ORNL/ER-433/V1&2

ENVIRONMENTAL MANAGEMENT & ENRICHMENT FACILITIES

Old Hydrofracture Facility Tanks Contents Removal Action Operations Plan at the Oak Ridge National Laboratory, Oak Ridge, Tennessee

Volume 1: Text

Volume 2: Checklists and Work Instructions

MANAGED BY
BECHTEL JACOBS COMPANY LLC
FOR THE UNITED STATES
DEPARTMENT OF ENERGY

BJFC-4 (4-98)

BECHTEL
JACOBS
Bechtel Jacobs Company LLC

ORNL/ER-433/V1

ENVIRONMENTAL MANAGEMENT & ENRICHMENT FACILITIES

Old Hydrofracture Facility Tanks Contents Removal Action Operations Plan at the Oak Ridge National Laboratory, Oak Ridge, Tennessee

Volume 1: Text

This document has been approved for release to the public. Date: 5/7/98

MANAGED BY
BECHTEL JACOBS COMPANY LLC
FOR THE UNITED STATES
DEPARTMENT OF ENERGY

BJFC-4 (4-98)

BECHTEL JACOBS
Bechtel Jacobs Company LLC

CDM Federal Programs Corporation

contributed to the preparation of this document and should not be considered an eligible contractor for its review.

DISCLAIMER

ORNL/ER-433/V1

Old Hydrofracture Facility Tanks Contents Removal Action Operations Plan at the Oak Ridge National Laboratory, Oak Ridge, Tennessee

Volume 1: Text

Date Issued—May 1998

Prepared by
CDM Federal Programs Corporation
Oak Ridge, Tennessee
under subcontract 95B-99425C

Prepared for the
U.S. Department of Energy
Office of Environmental Management

Environmental Management Activities at
EAST TENNESSEE TECHNOLOGY PARK
Oak Ridge, Tennessee 37831
managed by
BECHTEL JACOBS COMPANY LLC
for the
U.S. DEPARTMENT OF ENERGY
under contract DE-AC05-98OR22700

ORNL/ER-433

APPROVAL PAGE

Operations Plan for the Old Hydrofracture Facility Tanks Contents Removal Project at Oak Ridge National Laboratory, Oak Ridge, Tennessee

5/5/98
ORNL Environmental Restoration
Site Project Manager
(Clay Bednarz)

5-5-98
OHF Facility Manager
(Lynn Whitehead)

5/5/98
Project Engineer
(Greg Boris)

CONTENTS

VOLUME 1

VOLUME 2

PRE-OPERATIONAL TEST CHECKLISTS

DAILY CHECKLISTS

WORK INSTRUCTIONS

FIGURES

TABLES

ABBREVIATIONS

ALARA	as low as reasonably achievable
ANSI	American National Standards Institute
ASME	American Society of Mechanical Engineers
CDM Federal	CDM Federal Programs Corporation
DOE	U.S. Department of Energy
DOP	di-2-ethylhexyl phthalate
DP	distribution panel
Energy Systems	Lockheed Martin Energy Systems, Inc.
HEPA	high-efficiency particulate air
HP	horsepower
I&C	instrumentation and controls
LLLW	liquid low-level (radioactive) waste
LMER	Lockheed Martin Energy Research Corp.
MVST	Melton Valley Storage Tanks
OHF	Old Hydrofracture Facility
ORNL	Oak Ridge National Laboratory
OMI	operator machine interface
PLC	programmable logic controller
PNNL	Pacific Northwest National Laboratory
PPE	personal protective equipment
PVC	polyvinyl chloride
SSHO	Site Safety and Health Officer
UPS	uninterrupted power system
WAG	waste area grouping

EXECUTIVE SUMMARY

This Operations Plan summarizes the operating activities for transferring contents of five low-level (radioactive) liquid waste storage tanks associated with the Old Hydrofracture Facility (OHF) to the Melton Valley Storage Tanks (MVST) for secure storage. The transfer will be accomplished through sluicing and pumping operations which are designed to pump the slurry in a closed circuit system using a sluicing nozzle to resuspend the sludge. Once resuspended, the slurry will be transferred to the MVST. The report documenting the material transfer will be prepared after transfer of the tank materials has been completed.

The OHF tanks contain approximately 52,600 gal (199,000 L) of low-level radioactive waste consisting of both sludge and supernatant. This material is residual from the now-abandoned grout injection operations conducted from 1964 to 1980. Total curie content is approximately 30,000 Ci.

A sluicing and pumping system has been specifically designed for the OHF tanks contents transfer operations. This system is remotely operated and incorporates a sluicing nozzle and arm (Borehole Miner) originally designed for use in the mining industry. The Borehole Miner is an in-tank device designed to deliver a high pressure jet spray via an extendable nozzle. In addition to removing the waste from the tanks, the use of this equipment will demonstrate applicability for additional underground storage tank cleaning throughout the U.S. Department of Energy complex. Additional components of the complete sluicing and pumping system consist of a high pressure pumping system for transfer to the MVST, a low pressure pumping system for transfer to the recycle tank, a ventilation system for providing negative pressure on tanks, and instrumentation and control systems for remote operation and monitoring.

Before sluicing operations begin, pre-operational testing will be performed. Testing will include system leak testing, instrumentation and controls testing, and support system testing (air compressor and process water). Upon successful completion of pre-operational testing, supernatant will be distributed among the tanks to achieve a solids concentration goal of 10% and denaturing will be performed. Sluicing operations will then begin following detailed work instructions.

1. INTRODUCTION

1.1 PROJECT OBJECTIVES

The primary objective of the Old Hydrofracture Facility (OHF) tanks contents removal project is to safely transfer sludge and supernatant from five liquid low-level (radioactive) waste (LLLW) storage tanks associated with the OHF to the Melton Valley Storage Tanks (MVST) for secure storage. A sluicing and pumping system has been specifically designed for meeting this objective. This system incorporates a remotely operated sluicing nozzle and arm (Borehole Miner) originally designed for use in the mining industry. A secondary objective of this project is to demonstrate the Borehole Miner's applicability to underground storage tank cleaning for future application and benefit throughout the U.S. Department of Energy (DOE) complex.

1.2 SYSTEM BACKGROUND

Lockheed Martin Energy Systems, Inc. (Energy Systems) tasked CDM Federal Programs Corporation (CDM Federal) to configure, build, and operate a system to sluice the OHF tanks contents into a slurry of supernatant and sludge, then pump the slurry to the MVST. The basis for system configuration was described in the Project Preliminary Engineering Report (Energy Systems 1996a). In completing the system configuration, some modifications were made from the system described in the Preliminary Engineering Report. These modifications were made to improve performance and efficiency and to reduce system cost. In May 1997, CDM Federal issued the 100% Configuration for the sluicing and pumping system.

A key component of the sluicing and pumping system, the Borehole Miner, is provided by Pacific Northwest National Laboratory (PNNL). The Borehole Miner is an in-tank device designed to deliver a high pressure jet spray via an extendable nozzle. The system provided by PNNL includes the extendable nozzle, a positive displacement pump (referred to as the sluicer pump), a hydraulic power unit, and associated controls. The Borehole Miner and sluicer pump system has been developed and configured in coordination with other components of the system as described in Sect. 1.3.

1.3 SLUICING AND PUMPING SYSTEM CONFIGURATION

The sluicing and pumping system consists of five main sub-systems:

- sluicing system (Borehole Miner and sluicer pump),
- high pressure pumping system (providing slurry circulation and slurry transport to the MVST through the existing 2-in. LLLW pipeline),
- low pressure pumping system (providing slurry transfer to recycle OHF tank T-9) through the active LLLW system,

- ventilation system [providing negative pressure on the tanks and high-efficiency particulate air (HEPA) filtration], and

- instrumentation and control (I&C) systems (providing remote control and monitoring of all systems).

1.4 OPERATIONAL RESPONSIBILITIES

The operation of the sluicing and pumping system is the responsibility of four main personnel: the Field Operations Superintendent, I&C engineer, and two operations technicians. Safety responsibilities of the Site Safety and Health Officer (SSHO) and Health Physics personnel are discussed in the Site-Specific Health and Safety Plan (Energy Systems 1997a).

The Field Operations Superintendent is responsible for all the day-to-day field operations and routine safety issues at the site. This includes assigning daily tasks to the operations personnel, conducting daily meetings, verifying that site documentation has been completed and is correct, ensuring that all applicable documents and procedures are followed, verifying that all operational steps have been performed in accordance with the work instructions, and preparing and using a punch list in conjunction with keeping a logbook for managing equipment problems.

The Field Operations Superintendent, with the SSHO, will hold a meeting at the start of each day to review the plan of operations for the day. The meeting will cover health and safety requirements and, as appropriate, the following topics:

- equipment status,
- lockout/tagout status,
- information regarding special operations or instructions,
- any relevant information regarding any occurrences or nonconformities, and
- any relevant as low as reasonably achievable (ALARA) or radiological information.

The I&C engineer will be responsible for the remote operation of the sluicing and pumping system through a PC-based computer control panel with programmable logic controller (PLC). This will include monitoring, troubleshooting, and maintaining the I&C components.

The two operations technicians will be responsible for performing routine operations, emergency operations, and maintenance operations associated with the sluicing and pumping system as directed by the Field Operations Superintendent. Operations technicians were trained on these operational procedures during the Cold Test and will follow work instructions located in Volume 2 when performing these activities.

1.5 PROJECT DOCUMENTATION

This Operations Plan provides the basis for tank contents transfer operations at the OHF site. Volume 1 of this document is arranged as follows: Chap. 1 presents the project objectives and the removal system configuration; Chap. 2 provides site history, modifications, and site setup; the sluicing and pumping system configuration is found in Chap. 3; Chap. 4 describes the tests to be conducted before actual sluicing of the tanks; the sequence of events for each tank is in Chap. 5;

system maintenance is in Chap. 6; system decontamination/disassembly is in Chap. 7; and references are in Chap. 8. Volume 2 includes operational checklists and work instructions. Other documents and procedures that will govern the work to be conducted at the OHF site include:

- Project Management Plan (Energy Systems 1998a),
- ALARA Plan (Energy Systems 1998b),
- Site-Specific Health and Safety Plan (Energy Systems 1997a),
- Conduct of Operations Matrix (Energy Systems 1997b),
- Configuration Management Plan (Energy Systems 1997c),
- Quality Assurance Project Plan (Energy Systems 1996b),
- Lockout/Tagout Procedure (Energy Systems 1996c), and
- Contingency Plan for the OHF Project (Energy Systems 1996d).

2. OLD HYDROFRACTURE FACILITY

The OHF is located in Melton Valley, approximately 1.1 mi (1.8 km) south of the Oak Ridge National Laboratory (ORNL) main plant within the secured area of Waste Area Grouping (WAG) 5. Figure 2.1 shows the location of WAG 5 and the OHF in relation to other ORNL facilities. The five OHF underground storage tanks (T-1, T-2, T-3, T-4, and T-9) are situated less than 110 yd (101 m) west of Building 7852 and approximately 130 yd (119 m) east of White Oak Creek. The WAG 5 Remedial Investigation Report (DOE 1995) provides a detailed description of the environmental setting of the OHF.

2.1 SITE HISTORY

The OHF was built in 1963 to dispose of liquid waste by mixing it with grout and injecting the waste into a shale formation approximately 1000 ft below ground surface. The facility operated from 1964 until it was shut down in 1980. During the original 1963 construction, three carbon steel storage tanks (T-1, T-2, and T-9) were installed at the OHF to store LLLW for injection. These tanks were installed in a 13-ft- (4-m-) deep pit that was divided into three cells with 4-ft- (1.2-m-) high concrete block walls. A perforated pipe and dry well were installed in the bottom of each cell for leak detection. In each of the three cells, a tank was installed and the cell was half filled with 1-in. (2.5-cm) gravel. The gravel was covered with polyethylene sheeting and soil was used to fill the pit to grade. Figure 2.2 illustrates the configuration of tanks T-1, T-2, and T-9. In 1966, two carbon steel, rubber-lined storage tanks (T-3 and T-4) were installed at the OHF. These tanks were designed and installed similarly to tanks T-1, T-2, and T-9, but had no dividing walls, and included a single dry well for leak detection. Figure 2.3 illustrates the configuration of tanks T-3 and T-4. A total of about 2.3 M gal (8.7 M L) of the waste grout mixture containing approximately 650,000 curies of radionuclides was disposed of during 18 injections.

Over 52,000 gal (2.0×10^5 L) of liquid and sludge were left in the tanks after facility shutdown. Table 2.1 lists the sludge and supernatant contents remaining in each tank as well as the nominal tank capacity.

2.2 SITE MODIFICATIONS

Several modifications to the OHF tanks have been made to allow installation of sluicing and pumping equipment. In the Fall of 1996, MK-Ferguson of Oak Ridge Company installed 26-in.- (66-cm-) diameter risers at either end of each tank. At the completion of riser installation, a 6 in. (15 cm) layer of gravel was spread over the tank pit area to act as a physical barrier between site workers and contaminated soils.

The sluicing and pumping system configuration requires a connection to the active LLLW system for transferring waste to the MVST. In the spring of 1997, MK-Ferguson of Oak Ridge Company modified a valve box west of the OHF to facilitate this connection.

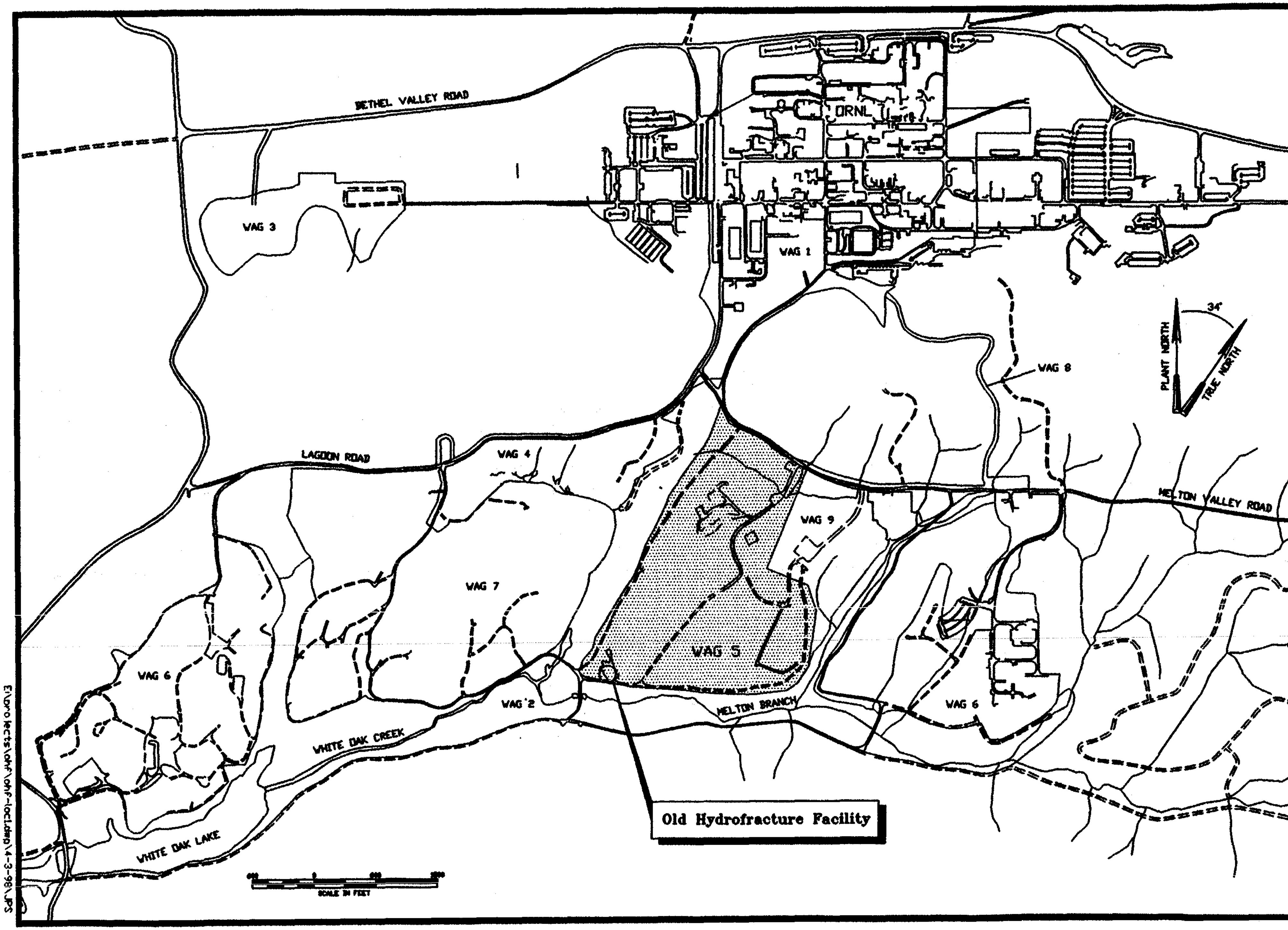


Fig. 2.1. Old Hydrofracture Facility location map.

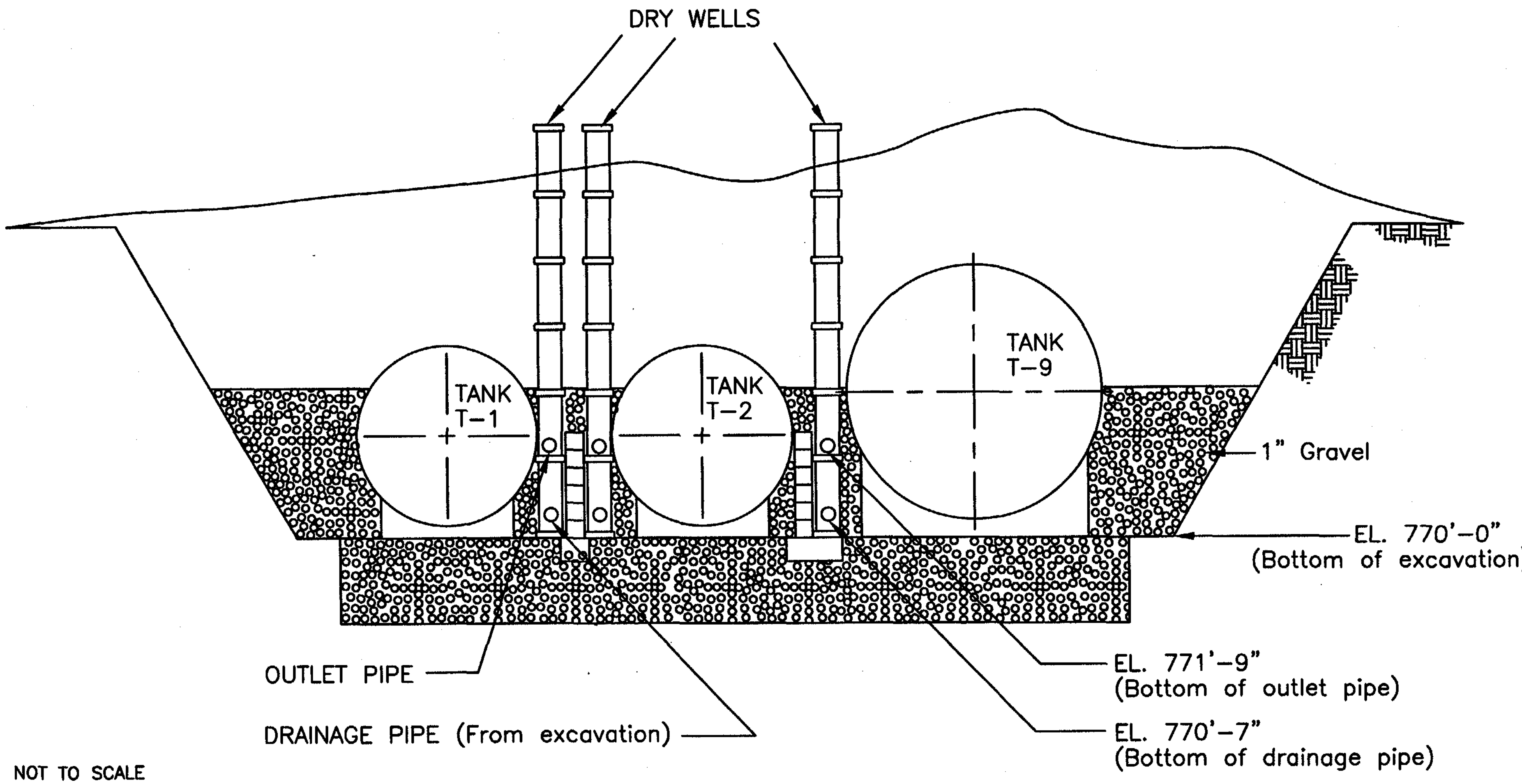


Fig. 2.2. Containment and drainage system for OHF tanks T-1, T-2, and T-9.

E:PROJECTS\5151-011-100\DRAINSYSTEM\03/16/98\JPS

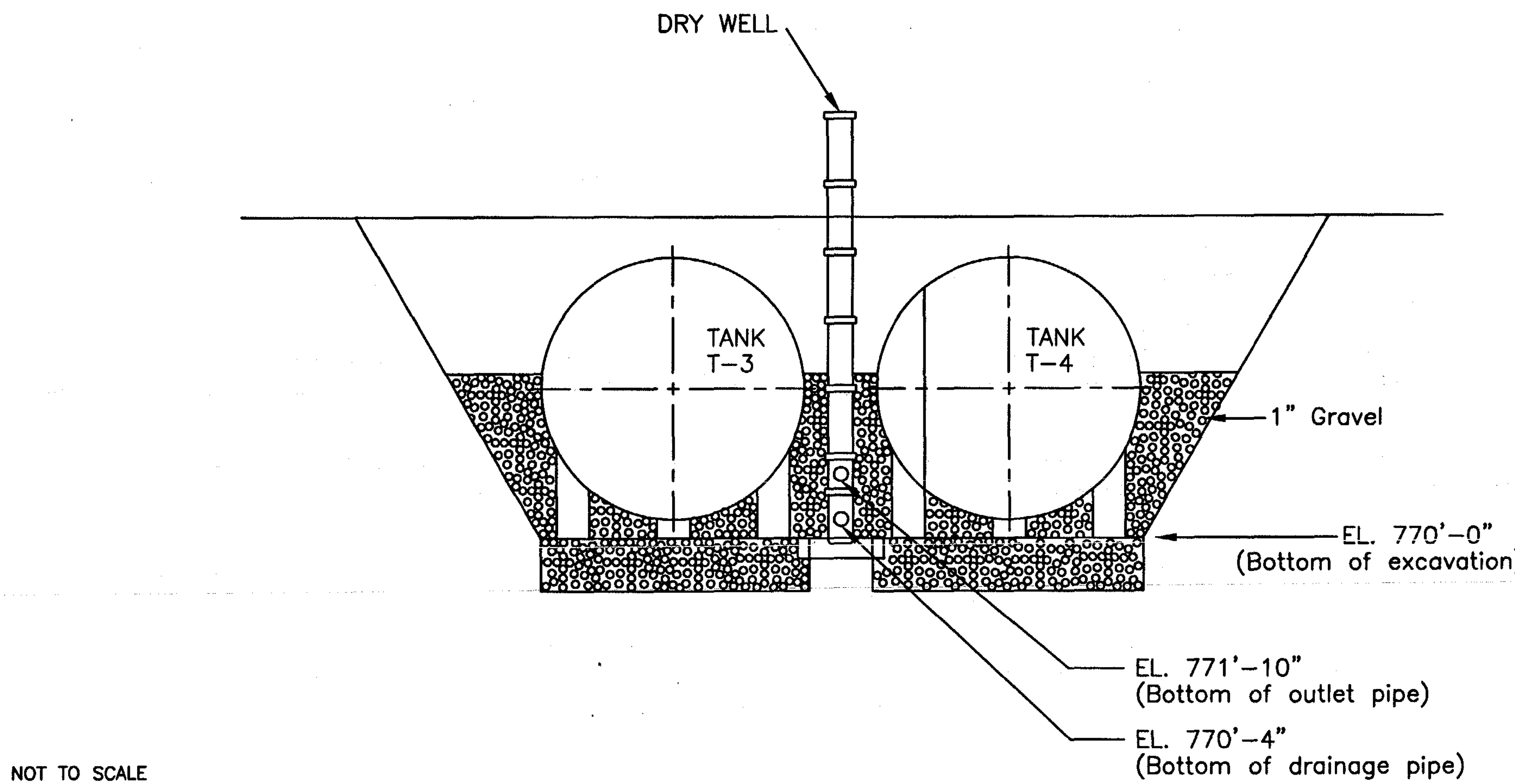


Fig. 2.3. Containment and drainage system for OHF tanks T-3 and T-4.

E:PROJECTS\5151–011–100\DRAINSYSTEM–1\03/16/98\JPS

Table 2.1. OHF tank waste volumes[a]

	Tank length		Tank diameter		Nominal capacity		Supernatant volume		Sludge volume		Total waste	
Tank	ft	m	ft	m	gal	L	gal	L	gal	L	gal	L
T-1	44	13.4	8	2.4	15,000	56,780	10,780	40,810	1,410	5,340	12,190	46,140
T-2	44	13.4	8	2.4	15,000	56,780	10,630	40,240	1,560	5,910	12,190	46,140
T-3	42.5	13	10.5	3.2	25,000	94,640	1,960	7,420	3,120	11,810	5,080	19,230
T-4	42.5	13	10.5	3.2	25,000	94,640	14,790	55,990	2,310	8,740	17,100	64,730
T-9	24	7.3	10	3	13,000	49,210	4,930	18,660	1,140	4,320	6,070	22,980
Total					93,000	357,050	43,090	163,120	9,540	36,120	52,630	199,220

[a]Maximum volumes as calculated by Boris (1997) (rounded to nearest tens).

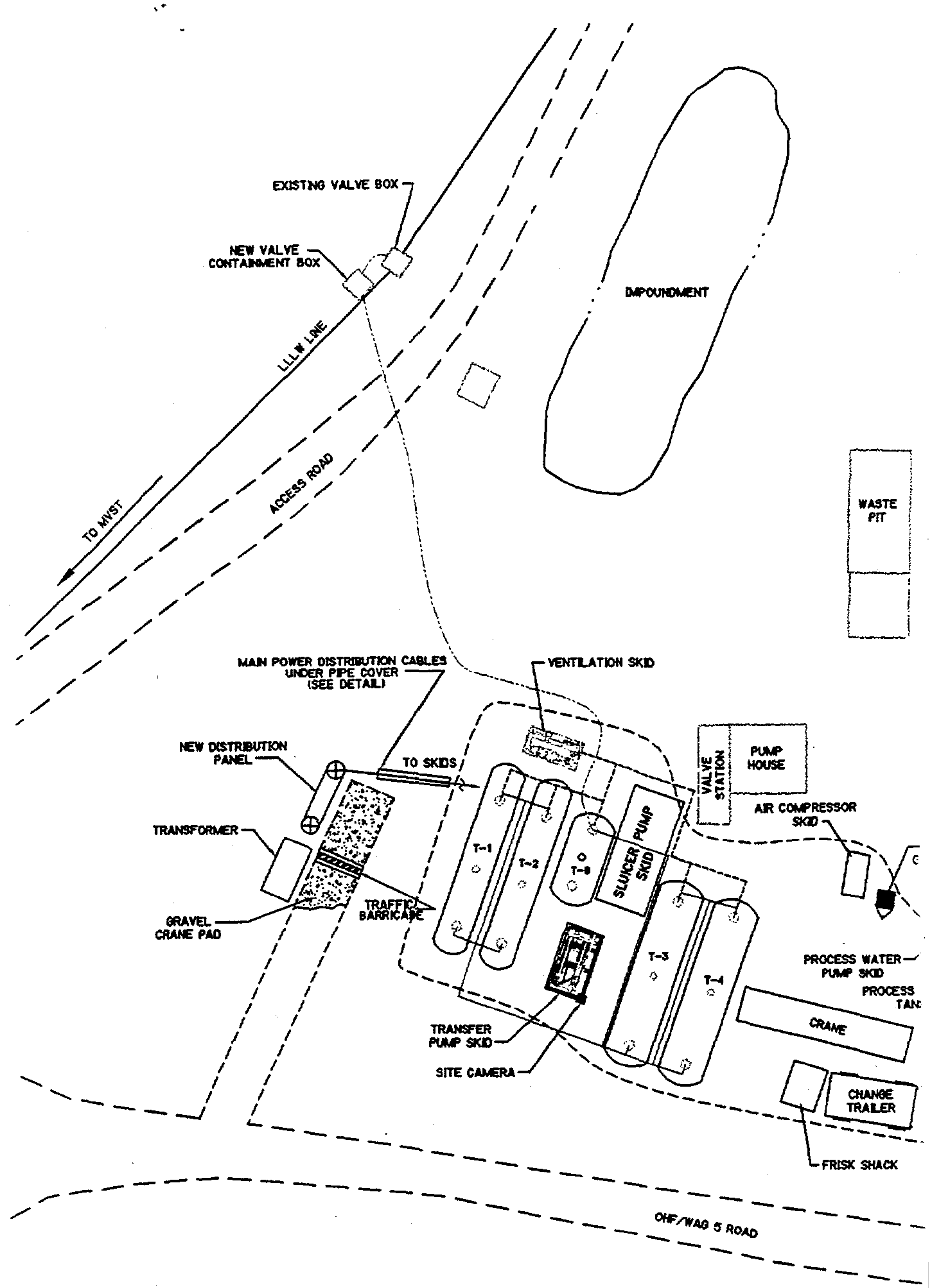
During the WAG 5 remedial investigation, a structural evaluation of the bulk storage bins at the OHF site was conducted. These storage bins were determined to be deteriorated and warrant the use of safety precautions during periods with winds greater than 30 mph (48 km/hour). Removal of the bins was completed in November 1997. During this activity, additional gravel was spread and power lines relocated to improve site access.

Currently, negative air pressure is maintained on the OHF tanks by a HEPA system that was installed in 1973. This HEPA system will be replaced with a separate system specifically designed to provide adequate ventilation during sluicing operations. Lockheed Martin Energy Research Corp. (LMER) personnel will block the old HEPA system before installing the new system.

Finally, the systems to be installed for sluicing and pumping require more power than can be provided by transformers currently located at the site. A temporary transformer was installed by Energy Systems to provide additional power during sluicing operations.

2.3 SITE SETUP

The equipment will be set up at the OHF site essentially as described in the 100% Configuration (CDM Federal 1997). The site plan provided in the 100% Configuration has been slightly modified based on the Cold Test. This revised site plan is shown on Fig. 2.4. Modifications to the current configuration may be made during setup. Revised drawings will be provided based on actual site configuration. Work zones will be established in accordance with the Site-Specific Health and Safety Plan (Energy Systems 1997a) as shown in Fig. 2.5.



REV. NO.	DATE	DRWN	CHKD	REMARKS
-	3-27-97	-	-	50% Configuration - Technical Review
1	5-8-97	ATB	CP	100% Configuration - Technical Review
2	5-19-97	ATB	CP	100% Configuration
3	3-12-98	JPS	CP	100% Configuration

DESIGNED BY: A. Burgess
DRAWN BY: A. Burgess
SHEET CHK'D BY: C. Prescot
CROSS CHK'D BY:
APPROVED BY: C. Prescot
DATE: A22628[illegible]

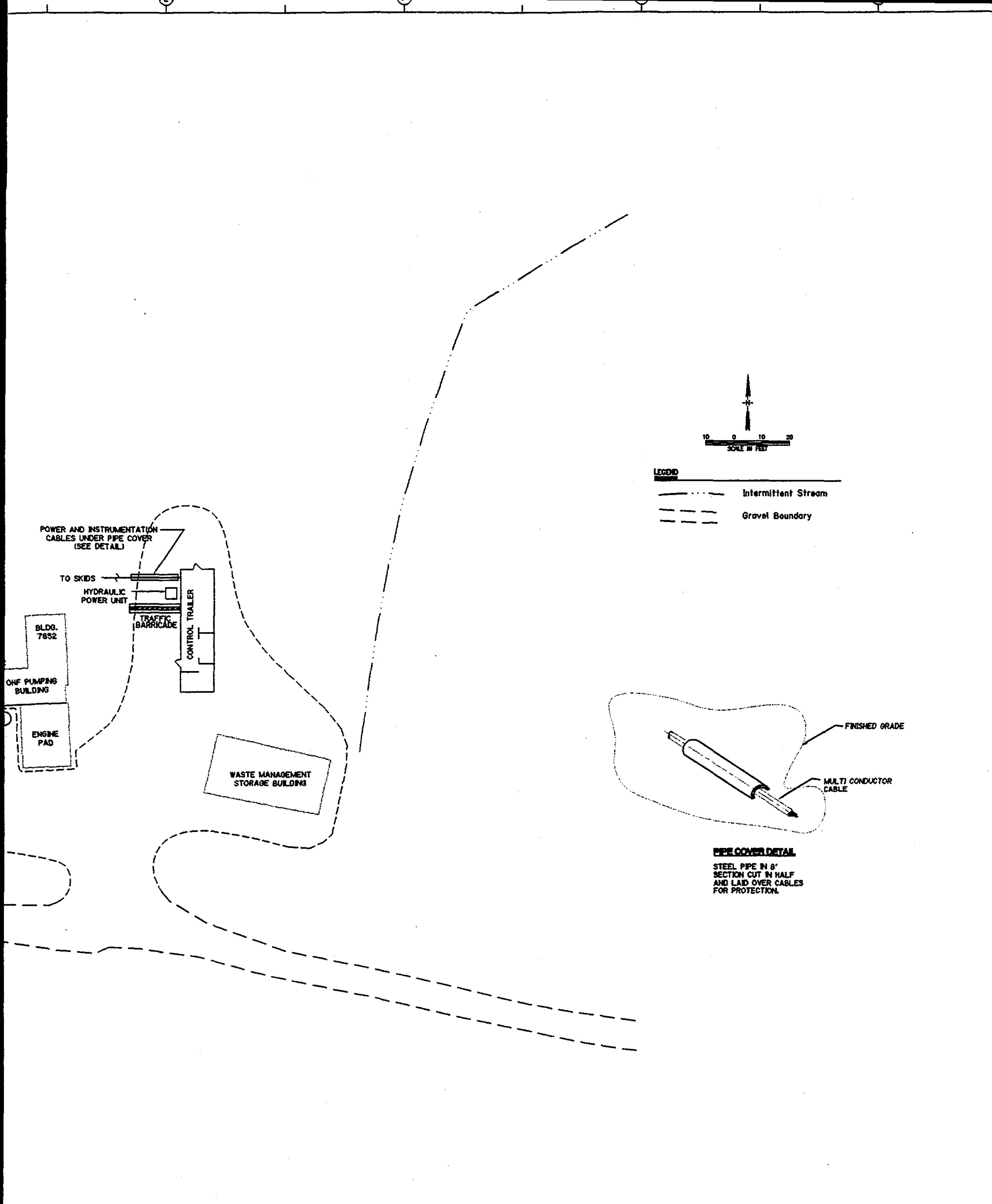
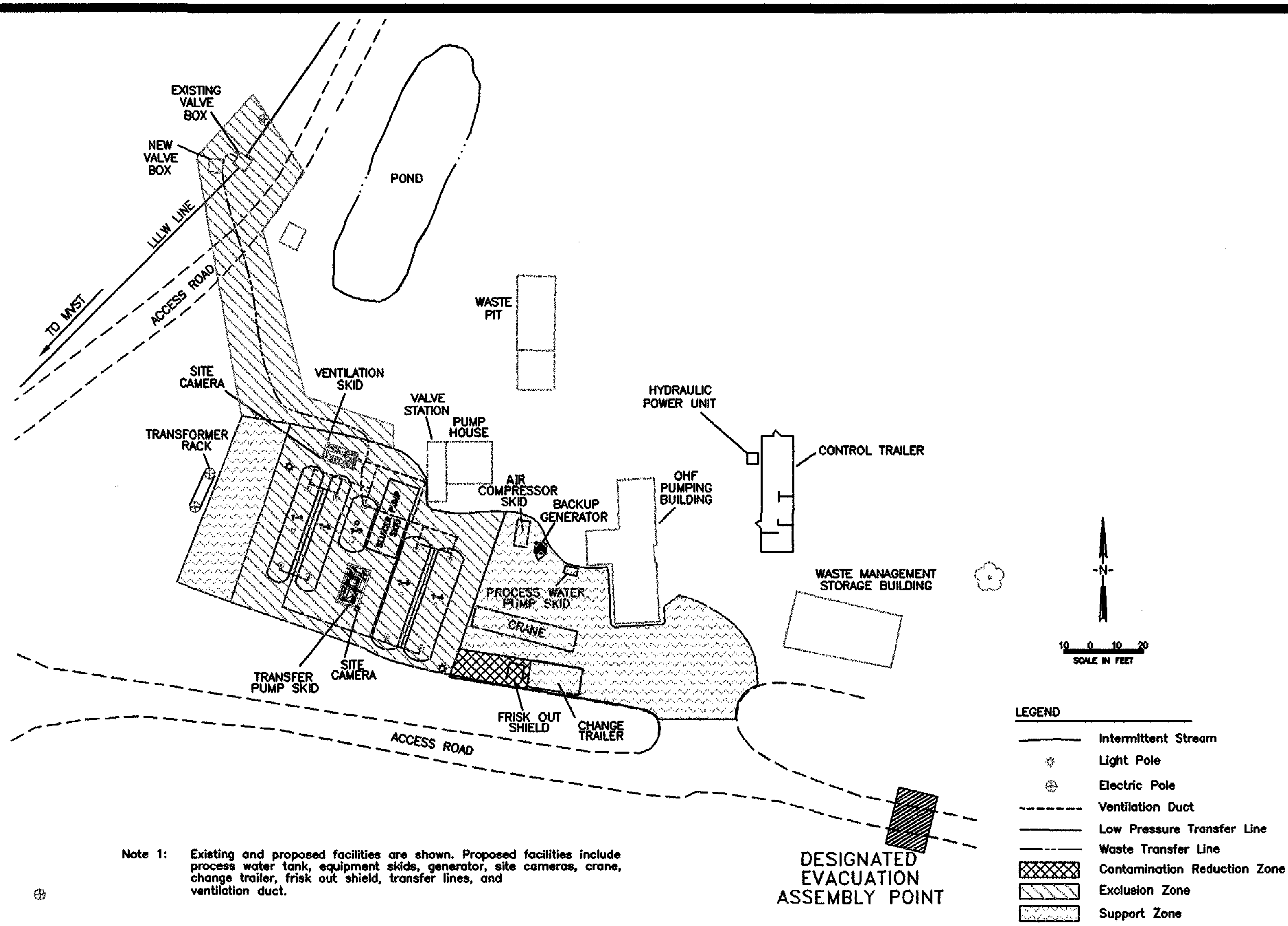


Fig. 2.4. Site Plan
Oak Ridge National Laboratory
Old Hydrofracture Tank Contents Removal Project

PROJECT NO. 5151-011
FILE NAME: A2362BLDWG



Note 1: Existing and proposed facilities are shown. Proposed facilities include process water tank, equipment skids, generator, site cameras, crane, change trailer, frisk out shield, transfer lines, and ventilation duct.

Fig. 2.5. Proposed work zones.

3. SLUICING AND PUMPING EQUIPMENT

The sluicing and pumping system was designed to transfer contaminated slurry (supernatant and sludge) from the OHF underground storage tanks to the MVST using a batch process. The batch process begins by pumping slurry from a tank containing wastes to the recycle tank (tank T-9 is designated as the recycle tank). In the recycle tank, a mixer will mix the slurry and maintain the solids in suspension. From the recycle tank, the slurry is pumped to the sluicer nozzle at high pressures. As the sluicer nozzle is aimed at sludge in the bottom of the tank being sluiced, more solids become suspended in the slurry which is pumped back to the recycle tank completing the circuit. This closed loop system is continued until the sludge has been sufficiently resuspended, at which time the material is transferred to the MVST through the LLLW system. This transfer can be accomplished independently or during sluicing. Figure 3.1 is the process flow diagram for the OHF sluicing and pumping system. The process flow diagram has been updated from the 100% Configuration (CDM Federal 1997) based on fabrication and cold testing.

The sluicing and pumping system has been designed to be operated remotely from the control trailer. The system is designed to maintain the flows and pressures specified by the operators. The system also has been designed to allow an operating range providing the operator flexibility during sluicing and pumping operations. This flexibility allows adjustment of sluicing nozzle pressures from nominal to 1500 psi (1.0×10^7 N/m^2) and flows from 50 to 150 gpm (189 to 568 L/min); also, the system allows bypassing of the recycle tank and/or the sluicer pump, if desired.

The system was given a modular design to simplify construction and transport. Each module was designed to meet particular system requirements and to be integrated with other modules. The following sections describe the operational details of each module and their performance requirements.

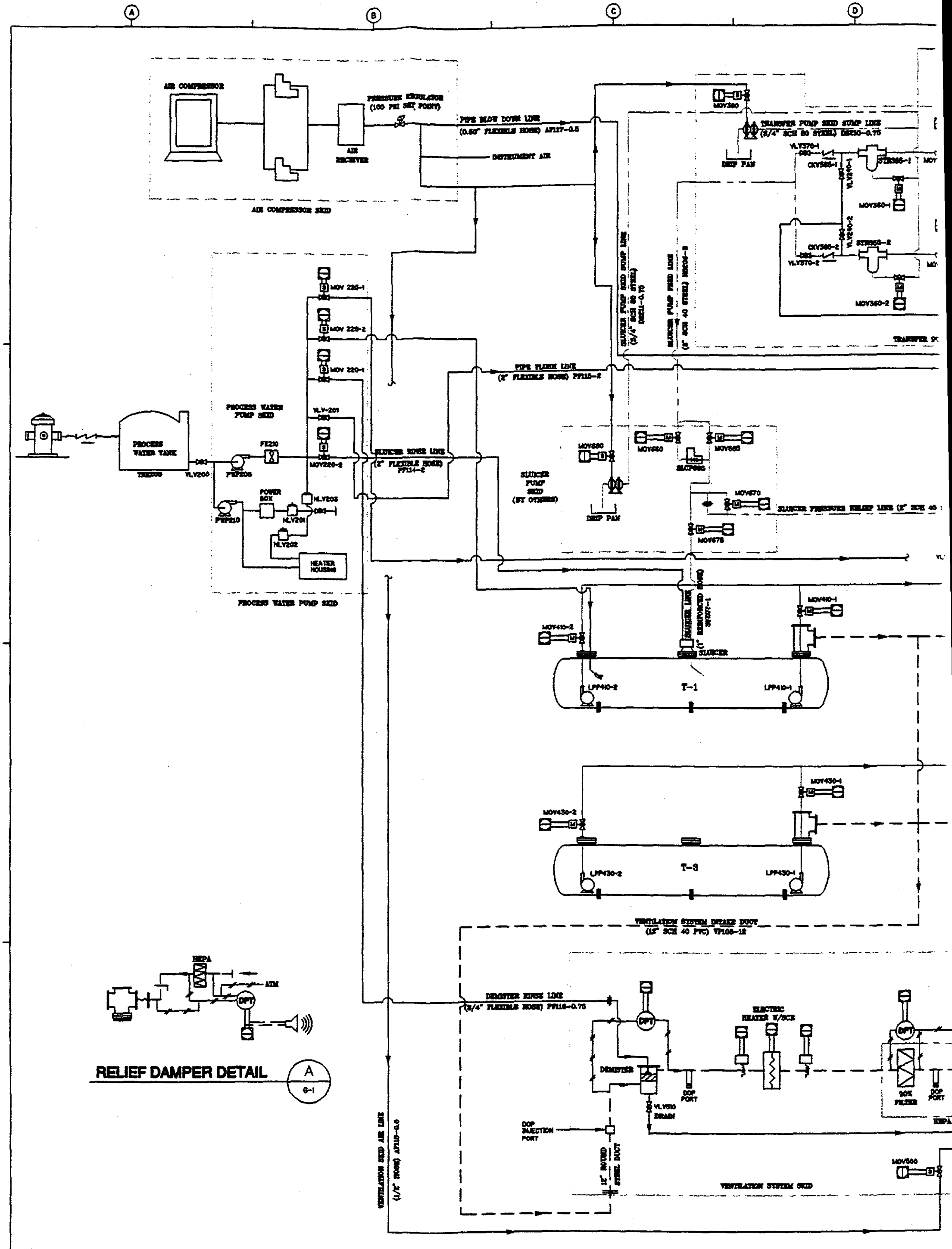
3.1 IN-TANK EQUIPMENT

Several pieces of equipment are to be installed in each of the OHF tanks. This equipment includes submersible pumps, an in-tank mixer (tank T-9 only), and in-tank video cameras. Tank modifications due to equipment installation are shown in Fig. 3.2.

3.1.1 Submersible Pumps

Submersible pumps (low pressure system) will be lowered through both end risers of tanks T-1, T-2, T-3, and T-4. The pump at the north end of the tank will be positioned on the bottom of the tank. The purpose of this pump is to transfer slurry from the tank being sluiced to the recycle tank. The pump at the south end of the tank will be suspended on cables from hand crank winches. Initially, this pump will be placed in the supernatant to facilitate liquid transfer between tanks. Before sluicing a tank, the south pump must be lowered to the bottom of the tank to facilitate movement of supernatant as well as sludge.

One submersible pump will be installed in the south riser of tank T-9. This pump will be installed at the bottom of the tank. The purpose of this pump is to feed slurry to the high pressure (Moyno) pumps located on the transfer pump skid (Sect. 3.2).



REV. NO.	DATE	DRWN	CHKD	REMARKS
	3-30-97			50% Configuration - Technical Review
1	4-21-97	ATB	CP	50% Configuration - Submersible Pumps
2	5-8-97	ATB	CP	100% Configuration - Technical Review
3	9-25-97	JWB	CP	AS-BUILT REVISIONS #1
4	3-12-98	JPS	CP	ENGINEERING CHANGES PER MARK-UPS

DESIGNED BY: A. Burgess
DRAWN BY: A. Burgess
SHEET CHK'D BY: C. Pressel
CROSS CHK'D BY:
APPROVED BY: C. Pressel
DATE:

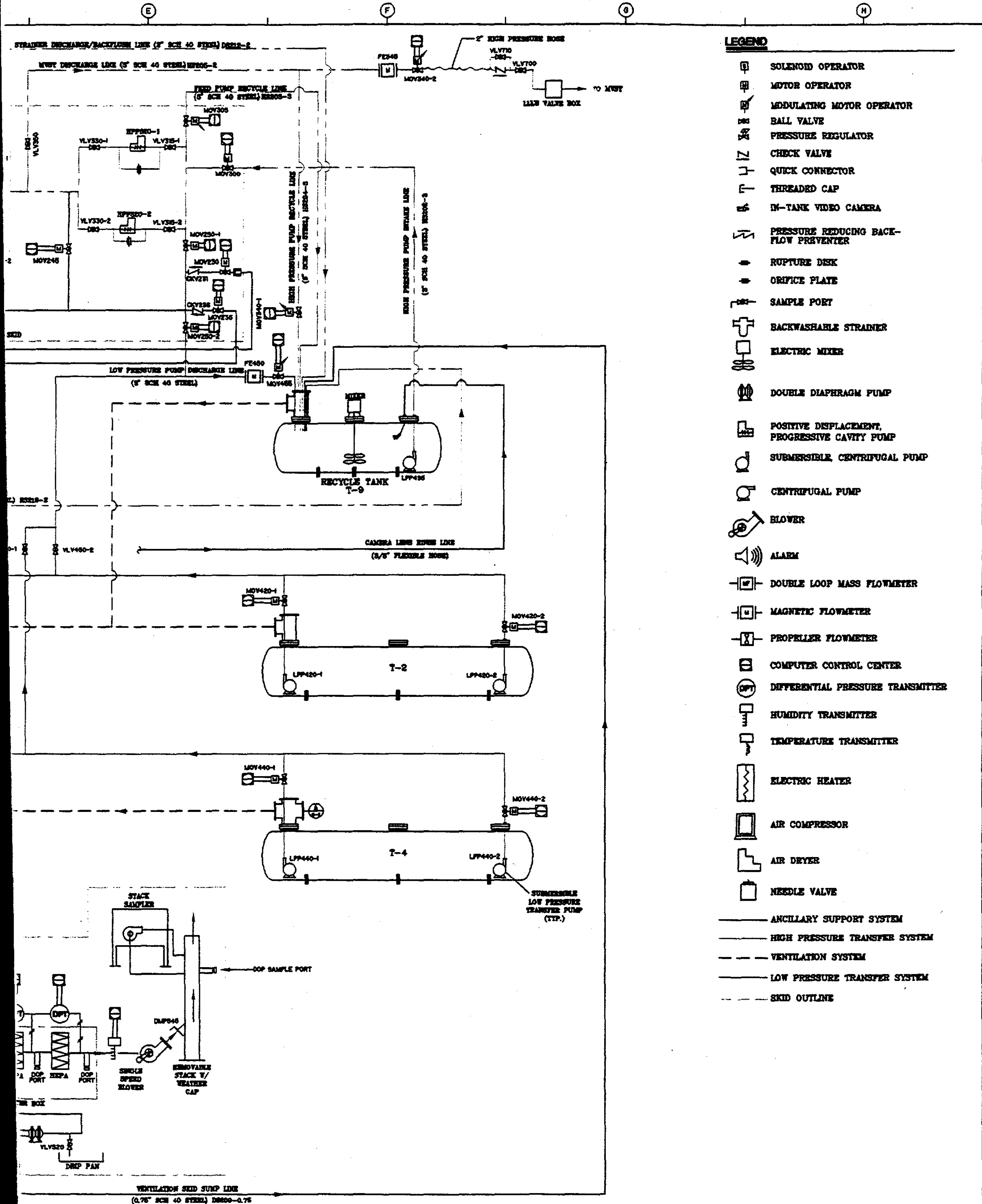


Fig. 3.1. Process Flow Diagram
Oak Ridge National Laboratory
Old Hydrofracture Tank Contents Removal Project

PROJECT NO. 5151-0II
FILE NAME: A23658-A.DWG
SHEET NO.

The submersible pumps were specified to be single speed, centrifugal pumps capable of transferring 200 gpm (757 L/min) at 45 ft (14 m) of head and capable of operating unsubmerged for extended periods. The pumps purchased for this system are Vortex SP-50 as manufactured by Pumpex. Additional equipment information is contained in the vendor manual which is indexed and located in the control trailer on-site. The pumps were not fitted with discharge check valves to allow line flushing and supernatant transfer via back-flow through the pumps. One-inch screens were installed around the intakes of the pumps to prevent large particles from entering the system.

Electrical service to the submersible pumps is supplied through the local power panel mounted on the exterior of the transfer pump skid (high pressure system). Connection to the panel for the pumps in tanks T-1 through T-4 is accomplished through heavy duty, 30 amp receptacles. Since there are only four receptacles, only four pumps may be energized at one time. Transferring power from an energized pump to an unenergized pump is accomplished manually at the local panel.

Electrical service to the submersible pump in tank T-9 is supplied through the local power panel mounted on the exterior of the transfer pump skid via a hardwired connection.

Operation and control of the low pressure submersible pumps is accomplished from the PLC in the control trailer. The low pressure pumps in tanks T-1 through T-4 serve to transfer slurry from the sluice tank to the recycle tank. The pumps are start/stop controlled directly from the PLC. Flow from the pumps is regulated by valve MOV455 (low pressure transfer throttle valve). The setting of MOV455 can be automatically modulated by the PLC to maintain the operator-specified liquid level in the recycle tank (T-9).

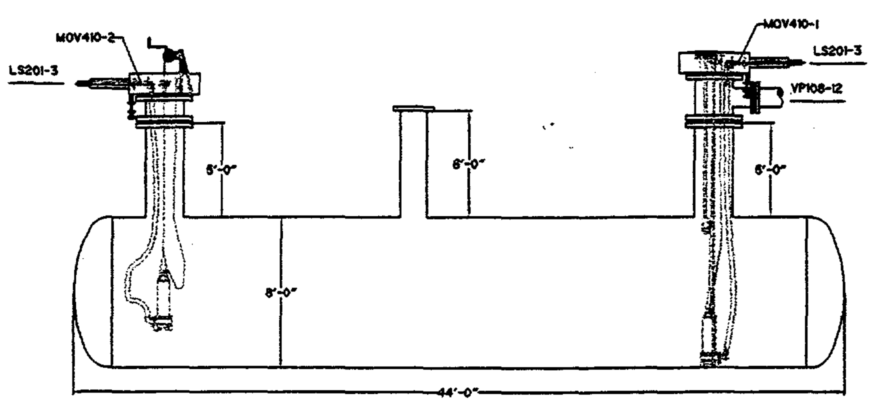
The purpose of the pump in tank T-9 is to feed slurry from the recycle tank to the high pressure pump. The T-9 submersible pump is start/stop controlled directly from the PLC. Discharge from the pump is split between the high pressure pumps and the feed pump recycle line that runs back to the recycle tank. The purpose of the recycle line is to prevent overpressurization of the high pressure pump intake by diverting excess flow. Flow through the recycle line is controlled by valve MOV305 (feed pump recycle valve). The setting of MOV305 can be automatically modulated by the PLC to keep the high pressure pump intake pressure within a pre-programmed range.

3.1.2 In-Tank Mixer

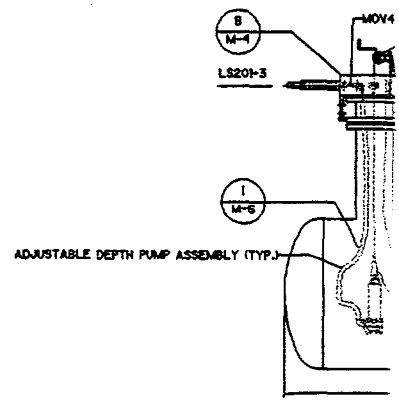
An in-tank mixer will be installed through the center riser of tank T-9 to mix the slurry and maintain solids suspension in the recycle tank. The mixer is a twin blade, vertical shaft mixer by Pro Quip (model 7QGU25B). The mixer was specified to be capable of maintaining suspension in the tank and capable of operating partially or totally unsubmerged. The blades on the mixer are standard blades with a locking mechanism. Additional equipment information is contained in the vendor manual which is indexed and located in the control trailer on-site.

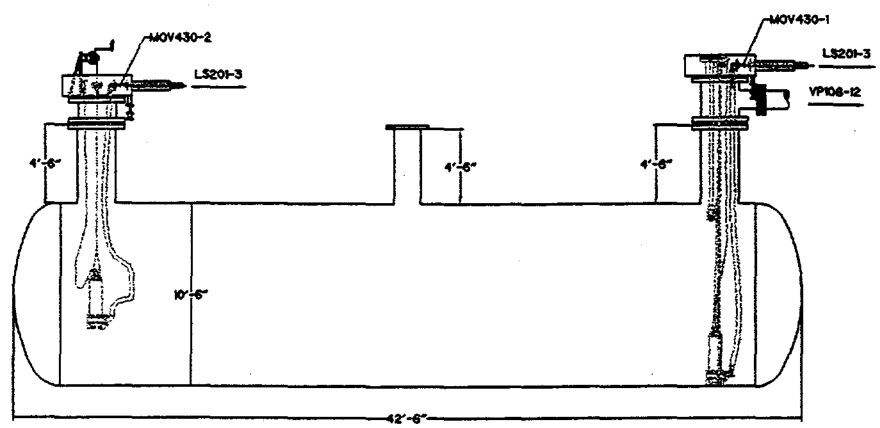
Electrical service to the in-tank mixer is supplied through the local power panel mounted on the exterior of the transfer pump skid via a hardwired connection.

The mixer is start/stop controlled directly from the PLC. During automatic operation, the mixer will start on initiation of the PLC sluicing startup sequence and stop on system shutdown. During remote-manual operation, the mixer will start/stop on operator-initiated command from the PLC.

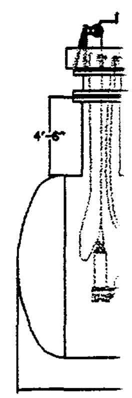


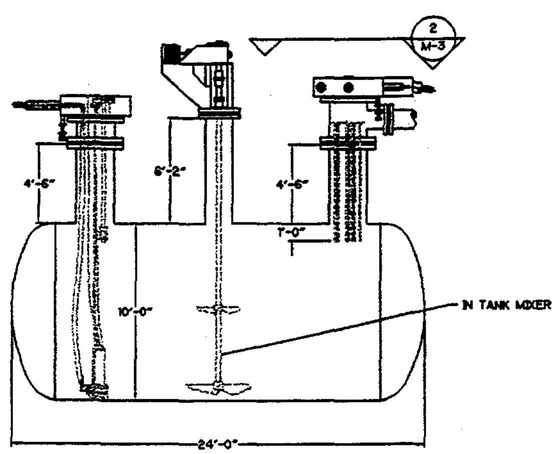
T-1 (EAST SIDE VIEW)





T-3 (EAST SIDE VIEW)

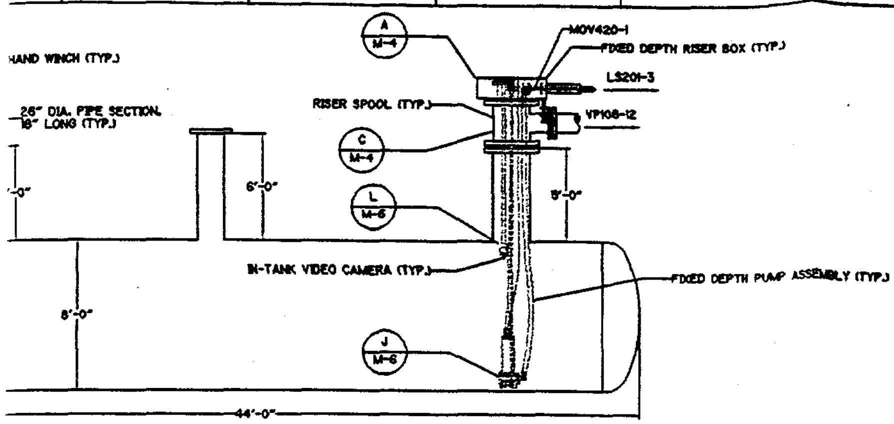




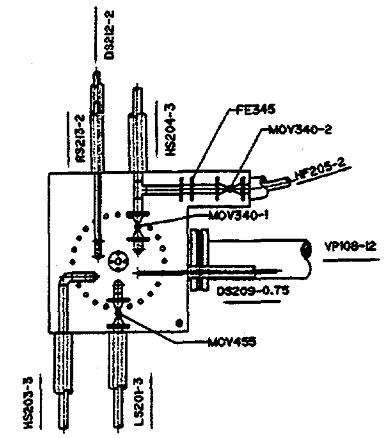
T-9 (EAST SIDE VIEW)

REV. NO.	DATE	DRWN	CHKD	REMARKS
	3-30-97			50% Configuration - Technical Review
1	6-11-97	ATB		100% Configuration - Technical Review
2	6-19-97	ATB		100% Configuration

DESIGNED BY: A. [illegible]
DRAWN BY: A. [illegible]
SHEET CHK'D BY: C. [illegible]
CROSS CHK'D BY:
APPROVED BY: C. [illegible]
DATE: [illegible]

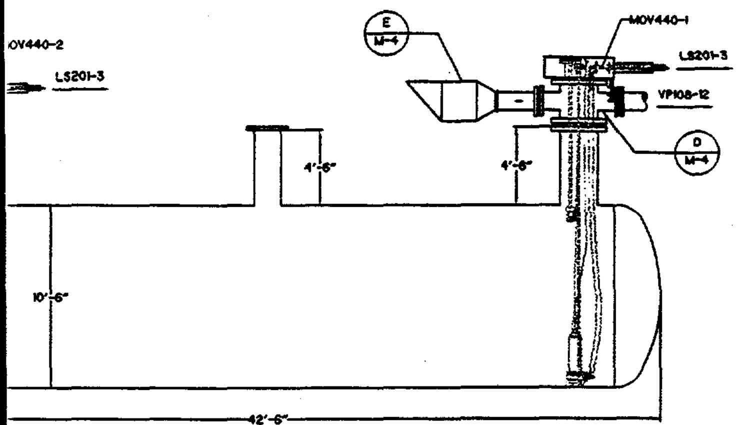


T-2 (EAST SIDE VIEW)

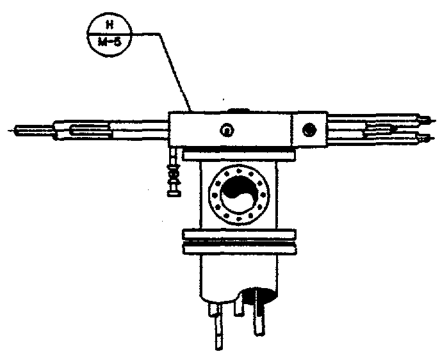


PLAN

SECTION 2 M-3
NTS

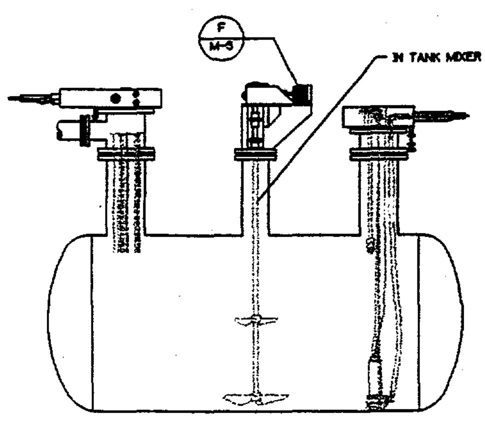


T-4 (EAST SIDE VIEW)



SIDE

SECTION 3 M-3
NTS



T-9 (WEST SIDE VIEW)

NOTE: Containment piping shall be clear PVC as manufactured by R&G Sloane Manufacturing or approved equivalent. Containment piping shall be sloped to drain to the transfer pump skid drip pan.

Fig. 3.2. Tank modifications
Oak Ridge National Laboratory
Old Hydrofracture Tank Contents Removal Project

PROJECT NO. 5151-011
FILE NAME: A2373C-A.dwg
SHEET NO.

3.1.3 In-Tank Video Cameras

The south riser box of tank T-9 and north riser boxes of tanks T-1, T-2, T-3, and T-4 are equipped with 6-in. (15-cm), 150-lb (68-kg) flange ports to allow the installation of in-tank cameras. Two cameras (one in the recycle tank and one in the tank being sluiced) will be used for visual monitoring during sluicing and pumping operations. These cameras will be suspended from poles mounted to 6-in. (15-cm), 150-lb (68-kg) flange plates. The in-tank cameras specified for this system (CaZoom III manufactured by Visual Inspection Technologies) are capable of operating submerged and in radioactive environments. Additional equipment information is contained in the vendor manual which is indexed and located in the control trailer on-site. Small water lines have been mounted on the camera poles to allow rinsing of the camera lens. The Borehole Miner will be carefully manipulated so as not to hit the camera.

Both power and operation of the in-tank cameras are accomplished through control consoles located in the control trailer.

3.2 TRANSFER PUMP SKID

The transfer pump skid is the central component in the pumping system. This skid includes an electrical distribution panel, valve control panels, high pressure (Moyno) pumps, strainers, pipe flush/blow down manifold, recycle tank bypass, leak detection, and drip pan pump. A layout of the transfer pump skid is shown on Fig. 3.3.

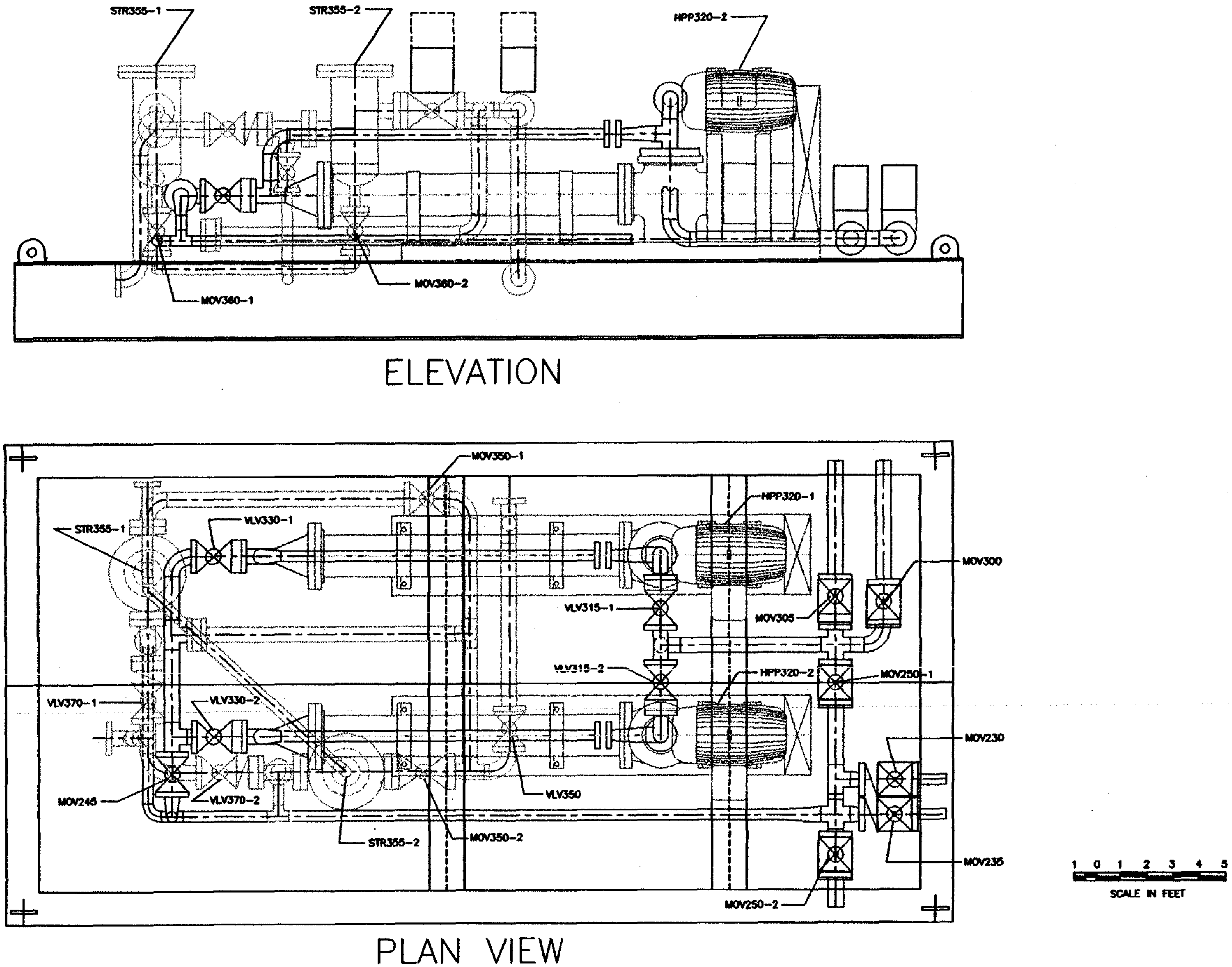
3.2.1 Skid Construction

The skid is fully enclosed and underlain by a drip pan for leak/spray containment. The sides of the skid are constructed of plate steel to provide radiation shielding and to provide a mounting surface for the electrical panel and valve panels. The top of the skid is constructed of plexiglass to allow remote observation of the skid with an on-site camera.

3.2.2 Electrical Distribution Panels

Local electrical distribution panel TP-4 is mounted on the exterior of the transfer pump skid [100% Configuration, Sheet E-2 (CDM Federal 1997)]. This panel provides electrical service to the equipment mounted on the transfer pump skid as well as the submersible pumps and the in-tank mixer in tank T-9. Additionally, a transformer is included to provide 120 volt power outlets on the transfer pump skid.

Connection to the panel for the pumps in tanks T-1 through T-4 is accomplished through heavy duty, 30 amp receptacles. Since there are only four receptacles, only four pumps may be energized at one time. Transferring power from an energized pump to an unenergized pump is accomplished manually at the local panel. Electrical service to the submersible pump in tank T-9 and the in-tank mixer is supplied via hard-wired connections.



REV. NO. | DATE | DRWN | CHKD | REMARKS

RSV/TDW

03/04/98

Fig. 3.3. Transfer Pump Skid
Oak Ridge National Laboratory
Old Hydrofracture Tank Contents Removal Project

FILE NAME: E:\PROJECTS\5151-011-100\OAK-R13.DWG

3.2.3 Valve Control Panels

Each of the motor-operated valves is controlled by a valve control box. With the exception of valves MOV660 (sluicer pump intake valve), MOV665 (sluicer pump bypass valve), MOV670 (sluicer pressure release valve), and MOV675 (sluicer pump discharge valve), the valve controller boxes are mounted on the exterior of the transfer pump skid. These control boxes provide the interface transmitter between the valve operator and the PLC. Features such as manual override, battery backup, and power failure set position are accessed at the valve control box. Additional information is contained in the vendor manual which is indexed and located in the control trailer on-site.

3.2.4 High Pressure Pumps

Two progressive cavity pumps (Moyno model 2000G1) are mounted in parallel on the transfer pump skid. These pumps are referred to as the high pressure pumps. The system was designed to operate with only one of the high pressure pumps in service at any given time. The second pump serves as a backup so that failure of one does not mandate immediate system shutdown and repair.

The high pressure pumps were specified to meet three different pumping objectives. The first objective is to directly feed the slurry to the sluicer nozzle with flows up to 150 gpm (568 L/min) and pressures up to 200 psi (1.4×10^6 N/m^2). The second objective is to feed slurry to the sluicer pump at 150 gpm (568 L/min) and 20 psi (1.4×10^5 N/m^2). The final objective is to transfer slurry from the OHF to the MVST which requires 50 gpm (189 L/min) at 50 psi (3.4×10^5 N/m^2) according to the waste acceptance criteria. To meet these objectives, the pumps are equipped with variable speed drives capable of sustaining flows from 50 to 200 gpm (189 to 757 L/min) at a discharge pressure of 200 psi (1.4×10^6 N/m^2). Additional equipment information is contained in the vendor manual which is indexed and located in the control trailer on-site.

Rupture disks have been installed across the discharge and intake of the high pressure pumps as a final, mechanical safety measure against overpressurization. The disks installed are BS&B Type S-90 with 240 psi (1.7×10^6 N/m^2) ±10% burst pressure.

Electrical service is supplied to the high pressure pumps from panel TP-4 mounted on the exterior of the transfer pump skid. TP-4 is shown in 100% Configuration on Sheet E-2 (CDM Federal 1997).

The high pressure pumps are start/stop and speed controlled directly from the PLC. Pump speed can be automatically modulated by the PLC based on the high pressure pump discharge pressure specified by the operator. Discharge from the pumps flows through one of two strainers and the MVST discharge line and/or the high pressure pump recycle line.

3.2.5 Strainers

Two in-line strainers are mounted downstream of the high pressure pumps mounted in parallel with each other on the transfer pump skid. The purpose of these strainers is to protect the sluicer nozzle from particles larger than 1/8 in. (0.32 cm). The strainers are a modified version of the Simplex 90 as manufactured by Hayward Industrial Products. They are fitted with 2-in. (5-cm) ports in the bottom to allow flushing on-line with supernatant from the tanks or off-line with process water. During operation, one strainer is on-line while the other is in a standby mode. Should the on-line strainer become plugged, flow can be diverted through the other unit without interruption from the PLC. Water used for strainer flushing is returned to tank T-9.

The operating condition of the strainers is monitored by the pressure drop across the strainers. If the differential pressure is high, the operator will flush the strainer by the method described in Work Instruction 8 (On-Line Strainer Flushing) which is located in Volume 2.

3.2.6 Pipe Flush/Blow Down Manifold

The transfer pump skid includes manifold piping that allows flushing of the pipes with supernatant, process water, or compressed air. The purpose of supernatant and process water flushing is to reduce the volume of radioactive material that is above ground, thereby reducing the exposure to workers when the system is not in operation. The purpose of compressed air blow down is to dry the pipes prior to dismantlement or repairs requiring line breaks. To prevent overpressurization of the lines with compressed air, the air system is limited to 100 psi (6.9×10^5 N/m^2). THE COMPRESSED AIR IN THIS SYSTEM WILL NEVER BE USED AT A HIGHER PRESSURE NOR SHOULD IT BE USED TO CLEAR LINE CLOGGING.

3.2.7 Recycle Tank Bypass

The transfer pump skid includes piping that allows the recycle tank to be bypassed. In the bypass mode, the submersible pump in the sluice tank is used to feed the high pressure pump. This bypass is accomplished by fully closing valves MOV300 (feed pump discharge valve) and MOV455 (low pressure transfer throttle valve) and opening valves MOV250-1 (recycle tank bypass valve) and MOV250-2 (recycle tank bypass valve). Valve locations are shown on the Process Flow Diagram, Fig. 3.1. Recycle tank bypass may be used during supernatant transfers and during the sluicing of tank T-9.

3.2.8 Leak Detection

All pipes transferring waste have secondary containment in the form of containment pipes, skid enclosures, and riser boxes. The secondary containment pipes drain to drip pans on the transfer pump skid and on the sluicer pump skid. These drip pans are equipped with leak sensors that alert the operators through the PLC. The operators will then start the corresponding drip pan pump.

Connections to in-tank equipment are contained through riser boxes. Float switches in the riser boxes will alert the PLC if a leak is detected. Drain lines in the riser boxes are connected to the riser spool piece so that leakage can be returned to tank T-9.

3.2.9 Drip Pan Pump

The skid drip pan is equipped with an air-operated, double diaphragm pump that will transfer leakage from the drip pan to tank T-9. The pump is started by the PLC opening an actuated valve in the pump's air line. The drip pan pump is model M1-AYYB/BN/BN/ABN, manufactured by Wilden, and is a self-priming pump that is not damaged by dry operation. Back-flow through the drip pan pumps is not possible because check valves are integral to the operation of a double diaphragm pump.

3.3 SLUICER PUMP SKID

The sluicer pump skid is part of the Borehole Miner extendable nozzle sluicing system provided by PNNL. This skid includes an electrical distribution panel, valve control boxes, the sluicer pump, pulsation dampener, the sluicer pump bypass, and the sluicer pressure release valve. Figure 3.4 provides a schematic diagram of the sluicer pump skid. The sluicing and pumping system can be operated without the sluicer pump skid; however, operation under this configuration will limit the maximum sluicing pressure to approximately 200 psi (1.4×10^6 N/m^2).

3.3.1 Valve Control Boxes

Each of the motor-operated valves on the sluicer pump skid is controlled by a valve control box mounted on the skid. These control boxes provide the interface transmitter between the valve operator and the PLC. Features such as manual override, battery backup, and power failure set position are accessed at the valve control box. Additional information is contained in the vendor manual which is indexed and located in the control trailer on-site.

3.3.2 Sluicer Pump

The sluicer pump is a model JWS-340 horizontal triplex piston pump manufactured by National Oil Well Company. The pump is equipped with a variable speed motor to allow flows up to 150 gpm (568 L/min) and pressures up to 1500 psi (1.0×10^7 N/m^2). The pump discharge is fitted with a rupture disk as a final, mechanical safety against overpressurization. Discharge from a rupture disk failure is piped to the recycle tank. The disk installed is a BS&B Type SRB-7RS with a 1800–2000 psi (1.2×10^7–1.4×10^7 N/m^2) rating.

The sluicer pump can be started/stopped and speed controlled directly from the PLC or manually. Pump speed is maintained by the PLC at an operator-specified set point. This set point can be changed during system operation without system interruption. Additional equipment information is contained in the vendor manual which is indexed and located in the control trailer on-site.

3.3.3 Pulsation Dampener

The normal operation of triplex pumps will result in flow pulsations. To prevent operational problems from high pressure spikes, a pulsation dampener has been installed on the intake of the sluicer pump. This dampener is a model IP21/2-3600 manufactured by HYDRIL. To prevent sluicer pump cavitation, a recycle line has been installed at the discharge of the high pressure pumps (see Sect. 3.2) so that the high pressure pumps can operate at a higher flow rate than the sluicer pump. Additional equipment information is contained in the vendor manual which is indexed and located in the control trailer on-site.

3.3.4 Sluicer Pump Bypass

The piping on the sluicer pump skid includes a line for bypassing the sluicer pump. If it is desirable to sluice at pressures of 200 psi (1.4×10^6 N/m^2) or less, the slurry can be fed directly from the high pressure pumps to the sluicer nozzle via the sluicer pump bypass line. Bypassing the sluicer pump is accomplished by closing valve MOV660 (sluicer pump intake valve) and opening valve MOV665 (sluicer pump bypass valve). Valves are shown on the schematic, Fig. 3.4.

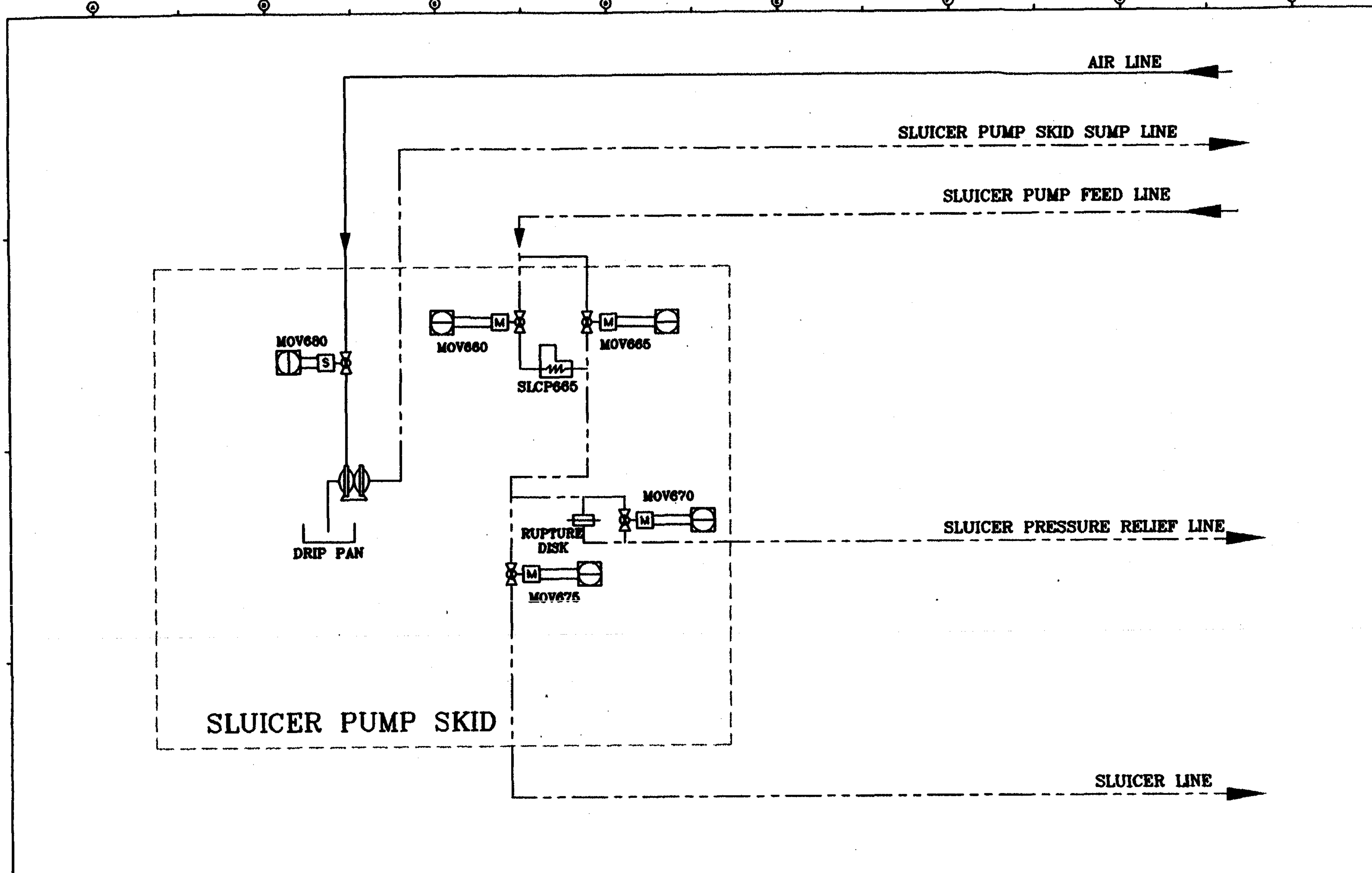


Fig. 3.4. Sluicer Pump Skid
Oak Ridge National Laboratory
Old Hydrofracture Tank Contents Removal Project

FILE NAME: R:\PROJECTS\5161-011\3.4-INSERT1.DWG

3.3.5 Sluicer Pressure Release Valve

If the sluicer nozzle becomes plugged, the PLC will immediately shut down the system on a high pressure alarm. If pressure buildup in the sluicer is not instantaneous, the sluicer pump rupture disk may not fail before the system is shut down. Such an event would result in high pressure remaining downstream of the sluicer pump after system shutdown. The purpose of MOV670 (sluicer pressure release valve) is to allow the operator to relieve this pressure. Operation of the sluicer pressure release valve must be initiated manually from the PLC by the operator.

3.3.6 Drip Pan Pump

The skid drip pan is equipped with an air-operated, double diaphragm pump that will transfer leakage from the drip pan to tank T-9. The pump is started by the PLC opening an actuated valve in the pump's air line. The drip pan pump is model M1-AYYB/BN/BN/ABN, manufactured by Wilden, and is a self-priming pump that is not damaged by dry operation. Back-flow through the drip pan pumps is not possible because check valves are integral to the operation of a double diaphragm pump. Additional operating information for the double diaphragm pump is indexed and located in the control trailer on-site.

3.4 SLUICING SYSTEM

The Borehole Miner is a hydraulically actuated arm that is used to direct a high pressure spray through a nozzle at the end of the arm. By aiming the spray at sludge in the bottom of the tanks, the sludge can be physically dislodged and put into a suspended slurry. The sluicing system consists of the Borehole Miner (sluicer), hydraulic power unit, and sluicer control panel.

3.4.1 Borehole Miner

The Borehole Miner, manufactured by Waterjet Technology, Inc., consists of a 30-ft- (9.1-m-) long mast from which an arm can be extended, rotated, and angled to direct a stream of liquid or slurry. The stream flows through the middle of the 10-ft (3-m) arm and discharges from a nozzle in the end of the arm. For use in underground storage tanks, a support stand (or bridge) was constructed and the Borehole Miner modified to operate from the bridge. Figure 3.5 illustrates how the Borehole Miner appears when installed above an underground storage tank. The purpose of the Borehole Miner system is to direct and focus the flow of slurry that is being fed to it and to dislodge and suspend consolidated material in the bottom of the tanks. The Borehole Miner is not capable of increasing the flow or the pressure of the slurry feed.

3.4.2 Hydraulic Power Unit

Power for arm motion is provided by a hydraulic power unit. Location of the hydraulic power unit is shown on the site plan, Fig. 2.4. The unit supplied by PNNL is manufactured by S.A.S. Fluid Power, Inc. This unit consists of a positive displacement pressure compensated pump, driven by a 20 HP electric motor. The hydraulic power unit is mounted on a skid located near the sluicer control panel. Hydraulic fluid is pumped from the hydraulic power unit to the control panel where a series of valves directs the fluid toward the desired actuator in the sluicer mast.

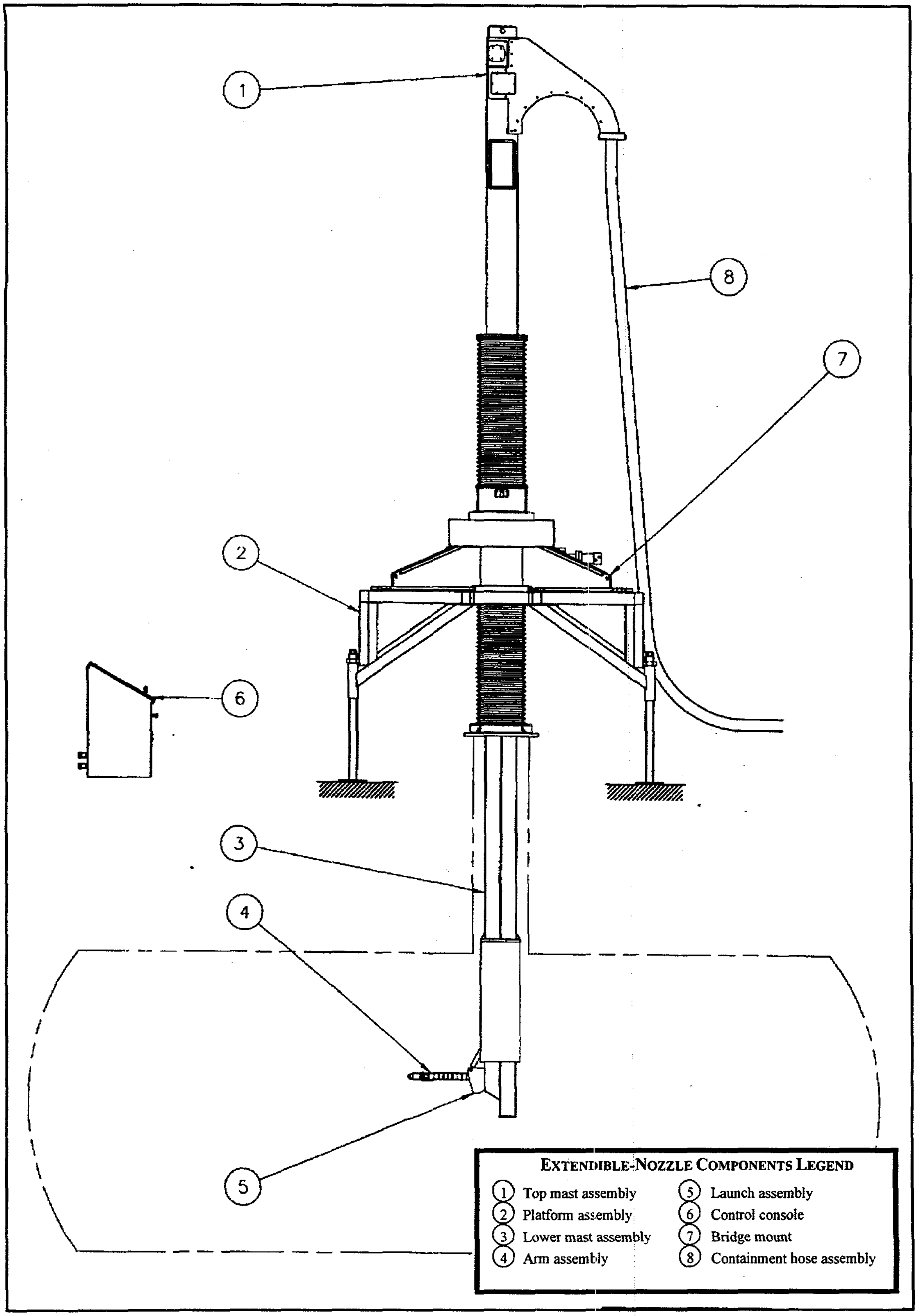


Fig. 3.5. Borehole Miner System

Electrical service to the hydraulic power unit is provided from local panel TP-8 which is mounted on the skid with the power unit [100% Configuration, Sheet E-2 (CDM Federal 1997)]. Start/stop control of the hydraulic power unit is accomplished manually from the sluicer control panel located in the control trailer.

Operation of the Borehole Miner within each tank will be monitored with an in-tank video camera and the sluicer visualization system.

3.4.3 Sluicer Control Panel

The operator controls movement of the sluicer arm from the sluicer control panel located in the control trailer. Arm extension length, arm angle, and mast angle are digitally displayed on the sluicer control panel, transmitted to the PLC, and transmitted to the visualization system (described in Sect. 3.8.3). Arm extension pressure, arm angle pressure, mast rotation pressure, and hydraulic system pressure are also displayed at the control panel with gauges.

3.5 VENTILATION SYSTEM

A skid-mounted ventilation system was designed for the tanks contents removal project to maintain less than atmospheric tank pressure and to prevent the unfiltered release of vapors from the tanks. This system consists of a ductwork manifold, intake assembly, demister, heater, filters, blower, and stack sampler (Fig. 3.6).

3.5.1 Ductwork Manifold

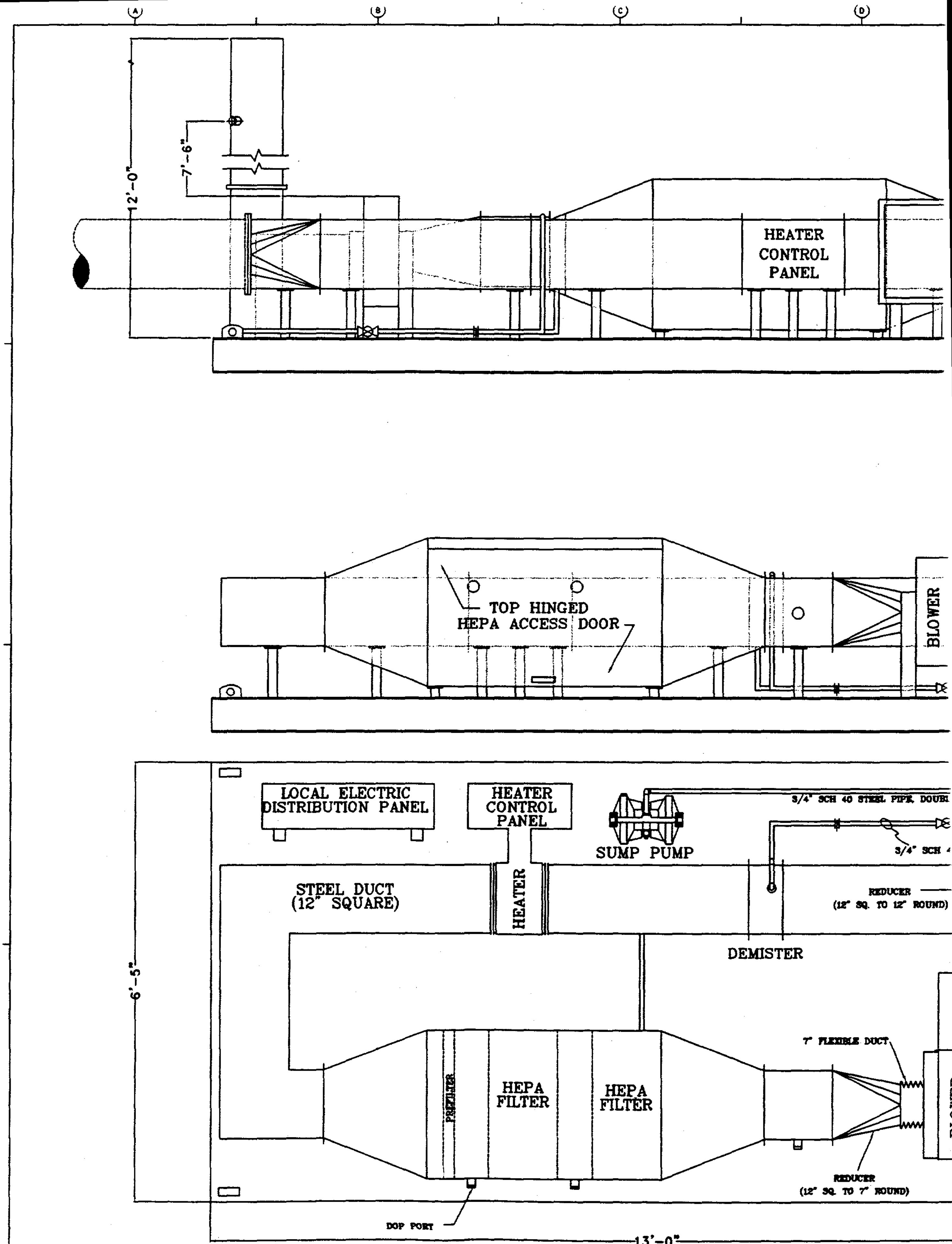
A reducing tee will be installed on the north riser of each tank to facilitate connection of the ductwork to the tanks. The tees are 26-in. (66-cm) pipes along the axis with 12-in. (30.5-cm) pipe side ports. Twelve-inch polyvinyl chloride (PVC) pipe will be connected in a manifold to the side ports on the reducing tees and to the intake of the ventilation skid.

3.5.2 Intake Damper and Filter

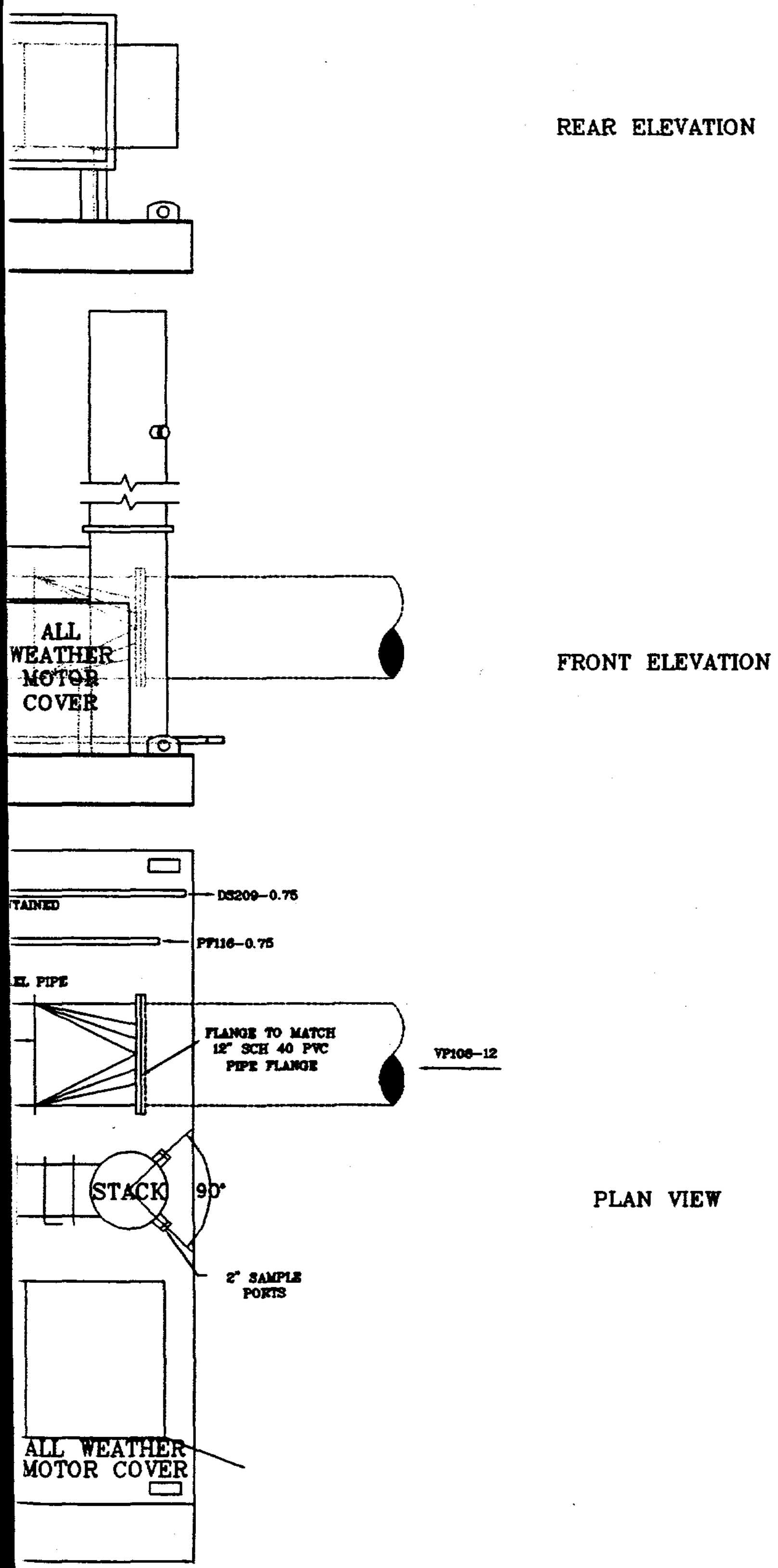
The reducing tee installed on the north riser of tank T-4 is a double-sided tee. The ductwork manifold will be attached to the north branch of the tee. The intake assembly will be connected to the south branch of this tee. A damper on the assembly allows manual operation to regulate the vacuum pressure on the tanks. A 30% prefilter and a HEPA filter on the intake serves to reduce particulate loading of the HEPA filters on the ventilation skid and to prevent the release of unfiltered vapors in the event of a ventilation system failure.

3.5.3 Demister

The first item in the treatment train on the ventilation skid is a demister manufactured by Air Plastics, Inc. The demister contains a stainless steel mesh that captures mist being transported in the air stream and thereby reduces moisture loading of the HEPA filters. The PLC monitors differential pressure across the demister through PDIT500. High differential pressure is an indicator of particulate clogging of the demister mesh. A rinse line has been installed to flush the mesh should it become clogged. Additional vendor information for the demister is indexed and located in the control trailer on-site.



REV. NO.	DATE	DRWN	CHKD	REMARKS	
	3-20-97			[illegible] Configuration - Technical Review	DESIGNED BY: [illegible]
1	4-8-97	ATB		[illegible] Configuration - Technical Review	DRAWN BY: [illegible]
					SHEET CHK'D BY: [illegible]
					CROSS CHK'D BY:
					APPROVED BY: [illegible]
					DATE: [illegible]



NOTES:

1. FINAL SKID LAYOUT MAY BE MODIFIED DURING FABRICATION.
2. SKID PUMP SHALL BE MOUNTED DIRECTLY OVER DRIP PAN AND ENCLOSED IN SPRAY SHIELDING.
3. SKID PUMP SHALL BE A MODEL M1 DOUBLE DIAPHRAGM PUMP AS MANUFACTURED BY WILDEN PUMP AND ENGINEERING CO.

Fig. 3.6. Ventilation System Skid
Oak Ridge National Laboratory
Old Hydrofracture Tank Contents Removal Project

PROJECT NO. 5151-01
FILE NAME: A23688-A.dwg

SHEET NO.

3.5.4 Heater

To avoid HEPA moisture loading from condensate, the dew point of the air must be raised before filtration. To accomplish this, a 480-volt, 3-HP, 5-kilowatt heater has been installed between the demister and the filters (Fig. 3.1). The heater is model number 97-4139, and is manufactured by Aumer Company, Inc.

Electrical service to the heater is supplied from panel TP-1 that is mounted on the ventilation skid. TP-1 is shown in the 100% Configuration on Sheet E-2 (CDM Federal 1997).

The heater is start/stop and intensity controlled directly from the PLC. Intensity is adjusted automatically by the PLC to maintain the operator-specified differential temperature across the heater. Additional vendor information for the heater is indexed and contained in the control trailer on-site.

3.5.5 Filters

A 90% pre-filter and two HEPA filters in series are the primary treatment for the ventilation system. The system is a single cartridge, bag-in/bag-out design by Flanders (model BF1-1H-1W266F-30403). Filter status is monitored and alarmed by the PLC based on differential pressure across the filters. Should filters become clogged, the system will be shut down in accordance with Work Instruction 4 (Normal System Shutdown) and filters will be replaced in accordance with Work Instruction 16 (Ventilation System Filter Changeout). Work instructions are located in Volume 2 of this report. Additional vendor information for the filters is indexed and contained in the control trailer on-site.

3.5.6 Blower

The blower is a single speed, centrifugal blower by Barry Blower (model 7 IND AH CCLN). The blower is capable of 510 cfm (14.4 m^3/min) and all-weather operation (Fig. 3.1).

Electrical service to the blower is supplied from panel TP-1 which is mounted on the ventilation skid. TP-1 is shown in the 100% Configuration on Sheet E-2 (CDM Federal 1997).

The blower is start/stop controlled directly from the PLC. Additional vendor information for the blower is indexed and contained in the control trailer on-site.

3.5.7 Stack Sampler

Bechtel Jacobs Company will collect continuous samples from the stack for the purpose of air discharge monitoring (Fig. 3.1). Sample ports have been installed in the stack for this purpose. Electrical service to the stack sampler is supplied from a 120-volt transformer that is fed from panel TP-1 mounted on the ventilation skid. TP-1 is shown in the 100% Configuration on Sheet E-2 (CDM Federal 1997).

3.5.8 Drip Pan Pump

The ventilation skid is equipped with an air-operated, double diaphragm pump that will transfer liquid from the demister drain line to tank T-9. The pump is started by the PLC opening an actuated valve in the pump's air line. The pump is model M1-AYYB/BN/BN/ABN, manufactured by Wilden, and is a self-priming pump that is not damaged by dry operation. Back-flow through the pump is not possible because check valves are integral to the operation of a double diaphragm pump. Additional vendor information for the double diaphragm pump is indexed and contained in the control trailer on-site.

3.6 PROCESS WATER SYSTEM

The process water system includes a process water tank, a skid-mounted process water pump, and an electrical distribution panel. A schematic of the process water system is shown on Fig. 3.7.

3.6.1 Process Water Tank

A 2500-gal (9460-L) poly-tank will be installed for process water storage because there are no active sources of process water at the OHF. A fire hose will be used to periodically fill this tank from a fire hydrant located near the MVST facility. During the filling of the tank, special care will be taken to avoid the discharge of chlorinated water into White Oak Creek and its tributaries.

3.6.2 Electrical Distribution Panel

Local electrical distribution panel TP-2 is mounted on the process water pump skid. This panel provides electrical service to the process water pump. Additionally, a transformer is included to provide 120-volt power outlets on the transfer pump skid. Service to panel TP-2 is provided from the main distribution panel (DP) through a heavy duty receptacle. In the event of a power failure, service to local panel TP-2 can be manually switched from the DP to the backup generator. TP-2 is shown in the 100% Configuration on Sheet E-2 (CDM Federal 1997).

3.6.3 Process Water Pump

The process water pump is model 3196 manufactured by Goulds. This pump is capable of flushing the OHF piping [50 gpm (189 L/min) at nominal pressure] and capable of flushing the LLLW line [50 gpm (189 L/min) at 50 psi (3.4×10^5 N/m^2)]. It is a single speed centrifugal pump that is start/stop controlled from the PLC. Electrical service to the process water pump is provided from panel TP-2. Additional vendor information for the process water pump is indexed and contained in the control trailer on-site.

3.7 BACKUP GENERATOR

A 100-kilowatt generator manufactured by Atlas Copco has been included so that the ventilation skid and the process water skid can be operated in the event of a power outage at the OHF. The continued operation of these skids will maintain a negative pressure on the tanks, allow flushing of waste lines, and allow flushing of the LLLW line. Electrical service to these skids is switched from the DP to the backup generator by manually changing electrical receptacles at the local skid panels [TP-1 and TP-2 which are located in the 100% Configuration on Sheet E-2 (CDM Federal 1997)].

3.8 INSTRUMENTATION AND CONTROLS

An extensive system of monitoring, instrumentation, and controls has been included in the design because (1) the radioactive nature of the materials at the OHF require extreme caution to prevent or minimize any leaks or line clogging and (2) the system must be operated remotely. The system consists of the sluicer control panel, the PLC, the visualization system, the camera systems, and the tank leak detection system (Fig. 3.8).

3.8.1 Sluicer Control Panel

Movement of the sluicer arm is accomplished from the sluicer control panel located in the control trailer near the PLC. Arm extension length, arm angle, and mast angle are digitally displayed on the sluicer control panel, transmitted to the PLC, and transmitted to the visualization system. Arm extension pressure, arm angle pressure, mast rotation pressure, and hydraulic system pressure are also displayed at the control panel (gauges) and also transmitted to the PLC.

3.8.2 Programmable Logic Controller

The PLC is a personal computer-based program linked with an operator machine interface (OMI). When running in an automatic mode, the PLC/OMI operates the sluicing and pumping system so that the operator can specify general system set points and the PLC will adjust system variables to maintain those set points. In addition to the automatic mode, the operator has the option of running part or all of the system in a manual mode where all system variables are specified by the operator. Volume 2 contains the control loop descriptions that form the basis of the PLC program. Vendor information for the PLC components is indexed and contained in the control trailer on-site.

3.8.3 Visualization System

The visualization system is a computer workstation provided by PNNL that receives sluicer position data from the sluicer control panel. The system combines the position data with tank profile images to provide a visual representation of the position of the sluicer nozzle in the tank.

3.8.4 Site Camera

One site camera will be installed on a pole mounted to the transfer pump skid. The camera is an off the shelf, all-weather security camera with pan, tilt, and zoom capabilities. Power, control, and monitoring of the camera is supplied from the camera controller located in the control trailer. The site camera will provide real-time visual surveillance of site activities. Vendor information for the site camera is indexed and contained in the control trailer on-site.

3.8.5 Tank Leak Detection System

The OHF tanks were installed in pits partially filled with gravel (see Sect. 2.1). Dry wells were installed in the pits to monitor for tank leakage. The dry wells consist of a perforated, 6-in. (15-cm) pipe placed along the bottom of the pit connecting to a 12-in. (30.5-m) vertical pipe for monitoring. Approximately 1.5 ft (0.5 m) above the perforated pipe, a 6-in. (15-cm) outlet pipe runs from the dry well to a nearby discharge box.

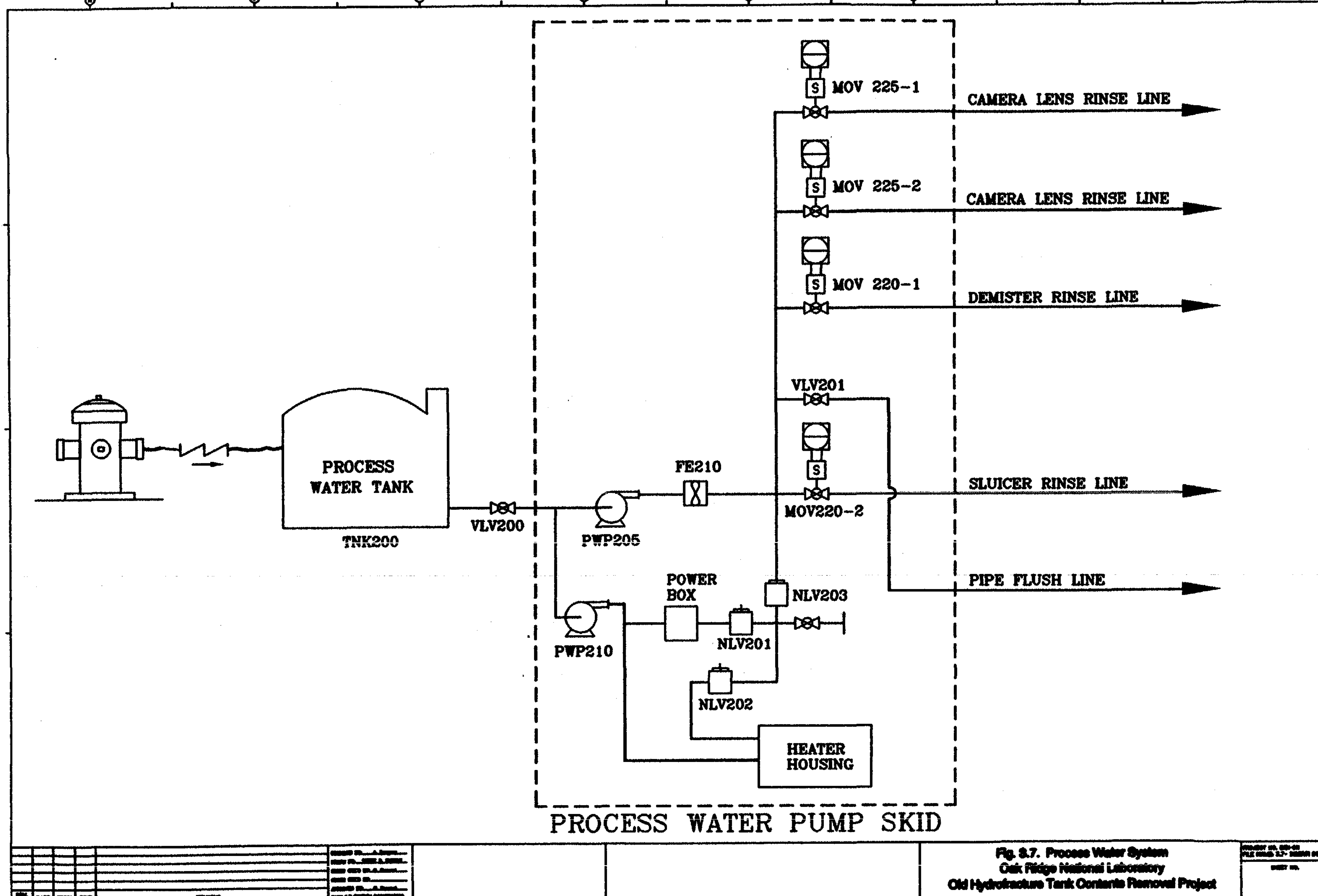


Fig. 3.7. Process Water System
Oak Ridge National Laboratory
Old Hydrofracture Tank Contents Removal Project

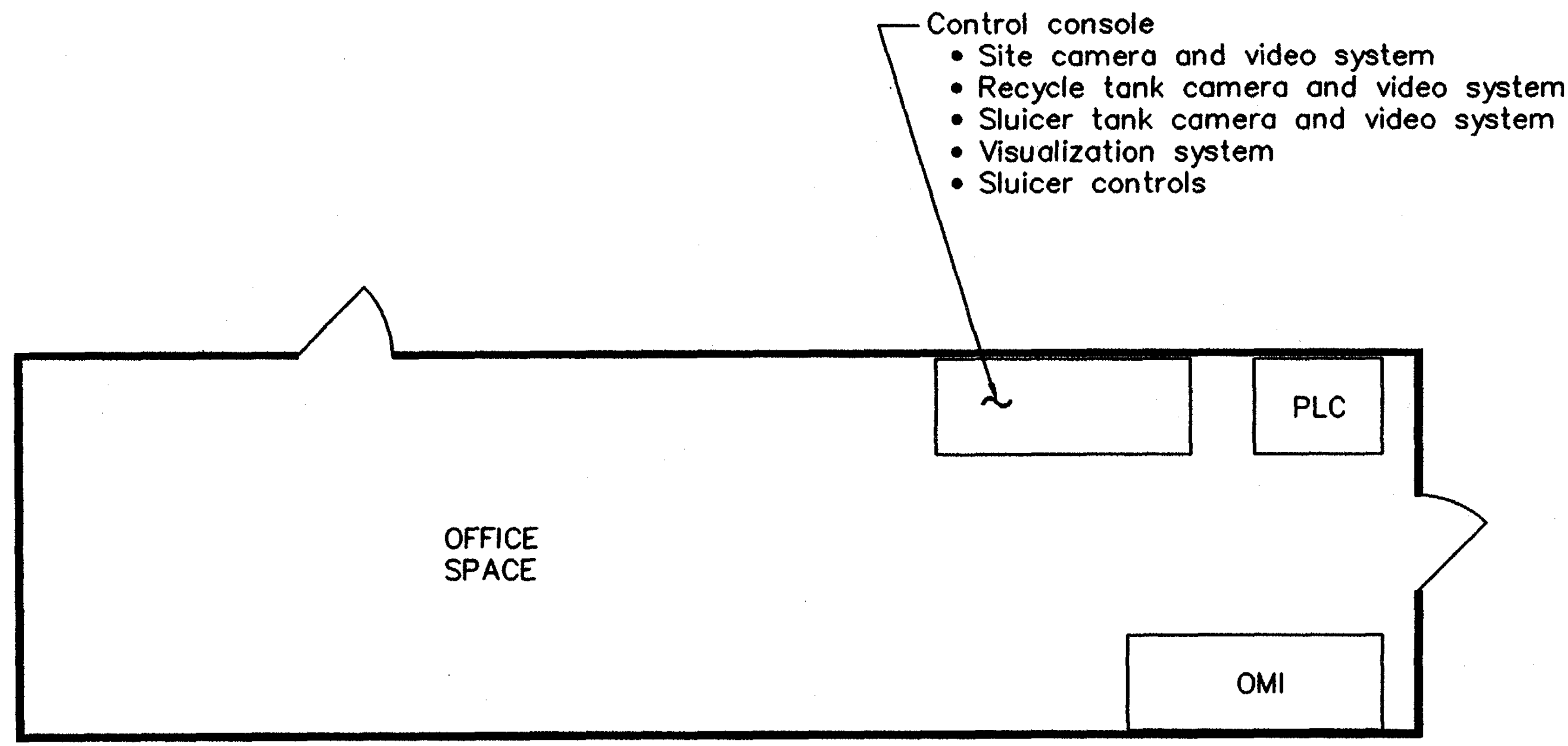


Fig. 3.8. Control Trailer Layout

In the event of an underground release from one of the OHF tanks, the waste would collect in the pit. To contain such a leak, a Muni Ball Plug will be installed in the outlet pipe of each dry well at the point where the pipe connects to the dry well. To monitor for leakage, an extended range gamma detector will be deployed into the dry well of the recycle tank (T-9) where it will remain throughout sluicing operations. A second gamma detector will be moved into the dry well nearest the tank being sluiced and remain until sluicing is completed. Gamma detector readings will be monitored by the PLC from the control trailer.

The gamma detectors specified are manufactured to withstand temperature extremes, humidity extremes, and temporary submergence in water. The instruments will be fitted with removable shielding to minimize the interference of background radiation from the tank contents. The shielding will be open to the bottom of the dry well to maximize the sensitivity to leak detection.

4. PRE-OPERATIONAL TESTING

After completing the setup described in the 100% Configuration (CDM Federal 1997), pre-operational testing will be performed before sluicing of the tanks is initiated. Pre-operational testing consists of system leak testing, instrumentation and controls testing, and support system testing. Upon completion of pre-operational testing, the completed checklists will be attached to a short letter report which will document successful pre-operational testing results.

The following sections describe the purpose of each test. At the completion of each test, a checklist will be completed documenting the success or failure of the system being tested. Pre-operational test checklists are located in Volume 2.

4.1 SYSTEM LEAK TEST

A system leak test will be performed to check the primary piping system (secondary containment will not be tested) for structural integrity and leaks at ambient temperature. The test fluid will be clean process water containing no sludge. Pressure testing will be conducted up to the last valve or flange in the system. Each of the four major piping systems—low pressure transfer, high pressure pump intake, high pressure pump discharge, and the sluicer pump discharge—will be tested. An air-driven hydraulic pump hydrostatic tester will be used to apply pressure to the system. The test will be performed under the following guidelines:

- Pressure—The low pressure transfer, high pressure pump intake, and high pressure pump discharge piping systems will be tested at 1.5 times the maximum operating pressure (300 psi). The sluicer pump discharge piping system will be tested at 1.5 times the maximum operating pressure (2225 psi). Once testing pressure has been reached, pressure readings will be taken at intervals of 15 minutes or less.

- Time—The test will be conducted for a minimum of two hours.

- Inspections—Piping, valves, and instrumentation will be checked for leaks.

- Reporting—Testing protocol, collected data, observations, problems and their solutions (if any), and testing conclusions will be documented in the pre-operational letter report.

Prior to initiation of system tests, individual components will be manually tested to verify operation. This includes electrical component evaluation, such as verification of wiring and terminations as well as voltage checks. In addition, mechanical equipment will be tested to verify proper operation and rotation, and manual operation (open/close) of all motor-operated valves.

4.2 INSTRUMENTATION AND CONTROLS TEST

The purpose of the instrumentation and controls test is to demonstrate the functionality and performance of the primary elements, other instruments, and the monitoring and control system as an integrated system including all applicable hardware and software. The instrumentation and controls test will consist of:

- **Field Instrumentation and Equipment Tagging Verification Test.** The purpose of the field instrumentation and equipment tagging verification test is to verify that all instruments and equipment have been tagged in accordance with the 100% Configuration (CDM Federal 1997). Checklist 4.2.1 in Volume 2 will be completed at the end of testing.

- **PLC, Workstation, and Panel Audit Test.** The purpose of the PLC, workstation, and panel audit test is to verify that all equipment required has been provided and installed in accordance with the 100% Configuration (CDM Federal 1997). Checklist 4.2.2 in Volume 2 will be completed at the end of testing.

- **Process I/O Verification Test.** The purpose of the process I/O test is to verify that the connection between each process I/O and PLC is properly configured and installed. Checklist 4.2.3 in Volume 2 will be completed at the end of testing.

- **PLC, Workstation, and Panel Failure Test.** The purpose of the PLC, workstation, and panel failure test is to verify that proper system failure response, notification, and recovery function properly. Checklist 4.2.4 in Volume 2 will be completed at the end of testing.

- **Process Control Verification Test.** The purpose of the process control verification test is to verify that the control strategies for the OHF sluicing system exist and operate as designed. The testing will be accomplished on a loop-by-loop basis. After successful completion of the test, the system is ready for complete automatic operation. Checklists 4.2.5.1 through 4.2.5.57 in Volume 2 will be completed during testing.

- **Ventilation Skid Test.** The purpose of the ventilation skid test is to test the ventilation skid-PLC interface. The test includes verification that OMI displays reflects actual conditions, signals from the ventilation skid are received by the PLC, and set points are controlled from the OMI. Checklist 4.2.6 in Volume 2 will be completed during testing.

4.3 VENTILATION SYSTEM TEST

The OHF tank sluicing ventilation system is comprised of four major components (demister, heater, HEPA filters, and blower). The ventilation system will be pressure tested and di-2-ethylhexyl phthalate (DOP) aerosol tested. Each test will be conducted in accordance with the American National Standard *Testing of Nuclear Air-Cleaning Systems* (ANSI/ASME N510-1980).

4.4 SUPPORT SYSTEM TEST

The OHF tank sluicing system has two supporting systems, the compressed air system and the process water system.

4.4.1 Air Compressor Test

The compressed air system consists of an air compressor, air dryers, air receiver, and pressure regulating valve. This system will be inspected to verify it is operating correctly. This inspection will be facilitated by the compressed air system checklist in Volume 2. This checklist (checklist 4.4.1) will be completed during the test.

4.4.2 Process Water Test

The process water system consists of a process water storage tank, a pump, a flowmeter, and a control valve. The purpose of the process water test is to verify the proper operation of the process water system as installed. This will be accomplished by an off-line flush of the strainers following procedures in Work Instruction 9 (Process Water Strainer Backflushing) located in Volume 2. Checklist 4.4.2 in Volume 2 will be completed at the end of testing.

5. TANK SLUICING

As described in Chap. 3, the sluicing and pumping system was designed to resuspend sludge from the bottom of the OHF tanks into a slurry. The system accomplishes this by pumping the slurry in a closed circuit system using a sluicing nozzle to resuspend the sludge. Once resuspended, the slurry will be transferred to the MVST through the existing LLLW line.

5.1 OPERATIONAL APPROACH

The sluicing and pumping system has been designed to process sluiced waste using a batch approach. At the beginning of a sluicing run (or batch), the sluicer will be placed in one of the tanks through the center riser and the valves aligned so that the closed circuit operates through the sluicer to the tank being sluiced to the recycle tank and back to the sluicer.

The project team has determined that to meet MVST waste acceptance criteria, a slurry concentration of 10% solids (by weight) will be targeted for each of the batches. The percent solids for a given batch can be calculated based on the following information:

1. Energy Systems' calculations of the sludge volume in each tank,
2. analytical laboratory data that show the sludge is between approximately 30% and 40% solids by weight (40% solids was used in the calculation),
3. analytical laboratory data that show the specific gravity of the sludge is between 1.13 and 1.58 with an average of 1.25 (specific gravity of 1.25 was used in the calculation), and
4. the volume of water at the beginning of a batch.

Table 5.1 provides a summary of the batch volumes for each of the tanks. The total volume of supernatant from all the tanks exceeds the volume required to meet the 10% solids concentration criterion, but the supernatant is not distributed among the tanks appropriately to achieve the solids concentration goal. To meet the MVST waste acceptance criteria, supernatant will be transferred between the tanks so that the average percent solids will be 10%. Additionally, excess supernatant will be transferred to T-3 after it has been cleaned. This excess supernatant may be used for line flushing or for additional sluicing batches if required.

Once the proper slurry (i.e., supernatant to sludge ratio) has been obtained in a given tank, denaturing agent will be added and contents mixed adequately. Denaturing will be performed by the Chemical Technology Division of ORNL in accordance with the Denaturing Plan and Work Instruction prepared by them. Sluicing will begin only after denaturing has been performed. After completion of the sluicing pass, the sluicing tank will be inspected with the in-tank camera. From this inspection, the Field Operations Superintendent will determine if additional sluicing would be beneficial. The Field Operations Superintendent also has the option of continuing sluicing and transferring waste to MVST simultaneously. At the completion of slurry transfer, all system lines and the LLLW line will be flushed with process water or supernatant.

Table 5.1. OHF batch volumes

Tank	Sludge volume		Current supernatant		Maximum allowable	Supernatant required	
	gal	L	gal	L	(% solids)	gal	L
T-1	1,410	5,340	10,780	40,810	10	5,290	20,020
T-2	1,560	5,910	10,630	40,240	10	5,850	22,140
T-3	3,120	11,810	1,960	7,420	10	11,700	44,290
T-4	2,310	8,740	14,790	55,990	10	8,660	32,780
T-9	1,140	4,320	4,930	18,660	10	4,280	16,200

5.2 TANK T-3

Tank T-3 will be sluiced first because it contains the largest volume of sludge and is the only tank requiring additional supernatant. The mixture for this sluicing batch will include the waste in tank T-3, the waste in tank T-9, and 9,090 gal (34,410 L) of supernatant from the other tanks. Total slurry volume for this batch will be 20,240 gal (76,620 L) with suspended solids of 10%.

Preparations to sluice tank T-3 may begin after the sluicing and pumping system has been installed at the OHF site, the system has passed the pre-operational testing described in Chap. 4, and readiness assessment approval has been received.

Once the sluicer has been installed, the required additional supernatant will be transferred to tank T-9. A total of 5,490 gal (20,780 L) and 3,600 gal (13,630 L) of supernatant will be transferred from tanks T-1 and T-2, respectively. The supernatant will be transferred using the adjustable depth submersible pump in each of the tanks mentioned above. Care will be taken to transfer supernatant only. This will be done by observing the in-tank cameras and lowering the adjustable depth submersible pumps on an as-needed basis to transfer supernatant without disturbing the sludge layers of the target tanks.

The final step in preparation for sluicing T-3 is to complete denaturing of tanks T-3 and T-9 by mixing the sludge and denaturing agent in accordance with the Denaturing Plan. Denaturing consists of the addition of an aqueous solution containing ^{238}U and/or ^{232}Th to the existing solutions in each tank to reduce the potential for criticality occurring during sluicing operations. The denaturing solution for each tank will vary based upon the nature of each tank contents. Denaturing will satisfy MVST waste criteria. Denaturing will be performed by the Chemical Technology Division of ORNL.

After the transfer of supernatant into tank T-9, the correct ratio of sludge and supernatant in tanks T-3 and T-9 will be appropriate for sluicing and transfer. Operators will initiate sluicing operations by executing Work Instruction 1 (Sluicing System Setup and Configuration) and Work Instruction 2 (Sluicing System Startup and Operation).

During sluicing operations, the condition of tank T-3 will be checked using the in-tank camera. To facilitate this inspection, the Field Operations Superintendent may conduct a partial transfer of slurry to the MVST. If tank T-3 is not sufficiently clean (as determined by the Field Operations

Superintendent), then sluicing operations will continue. If tank T-3 is sufficiently clean, then the slurry will be transferred to MVST using Work Instruction 3 (Transfer of Slurry to MVST).

Once the transfer to MVST has been completed, the system will be shut down in accordance with Work Instruction 4 (Normal System Shutdown) and the lines will be flushed in accordance with Work Instruction 5 (Line Flushing Sequence).

After tank T-3 has been cleaned, it will be used to store excess supernatant from tanks T-2 and T-4. The volumes of supernatant to be transferred to tank T-3 from these tanks are 1,180 gal (4470 L) and 6,130 gal (23,200 L), respectively.

At the completion of this step, the approximate contents in the OHF tanks should be as described in Table 5.2.

Table 5.2. Approximate OHF tanks contents after sluicing T-3 and transferring excess supernatant

	Supernatant		Sludge		Total waste	
Tank	gal	L	gal	L	gal	L
T-1	5,290	20,020	1,410	5,340	6,700	25,360
T-2	5,850	22,140	1,560	5,910	7,410	28,050
T-3	7,310	22,670	0	0	7,310	22,670
T-4	8,660	32,780	2,310	8,740	10,970	41,520
T-9	0	0	0	0	0	0
Total	27,110	97,610	5,280	19,990	32,390	117,600

5.3 TANK T-4

At the completion of the supernatant transfer described in Sect. 5.2, there should be 8,660 gal (32,780 L) of supernatant and 2,310 gal (8,740 L) of sludge in tank T-4. When fully mixed, this ratio will provide a slurry that is 10% solids.

Tank sluicing operations (preparation, denaturing, sluicing, MVST transfer, shutdown, and line flushing) for tank T-4 will be conducted in the same manner described in Sect. 5.2.

5.4 TANK T-1

At the completion of the supernatant transfer described in Sect. 5.2, there should be 5,290 gal (20,020 L) of supernatant and 1,410 gal (5,340 L) of sludge in tank T-1. When fully mixed, this ratio will provide a slurry that is 10% solids.

Tank sluicing operations (preparation, denaturing, sluicing, MVST transfer, shutdown, and line flushing) for tank T-1 will be conducted in the same manner described in Sect. 5.2.

5.5 TANK T-2

At the completion of the supernatant transfer described in Sect. 5.2, there should be 5,850 gal (22,140 L) of supernatant and 1,560 gal (5,910 L) of sludge in tank T-2. When fully mixed, this ratio will provide a slurry that is 10% solids.

Tank sluicing operations (preparation, denaturing, sluicing, MVST transfer, shut down, and line flushing) for tank T-2 will be conducted in the same manner described in Sect. 5.2.

5.6 TANK T-9

After tanks T-1, T-2, T-3, and T-4 have been sluiced, the camera in tank T-9 will be used to determine if sluicing of this tank is required. If sluicing is required, the in-tank camera will be used to inspect tank T-9 for obstructions to the installation of the sluicer. The sluicer will be installed through the center riser by the method described in Work Instruction 11 (Sluicer Mast Placement) while using the in-tank camera to monitor the installation.

The next step is to set up the low pressure transfer system to transfer excess supernatant from tank T-3 to tank T-9. Tank sluicing operations (preparation, denaturing, sluicing, MVST transfer, shut down, and line flushing) for tank T-9 will be conducted in the same manner described in Sect. 5.2.

5.7 EXCESS SUPERNATANT

Excess supernatant will be available in tank T-3 in the event additional sluicing is necessary for any of the tanks. The supernatant also may be used to flush pipelines as necessary. If tank T-9 requires sluicing, all excess supernatant will be transferred to T-9 for sluicing as described in Sect. 5.6. If tank T-9 does not require sluicing, excess supernatant will be transferred to the MVST.

5.8 OPERATOR AIDS

Operator aids will be used to provide system operators and other project personnel with reminders designed to promote proper equipment operation. Operator aids will be controlled as follows:

- operator aids will be approved by the Field Operations Superintendent and the lead engineer;
- operator aids will be reviewed every six months or as required by a change in this operations plan or work instructions;
- a log of approved operator aids will be kept in the control trailer at the OHF site; and
- each operator aid will be labeled with an identifying number (e.g., OPAID-001), a document control number, revision number, and date reviewed.

A sample operator aid is shown in Fig. 5.1.

OHF TANK CONTENTS REMOVAL OPERATOR AID FOR
PERFORMING E-STOP OF SLUICING OPERATIONS
OPAID-001

Emergency Stop (E-Stop)

Perform E-Stop when the following conditions occur:

- Leaks are detected
- Pressure changes beyond normal fluctuations
- Power failure
- Elevated radiation monitor readings
- Any condition that presents possible danger to human health or the environment
- Site emergencies such as fire, tornado, plant evacuation, etc.

Revision: 0 Date: 12FEB98 DCN: 5151-015-GU-BBWQ

Fig. 5.1. Sample Operator Aid

E:\projects\5151-015-100\emergency-stop\3-24-98\JPS

6. SYSTEM MAINTENANCE

Vendor manuals for equipment have been reviewed, indexed, and placed in the control trailer on-site for reference. None of the equipment at the site will require field calibration. System maintenance will be performed in accordance with vendor equipment manuals. Minimal maintenance will be required as the planned duration of operation of the OHF tanks contents removal system will be less than most of the vendor-recommended frequencies (monthly, quarterly, semiannually, and annually). Daily maintenance requirements will be tracked using the daily pre-operational and post-operational checklists included in Volume 2. For the purpose of maintenance, daily is defined as only those days in which the system will be operated. All other (non-daily) recommended vendor maintenance will be tracked using operations and maintenance logbooks.

7. SYSTEM DECONTAMINATION/DISASSEMBLY

System equipment will be decontaminated upon completion of the final tank contents transfer before final disassembly and disposition. Contamination in the system may result from water running through the pipes and accumulation of solids in the system. The system will not be disassembled before decontamination and will be treated as one unit.

Decontamination will be accomplished by flushing process water through the entire system in accordance with Work Instruction 5 (Line Flushing Sequence). Flushing will be performed twice. There is no requirement that equipment be decontaminated to any standard for release or tagging; therefore, this task will be considered complete by flushing twice. Water generated during flushing will be pumped to the MVST at the direction of Bechtel Jacobs Company. In addition, the active LLLW pipeline from the OHF to MVST will also be flushed with two pipeline volumes of process water after pumping is complete.

Final disassembly will be accomplished by disconnecting pipes and breaking down equipment to the condition in which it was shipped. The equipment materials will be staged for final disposal.

8. REFERENCES

ANSI/ASME (American National Standards Institute/American Society of Mechanical Engineers) N510-1980. *Testing of Nuclear Air-Cleaning Systems.*

Boris, G.F. 1997. "OHF Tanks Contents Waste Volumes." Engineering Transmittal PX092-132. April 23.

CDM Federal (CDM Federal Programs Corporation) 1997. *Oak Ridge National Laboratory Old Hydrofracture Facility Tanks Contents Removal Project 100% Configuration.* May.

DOE (U.S. Department of Energy) 1995. *Remedial Investigation Report on Waste Area Grouping 5 at Oak Ridge National Laboratory, Oak Ridge, Tennessee.* DOE/OR/01-1325&D2/V1. Oak Ridge, Tenn.

Energy Systems (Lockheed Martin Energy Systems, Inc.) 1996a. *Preliminary Engineering Report Old Hydrofracture Facility Tanks Content Removal Project.* ORNL/ER-372. Oak Ridge, Tenn.

Energy Systems (Lockheed Martin Energy Systems, Inc.) 1996b. *Quality Assurance Project Plan for Old Hydrofracture Facility Tanks Content Removal at Oak Ridge National Laboratory, Oak Ridge, Tennessee.* 005-225/0002-0796. Being updated.

Energy Systems (Lockheed Martin Energy Systems, Inc.) 1996c. "Lockout/Tagout of Hazardous Energy Sources." Procedure OSHP-059, Rev. 0. Feb. 8.

Energy Systems (Lockheed Martin Energy Systems, Inc.) 1996d. *Contingency Plan for the Old Hydrofracture Facility Tanks Sluicing Project at Oak Ridge National Laboratory, Oak Ridge, Tennessee*. ORNL/ER-383. October.

Energy Systems (Lockheed Martin Energy Systems, Inc.) 1997a. *Site-Specific Health and Safety Plan for the Old Hydrofracture Facility Tanks Contents Removal Project at Oak Ridge National Laboratory, Oak Ridge, Tennessee,* ORNL/ER-427, Oak Ridge, Tenn.

Energy Systems (Lockheed Martin Energy Systems, Inc.) 1997b. "Draft Conduct of Operations Matrix." December.

Energy Systems (Lockheed Martin Energy Systems, Inc.) 1997c. *Configuration Management Plan for the Old Hydrofracture Facility Tank Contents Removal Project Sluicing and Pumping System at Oak Ridge National Laboratory, Oak Ridge, Tennessee.* ORNL/ER/MS-11. December.

Energy Systems (Lockheed Martin Energy Systems, Inc.) 1998a. *Draft Project Management Plan for Waste Area Grouping 5 Old Hydrofracture Facility Tanks Contents Removal at Oak Ridge National Laboratory, Oak Ridge, Tennessee.* ORNL/ER-375/R1. January.

Energy Systems (Lockheed Martin Energy Systems, Inc.) 1998b. *ALARA Plan for the Old Hydrofracture Facility Tanks Contents Removal Project at Oak Ridge National Laboratory, Oak Ridge, Tennessee.* ORNL/ER-429. To be published.

DISTRIBUTION

1–2. C. A. Bednarz
3. G. F. Boris
4. J. R. LaForest
5. D. L. McCurry
6. P. T. Owen
7. C. A. Provost
8. L. B. Raulston
9. S. Salcido
10. M. L. Whitehead
11. Central Research Library
12. File—EMEF DMC—RC
13. C. L. Callis, CDM Federal Programs Corp., 800 Oak Ridge Turnpike, Oak Ridge, TN 37830
14. J. Mitchell, CDM Federal Programs Corp., 800 Oak Ridge Turnpike, Oak Ridge, TN 37830
15. R. Salley, CDM Federal Programs Corp., 800 Oak Ridge Turnpike, Oak Ridge, TN 37830