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SOUTH FIELD EXTRACTION SYSTEM FUNCTIONAL REQUIREMENTS AND DESIGN BASIS DOCUMENT - OPERABLE UNIT 5 - PROJECT ORDER 126 - MAY 1995 - REVISION 0

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South Field Extraction System Functional Requirements and Design Basis Document

Operable Unit 5
Project Order 126
May 1995
Revision 0

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

Fairfield Executive Center
6120 South Gilmore Road
Fairfield, Ohio 45014

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APPROVED FOR ISSUE

Approved By:

Richard W. Brettin 5-12-95

Richard W. Brettin, Project Manager, CRU-5, PARSONS — Date

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South Field Extraction System Functional Requirements and Design Basis Document

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LIST OF ACRONYMS AND ABBREVIATIONS

AASHTO	American Association of State Highway and Transportation Officials
ANSI	American National Standards Institute
ARAR	Applicable or Relevant and Appropriate Requirements
ASCE	American Society of Civil Engineers
ASTM	American Society for Testing and Materials
AWWA	American Water Works Association
AWWT	Advanced Wastewater Treatment
CDR	Conceptual Design Report
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CFR	Code of Federal Regulations
CRU	CERCLA/RCRA Unit
D&D	Decontamination and decommissioning
DCP	Design Criteria Package
DOE	United States Department of Energy
FAST	Functional Analysis System Technique
FEMP	Fernald Environmental Management Project
FERMCO	Fernald Environmental Restoration Management Corporation
FR&DBD	Functional Requirements and Design Basis Document
FRD	Functional Requirements Document
gpm	gallons per minute
HDPE	High-Density Polyethylene
IAWWT	Interim Advanced Wastewater Treatment
MSS	Manufacturers Standardization Society
NFPA	National Fire Protection Agency
NPDES	National Pollutant Discharge Elimination System
ODOT	Ohio Department of Transportation
OU	Operable Unit
ppb	parts per billion
psig	pounds per square inch gage
PWS	Public Water Supply
RCRA	Resource Conservation and Recovery Act
SCS	Soil Conservation Service
SFES	South Field Extraction System
SPIT	South Plume Interim Treatment

LIST OF ACRONYMS AND ABBREVIATIONS (Continued)

S/RID	Standards/Requirements Identification Documents
SSC	Structure, System, and Component
SWRB	Stormwater Retention Basin
TBC	To Be Considered
TBD	To Be Determined
UCRL	University of California Research Laboratory

SECTION 1

PROJECT DESCRIPTION

This Functional Requirements and Design Basis Document (FR&DBD) documents the results of the Preliminary (Title I) Design for the South Field Extraction System (SFES).

1.1 Background

The Fernald Environmental Management Project (FEMP), located at Fernald, Ohio, is being remediated pursuant to the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA). The FEMP is currently treating wastewater, stormwater runoff, and extracted groundwater for uranium removal prior to discharging it to the Great Miami River. Future remedial activities include recovery of large volumes of uranium-contaminated groundwater for subsequent treatment and discharge or reuse.

The South Plume is an area of elevated uranium concentration within the Great Miami Aquifer. The South Plume extends south of the production area and is currently being contained by the South Plume Removal Action 3. The primary purpose of the South Plume recovery system is to prevent the further southward spread of the groundwater contamination plume. The South Plume recovery system currently extracts approximately 1,500 gpm of contaminated Great Miami Aquifer groundwater for subsequent treatment and/or discharge to the Great Miami River.

Preliminary Great Miami Aquifer modeling based on the Sandia Waste Isolation Flow and Transport (SWIFT) code has determined that additional groundwater extraction systems will be required to comply with remediation goals established by the Operable Unit 5 (OU-5) Record of Decision (ROD). The SFES is intended to provide active remediation of the South Plume through groundwater extraction.

United States Department of Energy (DOE) Order 4700.1 requires the development of design criteria for each project. The criteria are based upon the functional parameters that the project must meet. The design criteria are further developed, validated, and expanded during a conceptual design phase. The preliminary stage of project design (Title I) utilizes the conceptual design and/or design criteria that have been prepared for the project as a design basis. According to DOE Order 4700.1, Title I design generally includes, but is not limited to:

1) Definition of project design criteria and establishment of quality levels for structures, systems, and components (SSCs)

2) Expansion of conceptual design drawings in greater detail or development of new drawings based on new design concepts

3) Development of outline specifications

4) Additional analysis of health, safety, and environmental protection

5) Development of preliminary cost estimates

Fernald Environmental Restoration Management Corporation (FERMCO) Engineering procedures provide guidelines for the preparation of a project-specific Functional Requirements Document (FRD), Conceptual Design Report (CDR), Design Criteria Package (DCP), and Preliminary (Title I) Design. FERMCO Engineering Procedure 12-4001 allows that for projects assigned Performance Grades of 4 and 5, the preparation of an FRD, a CDR, and a DCP is optional. In accordance with the FERMCO Safety Assessment for the South Field Extraction System (Appendix E), this project was determined to be an Industrial Facility (Performance Grade 5), thus, FERMCO did not require issuance of a separate FRD, CDR, or DCP.

1.2 Document Purpose

This FR&DBD was developed at FERMCO's discretion to meet the Title I Design requirements of DOE Order 4700.1 as applied in FERMCO Engineering procedures. This FR&DBD also includes functional and design requirements identified during Title I work. Some of these requirements may not be fully defined until the detailed design phase. This FR&DBD is, therefore, a dynamic document which may require revision during Title II design. This FR&DBD:

1) Provides a documented reference for use in Title II Design

2) Serves as a basis for technical reviews

3) Provides a documented reference to support operability evaluations or determinations for continued or modified operation

4) Provides a documented reference to support review of proposed changes to technical specifications

This FR&DBD provides information that identifies the specific functions to be performed by a structure, system, or component of a facility and the specific values or ranges of values chosen for controlling parameters for reference bounds for design. This document is based on restraints and requirements, which in turn are generated through calculations and analysis. This document will serve as the technical project baseline for proceeding with Title II Design and is formatted to follow the development of the project design from development of the functional requirements through preparation of the Title I Design. Section 1 includes a general description defining the project purpose, project scope and boundaries,

project interfaces, and project functional objectives. Section 2 provides the project design criteria and considerations. Section 3 provides the design basis for proceeding with detailed (Title II) design. In addition, the following information is provided in the appendices to this document:

1) Recommended performance grades for each SSC of the SFES.

2) Title I specifications, which consist of brief descriptions of materials, finishes, and methods to be used for the project

3) A preliminary list of design drawings which may be prepared during Title II Design

4) A Site Plan and a Preliminary Piping and Instrumentation Diagram

5) FERMCO Safety Assessment for the SFES

A preliminary project cost estimate, including life-cycle costs, will be provided as a separate document.

1.3 Project Objectives

The objectives of the SFES project include:

1) Extract uranium-contaminated groundwater from the Great Miami Aquifer by installing a number of extraction wells in the general vicinity of the South Field Area

2) Measure the flow and sample the effluent uranium concentration for each well.

3) Transport extracted groundwater from each well to treatment or direct discharge to the Great Miami River

The project design objectives also include:

1) Comply with all pertinent regulatory requirements, DOE Orders, and national codes and standards

2) Utilize existing transport and utility systems to the extent practicable

3) Provide for future expansion of the extraction system

4) Coordinate with current and future FEMP remedial activities

5) Minimize threats to worker health and safety and the environment

6) Provide an extraction system that is operable, maintainable, and constructable

7) Provide for future decommissioning and decontamination of the extraction system

8) Provide a design which meets all requirements for worker and public safety

1.4 Project Scope and Boundaries

The SFES project scope and boundaries are presented in Figure 1-1. The project scope and boundaries include:

1) South Field Extraction Wells: Based on preliminary groundwater modeling results, FERMCO provided design data for each new extraction well, including the well location and its extraction rate. The well design data are summarized in Section 5. The well locations were verified by field inspection, and some were relocated to more accessible areas.

2) Pumps: The project scope included the selection of pumps to provide the motive force for groundwater extraction and transport. The pump selection process included evaluating different pump types (i.e., vertical turbine, submersible), selecting the preferred pump type, and sizing the pump. Impacts to the FERMCO well design by the pump selection were also evaluated.

3) Transport Pipelines: Pipelines were preliminarily sized to accommodate both current and future flow. Pipeline materials were selected. Preliminary pipeline routings were selected.

4) Tie-Ins to Existing Systems: The SFES will tie into the following existing systems:
   (1) South Plume Removal Action Pipeline: Tie-in points were identified for detailed design. The South Plume pipeline capacity was verified as adequate for current and future flow.
   (2) Discharge to the Great Miami River: Tie-in points were identified for detailed design. The discharge pipeline capacity was verified as adequate for current and future flow. Tie-in point is upstream of the NPDES monitoring point.
   (3) AWWT Control Room: Tie-in points were identified for detailed design. The adequacy of AWWT Control Room equipment to monitor all SFES operating data and conditions will be evaluated during detailed design.

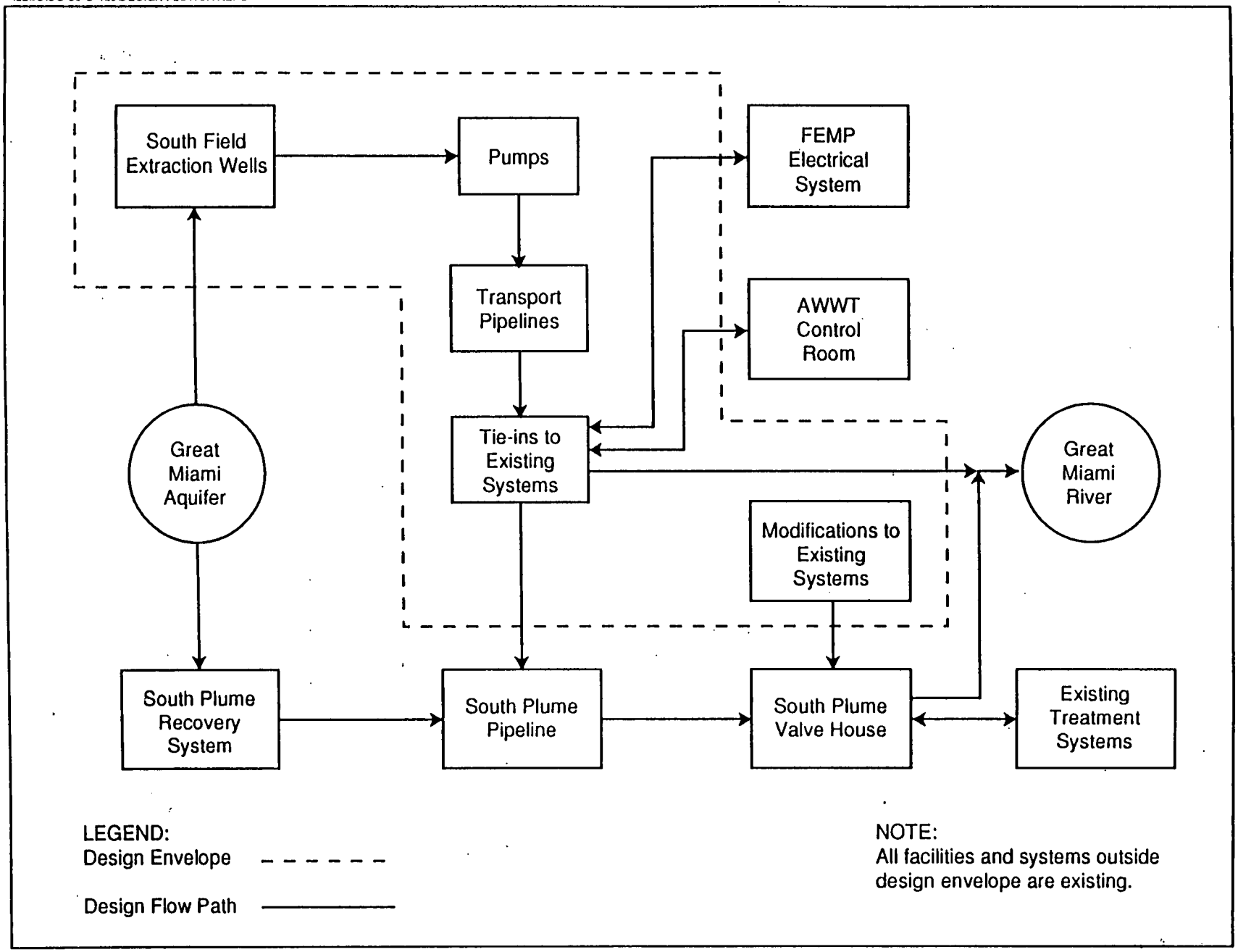


Figure 1-1 - Project Design Envelope

(4) FEMP Electrical System: Connection locations and routing of the electrical distribution system will be determined during detailed design. Connections shall be made to the existing site 13.2 kV system.

(5) Modifications to Existing Systems: Existing piping systems may be modified to accommodate the piping strategy for the SFES.

1.5 Project Interfaces

The SFES requires interfacing with existing systems and procedural processes. The physical interfaces are:

1) South Plume Removal Action transport header
2) South Plume Valve House
3) AWWT Control Room instrumentation
4) Electrical source
5) Site access roads
6) Planned future expansions
7) Monitoring wells

The design considerations which will be followed in attaining these interfaces are addressed in Subsection 2.4.2.

Procedural interfaces are identified in Section 2.

1.6 Functional Objectives

The first step in the design process is to identify the functional objectives. The functional objectives establish what the final design must be capable of doing and establishes a baseline upon which the design criteria and title design evolve. In the most basic terms, the functional objectives define what the end product of the design must do.

A Functional Analysis System Technique (FAST) diagram (Figure 1-2) was produced to establish the functions to be performed by the SFES. The project objective becomes the primary functional objective as depicted on the left side of the FAST diagram. Proceeding from left to right, the lower-level objectives, which explain how the primary objective will be met, are identified. To the far right are the subfunctions, which identify the functional elements needed to achieve the primary function.

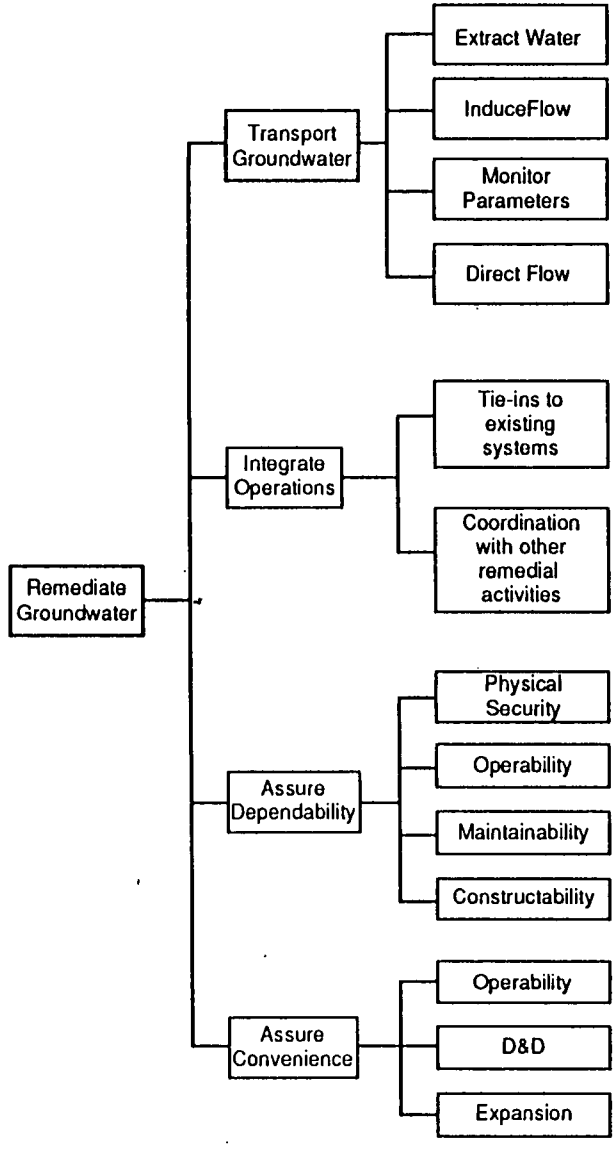


Figure 1-2 - SFES FAST Diagram

The four basic functions that must be accomplished by the SFES are:

1) Transport Groundwater
2) Integrate Operations
3) Assure Dependability
4) Assure Flexibility

1.6.1 Transport Groundwater

The primary objective for the SFES is to extract and transport groundwater for remediation. This objective is broken down into four general functions:

Extract Water

The SFES must extract water from target areas of uranium concentration in the Great Miami Aquifer to lower the water contamination to an average 20 ppb uranium concentration as described in the OU-5 FS.

Induce Flow

Preliminary groundwater remediation modeling indicates that the SFES must be capable of extracting up to 4,000 gpm over a 30-year time frame. The system must be able to vary the individual well pumping rates to account for extraction sequencing.

Monitor Parameters

The SFES must have monitoring capabilities which allow measurement of the extraction well performance, transport header integrity, and direction of effluent flow. Additionally, the SFES must have sample stations to allow for periodic lab analysis to determine water quality.

Direct Flow

The SFES must have the capability to direct each individual extraction well's effluent either to treatment facilities or to be discharged to the Great Miami River.

1.6.2 Integrate Operations

In addition to its primary objective of transporting water, the SFES must also minimize project costs and have a minimal impact on other site remedial activities. This objective is broken down into two general functions as follows.

Interface with Existing Systems

The SFES must be capable of using existing treatment and transport systems to the maximum extent practicable, while remaining within planned operation and control strategies.

Coordination with Other Site Activities

The SFES must be designed and constructed such that interferences with other existing and planned remediation activities and systems are minimized.

1.6.3 Assure Dependability

The SFES must provide an extraction and transport system which is dependable throughout its operational lifetime. To accomplish this, the following general objectives must be met.

Physical Security

The SFES must be designed such that its components are physically secure from random acts of vandalism, theft, and/or sabotage.

Operability

The SFES must be designed to incorporate measures that provide for ease of operations, where practical.

Maintainability

The SFES must be designed to incorporate measures that provide for ease of maintenance, where practical.

Constructability

The SFES must be designed to incorporate measures that provide for ease of construction, where practical.

1.6.4 Assure Flexibility

The SFES must provide for future expansion and eventual decommissioning. This objective consists of the following general objectives.

Expansion

The SFES must allow for and incorporate measures to provide ease of expansion for additional groundwater extraction systems.

Decontamination and Decommissioning

The SFES must be designed to minimize the required effort for the future decontamination and decommissioning of the system.

SECTION 2

DESIGN CRITERIA AND CONSIDERATIONS

2.1 ARAR and Environmental DOE Order Compliance

The final draft Operable Unit 5 Feasibility Study (dated March 1995) contains a list of Applicable or Relevant and Appropriate Requirements (ARARs) and To-Be-Considered (TBC) requirements for the remediation of soil and groundwater at the FEMP. DOE Orders related to protection of human health and the environment were included as TBCs. Design and safety-related DOE Orders are not typically categorized as TBCs and were not included. These DOE Orders are discussed in Subsection 2.2 of this FR&DBD.

The ARARs and TBCs identified in Tables 2-1 and 2-2 represent only those requirements that pertain to the design of the SFES. Note that discharge requirements are not included in these tables, as wastewater discharges to the Great Miami River are not in the scope of this design project. Each table provides a regulatory citation, requirement summary, and implementation strategy.

Table 2-1 - Applicable or Relevant and Appropriate Requirements

Citation	Requirement	Implementation Strategy
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 • nutrients that create nuisance growth	Discharges into the Great Miami River will meet the requirements specified in the FEMP NPDES permit.
OAC 3745-1-07	Surface waters in the State of Ohio must comply with the maximum concentrations of each contaminant listed in this regulation for inside and outside the mixing zones of the receiving water to protect warm water aquatic habitats. "Outside the mixing zone" is defined as after the effluent and the receiving water have been determined to be reasonably well mixed based upon information readily available to the Ohio EPA Director. "Inside the mixing zone" is defined as end-of-pipe maximum effluent limits or as criteria to be met within a short distance of the effluent pipe if it can be demonstrated that the discharge-induced mixing occurs as per the definition of "area of initial mixing" per OAC 3745-1-02.	Discharges into the Great Miami River will meet the requirements specified in the FEMP NPDES permit.
OAC 3701-38-15(A)(1)(B)	Operations causing air emissions shall be conducted such that: • the total effective dose equivalent to individual members of the public from the operation does not exceed 100 mrem in a year • the dose in any unrestricted area from external sources does not exceed 2 mrem in any one hour.	Emissions from the South Field groundwater extraction system will not exceed these limits due to the extremely low level of radionuclides present. This issue will be further addressed in Title II design.
40 CFR 61.190, 192 Subpart Q	No source at a DOE facility shall emit more than 20 pCi/m^2s of Radon-222 as an average for the entire source, into the air.	Due to the low concentrations of radon parent radionuclides, significant radon generation is not a concern. This issue will be further addressed in Title II design.

Table 2-1 - Applicable or Relevant and Appropriate Requirements (Continued)

Citation	Requirement	Implementation Strategy
40 CFR 61.92,93 Subpart H	Emissions of radionuclides (except Rn-220 and Rn-222) to the ambient air from DOE facilities shall not exceed those amounts that would cause any member of the public to receive in any year an effective dose equivalent of 10 mrem/yr. To determine compliance with the standard, radionuclide emissions shall be determined and effective dose equivalent values to member of the public calculated using EPA approved sampling procedures, computer models CAP-88 or AIRDOS-PC, or other procedures for which EPA has granted prior approval.	Due to the low concentrations of radionuclides, significant doses are not a concern. This issue will be further addressed in Title II design.
OAC 3745-33-05	The discharge point of compliance must be equipped with instrumentation to monitor and record data and other information about the operation of the point source.	Monitoring will be provided at points specified in the FEMP NPDES permit.
OAC 3745-09-05 (A) and (B) OAC 3745-09-06 (A), (B), (D), and (E)	Specifies minimum construction requirements for new groundwater wells for casing material, casing diameters, casing depth, potable water, annular spaces, use of drive shoe, opening to allow water or contaminant entry.	The design and installation of the groundwater extraction wells will be done by FERMCO in accordance with Appendix J of the EPA-approved *Sitewide CERCLA Quality Assurance Project Plan*. FERMCO Regulatory Compliance will ensure that the extraction well design meets these requirements.

Table 2-1 - Applicable or Relevant and Appropriate Requirements (Continued)

Citation	Requirement	Implementation Strategy
OAC 3745-09-07	This requirement establishes specific surface design requirements, such as height above ground, well vents, well pumps, etc.	The design and installation of the groundwater extraction wells will be done by FERMCO in accordance with Appendix J of the EPA-approved *Sitewide CERCLA Quality Assurance Project Plan*. FERMCO Regulatory Compliance will ensure that the extraction well design meets these requirements.
OAC 3745-09-08 (A) and (C)	This requirement describes procedures for disinfection and decontamination of new wells and use of potable water for priming pumps.	The design and installation of the groundwater extraction wells will be done by FERMCO in accordance with Appendix J of the EPA-approved *Sitewide CERCLA Quality Assurance Project Plan*. FERMCO Regulatory Compliance will ensure that the extraction well design meets these requirements.
OAC 3745-09-09 (A-C), (B-1), and (E-6)	This requirement establishes specific maintenance and modification requirements for casing, pumps, and wells.	The SFES will use the existing FERMCO procedures for well maintenance and modification. These existing procedures were developed in accordance with Appendix J of the EPA-approved *Sitewide CERCLA Quality Assurance Project Plan*. FERMCO Regulatory Compliance will ensure that the extraction well design meets these requirements.
OAC 3745-09-10	Upon completion of testing, a test hole shall be either completely filled with grout or other such material as to prevent contaminants from entering groundwater.	The abandonment of wells will be performed by FERMCO in accordance with Appendix J of the EPA-approved *Sitewide CERCLA Quality Assurance Project Plan*.

Table 2-2 - To-Be-Considered Requirements

Citation	Requirement	Implementation Strategy
DOE Order 5400.5 Chap II(1)	The exposure to 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 of more than 100 mrem for all exposure pathways. If unusual circumstances affect a DOE activity in such a manner that the potential public dose could exceed an effective dose equivalent of 100 mrem in a year, DOE may authorize a temporary increase of the dose limit up to 500 mrem.	Total off-site dose to the public will not exceed 100 mrem/yr because of the extremely low concentrations of radionuclides in the groundwater. The contribution of this action to the sitewide dose will be calculated during title design.
DOE Order 5400.5 Chap II(2)	Field elements shall develop a program and shall require contractors to implement an ALARA process for DOE activities and facilities that have the potential to cause radiation exposure to the public.	ALARA concepts will be incorporated during title design in accordance with the FEMP ALARA program. Exposure calculations will be performed to determine where dose reduction is necessary.

2.2 Laws, Regulations, Codes, Standards, and DOE Orders

This subsection presents the general laws, regulations, codes, standards, and orders that are to be followed for the design of the SFES in addition to the ARAR List (Table 2-1) and the TBC List (Table 2-2).

2.2.1 General Criteria

The following codes, standards, and DOE Orders apply to multiple disciplines in achieving the SFES design:

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

2) Ohio Basic Building Code (1994)

3) Uniform Building Code (1994)

4) DOE-STD-1020-94, "Natural Phenomena Hazards Design and Evaluation Criteria for Department of Energy Facilities"

5) National Fire Protection Agency (NFPA) 70, National Electrical Code

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

7) 29 Code of Federal Regulations (CFR) Part 1910, "Occupational Safety and Health Administration"

2.2.2 Specific Criteria

The following discipline specific criteria apply to the SFES design:

Architectural

1) DOE Order 5480.10, "Contractor Industrial Hygiene Program"
2) 10 CFR Part 835, "Radiation Protection for Occupational Workers"
3) NFPA 101, "Code for Safety to Life from Fire in Buildings and Structures"
4) American Disabilities Act 1992
5) NFPA 75, "ADP Facilities Fire Protection"

6) Metal Building Manufacturers Association - Recommended Design Practice Manual
7) American Society for Testing and Materials (ASTM) standards as referenced

Civil

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

2) American Society of Civil Engineers (ASCE) 37, "Design and Construction of Sanitary and Storm Sewers," ASCE

3) North American Datum of 1983

4) North American Vertical Datum of 1929

5) Soil Conservation Service (SCS), Soil Survey of Hamilton County, Ohio

6) SCS, "TR-55 Urban Hydrology for Small Watersheds," Technical Release 55, SCS

7) American Water Works Association (AWWA) C 600-93 Installation of Ductile-Iron Water Mains and their Appurtenances

8) AWWA C 906-90 Polyethylene (PE) Pressure Pipe and Fittings, 4 Inch through 63 Inch for Water Distribution

9) TM 5 814-2, "Sanitary and Industrial Wastewater Collection - Pumping Stations and Force Mains," U.S. Dept. of Army

10) SCS, "Water Management and Sediment Control to Urbanizing Areas"

11) FEMP Stormwater Pollution Prevention Plan for construction activities

12) Ohio Department of Transportation, Location and Design Manual, Volume Two, Drainage Design

13) Ohio Department of Transportation, Construction and Material Specifications, January 1995

Electrical

1) American National Standards Institute (ANSI) C2, National Electrical Safety Code
2) ANSI C84.1, Electrical Power Systems and Equipment - Voltage Ratings (60 Hz)
3) NFPA 780, Lightning Protection Code
4) Illuminating Engineering Society (IES) Handbook
5) NFPA 101, Life Safety Code

Geotechnical

1) ASTM Annual Book of Standards, Volumes 4.08 and 4.09 (applicable standards relating to soil, rock, and geosynthetics as required)

Instrumentation

1) Instrument Society of America, Codes and Standards

Environmental Safety and Health

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

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

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

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

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

6) NFPA 101, Life Safety Code

7) 10 CFR 835, Occupational Radiation Protection

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

9) 29 CFR 1926 Safety and Health for Construction

10) RM-0021, Safety Performance Requirements Manual

Piping

1) American Society of Mechanical Engineers B31.3, Chemical Plant and Petroleum Refinery Piping

2) ASTM A-36, Structural Steel

3) ASTM A-576, Steel Bars, Carbon, Hot-Wrought, Special Quality

4) ASTM C534, Cellular Elastomeric Insulation

5) American Welding Society D.1.1, Structural Welding Code - Steel

6) Manufacturers Standardization Society (MSS) SP-58, Pipe Hangers and Supports - Material, Design, and Manufacture

7) MSS SP-69, Pipe Hangers and Supports Selection and Application

8) MSS SP-89, Pipe Hangers and Supports Fabrication and Installation Practices

9) Occupational Safety and Health Administration 29 CFR 1910

10) Applicable insulation and sheeting specifications

11) American Society for Nondestructive Testing SNT-TC-1A, Recommended Practice

Structural

1) American Concrete Institute 318-89, Building Code Requirements for Reinforced Concrete

2) American Institute of Steel Construction Manual, 9th Edition

3) ASCE 7-93, Minimum Design Loads for Buildings and Other Structures

4) DOE-STD-1021-93, "Natural Phenomena Hazards Performance Categorization Criteria for Structural, Systems and Components"

5) TM-5-809-10.0, Seismic Design for Buildings

6) University of California Research Laboratory (UCRL)-53526, Rev. 1, Natural Phenomena Hazards Modeling Project: Extreme Wind/Tornado Hazard Models for Department of Energy Sites

7) UCRL 53852, Rev. 1, Natural Phenomena Hazards Modeling Project: Seismic Hazard Models for Department of Energy Sites

8) Metal Building Manufacturers Association - Recommended Design Practice Manual

9) ASTM Standards

2.3 Project-Specific S/RIDs

The FERMCO Management Plan (RM-0016, Rev. 4), which provides the Standards/Requirements Identification Documents (S/RIDs) for 24 functional areas, was reviewed to identify the design requirements for the SFES. Many of the functional areas apply to programmatic activities that the design process (as well as other site activities) must adhere. These S/RIDs are implemented by existing (or in the case of the SFES, future) departmental procedures and site policies. However, because these programmatic functional areas do not directly impact the engineering design itself, they have not been included in this FR&DBD. The excluded functional areas are:

1) Configuration Management
2) Research and Development/Experimental Activities
3) Management Systems
4) Packaging and Transportation
5) Training and Qualification
6) Human Resources and Industrial Relations
7) Project Controls
8) Public Involvement
9) Emergency Preparedness
10) Maintenance
11) Operations
12) Quality Assurance
13) Construction
14) Acquisitions
15) Property Management
16) Financial Management

Only those requirements that apply to the design of the SFES are discussed. In some cases, a portion of a functional area (i.e., security) was referenced if it pertained to design. The following subsections provide the identification of the project-specific S/RIDs.

2.3.1 Engineering Design

All Engineering Design S/RIDs apply to this design project with the exception of the contractual requirements specified in Requirement 2.3.1 of Engineering Design S/RID in the FERMCO Management Plan, as these are considered programmatic. Specific design requirements, such as building codes and design standards, are discussed in Subsection 2.2 of this FR&DBD.

2.3.2 Environmental Protection

Many of the Environmental Protection S/RIDs apply to this design project. Specific requirements are those included the ARARs and TBC requirements identified in Subsection 2.1. ARARs address environmental regulations and TBCs address guidance, proposed environmental regulations, and environmental-related DOE Orders.

2.3.3 Fire Protection

All Fire Protection S/RIDs apply to this design project with the exception of Requirements 6.4.4 and 6.4.5 of the Fire Protection S/RID in the FERMCO Management Plan.

2.3.4 Nuclear and Systems Safety

Nuclear and Systems Safety S/RIDs apply to this design project with the exception of Requirement 9.3.1 of the Nuclear and Systems Safety S/RID in the FERMCO Management Plan as contractual requirements are programmatic.

2.3.5 Occupational Safety and Health

Most Occupational Safety and Health S/RIDs do not apply to this design project as they are programmatic. Requirements 10.3.4 and 10.3.6 are the only requirements in the Occupational Safety and Health S/RID in the FERMCO Management Plan that are pertinent to this design.

2.3.6 Radiological Protection

All Radiological Protection S/RIDs apply to this design project with the exception of Requirements 14.3.2, 14.3.6, 14.4.1, 14.4.3, 14.4.4, 14.4.5, 14.4.6, 14.4.8, 14.4.9, and 14.4.10 of the Radiological Protection S/RID in the FERMCO Management Plan.

2.3.7 Security

The programmatic aspects of the Security S/RID do not apply to this design project. However, the design requirements (such as fencing, sign posting, surveillance equipment, etc.) do apply and will be incorporated into the design. Specific requirements include 15.3.4, 15.3.5, 15.3.6, 15.3.12, 15.3.18, and 15.3.19 of the Security S/RID in the FERMCO Management Plan apply.

2.3.8 Environmental Restoration and Waste Management

Environment Restoration and Waste Management S/RIDs apply to this design project. These include the ARARs and TBC requirements identified in Subsection 2.1. ARARs address environmental regulations and TBCs address guidance, proposed environmental regulations, and environmental-related DOE Orders.

2.4 Design Considerations

This subsection lists the design considerations which will be addressed in the design of the SFES. These design considerations stem from the functional objectives and, along with the ARARS, codes, standards, and DOE Orders identified in subsections 2.1 and 2.2, provide the basis for Title I and II Design.

2.4.1 Flow Inducement

The extraction well pumps will be variable speed with a flow range of 100 to 400 gallons per minute (gpm) for the first 15 years and a nominal pumping rate of 800 gpm for years 16 through 30.

Extraction pumps will be vertical turbine pumps with the capability of varying column length to address conditions found during field drilling.

The SFES will be designed for a 35-year design lifetime. This lifetime was chosen to provide operational flexibility based on an estimated 30-year operation lifetime as determined by computer modeling.

2.4.2 Flow Containment and Direction

Each extraction well's effluent will have the capability of being sent to treatment or being discharged to the Great Miami River.

Based upon existing and planned treatment capacities, the treatment header will be designed to a minimum of 2,500 gpm capacity.

Design will use existing transport headers where possible, to minimize construction costs.

The discharge header will be designed to a minimum of the combined discharge capacities of the South Plume Removal Action, and the SFES including planned expansions (5,800 gpm).

Valves will be locally operated with a remote valve position indication located in the AWWT control room.

Main feeder headers including the existing South Plume Removal Action header will have isolation capabilities from the main treatment and discharge headers.

The treatment header will have the ability to send water to South Plume Interim Treatment (SPIT), Interim Advanced Wastewater Treatment (IAWWT) Stormwater Retention Basin (SWRB), and/or AWWT for treatment.

2.4.3 Parameter Monitoring

Each extraction well will have the capability of effluent sampling at the pump discharge prior to header mixing.

Each extraction well will have an associated monitoring well(s) capable of monitoring the extraction well's performance.

Instrumentation will include, as a minimum, motor rpm, individual well flow rates, individual well discharge pressure, valve positions, and main header pressures. These parameters will have a remote readout in the AWWT control room.

2.5 Integrating Operations

2.5.1 Interfaces with Existing Systems

To allow for optimum use of resources, the SFES will use existing system capabilities to the maximum extent possible while limiting the impact on current operations. The physical interfaces are as follows:

1) South Plume Removal Action Force Main - This force main will be utilized as the SFES's treatment force main. The South Plume effluent will then be piped and valved such that it can be directed to either the existing force main, which will be used as the treatment header, or the newly constructed discharge force main. Using the existing South Plume transport header as the treatment force main minimizes the impact on physical configuration and operation of the South Plume Valve House.

2) South Plume Valve House - Based upon current flow direction strategy, the impact and interface with the South Plume Valve House will be minimal. Some slight modifications will be required and these will be identified with the South Field Extraction System Title II design package.

3) AWWT Control Room Instrumentation - Parameter monitoring will have indicators located within the AWWT Control Room. Pump start/stop and speeds will be controllable from the AWWT Control Room. This maximizes the use of existing facilities and enhances the overall control and coordination of groundwater remediation efforts.

4) Electrical Source - The SFES will extend the FEMP 13.2 kV system for power distribution to the well locations. A concrete encased underground ductbank shall extend 13.2 kV service from the site to centrally located unit substations in the SFES area. Aerial 480 V service will extend from the substations to the extraction well pump houses.

5) Site Access Roads - The access roads to each well will intersect with the current access roads such that new road construction is minimized and traffic flow and safety problems are not induced on current roadways.

6) Planned Future Expansions - The SFES design will account for the planned future expansions as depicted in the OU-5 Feasibility Study. These future expansions will be accounted for in the sizing of transport systems, provision of flanged tie-in points, and utility planning.

7) Monitoring Wells - Proper monitoring of well performance requires the use of monitoring wells. Several wells currently exist which could be used in monitoring extraction performance. This capability may need augmentation with additional monitoring wells.

8) Parshall Flume Outfall Force Main - The SFES will discharge into the Parshall Flume Outfall force main. This tie-in may affect the characteristics and capacities of the existing pumps and pipelines within the SPIT, AWWT, and IAWWT (SWRB) treatment facilities. The extent of this impact will be established during Title II Design.

9) FERMCO Well Design - The SFES design will interface with the FERMCO well design at the bore hole cap. PARSONS will provide the design and specifications for the pumps. FERMCO will determine well depth, required flow rates, and screen and packing parameters. PARSONS will provide the requirements for the concrete pad upon which the vertical turbine pump and associated valving and instruments are contained.

10) Site Alarm and Communications Systems - The extraction well houses and the valve houses will not require installed alarm and communication systems. Communications will be performed using two-way radios.

2.5.2 Coordination with Ongoing and Planned Site Activities

The SFES design will consider other site activities, planned or ongoing, which may impact or be impacted by the SFES construction and operation. The following potential conflicts have been identified:

1) CRU-2 South Field and Fly Ash Remedial Actions - The possibility exists of potential conflicts between the placement of extraction system wells and planned activities under CRU-2 remedial actions. The wells that are potentially conflicting will be evaluated for potential relocation. Should relocation not be feasible, the design will minimize the impact of the conflict by providing for possible removal and replacement of the wells.

2) Utility, CRU-2 Seepage Collection Project, Public Water Supply (PWS) Tap, CRU-1 potential gas line interferences - The potential exists for land use interferences between these planned and existing projects and the SFES. These interferences will be addressed by identifying the interference points and evaluating the routing possibilities to account for these interferences.

3) Routing Corridor Restrictions - The potential exists for land use interferences between the SFES force main and existing and planned projects located within the same geographic area. The topographical conditions present in the South Field Area limit pipeline and utility routing to the current restricted corridor.

The existing 20-inch South Plume force main and a 6-inch PWS line are currently routed through this area. Additionally, CRU-2 is preparing for Removal Action 30, Seepage Control and Removal of Sediment, which also plans to run an underground line through this area. This removal action also requires an underground pump station located between the Active Fly Ash Pile and the South Field. CRU-1 currently plans to route a gas line along this same corridor. These interferences will be addressed by coordinating with other activities and evaluating routing possibilities to minimize the congestion.

4) CRU-2 On-Site Waste Disposal Cell Borrow Areas - There is the potential that portions of the SFES will run through the planned CRU-2 borrow areas. This potential conflict will be investigated and alternative solutions will be proposed as needed.

2.6 Assuring Dependability

2.6.1 Providing Physical Security

The SFES's wells and valve house will lie outside the FEMP's fenced areas. As such, the SFES design will provide for physical safeguards for the protection of exposed equipment.

2.6.2 Operability

The SFES design will consider and incorporate operability concerns. Among the concerns which will be addressed are:

1) Accessibility - The SFES's components will be installed such that they are readily accessible for operations. Extraction wells will have access roads to permit ease of operations.

2) Equipment and Material Selection - The SFES's components will be selected such that they are operator friendly and can withstand extended operations.

3) Hydraulic Parameters - The extracted water will contain minor amounts of silt, which is abrasive. Provisions for cleanouts and minimal dead-end piping will be incorporated into the design. Due to numerous wells using a common header, pressure surges and water hammer will likely be common. The selection of valves, controls, and piping materials will consider these phenomena. The rolling terrain and combination of flows may create air pockets in the force main, which would reduce the hydraulic efficiency of the main. Air release mechanisms at the well heads and along high points in the header will be considered.

4) Human Factors - The SFES design will incorporate human factors into the control philosophy and equipment layout to aid the operators in performing operations.

5) Safety - The SFES design will identify required engineered safety measures which help ensure operator safety. As an example, all energy sources that may be required to be isolated for "lock-out" (e.g., valves, pumps, switches) will be identified and designed to accept a lock hasp and tag.

2.6.3 Maintainability

The SFES design will consider and incorporate maintainability concerns. Among the concerns which will be addressed are:

1) Accessibility - The SFES's components will be installed such that they are readily accessible for maintenance. Extraction wells will have access roads to permit ease of maintenance.

2) Equipment and Material Selection - The SFES's components will be selected such that they are easily maintained and replacement parts are readily available.

3) Hydraulic Parameters - The extracted water will contain minor amounts of silt, which is abrasive. Provisions for cleanouts and minimal dead-end piping will be incorporated into the design. Due to numerous wells using a common header, pressure surges and water hammer will likely be common. The selection of valves, controls, and piping materials will consider these phenomena. The rolling terrain and combination of flows may create air pockets in the force main, which would reduce the hydraulic efficiency of the main. Air release mechanisms at the well heads and along high points in the header will be considered.

4) Human Factors - The SFES design will incorporate human factors into the equipment layout to aid maintenance personnel in performing maintenance and repairs.

5) Safety - The SFES design will identify required engineered safety measures which help ensure personnel safety. As an example, all energy sources that may be required to be isolated for "lock-out" (e.g., valves, pumps, switches) will be identified and designed to accept a lock hasp and tag.

6) Environmental Protection - The SFES's components will be protected from the environment to limit the degradation of components due to environmental conditions.

2.6.4 Constructability

The SFES design will consider and incorporate constructability concerns. Among the concerns which will be addressed are:

1) Accessibility - The SFES will be sited such that the locations are readily accessible for construction.

2) Safety - The SFES design will incorporate measures to help ensure the safety of workers during construction. Among these measures are siting plans to limit interference with existing systems and contamination zones.

3) Site Conditions - The SFES will be sited such that construction on steep slopes and other undesirable topographical conditions is minimized.

4) Material Selection - The force mains will need to traverse rolling terrain. The piping materials will have to adapt to numerous bends, both horizontally and vertically.

2.7 Assuring Convenience

2.7.1 Future Expansion

The SFES design will provide for interfacing with future extraction systems. The design will consider valving, flanged connections, instrument coordination, and utility use in addressing future expansions.

2.7.2 Decontamination and Decommissioning

The SFES will be designed to account for future decontamination and decommissioning (D&D). The design will include measures to allow for the ease of D&D efforts wherever practical.

2.8 Secondary Containment

DOE Order 6430.1A, Division 13 governs the requirements for secondary containment systems. Division 13 applies to Special Facilities, which are nuclear facilities or explosive facilities.

DOE Order 6430.1A defines a nuclear facility as:

> "A facility whose operations include radioactive materials in such a form and quantity that a significant nuclear hazard potentially exists to the employees or the general public."

A safety assessment (Appendix F) was performed on the SFES by the FERMCO Safety Analysis Department. This safety assessment classified this project as an industrial facility conducting hazardous waste activities. This classification does not meet the definition of a nuclear facility as defined in DOE Order 6430.1A; therefore, secondary containment is not required for the SFES and will not be included in its design.

SECTION 3

SYSTEM LOCATION

As seen on the site plan (Appendix D), the SFES is located in the southwest corner of the FEMP property. The SFES Valve House is sited to coincide with the convergence point of the existing South Plume Force Main and the new SFES Discharge Force Main. The siting and piping strategy and routing resulted from topographical features as well as the physical interfaces as described in Subsection 2.4.2.

Table 3-1 shows the extraction well coordinates.

Table 3-1 - Coordinates of Extraction Wells

Well Number	Coordinates (NAD 83)	
13	N477650.0	E1347640.0
14	N477074.0	E1347935.0
15	N477573.0	E1348411.0
16	N477065.0	E1348325.0
17	N477864.0	E1348778.0
18	N477007.0	E1348933.0
19	N477437.0	E1349101.0
20	N477659.0	E1349271.0
21	N477937.0	E1349440.0
22	N477816.0	E1350067.0

A recent topographical survey has not yet been completed. As such, the coordinates shown in Table 3-1 should be considered preliminary.

SECTION 4

SYSTEM DESCRIPTION

The SFES will provide a means of extracting uranium-contaminated groundwater and transporting that extracted groundwater to either treatment or discharge, depending upon its contamination concentration. It achieves this objective using an arrangement of extraction wells, pumps, pipelines, valving, and associated instrumentation. Figure 4-1 depicts a simplified line diagram of the proposed SFES. This figure establishes the general relationships between the various components and provides the terminology assigned to the various pipelines and structures. Appendix E contains the Piping and Instrumentation Diagrams, which provide additional detail.

4.1 Extraction Wells and Well House

The SFES will consist of 10 extraction wells which will provide a means of extracting contaminated groundwater from target zones in the Great Miami Aquifer. These extraction wells will have vertical-turbine, aboveground discharge pumps which will be located within well houses. The well houses will be designed to protect the extraction pumps and their associated instrumentation and aboveground piping and valving. Well houses will have removable roofs or hatches to allow pumps to be pulled for maintenance or replacement. Each extraction well will have a sample port and the ability to divert effluent to either the well treatment header tie-in or the well discharge force main.

4.2 Extraction Well Treatment Flow Path

Based on the uranium concentration of the sample taken from the sample port located within each well house, higher concentration well effluent will be directed to treatment. This flow diversion will occur within the respective well house using locally operated valves to isolate the discharge path. Effluent from Extraction Wells 13 and 14 will combine in the west SFES treatment header and will be directed into the SFES Valve House. Effluent from Extraction Wells 15 and 17 will combine and be directed into the SFES treatment force main. Effluent from Extraction Wells 16, 18, 19, 20, 21, and 22 will be directed to the east SFES treatment header which will flow into the SFES Valve House.

Within the SFES Valve House, the flows from the east and west SFES treatment headers will combine into the SFES treatment force main. The SFES treatment force main is the existing 20-inch HDPE pipeline used for the South Plume Removal Action. The SFES treatment force main will direct flow into the South Plume Valve House, where it will be directed toward treatment in either the AWWT, SPIT, or IAWWT (SWRB) facility via the existing South Plume Valve House.

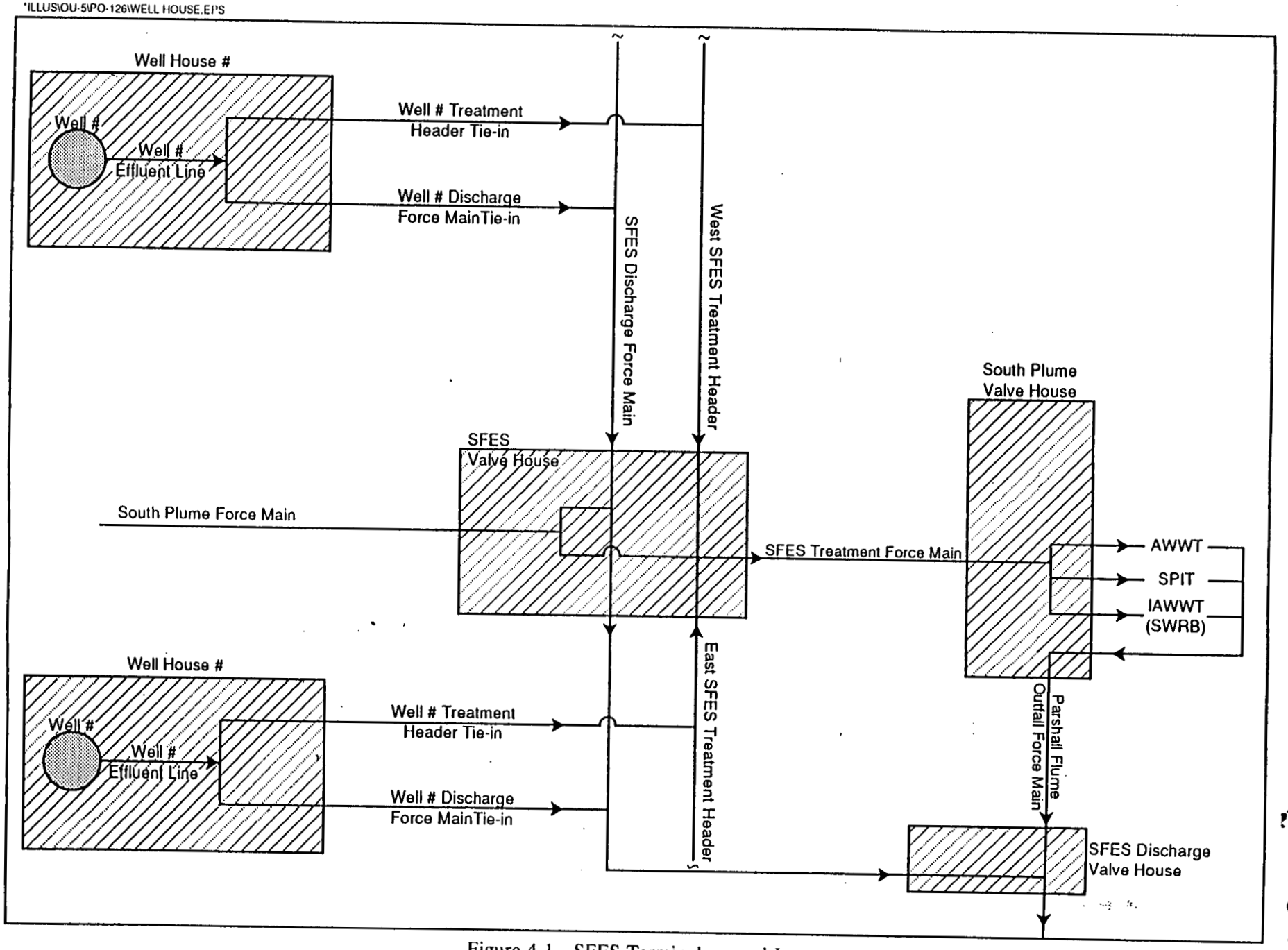


Figure 4-1 - SFES Terminology and Layout

4.3 Extraction Well Discharge Flow Path

Extraction well effluent can be directed to discharge directly to the Great Miami River. Discharge effluent from Extraction Wells 13, 14, 15, and 17 will combine into the SFES discharge force main and will be directed to the SFES Valve House.

The SFES discharge force main will continue eastward through the SFES Valve House and receive discharge effluent from Extraction Wells 16, 18, 19, 20, 21, and 22. This force main, which runs northeasterly, will combine with the existing 24-inch HDPE Parshall Flume Outfall force main. An SFES Discharge Valve House will be located at this tie-in point and isolation capability on the SFES discharge force main will be provided.

4.4 South Plume Flow Path

The South Plume effluent will follow its existing flow path into the SFES Valve House. Inside the SFES Valve House, the South Plume force main will have connections with both the SFES treatment force main and the SFES discharge force main. These connections will be valved to allow flow to be directed into either path depending on effluent concentrations.

SECTION 5

COMPONENT DESIGN BASIS

5.1 Wells

The SFES project contains two types of wells: extraction wells and monitoring wells.

5.1.1 Extraction Wells

Function - Provide a vertical conduit to target zones of the Great Miami Aquifer through which contaminated groundwater can be extracted.

Basis - Extraction wells are required to restore contaminated portions of the Great Miami Aquifer to below 20 ppb uranium. FERMCO has provided locations, depths, and pumping rates for 10 extraction wells which comprise the SFES, to be used for this purpose.

Description - Table 5-1 provides a preliminary listing of extraction well field design details. Detailed final design of the extraction wells will be performed by FERMCO, and will be based on data collected during field investigations to be conducted prior to well installation and construction.

Table 5-1 - Preliminary Listing of Extraction Well Field Design Details

Proposed Extraction Well	Screen Depth (feet)	Pumping Range 0 - 15 Years (gpm)	Nominal Pumping Rate 16 - 30 Years (gpm)
13	100	100 - 400	800
14	100	100 - 400	800
15	100	100 - 400	800
16	100	100 - 400	800
17	100	100 - 400	0
18	100	100 - 400	800
19	100	100 - 400	0
20	100	100 - 400	0
21	100	100 - 400	0
22	100	100 - 400	0

5.1.2 Monitoring Wells

Function - Monitoring wells provide a vertical conduit to target zones of the Great Miami Aquifer through which groundwater may be monitored for various parameters and purposes.

Basis - Monitoring wells are required for two reasons. First, monitoring wells will be used to determine extraction well performance and efficiency based on observed water levels. Second, monitoring wells will be used to determine the effectiveness of the extraction system through confirmation of modeling results of capture zone and future concentration reductions.

Description - Monitoring wells (still wells) installed within the annular space of the extraction wells will be used to determine extraction well performance and efficiency based on observed water levels. Excessive drawdown in extraction wells may indicate poor well efficiency resulting from design, construction, or maintenance factors.

System effectiveness can be evaluated through monitoring groundwater elevations and water quality in Type 2, 3, and 4 monitoring wells at some distance away from the extraction well and within the extraction wells. Existing monitoring wells will be used to the extent practicable for these purposes. Additional wells will be installed only if existing monitoring wells are not adequately positioned to meet the functional objectives. Based on preliminary assessment of predicted drawdowns associated with the proposed extraction system, positioning of at least one monitoring well within 150 feet from each extraction well is recommended. It should be noted that this distance is preliminary and that data from the pumping test to be conducted at Extraction Well 18 will be needed to confirm this estimate. A preliminary listing of existing and proposed monitoring wells which can be used for monitoring system effectiveness is provided in Table 5-2. As shown in the table, at least four additional monitoring wells are recommended to provide monitoring of Extraction Wells 14, 19, 21, and 22.

Table 5-2 - Preliminary Listing of Existing and Proposed Monitoring Wells

Proposed Extraction Well	Existing Monitoring Wells Within 150 Foot Radius	Approximate Distance of Existing Monitoring Wells From Proposed Extraction Well (feet)	Are Additional Monitoring Wells Required?
13	1016, 2016, 3016, 4016, 21190	60	No
14	None	N/A	Yes
15	1048, 2048	65	No
16	1045, 2045, 3045	70	No
17	1065, 2065, 3065	125	No
18	2387, 3387	150	No*
19	None	N/A	Yes
20	2386	75	No
21	None	N/A	Yes
22	None	N/A	Yes

* Pending results from the pumping test to be conducted at Extraction Well 18.

5.2 Extraction Pumps

Function - To extract water from South Field extraction wells and provide the motive force for transport to treatment or discharge. Based on preliminary groundwater remediation modeling, groundwater extraction rates will range from 100 gpm to 400 gpm for the first 15 years of extraction. Groundwater will be extracted at a constant 800 gpm rate for a second 15-year period.

Basis - During the initial extraction period (0 - 15 years), pumps will operate between 100 gpm and 400 gpm. Variable speed drives will allow flow adjustments and control will be provided to maintain flow rates under changing conditions. Pumps will be changed out for the second extraction period. During the second extraction period (16 - 30 years), pumps will have nominal flow rates of 800 gpm. The pump total heads are assumed to be 250 feet but will be verified by calculation during Title II Design.

Description - Electric motor driven, vertical turbine, aboveground discharge pumps.

5.3 Piping

5.3.1 Well Effluent Line

Function - Transport extracted groundwater from extraction pump discharge to well treatment header tie-in line or the well discharge force main tie-in line.

Basis - To convey up to maximum well discharge flow (800/400 gpm) at an estimated maximum working pressure of 150 pounds per square inch gage (psig).

Description - Aboveground, carbon steel piping with welded joints and flanged connections for pump discharge and in-line valving.

5.3.2 Well Treatment Header Tie-In Line

Function - Transport extracted groundwater from the well effluent line to the east or west treatment headers.

Basis - To convey up to maximum well discharge flow (800/400 gpm) at an estimated maximum working pressure of 150 psig.

Description - Buried High-Density Polyethylene (HDPE) with fused joints located in a common trench for treatment and discharge tie-in lines where feasible.

5.3.3 Well Discharge Force Main Tie-In Line

Function - Transport extracted groundwater from the well effluent line to the SFES Discharge Force Main.

Basis - To convey up to maximum well discharge flow (800/400 gpm) at an estimated maximum working pressure of 150 psig.

Description - Buried HDPE with fused joints located in a common trench for treatment and discharge tie-in lines where feasible.

5.3.4 East and West Treatment Headers

Function - Transport extracted groundwater from the well treatment header tie-in lines to the SFES Treatment Force Main.

Basis - To convey up to the combined maximum well discharge flows (800/400 gpm each) at an estimated maximum working pressure of 150 psig.

Description - Buried HDPE with fused joints located in a common trench for treatment and discharge lines where feasible.

5.3.5 South Plume Force Main

Function - Transport extracted groundwater from the South Plume Removal Action extraction wells to the SFES valve house.

Basis - Determined during the South Plume Removal Action design.

Description - Existing 20-inch buried HDPE force main with fused joints.

5.3.6 SFES Discharge Force Main

Function - Transport extracted groundwater from the South Plume Force Main, and the well discharge force main tie-in lines to the SFES Discharge Valve House.

Basis - Capable of transporting up to 5,800 gpm combined flow capacity from the South Plume Removal Action and the SFES (includes anticipated future expansion flow rates) at a maximum working pressure of 150 psig.

Description - Buried HDPE force main with fused joints.

5.3.7 SFES Treatment Force Main

Function - Transport extracted groundwater from the SFES Valve House to the South Plume Valve House for ultimate treatment.

Basis - Capable of transporting up to 2,500 gpm combined flow for treatment.

Description - Existing buried 20-inch HDPE force main with fused joints.

5.3.8 Parshall Flume Outfall Force Main

Function - Transport extracted groundwater from the SFES Discharge Valve House to the Great Miami River.

Basis - Design determined in previous design project.

Description - Existing 24-inch buried HDPE force main with fused joints.

5.4 Enclosures

5.4.1 Well Houses

Function - Provide shelter and operating space for extraction well pumps and their associated valving and instrumentation.

Basis - Withstand structural load characteristics (TBD)

Description - Size and type of assembly TBD. Use of space heaters or heat tracing TBD.

5.4.2 SFES Valve House

Function - Provide shelter and operating space for flow valves and instrumentation from extraction well headers to either treatment or discharge.

Basis - Withstand structural load characteristics (TBD)

Description - Size and type of assembly TBD. Use of space heaters or heat tracing TBD.

5.4.3 SFES Discharge Valve House

Function - Provide shelter and operating space for the tie-in point at the Parshall Flume Outfall Force Main.

Basis - Withstand structural load characteristics (TBD)

Description - Size and type of assembly TBD. Use of space heaters or heat tracing TBD.

5.4.4 Cleanouts

Function - A watertight facility to contain valves that can control flows and allow for maintenance of the lateral and header pipelines.

Basis - Check valves to prevent backflow. Wyes with gate valves and cleanout ports to allow for draining off water in the pipe and for inserting maintenance equipment and tools.

Description - Valves to be steel/cast iron body with flanged ends attached to ductile iron pipes. The ductile iron pipes to be connected to the HDPE pipe. Valves should not create sudden surges in the flow in the pipeline. The cleanout facility shall be either concrete (Ohio Department of Transportation Item 499 Class C, 4,000 psi) or HDPE.

5.5 Instrumentation

5.5.1 South Field Extraction Well Flow Meters/Transmitters

Function - To provide a means to accurately measure (± 2 percent), display and transmit flow rate (gpm) and accumulated flow totals (gallons) as produced by each extraction well.

Basis - To measure extraction well discharge flow rate between 0 and 400 (800) gpm, and record accumulated flow in gallons.

Description - Ultrasonic flow meter, 0 to 400 (800) gpm, clamp on, 4-20 mAdc output (flow rate), local digital readout displaying flow rate and accumulated flow

5.5.2 South Field Extraction Well Pump Discharge Pressure Transmitters

Function - To provide a means to accurately measure and transmit the discharge pressure of the individual extraction well pumps.

Basis - To measure well pump discharge pressure on an individual well basis to be able to remotely assess the performance of the extraction well pumps, and the available pressure to operate the associated pipeline. High and low pressure interlocks should be provided to shut off the pumps.

Description - Electronic output pressure transmitter, 0 to 150 psi input, 4-20 mAdc output

5.5.3 Wellfield Header and Pipeline Pressure Transmitters

Function - To provide a means to accurately measure and transmit the pressure of the wellfield header and pipeline operating pressures.

Basis - To measure wellfield header pressure and pipeline header pressure to be able to remotely assess the performance of the associated wellfield header and/or pipeline segment.

Description - Electronic output pressure transmitter, 0 to 150 psi input, 4-20 mAdc output

5.5.4 Remote Data Multiplexers

Function - To provide a means to gather analog and digital signals which represent pertinent information on the SFES for operations and maintenance at a remote location from the system equipment.

Basis - To relay analog and digital signals in a reliable fashion to the AWWT Control Room, such that an operator may assess operation of equipment to maintain production of the SFES.

Description - Multiple analog and digital input remote multiplexer, 1 to 5 Vdc analog inputs, dry contact closure/TTL digital inputs, telephone modem output configured to interface with existing equipment, data quality phone lines required

5.5.5 Existing South Plume Extraction Flow Meters/Transmitters

Function - To provide a means to accurately measure ($\pm$2 percent), display and transmit flow rate and accumulated flow totals (gallons) from the existing extraction system.

Basis - To measure extraction well discharge flow rate between 0 and 1,500 gpm, and record accumulated flow in gallons.

Description - Ultrasonic flow meter, 0 to 1,500 gpm, clamp on, 4-20 mAdc output (flow rate), local digital readout displaying flow rate and accumulated flow

5.6 Electrical

5.6.1 Variable Frequency Drives

Function - To provide a means to vary the speed of the extraction well pumps to adjust the pumping rate of the extraction wells to provide the desired production of groundwater.

Basis - To vary the speed of the extraction pumps between 50 percent and 100 percent of pump speed by frequency adjustment of the power source.

Description - Variable frequency drive to change the power supply frequency between 0.10 and 100 Hertz, 480 Vac, three phase input power, sized for the particular extraction well pump

5.6.2 Electrical Distribution System

Function - To provide reliable electrical power at the required voltage level for electrical loads at the respective well sites.

Basis - To be sized and designed for the capacity requirements of each well site.

Description - Distribution will be at 13.2 kV using two feeder circuits (normal and alternate) from the FEMP distribution system. The feeders will be 3-1/C 350 kcmil, 15 kV, shielded, insulated cable. The feeders will be in PVC conduit, concrete encased. Centrally located 13.2 kV to 480 V, three-phase, 60 Hz substations shall be sized and installed for the surrounding extraction well pump house loads. Additional 480 V - 120/ 240 (or 208) V transformer/panelboard combinations will be provided to serve loads such as lighting and instrument power as required. No standby power or uninterruptible power is anticipated for the well sites.

5.7 Roads

Function - To provide access to the wells and the valve houses for construction, and operation and maintenance activities.

Basis - To support a truck-mounted well drilling rig (assume AASHTO WB-40 design vehicle and H-20 load) for drilling the extraction wells and access for maintenance vehicles (assumed to be standard pickup trucks). No appreciable traffic volume is anticipated on the service roads. Access from existing site roads and route through uncontaminated areas. Avoid wetlands, gullies, and other undesirable terrain. Drainage shall be designed for the 25-year, 24-hour storm. Entrance onto public roads shall have adequate sight distance. Road geometry based on 25 miles per hour design speed (AASHTO GDHS-90). Use Ohio Department of Transportation Construction and Material Specifications as the basis for material specifications and construction standards.

Description - Consideration should be given to using bituminous concrete for permanent primary roads. Service roads should be crushed aggregate. For construction and for the base course, use a crushed aggregate roadway, 12 feet wide with filter fabric. Supplement crushed aggregate with wood mats where road crosses contaminated or unsuitable subgrade.

APPENDIX A

PERFORMANCE GRADES

Table A-1 - Performance Grade (PG) Evaluation

Date Prepared: 05/04/95 CRU/Div.: CRU-5

Facility/Project: South Field Extraction System HC Assigned: Industrial Facility (SA:95-0013)

#	SSC	Purpose/Function	PG
1	Extraction Wells	Vertical conduit for groundwater contamination	1 2 3 4 5
2	Monitoring Wells	Vertical conduit for obtaining samples of groundwater	1 2 3 4 5
3	Extraction Pump	Pump groundwater from well for treatment/discharge	1 2 3 4 5
5	Well Effluent Line	Piping from well to well treatment header tie-in line or the well discharge force main tie-in line.	1 2 3 4 5
6	Well Treatment Header Tie-in Line	Transport extracted groundwater from the well effluent line to the east or west treatment headers.	1 2 3 4 5
7	Well Discharge Force Main Tie-In Line	Transport extracted groundwater from the well to the SFES Discharge Force Main	1 2 3 4 5
8	East and West Treatment Headers	Transport extracted groundwater from the well treatment header tie-ins to SFES Treatment Force Main	1 2 3 4 5
9	South Plume Force Main	Transport Extracted Groundwater from the South Plume Removal Action extraction wells to the SFES valve house	1 2 3 4 5
10	SFES Discharge Force Main	Transport extracted groundwater from the South Plume Force Main and the well discharge force main tie-ins to the SFES Discharge Valve House	1 2 3 4 5
11	SFES Treatment Force Main	Transport extracted groundwater from the SFES Valve House to the South Plume Valve House for ultimate treatment	1 2 3 4 5
12	Parshall Flume Outfall Force Main	Transport extracted groundwater from the SFES Discharge Valve House to the Great Miami River	1 2 3 4 5
13	Well Houses	Provide shelter and operating space for extraction wells and their associated valving and instrumentation	1 2 3 4 5
14	SFES Valve House	Provides shelter and operating space for flow direction from extraction well headers to either treatment or discharge	1 2 3 4 5

Table A-1 - Performance Grade (PG) Evaluation (Continued)

#	SSC	Purpose/Function	PG
15	SFES Discharge Valve House	Provide shelter and operating space for the tie-in point at the Parshall Flume Outfall Force Main	1 2 3 4 5
16	Cleanouts	A watertight facility to contain valves that can control flows and allow for maintenance of the lateral and header pipelines	1 2 3 4 5
17	SFES Extraction Well Flow Meters/Transmitters	Provide a means to measure, display and transmit flow rate and accumulated flow totals as produced by each extraction well	1 2 3 4 5
18	SFES Extraction Well Pump Discharge Pressure Transmitters	Provide a means to measure and transmit the discharge pressure of the individual extraction well pumps	1 2 3 4 5
19	Well Field Header and Pipeline Pressure Transmitters	Provide a means to measure and transmit the pressure of the well field header and pipeline operating pressures	1 2 3 4 5
20	Remote Data Multiplexers	Provide a means to gather analog and digital signals which represent pertinent information on the SFES for operations and maintenance at a remote location from the system equipment	1 2 3 4 5
21	Existing South Field Extraction Flow Meters/Transmitters	Provide a means to measure, display and transmit flow rate and accumulated flow totals from the existing extraction system	1 2 3 4 5
22	Variable Frequency Drives	Provide a means to vary the speed of the extraction well pumps to adjust the pumping rate of the extraction wells to provide the desired production of groundwater	1 2 3 4 5
23	Electrical Distribution System	Provides electrical power at the required voltage level for electrical loads at the respective well sites	1 2 3 4 5
24	Roads	Provide access to the wells and the valve houses for the construction, operation and maintenance activities	1 2 3 4 5

APPENDIX B

TITLE I SPECIFICATIONS

Appendix B
Title I Specifications

B.1 Division 2 - Sitework

The Division 2 - Sitework specification will include:

1) Site Preparation
2) Earthwork
3) Slope Protection and Erosion Control
4) Paving and Surfacing
5) Effluent Piping
6) Storm Drainage
7) Fences and Gates
8) Landscaping and Seeding

B.1.1 Site Preparation

The piping will be routed to minimize the amount of clearing required. Perimeter sediment control measures will be specified to be installed prior to beginning any clearing or earthwork. Work will be specified to be done in accordance with Ohio Department of Transportation (ODOT) standards. Fence material and topsoil will be removed and salvaged for re-use. Fernald Environmental Management Project (FEMP) standards for waste material will be specified for material that cannot be re-used and must be removed from the work zone.

B.1.2 Earthwork

Earthwork shall include all grading, excavation, trenching, and filling, and shall be specified to conform to ODOT standards. Trenching shall also conform to Occupational Safety and Health Administration (OSHA) standards. Where feasible, slopes should be a minimum of 0.5 percent for impervious surfaces, 2 percent for vegetated surfaces, and no greater than 3H:1V. Temporary access over contaminated or unstable soil will be done with stone aggregate and wood mats.

B.1.3 Slope Protection and Erosion Control

This includes temporary measures to prevent erosion and control sediment during construction. Some measures will need to be installed prior to any clearing or earthwork being performed. During construction, additional measures will be required, such as around new catch basins. All erosion and

sediment control measures will require maintenance during construction. ODOT standards for control measures will be specified.

B.1.4 Paving and Surfacing

All paving and surfacing methods, materials, design, and details will conform to ODOT standards. The American Association of Highways and Transportation Officials (AASHTO) *A Policy on Geometric Design of Highways and Streets* 1990 (GDHS-90) will be used as a reference for alignment. The design vehicle will be WB-40. Unless conditions dictate otherwise, the minimum slope shall be 0.50 percent.

B.1.5 Effluent Piping

The majority of the groundwater piping materials will be High-Density Polyethylene (HDPE) except at transitions required at valves, meters, structures, etc. where steel pipe or ductile iron will be used. All groundwater lines shall have a minimum depth of cover of 3.5 feet for frost protection. Layout shall minimize the amount of line under pavement. Maintain 10 feet horizontal separation from potable water. If laid closer than 10 feet, the crown of the effluent line shall be 18 inches below the bottom of the potable water line. Thrust blocks are required for all lines 3 inches or greater. Gate valves or post indicator valves (PIVs) shall be installed at line intersections and selected points throughout the distribution system to provide control over the service area in accordance with DOE Order 6430.1A. Effluent lines crossing under existing drainage courses are to be encased in concrete.

B.1.6 Storm Drainage

New systems will be designed for the 25-year, 24-hour storm. Open channels will use the 5-year storm for evaluating velocity. Culvert material will be corrugated HDPE with smooth interior, unless design considerations dictate otherwise.

B.1.7 Fences and Gates

Fencing shall be limited to that required for safety, physical security, and activity control. Temporary fencing shall be used during construction. The Fernald Environmental Restoration Management Corporation (FERMCO) is responsible for radiation control fencing. Existing fence material that is to be removed shall be salvaged for re-use. New fences and hardware shall be standard chain link fabric with three strands of barbed wire with a total fence height of 8 feet. The integrity of site perimeter security fencing shall be maintained. United States Department of Energy (DOE) and FEMP standards for fencing will be followed.

B.1.8 Landscaping and Seeding

All areas disturbed during construction, not being surfaced during construction shall be stabilized with topsoil, seed and mulch, or sod. Sod shall be specified if conditions warrant its use, such as velocity in channels. Supplements to the soil shall be specified if necessary. Seed and supplement rates and materials shall conform to ODOT standards. Temporary seeding, per ODOT standards, of exposed soil shall be required if the area is not expected to be worked for 30 days.

B.2 Division 3 - Concrete

The Division 3 - Concrete specification will include:

1) Concrete
2) Concrete Floor Finishing

Concrete

The cast-in-place concrete for the foundation will have 3,000 pounds per square inch (psi) and slab on grade will have 4,000 psi compressive strength at 28 days per American Concrete Institute (ACI) 318. Formwork will be designed, fabricated, erected, used, and removed in accordance with ACI 301. All reinforcing bars will be new deformed billet steel conforming to American Society for Testing and Materials (ASTM) A615, Grade 60. All welded wire fabric will conform to ASTM A185. Water stops will be fabricated from a plastic compound the basic resin of which will be polyvinyl chloride (PVC). Grout for setting structural members and/or embedded items in or on hardened concrete will consist of approved nonshrink, nonmetallic grout.

Concrete Floor Finishing

Finish on the concrete floor surfaces will be in accordance with ACI 301 and 302. Floors will be sloped uniformly to drains at 1/8 inch per foot unless noted otherwise. Exposed surface areas will be finished with steel trowel. Floor surfaces will be sealed by applying sealer in accordance with manufacturer's instructions.

B.3 Division 5 - Metals

The Division 5 - Metals specification will include:

1) Metal Fabrications

Metal Fabrications

Structural steel will conform to ASTM A-36 and will be designed, detailed, fabricated, and erected in accordance with the American Institute of Steel Construction (AISC) specification and code of standard practice. Bolts used to connect structural members will be high-strength steel bolts and will conform to ASTM A-325. Anchor bolts will conform to ASTM A-36. All welding will conform to the American Welding Society (AWS) specification AWS D.1.1. All fabricated carbon steel will be painted with one shop coat of primer.

B.4 Division 7 - Thermal and Moisture Protection

The Division 7 - Thermal and Moisture Protection specification will include:

1) Joint Sealers

Joint Sealers

This section includes preparing substrate surfaces and furnishing and installing joint backing materials and sealant.

B.5 Division 8 - Doors and Windows

The Division 8 - Doors and Windows specification will include:

1) Standard Steel Doors and Frames
2) Overhead Coiling Doors
3) Hardware

Standard Steel Doors and Frames

This section includes providing steel doors and associated frames as per the drawings.

Overhead Coiling Doors

This section includes the furnishing and installing the overhead coiling doors, the operating hardware, and the electric operators (if specified).

Hardware

This section provides all door hardware and locking devices. Locking devices to be according to FERMCO's Grand Master System.

B.6 Division 9 - Finishes

The Division 9 - Finishes specification will include:

1) Special Coatings
2) Painting

Special Coatings

This section includes the preparation of substrate surfaces and painting with high build glazed coatings all secondary containments, tanks, etc., if specified.

Painting

This section provides for furnishing all labor, materials, equipment, tools, and services required for all painting work as required by drawings and/or specified. This includes piping, structural supports, etc.

B.7 Division 13 - Special Construction

The Division 13 - Special Construction specification will include:

1) Pre-Engineered Structures

Pre-Engineered Structures

This section includes pre-engineered, shop fabricated metal buildings that will be designed to be assembled in the factory or on the site.

B.8 Division 15 - Mechanical

The Division 15 - Mechanical specification will include:

1) SFES Pumps
2) Exposed Piping and Valves

SFES Pumps

Electric motor drive, variable speed, vertical turbine, open line shaft, with water lubricated shaft bearings. Pump bowls will be standard fitted, multistage type. Motors will be in the 20 to 40 hp range, totally enclosed fan cooled, vertical hollow shaft, with non-reverse ratchets, and suitable for 460 volt, 3 phase, 60 Hz power. The pumps will be provided with shaft adjusting nuts. Pumps will have nominal rated flows of 100 to 400 gpm for the first 15 years of operating lifetime. Five of these pumps will be subsequently replaced with 800 gpm rated pumps and the remaining five wells will be removed. Pump heads will be approximately 250 feet.

Exposed Piping and Valves

1) Pipe: ASTM A53 seamless Grade A, standard weight.

2) Flanges: Class 150, raised face; rubber gaskets.

3) Fittings: Welded.

4) Valves:
   (1) Class 150.
   (2) Check valves: Non-slam type.
   (3) Isolating valves: Manually operated resilient seated butterfly with gear operators for sizes 6 inches and larger.
   (4) Sample, vent and drain valves: manual globe type.

5) Insulation: Cellular foam anti-sweat type.

6) Insulation jacket: none.

B.9 Division 16 - Electrical

The Division 16 - Electrical specification will include:

1) Basic Electrical Materials and Methods
2) Grounding
3) Underground Ductbank and Manholes
4) Medium Voltage Cable
5) Variable Frequency Drives
6) Electric Heating Cables
7) Controls

Basic Electrical Materials and Methods, Grounding, Underground Ductbank and Manholes, Medium Voltage Cable, and Variable Frequency Drives

Electrical conduit, wire, and general materials, as well as circuit breakers and disconnect switches and combination transformer panelboards, will be specified according to recognized national standards as required by DOE Order 6430.1A and the requirements of this project. Likewise, the grounding, ductbank and manholes, 15 kV distribution power cable, and variable frequency drives will be specified by the respective specifications.

Variable frequency drive to change the power supply frequency between 0.10 and 100 Hertz, 480 Vac, three phase input power, sized for the particular extraction well pump, NEMA 4 enclosure

Controls

Ultrasonic flow meters, 0 to 400 (800) gpm, or 0 to 1500 gpm, clamp on, 4-20 mAdc output (flow rate), local digital readout displaying flow rate and accumulated flow, National Electrical Manufacturers Association (NEMA) 4 enclosure, 750 ohm loop impedance

Electronic output pressure transmitter, 0 to 150 psi input, 4-20 mAdc output, 750 ohms loop impedance, NEMA 4 enclosure

Remote Multiplexer, multiple analog and digital inputs multiplexer, 1 to 5 Vdc analog inputs, dry contact closure/TTL digital inputs, telephone modem output configured to interface with existing equipment, data quality phone lines required, NEMA 4 enclosure

APPENDIX C

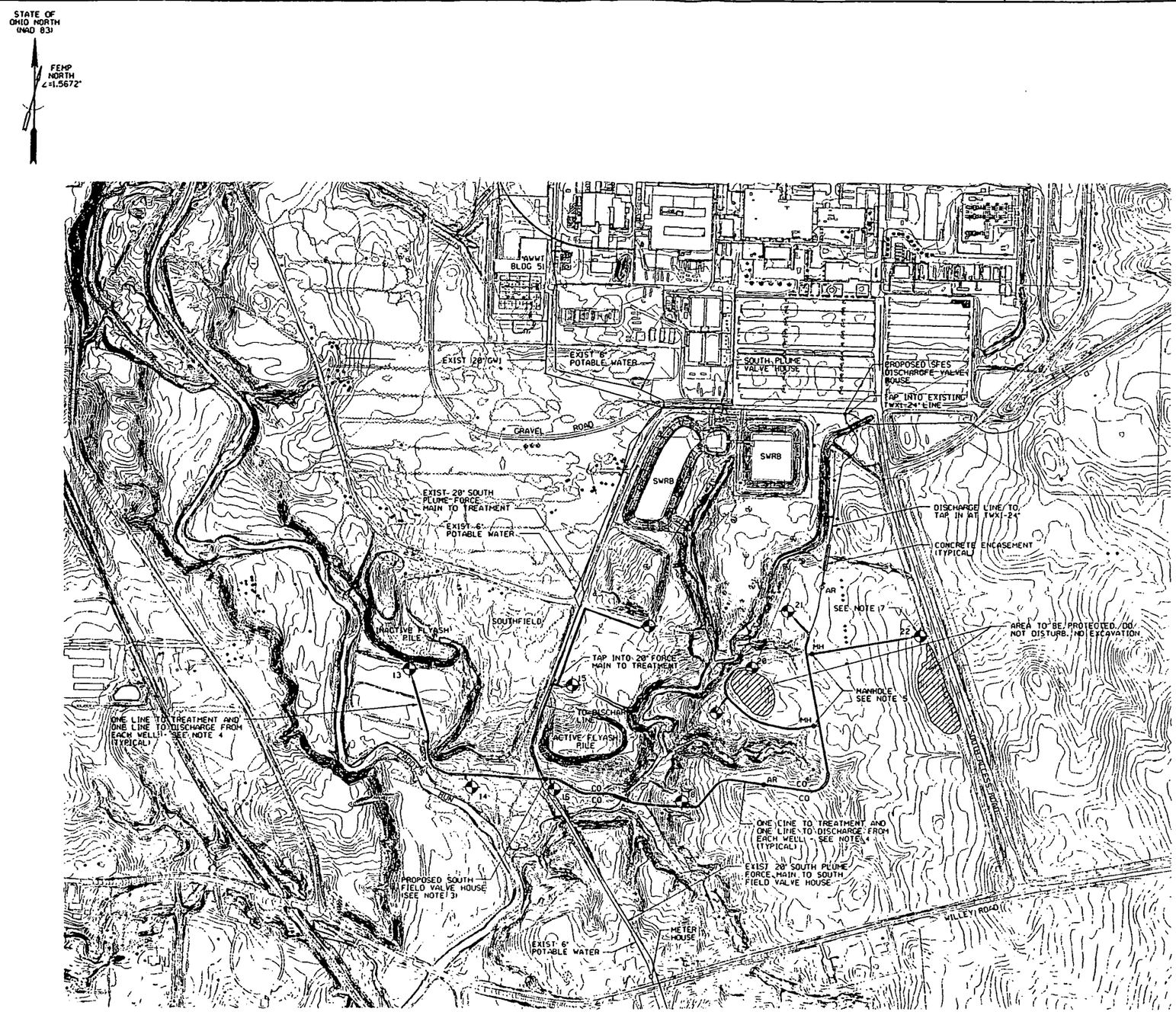
LIST OF TITLE II DESIGN DRAWINGS

Appendix C
List of Title II Design Drawings

1) Piping and Instrumentation Diagrams
2) Loop Diagram/Interconnects
3) Instrument Arrangement
4) Valve House Power Plans
5) Valve House Lighting and Details
6) SFES Valve House Piping Plan
7) SFES Valve House Piping Sections and Details
8) Well House Piping Plan
9) Well House Piping Sections and Details
10) Pipe Support Details
11) Miscellaneous Piping Details
12) Wellfield Plans and Profiles
13) Main Header Plans and Profiles
14) SFES Valve House Plans and Profiles
15) Master Site Plan
16) Sections and Details/Road Profiles
17) SFES Valve House Floor Plan and Elevations
18) Well House Plans and Elevations
19) Foundation Plan and Details
20) System Architecture - Multiplexers
21) Single Line Diagram
22) Electrical Well Power Plan(s)
23) Electrical Well Lighting Plan
24) Electrical Well Details
25) Electrical Panel Schedules
26) Electrical Site Plan
27) Electrical Schematics
28) Electrical Interconnection Diagrams

APPENDIX D

SITE PLAN



NOTES

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

   PARSONS TOPOGRAPHY, 1992
   FEMP CADD GRID/UTILITY DRAWINGS
   FEMP CONTRACTOR PROJECT DESIGN DOCUMENTS

2. ACTUAL LOCATIONS OF THE WELL HOUSES WILL BE CLOSER TO THE WELL HEADS THAN SHOWN.
3. GROUNDWATER WILL BE SENT TO TREATMENT BY THE EXISTING SOUTH PLUME LINE, GW1-20"-01. THE EXISTING 20" LINE SOUTH OF THE PROPOSED SOUTH FIELD VALVE HOUSE WILL BE DIVERTED TO EITHER DISCHARGE OR TREATMENT IN THE SOUTH FIELD VALVE HOUSE.
4. SIZES OF PIPELINES WILL RANGE FROM 4" TO 20" DIAMETER. MATERIAL WILL BE HDPE. FINAL PIPE SIZES, CLEAN OUT, MANHOLES AND VALVE LOCATIONS WILL BE DETERMINED IN TITLE II DESIGN.
5. MANHOLES COULD CONTAIN CLEANOUT PORTS, ISOLATION VALVES, AND CHECK VALVES. ARRANGEMENT OF EACH MANHOLE WILL BE DETERMINED IN TITLE II DESIGN.
6. MAINTAIN A MINIMUM 5' PIPE DEPTH WITHIN OU-2 REMEDIATION AREA.
7. WELL NO. 22 AND ASSOCIATED WELL HOUSE AND PIPING ARE FOR CONTINGENCY. THE NEED FOR WELL NO. 22 IS BEING VERIFIED BY GROUNDWATER MODELING PRIOR TO TITLE II DESIGN.

6902

LEGEND

EXISTING		PROPOSED
	AIR RELEASE CHAMBER	AR
	BUILDING	
	CLEANOUT MANHOLE	CO
	EXTRACTION WELL AND WELL HOUSE	21
	MAJOR CONTOUR	
	MINOR CONTOUR	
	MANHOLE	MH
	PIPELINE	
	SITE BOUNDARY	

PRELIMINARY
NOT FOR CONSTRUCTION

REV. NO.	ISSUE OR REVISION PURPOSE - DESCRIPTION	A-E INITIALS	FERNCO INITIALS	DATE
A	ISSUED FOR FR & OBD			

UNITED STATES DEPARTMENT OF ENERGY
FERNALD ENVIRONMENTAL MANAGEMENT PROJECT

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

PROJECT NAME
GROUNDWATER REMEDIATION
TITLE I/II DESIGN

DRAWING TITLE
CIVIL
SITE PLAN
SOUTH FIELD EXTRACTION SYSTEM

DRAWN BY	DATE	LEAD ENGINEER	DATE	CHECKED BY	DATE
R. ESPARZA	04-04-95			E. KUBRIN	05/08/95
PLANT/BLDG. NO.		FLOOR		SCALE	CLASS
				1"=200'	

SUBMITTED FOR APPROVAL — FERNCO CRU APPROVAL
000065
A-E DATE — DATE

PREPARED UNDER PARSONS PROJECT ORDER NUMBER	DOE PROJECT NO.	FEMP PROJECT NO.	DRAWING SHEET CODE NO.	SHEET NO.	REV. NO.
CRU5/P0126		VBS 1.1.1.1.5.3 00-90701	95X-5900-G-00192	G0001	A

APPENDIX E

PIPING AND INSTRUMENTATION DIAGRAMS

PIPING SYMBOLS

- GATE VALVE
- GLOBE VALVE
- BALL VALVE
- PLUG VALVE
- BUTTERFLY VALVE/DAMPER
- STOP CHECK
- NEEDLE VALVE
- CHECK VALVE
- SLIDING GATE VALVE
- BALL CHECK VALVE
- BACKFLOW PREVENTER
- DIAPHRAGM VALVE
- PINCH VALVE
- 3 WAY VALVE
- 3 WAY BALL VALVE
- 3 WAY PLUG VALVE
- ANGLE GATE VALVE
- ANGLE GLOBE VALVE
- FOOT VALVE
- HUB DRAIN OR FUNNEL
- DIAPHRAGM OPERATOR
- DIAPHRAGM W/ POSITIONER
- PISTON OPERATOR
- SAFETY RELIEF VALVE
- SOLENOID OPERATOR
- SELF-CONTAINED BACK PRESSURE REGULATING VALVE
- 2-WAY SOLENOID VALVE
- 3-WAY SOLENOID VALVE (INDICATES DEENERGIZED SECONDARY)
- 4-WAY SOLENOID VALVE
- VALVE WITH OPERATOR (VALVE TYPE UNDEFINED)

- STEAM TRAP
- HOSE QUICK COUPLING
- UNION
- DRAIN LEG
- EXPANSION JOINT
- HANDWHEEL
- EJECTOR
- STRAINER (Y TYPE)
- STRAINER (SINGLE BASKET)
- STRAINER (DOUBLE BASKET)
- STRAINER (CONE TYPE)
- STRAINER (SUCTION TYPE)
- CONCENTRIC REDUCER
- ECCENTRIC REDUCER
- ORIFICE
- VENTURI TUBE
- SIPHON TUBE
- THERMOWELL
- FLOW DIRECTION
- WELDED CONNECTION
- FLANGED CONNECTION
- FLEXIBLE HOSE
- PIPE CAP
- TIE/IN MARK
- PRIMARY
- SECONDARY
- EXISTING PIPING OR EQUIPMENT
- UNDERGROUND
- PACKAGED SYSTEM
- PIPING MATERIAL TRANSITION

- PULSATION DAMPENER
- AIR FILTER
- FILTER LUBRICATOR REGULATOR
- AIR OPERATED DIAPHRAGM PUMP
- HORIZONTAL CENTRIFUGAL PUMP
- VERTICAL CENTRIFUGAL PUMP
- SUMP PUMP
- CHEMICAL METERING PUMP
- AGITATOR (MIXER)

ABBREVIATIONS

BTU	BRITISH THERMAL UNIT
CU FT	CUBIC FEET
GPH	GALLONS PER HOUR
GPM	GALLONS PER MINUTE
KW	KILOWATT
LB/HR	POUNDS PER HOUR
SCFM	STD. CUBIC FT/MINUTE
NO	NORMALLY OPEN
NC	NORMALLY CLOSED
FO	FAIL OPEN
FC	FAIL CLOSED
AO	AIR TO OPEN
AC	AIR TO CLOSE
IA	INSTRUMENT AIR
ET	ELECTRIC TRACED AND INSULATED
ST	STEAM TRACED AND INSULATED
EF	EXHAUST FAN
GV	GRAVITY VENTILATOR
UH	UNIT HEATER
RED	REDUCER
ECC	ECCENTRIC
TBD	TO BE DETERMINED
TF	TOP FLAT
TYP	TYPICAL
MATL	MATERIAL
MED	MEDIUM
CO	CARBON MONOXIDE
RH	RELATIVE HUMIDITY
CFM	CUBIC FEET/MINUTE

INSTRUMENTATION SPECIAL DESIGNATIONS

DESIGNATION	FUNCTION/ABBREVATION
Σ/N OR AVG	AVERAGING
± OR BI	BIAS
1:1.1:3.2:1 (TYP)	BOOST.GAIN OR ATTENUATE (INPUT:OUTPUT)
△ OR DIF	DIFFERENTIAL
÷ OR DIV	DIVIDE
√ OR SQ.RT.	EXTRACT SQUARE ROOT
X OR MUL	MULTIPLY
N	RAISE TO POWER
REV	REVERSING
Σ OR SUM	SUMMING
L	LOW
LL	LOW LOW
H	HIGH
HH	HIGH HIGH
HL	HIGH LOW
∫	INTEGRATE (TIME INTEGRAL)
%	PROPORTIONAL
Y	UNDETERMINED COMPUTING RELAY
HOA	HAND-OFF-AUTO
∓	EXISTING INSTRUMENT TO BE RELOCATED
I/P	CURRENT TO PNEUMATIC TRANSDUCER
RUN	RUNNING
OA	OFF-AUTO
OCA	OPEN-CLOSE-AUTO
I/O	INPUT / OUTPUT
⊕	EXISTING INSTRUMENT
UD	UP/DOWN
EW	EAST/WEST
I/I	CURRENT TO CURRENT

PIPING SPECIFICATIONS

FLOWING MEDIUM	MED CODE	MATL CODE
BACK WASH	BW	T
CHILLED WATER	CHS, CHR	A
CHLORINE	CL	B1
CONDENSATE	LC	W, T
CONDENSER WATER	CWS, CWR	A
COOLING WATER	WS, WR	A
DRAIN	DR	A, T
THICKENER OVERFLOW	TO	T
FILTRATE EFFLUENT	FT	A
FLOCCULANT	FL	A
FLUSH WATER	FW	T
FORCE MAIN	FM	M
GROUND WATER	GW	A, B4
INSTRUMENT AIR	IA	T
MELTER OFF-GAS	OG	T
NITRIC ACID	AN	T1
PERCHED GND WATER	PGW	B
PHOSPHORIC ACID	PAPH	T1
PLANT AIR	PA	W
POLISHED WATER	PW	A
POTABLE WATER	DW	W, B, B3
PROCESS WATER	TW, TWX1	A, B4
PROCESS WASTEWATER	CE	A
RAW WATER	RW	A
RECYCLE WATER	RC	T, B2
SCRUBBER RECYCLE	RSL	T
SLURRY	SL	T
SODIUM CARBONATE	SC	A
SODIUM HYDROXIDE	NA	T
SODIUM SILICATE	SS	A
STORM WATER	ST	A
SULFURIC ACID	SB	T1
SUMP DISCHARGE	SU	T
VACUUM	V	A
VENTILATION AIR	VE	T
WASTE WATER	WW	T

EXAMPLE: CE-2"-A-100-ET
- CE — MEDIUM CODE
- 2" — NOMINAL PIPE SIZE
- A — MATERIAL CODE
- 100 — LINE NUMBER
- ET — HEAT TRACING AND INSULATION

A - A53,GR. A, SEAMLESS STEEL PIPE
B - PVC
B1 - PVDF
B2 - PVDF, 100 PSI
B3 - CPVC
B4 - HDPE
L - FIBERGLASS REINFORCED PLASTIC
M - DUCTILE IRON
T - 304L, STAINLESS STEEL PIPE
T1 - 316L, STAINLESS STEEL PIPE
W - A53,GR. A, GALVANIZED STEEL PIPE

SINGLE LINE AIR DUCT SYMBOLS

- FAN WITH INLET VANES AND BACKDRAFT DAMPER
- BACKDRAFT DAMPER
- MOTORIZED DAMPER
- MANUAL VOLUME DAMPER

INSTRUMENT SYMBOLS

- ELECTRICAL BINARY SIGNAL
- PNEUMATIC BINARY SIGNAL
- ELECTROMAGNETIC OR SONIC SIGNAL (GUIDED)
- ELECTROMAGNETIC OR SONIC SIGNAL (NON-GUIDED)
- INSTRUMENT/PLANT AIR SUPPLY
- ELECTRICAL SIGNAL
- DATA HIGHWAY
- CAPILLARY
- HYDRAULIC SIGNAL LINE
- PNEUMATIC OR VACUUM SIGNAL LINE
- INTERLOCK
- DIAPHRAGM SEAL
- ROTAMETER
- SIGHT GLASS
- LOCAL MOUNTED INSTRUMENT

- FRONT OF PANEL MOUNTED INSTRUMENT
- FRONT OF PANEL MOUNTED INSTRUMENT AUXILLIARY LOCATION
- REAR OF PANEL MOUNTED INSTRUMENT
- REAR OF PANEL MOUNTED INSTRUMENT AUXILLIARY LOCATION
- DIGITAL LOGIC OPERATOR INTERFACE AUXILIARY LOCATION
- DIGITAL LOGIC OPERATOR INTERFACE
- SHARED CONTROL AUXILIARY LOCATION
- SHARED DISPLAY COMPUTER CONTROL AND OPERATOR INTERFACE
- AIR VENT FILTER
- ULTRASONICIC FLOW METER
- POSITIVE DISPLACEMENT FLOW METER
- EQUIPMENT NUMBER

FY-102a
- FY — LETTERS OF IDENTIFICATION
- 102 — INSTRUMENT TAG NUMBER
- a — SPECIAL DESIGNATION

TYPICAL CALL OUT

LETTERS OF INSTRUMENT IDENTIFICATION

LETTER	FIRST LETTER: MEASURED OR INITIATING VARIABLE	2ND LETTER: MODIFIER	3RD OR 4TH LETTER: READ OUT OR PASSIVE FUNCTION
A	ANALYSIS	ALARM	ALARM
B	BURNER FLAME	----	----
C	CAMERA	CONTROLLER	CONTROLLER
D	DENSITY	DIFFERENTIAL	----
E	VOLTAGE	ELEMENT	ELEMENT
F	FLOW RATE	RATIO (FRACTION)	----
G	GAGING (DIM)	VIEWING DEVICE	GLASS
H	HAND (MANUAL)	----	HIGH
I	CURRENT (ELECT)	INDICATE	INDICATE
J	POWER	SCAN	----
K	TIME	----	----
L	LEVEL	LIGHT	LOW
M	MOIST OR HUMIDITY	----	----
N	----	----	----
O	OBSERVATION	----	ORIFICE
P	PRESSURE OR VACUUM	----	POINT (TEST)
Q	QUANTITY OR EVENT	TOTALIZER	----
R	RADIOACTIVITY	RECORDER	----
S	SPEED OR FREQUENCY	SAFETY/SWITCH	SWITCH
T	TEMPERATURE	TRANSMITTER	TRANSMITTER
U	USER'S GUIDE	----	MULTIFUNCTION
V	VISCOSITY	----	VENT, VALVE
W	WEIGHT OR FORCE	WELL	----
X	UNCLASSIFIED	----	UNCLASSIFIED
Y	RELAY	RELAY	----
Z	POSITION	----	----

NOTES

1. AIR RELEASE AND CLEANOUTS WILL BE SHOWN IN TITLE II DESIGN.

6902

REF DWG NO.	DRAWING TITLE

PRELIMINARY
NOT FOR CONSTRUCTION

REV NO.	ISSUE OR REVISION PURPOSE - DESCRIPTION	ORIG	PENCO	DATE
		INITIALS AND DATE		
B	ISSUED FOR FR&DBD			

UNITED STATES
DEPARTMENT OF ENERGY
FERNALD ENVIRONMENTAL MANAGEMENT PROJECT

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

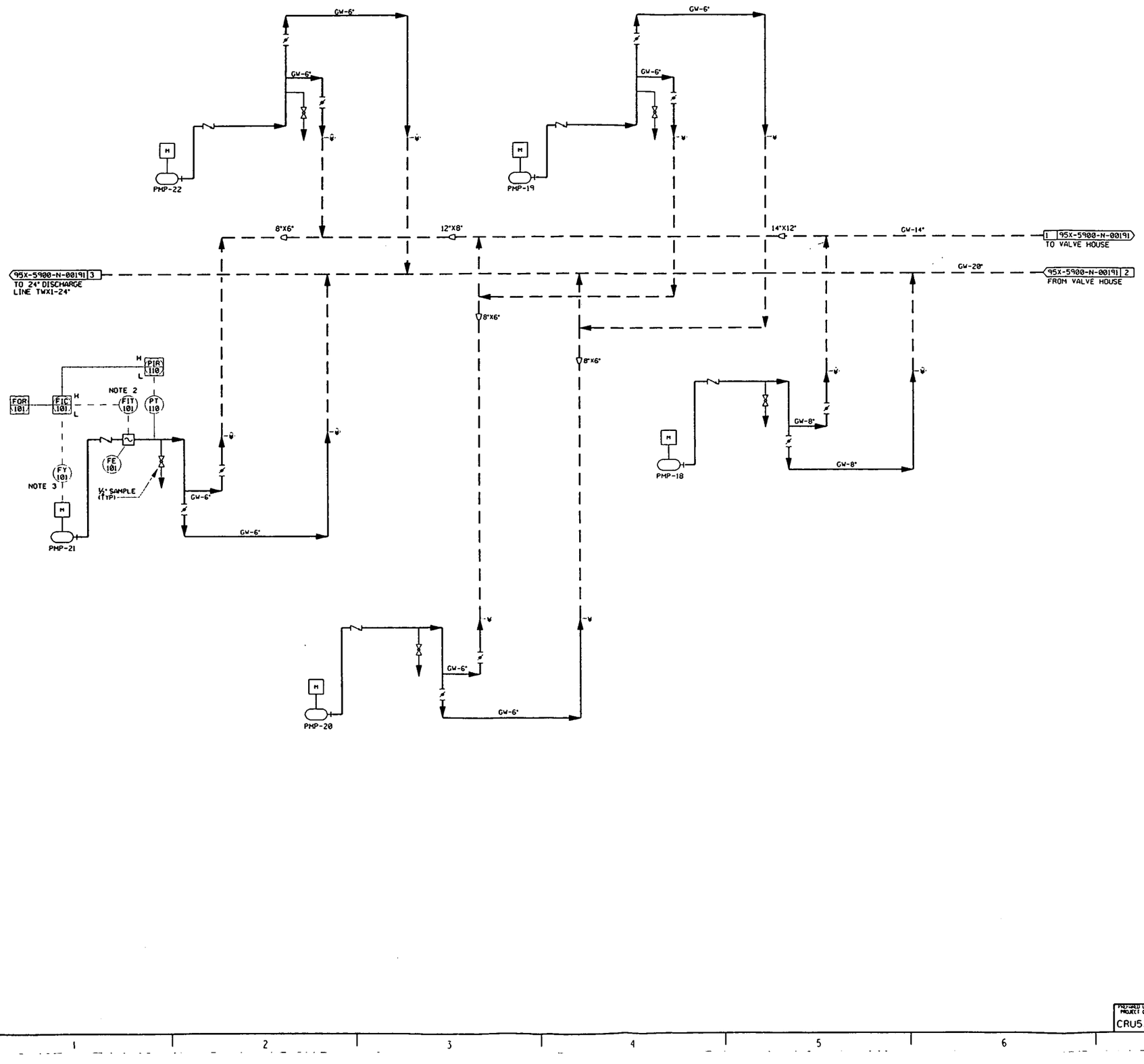
PROJECT NAME
GROUNDWATER REMEDIATION
TITLE I/II DESIGN

DRAWING TITLE
MECHANICAL PROCESS
PIPING AND INSTRUMENTATION DIAGRAM
SYMBOLS AND LEGEND

DRAWN BY	DATE	LEAD ENGINEER	DATE	CHECKED BY	DATE
G. AMBUSH	03-27-95			J. L. COOPER	4-6-95
PLANT/BLDG NO.		FLOOR		SCALE	QUALITY
				NONE	
SUBMITTED FOR APPROVAL		FINAL CAD APPROVAL			
DOE PROJECT NO.	DATE	TECH PROJECT NO.	DATE	DRAWING SHEET CODE NO.	SHEET NO.	REV. NO.
		VBS 1.1.1.1.5.3.1 00-9070I		95X-5900-N-00189	N0001	B

PREPARED UNDER WORK AND PROJECT ORDER NUMBER: CRU5/P0126

000067



NOTES

1. FOR SYMBOLS AND LEGEND SHEET, SEE DRAWING 95X-5900-N-00189.
2. THE FIELD INSTRUMENTS SHOWN ON PUMP PMP-21 ARE TYPICAL FOR ALL EXTRACTION WELL PUMPS
3. THE INSTRUMENT TAG DESIGNATION "FY" REPRESENTS A VARIABLE FREQUENCY DRIVE.

6902

REF DWG NO.	DRAWING TITLE
95X-5900-N-00189	SYMBOLS AND LEGEND
95X-5900-N-00191	PIPING AND INSTRUMENTATION DIAGRAM

PRELIMINARY
NOT FOR CONSTRUCTION

REV. NO.	ISSUE OR REVISION PURPOSE - DESCRIPTION	A-E INITIALS	FERNCO	DATE
B	ISSUED FOR FR&OBD			

UNITED STATES
DEPARTMENT OF ENERGY
FERNALD ENVIRONMENTAL MANAGEMENT PROJECT

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

PROJECT NAME
GROUND WATER REMEDIATION
TITLE I/II DESIGN

DRAWING TITLE
MECHANICAL PROCESS
PIPING AND INSTRUMENTATION DIAGRAM
SOUTH FIELD EXTRACTION SYSTEM SHEET 1 OF 2

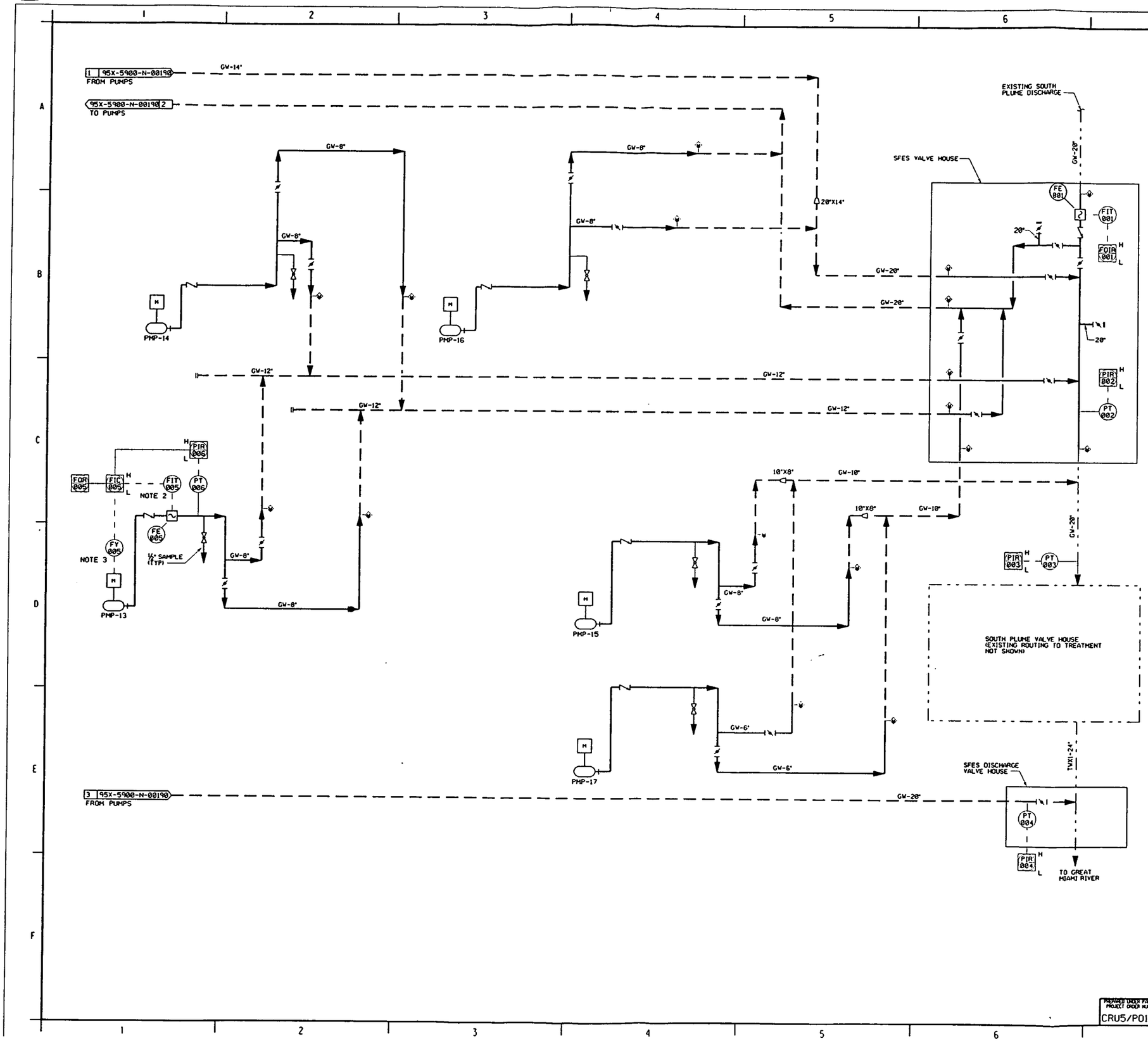
DRAWN BY	DATE	LEAD ENGINEER	DATE	CHECKED BY	DATE
G. AMBUSH	03-27-95			J. L. COOPER	4-6-95

PLANT/BLDG NO.	FLOOR	SCALE	CLASS

SUBMITTED FOR APPROVAL	FERNCO CRU APPROVAL

PREPARED UNDER PARSONS PROJECT ORDER NUMBER	A-E CODE PROJECT NO.	DATE	TEMP PROJECT NO.	DRAWING SHEET CODE NO.	SHEET NO.	REV. NO.
CRU5/P0126			VBS 1.1.1.1.5.3.1 00-90701	95X-5900-N-00190	N0002	B

000068



NOTES

1. FOR SYMBOLS AND LEGEND SHEET, SEE DRAWING 95X-5900-N-00189.
2. THE FIELD INSTRUMENTS SHOWN ON PMP-13 ARE TYPICAL FOR ALL EXTRACTION WELL PUMPS.
3. THE INSTRUMENT TAG DESIGNATION "FY" REPRESENTS A VARIABLE FREQUENCY DRIVE.

6902

REF DWG NO.	DRAWING TITLE
95X-5900-N-00189	SYMBOLS AND LEGEND
95X-5900-N-00190	PIPING AND INSTRUMENTATION DIAGRAM

PRELIMINARY
NOT FOR CONSTRUCTION

REV.	ISSUE OR REVISION PURPOSE - DESCRIPTION	A-E INITIALS AND DATE	FERNCO INITIALS AND DATE
B	ISSUED FOR FR&DBD		

UNITED STATES DEPARTMENT OF ENERGY
FERNALD ENVIRONMENTAL MANAGEMENT PROJECT

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CINCINNATI, OHIO

PROJECT NAME
GROUNDWATER REMEDIATION
TITLE I/II DESIGN

DRAWING TITLE
MECHANICAL PROCESS
PIPING AND INSTRUMENTATION DIAGRAM
SOUTH FIELD EXTRACTION SYSTEM SHEET 2 OF 2

DRAWN BY	DATE	LEAD CHECKER	DATE	CHECKED BY	DATE
G. AMBUSH	03-28-95			J. L. COOPER	4-6-95
PLANT/BLDG. NO.		FLOOR		SCALE	CLASS
SUBMITTED FOR APPROVAL		FERNCO CRU APPROVAL			
A-E DOE PROJECT NO.	DATE	TEAM PROJECT NO.	DATE DRAWING ROLF CODE NO.	SHEET NO.	REV. NO.
PREPARED UNDER PARSONS PROJECT ORDER NUMBER: CRU5/P0126		WBS 1.1.1.1.5.3.1 00-9070I	95X-5900-N-00191	N0003	B

000069

APPENDIX F

SAFETY ASSESSMENT FOR THE SFES

6902

REQUEST FOR SAFETY ASSESSMENT

(This section to be filled in by Manager, Nuclear and System Safety)

SAFETY ASSESSMENT IDENTIFICATION NUMBER:	☒ The request to provide a Safety Assessment by 3/27/95 is accepted; the individual assigned to the project is:
FERMCO:SH:(SA):95-0013	Name: Ron Bartos Phone No.: 738-9369

☒ An assessment has been performed for the project described in this request and this form will serve as the Safety Assessment document. Based on the information provided with this request for Safety Assessment, no further analysis or documentation is required because this project:

☐ does not introduce or involve hazards not routinely encountered in industry and accepted by the public.

RATIONALE:
(See NOTE below)

See attached SA.

☐ is of a type specifically excluded from requiring a Safety Analysis Report by DOE Letter "Streamlining the Safety Documentation Process" (C. C. Hawkins, 10/9/79).

RATIONALE:
(See NOTE below)

OK [illegible] 3/24/95

SIGNATURE OF MANAGER, NUCLEAR AND SYSTEM SAFETY:	DATE: 3-26-95

*NOTE: *If either rationale above is employed to conclude that further Safety Analysis Documentation is unnecessary, approval by the Manager, Regulatory Compliance, and the appropriate Technical Department Level-III Manager is required.*

[redacted] 000071

SIGNATURE OF TECHNICAL DEPARTMENT SECTION MANAGER:	DATE: 3/28/95

FERMCO:SH:(SA):95-0013

Safety Assessment SA 95-0013 South Field Extraction Well System

Purpose

The purpose of this Safety Assessment (SA) is to classify the facility hazard category of the South Field Extraction Well System in accordance with the guidance and criteria provided in DOE Limited Standard DOE-EM-STD-5502-94, *Hazard Baseline Documentation*, any recommend any further safety analysis documentation required.

System Description

This SA is based on the information provided by Dick Butterfield, CRU-5 Project Engineer, in the request for Safety Assessment and in discussions with him.

The South Field Extraction Well System (SFEWS) consists of nine wells. It is one part of the larger extraction system consisting of 28 wells that will make up the Great Miami Aquifer groundwater remediation program for the recovery of contaminated groundwater from the regional aquifer for subsequent treatment and discharge to the Great Miami River (GMR).

Wells numbered 13 through 22, excluding #17, make up the SFEWS (see Figure L.9-1 attached). Installation of the system will include drilling wells, and constructing valve/meter pits, control buildings, roadways, and a valve house. A dual header pipe will be installed to convey the recovered groundwater to the AWWT for treatment or to the South Plume force main for discharge to the GMR. The pipe will be buried, and made of high density polyethylene with fused joints -- similar to the piping used for the South Plume Extraction System.

Facility Hazard Category

The facility hazard category will be based on the maximum inventory of uranium contained in the groundwater being transported by the well extraction system at any one time. Other radioactive and hazardous material amounts are ignored since they are extremely small. All piping is assumed to be running full. The uranium mass will be based on the volume and uranium concentration of groundwater contained in the following piping:

- the piping down into the wells: assumed average of 100 ft deep (Ref D. Butterfield) for 9 wells with 12" diameter piping

  $$\text{Volume} = 9 \times \frac{\pi(1\ \text{ft})^2(100\ \text{ft})}{4} = 707\ \text{ft}^3$$

- piping connecting each of the nine wells to a common point at the south end of the pipe

to the AWWT: estimated at 5000 ft scaled from Fig. L.9-1, 20" diameter piping

$$\text{Volume} = \frac{\pi(20/12\ \text{ft})^2(5000\ \text{ft})}{4} = 10{,}908\ \text{ft}^3$$

- the header pipe to the AWWT from the common point: scaled at 3000 ft from the figure and agreed with by D. Butterfield, 20" diameter piping

$$\text{Volume} = \frac{\pi(20/12\ \text{ft})^2(3000\ \text{ft})}{4} = 6{,}545\ \text{ft}^3$$

Total volume of contaminated water in system = 18,160 ft^3
Assumed density of contaminated water in system= 62.4 lb/ft^3
Mass of contaminated water in system = 1,133,184 lb = 5.14E+08 g

Concentrations of uranium in the contaminated water from samples taken at monitoring wells in the area range from 300 ppb to 2000 ppb uranium. However, the modeling program used to estimate the actual uranium concentration of the groundwater being pumped in the system resulted in concentrations from 6 ppb to 242 ppb. This lower range of groundwater contamination results from the large amount of other groundwater being extracted from areas of lower uranium concentration. A worst case of 242 ppb uranium concentration will be used to estimate the mass of uranium in the system.

242 ppb = 242 lb $U/10^9$ lb water
Mass of uranium = (242 lb $U/10^9$ lb water)(1,133,184 lb water) = 0.274 lb U = 124 g U
Assuming 1% U-235 as a worst case:

Isotope	Isotopic %	Weight Isotope (g)	Specific Activity (Ci/g)	Activity (Ci)	40 CFR 302.4 (Ci)	DOE-STD-1027 Cat 3 Threshold (g)
U-234	0.009	0.01	6.24E-03	6.96E-05	0.1	670
U-235	1.000	1.24	2.14E-06	2.65E-06	0.1	1,900,000
U-238	98.991	122.75	3.34E-07	4.10E-05	0.1	13,000,000
				1.13E-04		

The above table shows the amounts of uranium in the well system are below the RQs listed in Appendix B to Table 302.4 of 40 CFR 302.4 and also below the Category 3 radionuclide threshold quantities listed in Attachment 1, Table A.1 of DOE-STD-1027-92.

Conclusion

The South Field Extraction Well System is classified as an industrial facility conducting hazardous waste activities, and according to DOE-EM-STD-5502-94 no further safety analysis is necessary.

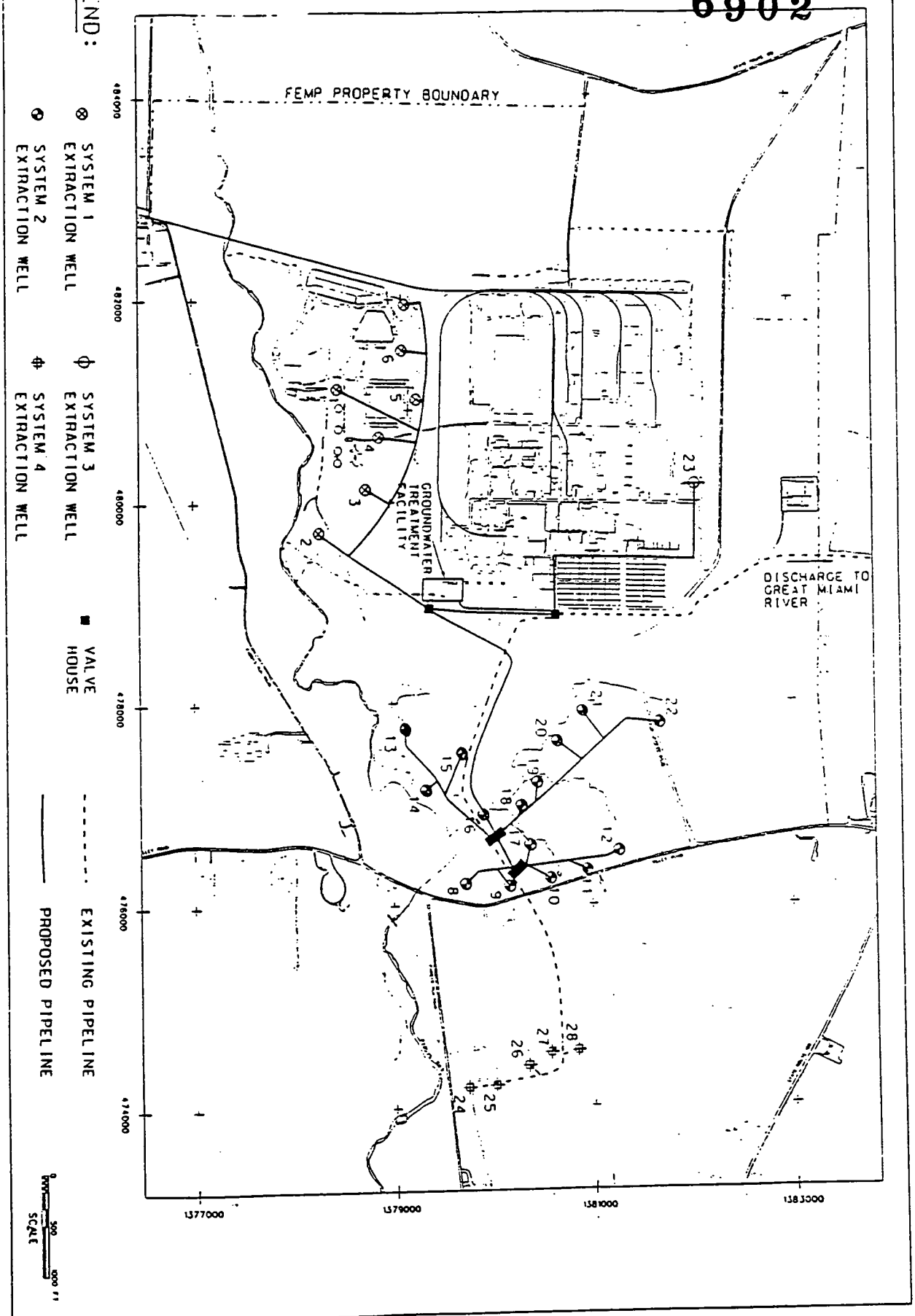

FIGURE L.9-1. RESTORATION TO 20 PPB
DESIGN - EXTRACTION SYSTEM COMPONENT LOCATIONS