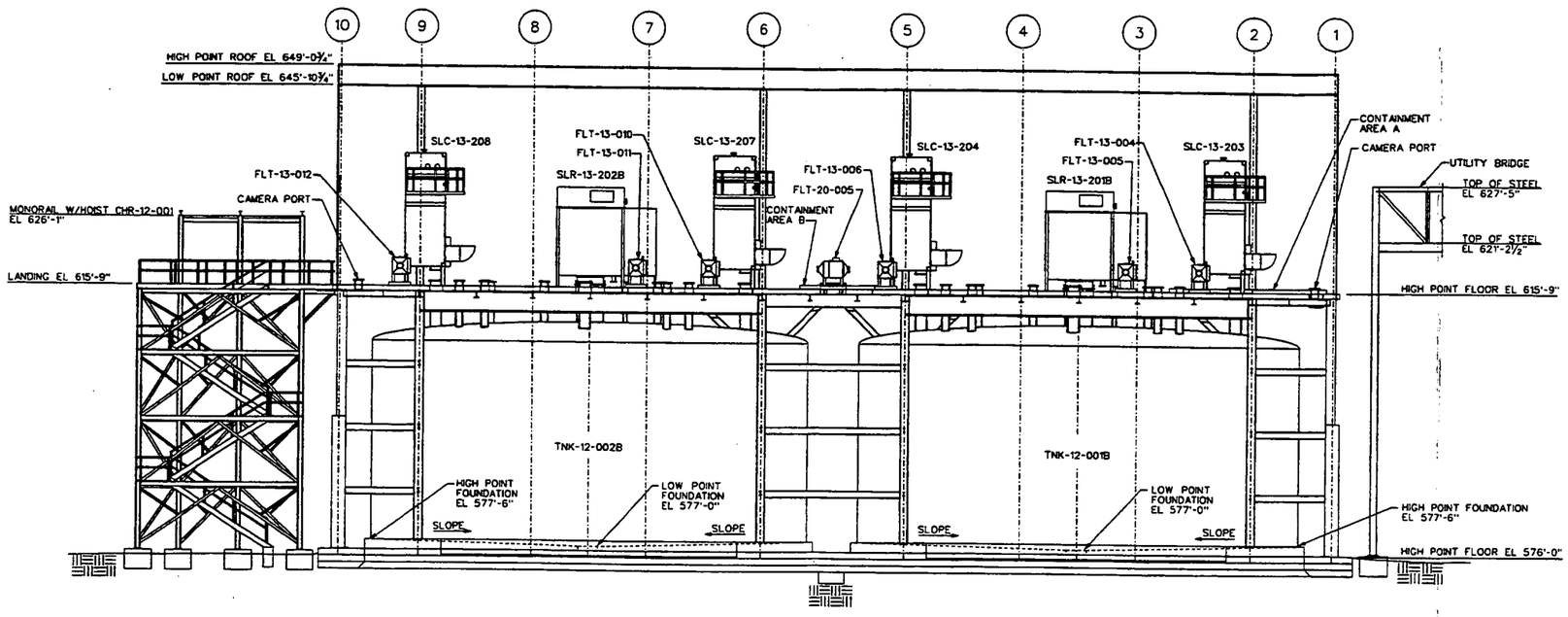
T.O. NUMBER	PROJECT NO.	DRAWING INDEX CODE NO.	SHEET NO.	REV. NO.
N/A	40710	94X-3900-M-01841	M7501	0

JEC PROJECT NO. 35H19606 FILENAME 94XM1841.DGN

DATE: 05/29/02
USER: NA

NOTES:

4448



SECTION
LOOKING WEST

D
M7500 M7501 M7502

000317

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

SECTION AND DETAIL KEY

8 0 8 16 24 FT
SCALE: ⅛" = 1'-0"

REF DWG NO.	DRAWING TITLE
M6000	MECHANICAL, GENERAL ARRANGEMENT OVERALL PLAN
N6000	INSTRUMENTATION, PIPING AND INSTRUMENTATION DIAGRAM PIPING, VALVES AND MISCELLANEOUS, SHEET 1 OF 3
N6001	INSTRUMENTATION, PIPING AND INSTRUMENTATION DIAGRAM INSTRUMENTATION, SHEET 2 OF 3
N6002	INSTRUMENTATION, PIPING AND INSTRUMENTATION DIAGRAM EQUIPMENT AND MISCELLANEOUS, SHEET 3 OF 3

REV. NO.	ISSUE OR REVISION PURPOSE - DESCRIPTION	DATE	REV. BY	APPR.
0	ISSUED TO CONSTRUCTION	05/29/02	[illegible]	[illegible]

INITIALS AND DATE

UNITED STATES DEPARTMENT OF ENERGY
FERNALD ENVIRONMENTAL MANAGEMENT PROJECT

THIS DRAWING PREPARED BY
JACOBS
125 Broadway Ave.
Oak Ridge, Tennessee 37830
Tel: 865-220-6800
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PROJECT NAME
AWR BOP OPTIMIZATION

DRAWING TITLE
MECHANICAL
GENERAL ARRANGEMENT
TRANSFER TANK AREA BUILDING SECTION

DRAWN BY	DATE	TECHNICAL LEAD	DATE	CHECKED BY	DATE
[illegible]	05/29/02	[illegible]	5/29/02	[illegible]	5/29/02

PLANT/BLDG. NO.	FLOOR	SCALE	CLASS
		⅛" = 1'-0"	U

SUBMITTED FOR 30% ISSUE	SUBMITTED FOR 60% ISSUE	SUBMITTED FOR 90% ISSUE
TECH LEAD	TECH LEAD	TECH LEAD
DATE	DATE	DATE

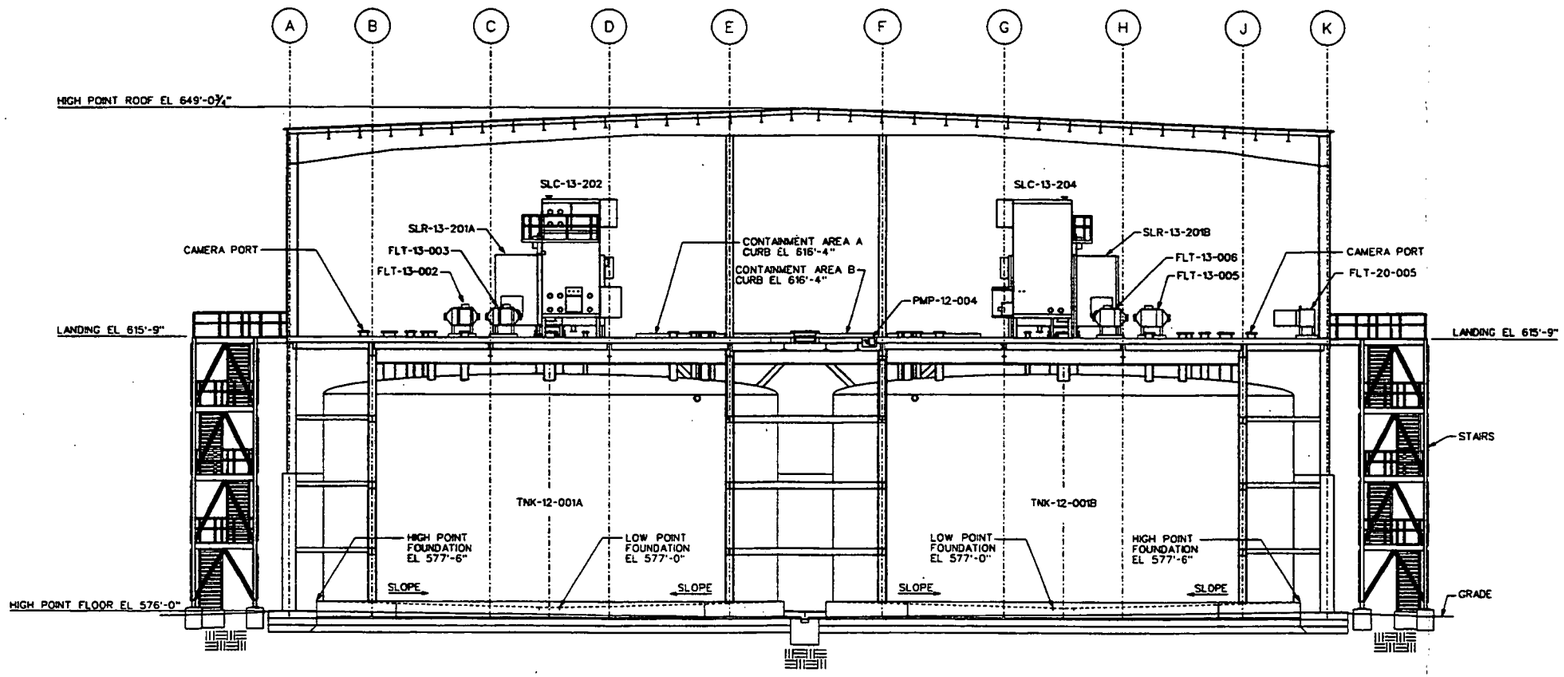
T.O. NUMBER	PROJECT NO.	DRAWING INDEX CODE NO.	SHEET NO.	REV. NO.
N/A	40710	94X-3900-M-01842	M7502	0

JEG PROJECT NO.	FILENAME
35H19606	94XM1842.DGN

DATE: 05/29/02
TIME: 11:33:50 AM
USER: [illegible]
DESIGN FILE: [illegible]

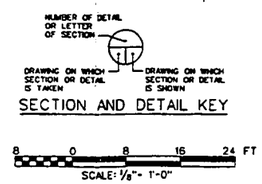
NOTES:

4448



SECTION
LOOKING NORTH
E
M7500
M7501
M7503

000318



SECTION AND DETAIL KEY

8 0 8 16 24 FT
SCALE: ⅛"= 1'-0"

REF DWG NO.	DRAWING TITLE
M6000	MECHANICAL, GENERAL ARRANGEMENT OVERALL PLAN
N6000	INSTRUMENTATION, PIPING AND INSTRUMENTATION DIAGRAM PIPING, VALVES AND MISCELLANEOUS, SHEET 1 OF 3
N6001	INSTRUMENTATION, PIPING AND INSTRUMENTATION DIAGRAM INSTRUMENTATION, SHEET 2 OF 3
N6002	INSTRUMENTATION, PIPING AND INSTRUMENTATION DIAGRAM EQUIPMENT AND MISCELLANEOUS, SHEET 3 OF 3

REV. NO.	ISSUE OR REVISION PURPOSE - DESCRIPTION	DATE	REV. BY	APPR.
0	ISSUED TO CONSTRUCTION	05/29/02	JDN	[illegible]

INITIALS AND DATE

UNITED STATES DEPARTMENT OF ENERGY
FERNALD ENVIRONMENTAL MANAGEMENT PROJECT

THIS DRAWING PREPARED BY
JACOBS
125 Broadway Ave.
Oak Ridge, Tennessee 37830
Tel: 865-220-4800
Fax: 865-220-4170

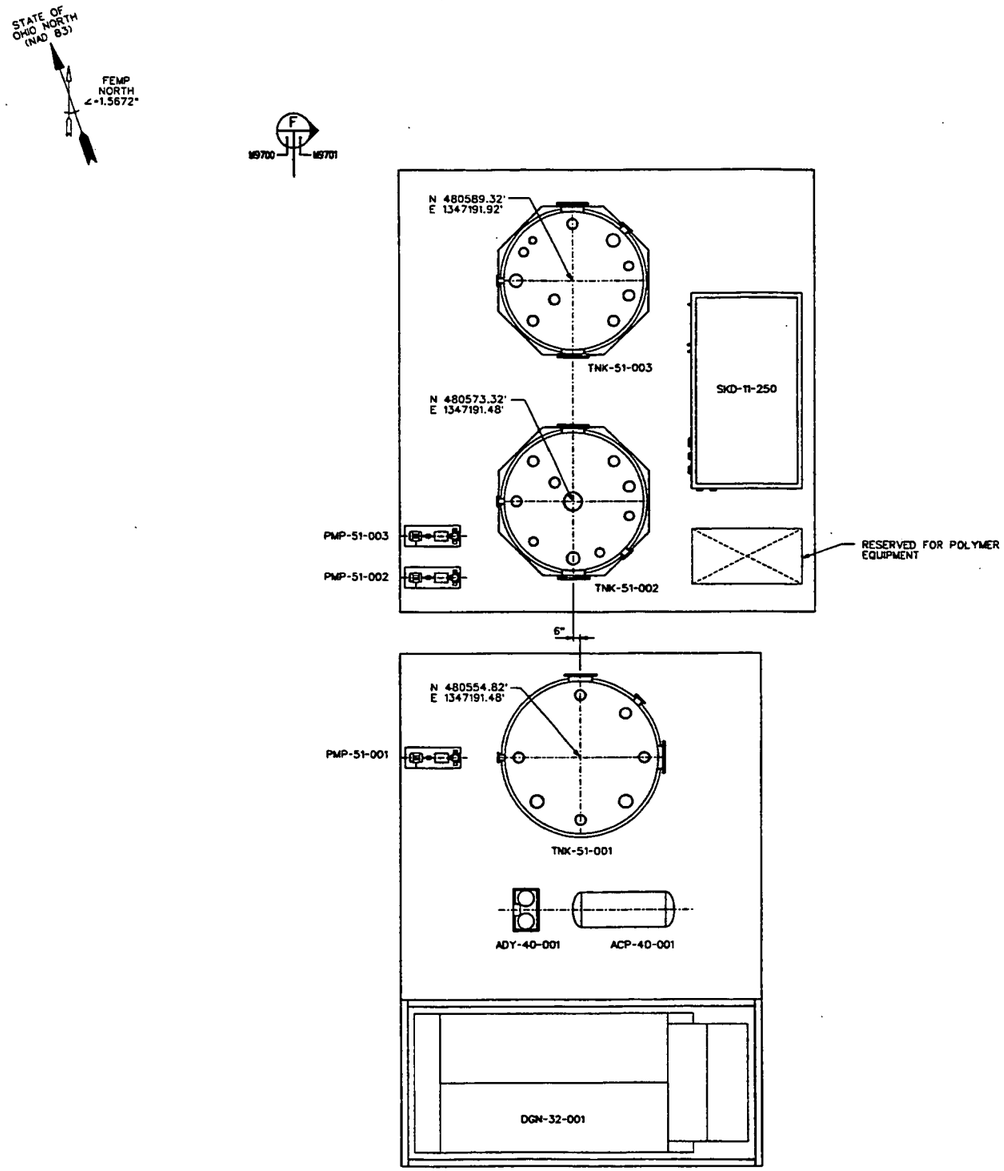
PROJECT NAME
AWR BOP OPTIMIZATION

DRAWING TITLE
MECHANICAL
GENERAL ARRANGEMENT
TRANSFER TANK AREA BUILDING SECTION

DRAWN BY	DATE	TECHNICAL LEAD	DATE	CHECKED BY	DATE
[illegible]	05/29/02	[illegible]	5/29/02	[illegible]	5/29/02
PLANT/BLDG. NO.		FLOOR		SCALE ⅛" = 1'-0"	CLASS U
SUBMITTED FOR 30% ISSUE		SUBMITTED FOR 60% ISSUE		SUBMITTED FOR 90% ISSUE	
TECH LEAD		TECH LEAD		TECH LEAD	
DATE		DATE		DATE	

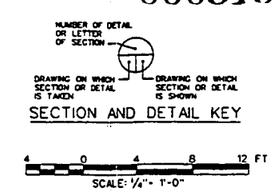
T.O. NUMBER	PROJECT NO.	DRAWING INDEX CODE NO.	SHEET NO.	REV. NO.
N/A	40710	94X-3900-M-02367	M7503	0
JEC PROJECT NO. 35H19606	FILENAME 94XM2367.DGN			

DATE: 05/29/02
TIME: 8:34:30 AM
USER: rn\
DESIGN FILE: j:\Eqp\Dwg\94xm2367.dgn



PLAN
ABOVE EL 575'-0"

000319



SECTION AND DETAIL KEY

NOTES:

4448

REF DWG NO.	DRAWING TITLE
M6000	MECHANICAL, GENERAL ARRANGEMENT OVERALL PLAN
N5000	INSTRUMENTATION, PIPING AND INSTRUMENTATION DIAGRAM PIPING, VALVES AND MISCELLANEOUS, SHEET 1 OF 3
N6001	INSTRUMENTATION, PIPING AND INSTRUMENTATION DIAGRAM INSTRUMENTATION, SHEET 2 OF 3
N6002	INSTRUMENTATION, PIPING AND INSTRUMENTATION DIAGRAM EQUIPMENT AND MISCELLANEOUS, SHEET 3 OF 3

REV. NO.	ISSUE OR REVISION PURPOSE - DESCRIPTION	DATE	REV. BY	APPR.
0	ISSUED TO CONSTRUCTION	05/29/02		

DETAILS AND DATE

UNITED STATES DEPARTMENT OF ENERGY
FERNALD ENVIRONMENTAL MANAGEMENT PROJECT

THIS DRAWING PREPARED BY
JACOBS

PROJECT NAME
AWR BOP OPTIMIZATION

DRAWING TITLE
MECHANICAL
GENERAL ARRANGEMENT
MAKE-UP WATER TANK AREA PLAN

DRAWN BY	DATE	TECHNICAL LEAD	DATE	CHECKED BY	DATE
	05/29/02		5/30/02		5/30/02

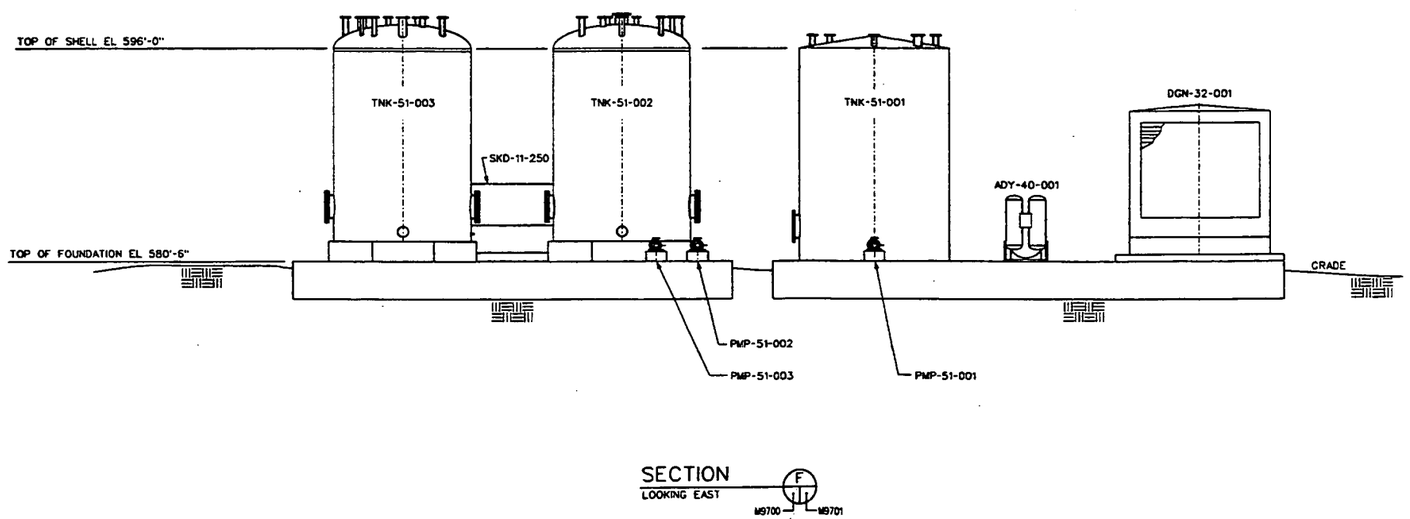
PLANT/BLDG. NO.	FLOOR	SCALE	CLASS
		1/4" = 1'-0"	U

SUBMITTED FOR 30% ISSUE	SUBMITTED FOR 60% ISSUE	SUBMITTED FOR 90% ISSUE
TECH LEAD	TECH LEAD	TECH LEAD
DATE	DATE	DATE

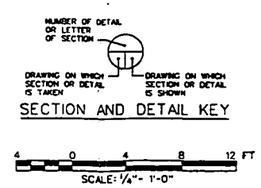
T.O. NUMBER	PROJECT NO.	DRAWING INDEX CODE NO.	SHEET NO.	REV. NO.
N/A	4071D	94X-3900-M-01843	M9700	0

JE PROJECT NO.	FILENAME
35H19606	94XM1843.DGN

DATE: 05/29/02
TIME: 8:34:08 AM
USER: N\
DESIGN FILE: J:\Eap\Dwg\94xm1843.dgn



000320



NOTES:

4448

REF DWG NO.	DRAWING TITLE
M6000	MECHANICAL, GENERAL ARRANGEMENT OVERALL PLAN
N6000	INSTRUMENTATION, PIPING AND INSTRUMENTATION DIAGRAM PIPING, VALVES AND MISCELLANEOUS, SHEET 1 OF 3
N6001	INSTRUMENTATION, PIPING AND INSTRUMENTATION DIAGRAM INSTRUMENTATION, SHEET 2 OF 3
N6002	INSTRUMENTATION, PIPING AND INSTRUMENTATION DIAGRAM EQUIPMENT AND MISCELLANEOUS, SHEET 3 OF 3

REV. NO.	ISSUE OR REVISION PURPOSE - DESCRIPTION	DATE	REV. BY	APPR.
0	ISSUED TO CONSTRUCTION	05/29/02	[illegible]	[illegible]

INITIALS AND DATE

UNITED STATES DEPARTMENT OF ENERGY
FERNALD ENVIRONMENTAL MANAGEMENT PROJECT

THIS DRAWING PREPARED BY

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125 Broadway Ave.
Oak Ridge, Tennessee 37830
Tel: 865-220-4000
Fax: 865-220-4119

PROJECT NAME
AWR BOP OPTIMIZATION

DRAWING TITLE
MECHANICAL
GENERAL ARRANGEMENT
MAKE-UP WATER TANK AREA SECTION

DRAWN BY	DATE	TECHNICAL LEAD	DATE	CHECKED BY	DATE
[illegible]	05/29/02	[illegible]	[illegible]	[illegible]	5/29/02

PLANT/BLDG. NO.	FLOOR	SCALE	CLASS
		1/4"=1'-0"	U

SUBMITTED FOR 30% ISSUE	SUBMITTED FOR 60% ISSUE	SUBMITTED FOR 90% ISSUE
TECH LEAD	TECH LEAD	TECH LEAD
DATE	DATE	DATE

T.O. NUMBER	PROJECT NO.	DRAWING INDEX CODE NO.	SHEET NO.	REV. NO.
N/A	40710	94X-3900-M-02368	M9701	0

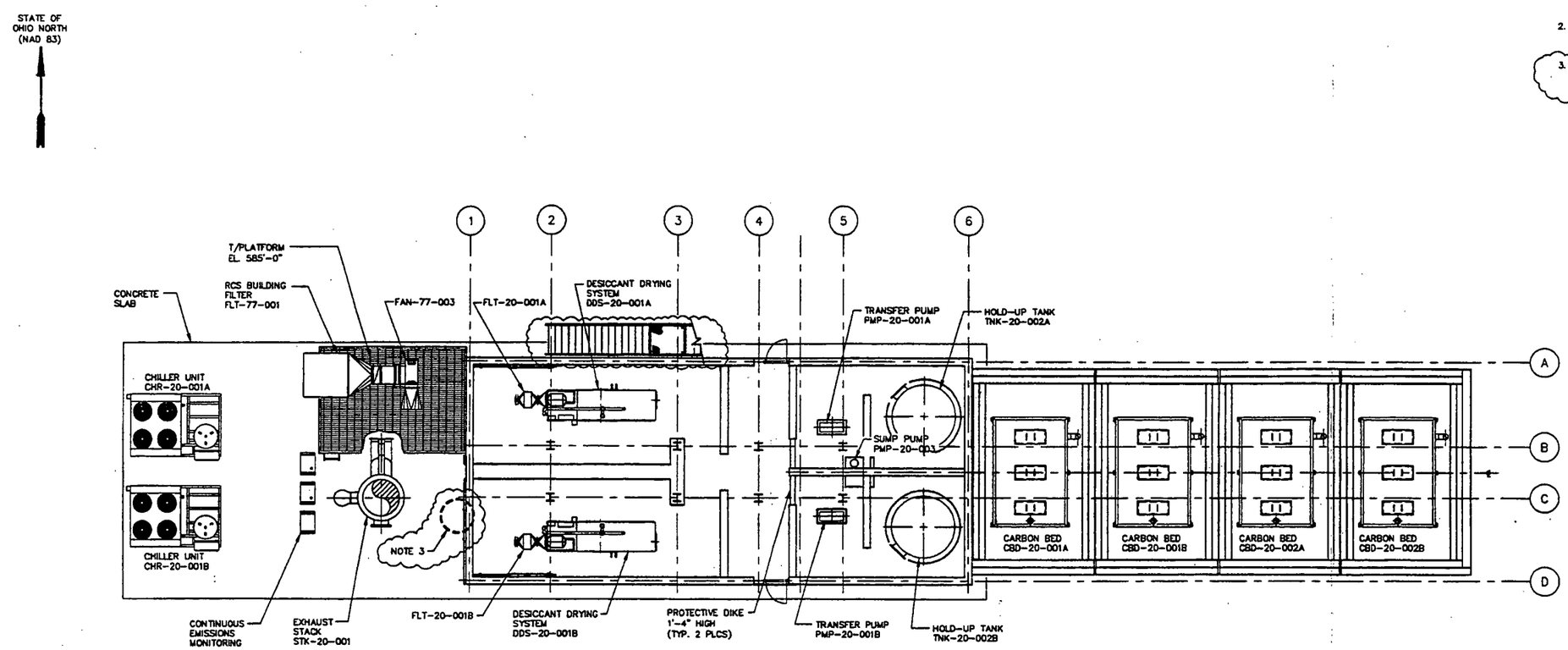
JEG PROJECT NO.	FILENAME
35H19606	94XM2368.DGN

DATE: 05/29/02
TIME: 14:34:54 AM
USER: [illegible]
DESIGN FILE: J:\Eco\Dwg\94xm2368.dgn

NOTES:

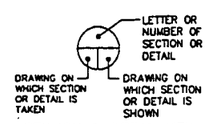
1. FOR CLARITY SYSTEM 20 RCS AND SYSTEM 77 MISCELLANEOUS HVAC FACILITIES HVAC SYSTEM ARE PRESENTED ON SYSTEM 20 DRAWINGS.
2. SHIELDING CANOPY ABOVE FILTERS FLT-20-001A/B IS NOT SHOWN FOR CLARITY.
3. PLATFORM, LADDER AND DOOR WERE REMOVED BY TITLE III ENGINEERING PER DCN 40710-DCN-086.

4448



CARBON BUILDING (94D)
AIR HANDLING BUILDING (94E)
FIRST FLOOR PLAN (@EL 585'-0")
SCALE: 1/8"=1'-0"

000321



SECTION & DETAIL KEY

REV	DATE	BY	CHK'D	APRV'D	DESCRIPTION/ISSUE
4	05/15/00	JF	JA	JWL	REVISED PER DCNS 40710-JEG-085 AND 086
3	12/04/01	RS	BSM	SWH	REVISED PER DCNS 40710-JEG-029, 40710-JEG-005, AND AWR-OCH-M-0010
2	05/15/00	JG	GCH	KDR	REVISED PER CHANGE PROPOSAL CP-00-004
1	01/07/00	WCB	SWH	KDR	CERTIFIED FOR CONSTRUCTION
0	11/01/99	WCB	MBF		PRELIMINARY DESIGN SUBMITTAL

RPE SEAL NOT REQUIRED FOR JACOBS GENERATED REVISIONS

DRAWN BY	W C BLUME	01/07/00
DESIGNED BY	W C BLUME	01/07/00
CHECKED BY	S W HUNGATE	01/07/00
APPROVED BY	KENNETH RICKETT	01/07/00
APPROVED BY	JOHN LAWSON	01/07/00

JACOBS PROJECT NO. 35H19606
FERNALD PROJECT NO. 40710
FIRST JACOBS REVISION NO. 3

JACOBS

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

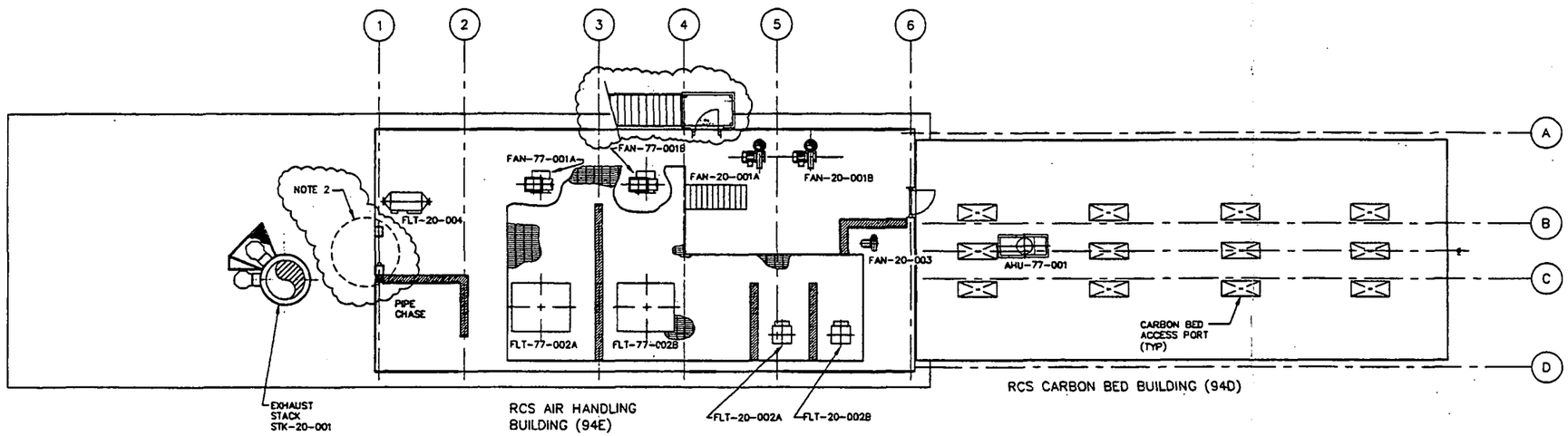
SIZE D | SCALE: 1/8"=1'-0" | DWG. NO. 20FMD027 | REV 4

FILENAME: 20FMD027.DWG

NOTES:
1. FOR CLARITY SYSTEM 20 RCS AND SYSTEM 77 MISCELLANEOUS HVAC FACILITIES HVAC SYSTEM ARE PRESENTED ON SYSTEM 20 DRAWINGS.
2. PLATFORM, LADDER AND DOOR WERE REMOVED BY TITLE III ENGINEERING PER DCN 40710-JEG-086.

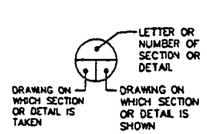
4448

STATE OF OHIO NORTH (NAD 83)



CARBON BED BUILDING (94D)
AIR HANDLING BUILDING (94E)
SECOND FLOOR PLAN (@ EL 601'-0")
SCALE: 1/8"=1'-0"

000322



SECTION & DETAIL KEY

REV	DATE	BY	CHK'D	APR'VD	DESCRIPTION/ISSUE
4	[illegible]	[illegible]	[illegible]	[illegible]	REVISED PER DCN 40710-JEG-085 AND 086
3	12/04/01	RS	BSM	SWH	REVISED PER DCN NO. 40710-JEG-029
2	05/15/00	JG	GCH	KDR	REVISED PER CHANGE PROPOSAL CP-00-004
1	01/07/00	WCB	SWH	KDR	CERTIFIED FOR CONSTRUCTION
0	01/01/99	WCB	MBF		PRELIMINARY DESIGN SUBMITTAL

RPE: RPE SEAL NOT REQUIRED FOR JACOBS GENERATED REVISIONS

		DATE
DRAWN BY	W C BLUME	01/07/00
DESIGNED BY	W C BLUME	01/07/00
CHECKED BY	S W HUNGATE	01/07/00
APPROVED BY	KENNETH RICKETT	01/07/00
APPROVED BY	JOHN LAWSON	01/07/00

JACOBS PROJECT NO. 35H19606
FORNALD PROJECT NO. 40710
FIRST JACOBS REVISION NO. 3

JE JACOBS

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	SCALE	DWG. NO.	REV
D	1/8"=1'-0"	20FMD028	4

FILENAME: 20FMD028.DWG