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Oak Ridge National Laboratory Old Hydrofracture Facility Waste Remediation Using the Borehole-Miner Extendible-Nozzle Sluicer

J. A. Bamberger
G. F. Boris[1)]

June 1999

Prepared for the U.S. Department of Energy
under Contract DE-AC06-76RLO 1830

This work is funded by the Office of Science and Technology within the Energy's Office of Environmental Management under the Tanks Focus Area Program

[1)]Bechtel Jacobs Company LLC

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Acknowledgments

The borehole-miner extendible-nozzle activities are part of the Retrieval Process Development and Enhancements (RPD&E) Project under direction of the US Department of Energy's EM-50 Tanks Focus Area. The borehole-miner development and deployment was conducted as a partnership between RPD&E and the Oak Ridge National Laboratory's US DOE EM-40 Old Hydrofracture Facility remediaton project team.

The following organizations and individuals were instrumental in the successful deployment of the borehole-miner extendible nozzle at the Oak Ridge National Laboratory Old Hydrofracture Facility:

- Bechtel Jacobs Company LLC – Greg Boris and Clay Bednarz directed the remediation and provided on site support during borehole miner system integration.
- CDM Federal Programs Company – Chris Provost and Charles Callis led the site operations team that included Jim LaForest, Joe La Rosa, Sergio Salcido, Rick Salley, Mike Stafford, and Jay Mitchell.
- Lockheed Martin Energy Systems –Mark Matthews provided site electrical. The site Plant and Equipment division (P&E) provided hoisting and rigging crews, as well radiation monitoring, and support from Chemical Technology division during chemical denaturing of the waste.
- Lockheed Martin Energy Research Corporation – Ben Lewis and Scot Babcock provided the Oak Ridge National Laboratory EM-50 interface with the EM-40 organization.

The borehole-miner extendible nozzle was provided by a team led by Pacific Northwest National Laboratory[1]. That team included support from the following organizations:

- Waterjet Technology, Inc. – Waterjet staff designed and constructed the borehole-miner extendible-nozzle and constructed the pump skid. Their team included Dan Alberts, Rick Stagi, and Joe Maloney, who provided on site support
- National Oilwell – Les Lestelle provided support for the high-pressure pump and variable speed motor, and Joey Bodin provided on site support during pump start up.

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[1] Operated for the U.S. Department of Energy by Battelle Memorial Institute.

Summary

A borehole-miner extendible-nozzle sluicing system was designed, constructed, and deployed at Oak Ridge National Laboratory to remediate five horizontal underground storage tanks containing sludge and supernate at the ORNL Old Hydrofracture Facility site. The tanks were remediated in fiscal year 1998 to remove ~98% of the waste, ~3% greater than the target removal of >95% of the waste. The tanks contained up to 18 in. of sludge covered by supernate. The 42,000 gal of low level liquid waste were estimated to contain 30,000 Ci, with 97% of this total located in the sludge. The retrieval was successful. At the completion of the remediation, the State of Tennessee Department of Environment and Conservation agreed that *the tanks were cleaned to the maximum extent practicable using pumping technology.*

This deployment was the first radioactive demonstration of the borehole-miner extendible-nozzle water-jetting system. The extendible nozzle is based on existing borehole-miner technology used to fracture and dislodge ore deposits in mines. Typically borehole-miner technology includes both dislodging and retrieval capabilities. Both dislodging, using the extendible-nozzle water-jetting system, and retrieval, using a jet pump located at the base of the mast, are deployed as an integrated system through one borehole or riser. Note that the extendible-nozzle system for Oak Ridge remediation only incorporated the dislodging capability; the retrieval pump was deployed through a separate riser.

The borehole-miner development and deployment is part of the Retrieval Process Development and Enhancements project under the direction of the US Department of Energy's EM-50 Tanks Focus Area. This development and deployment was conducted as a partnership between RPD&E and the Oak Ridge National Laboratory's US DOE EM040 Old Hydrofracture Facility remediation project team.

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1. Introduction

This report summarizes the installation, integration, and deployment of a borehole-miner, extendible-nozzle water-jetting system that was designed, constructed and deployed to remediate five horizontal underground storage tanks containing sludge and supernate at the Oak Ridge National Laboratory (ORNL) Old Hydrofracture Facility (OHF) site. The OHF tanks range in diameter from 8 to 10.5 ft and length from 23 to 44 ft. The tanks are submerged at depths up to 4 ft below grade. The tanks contained up to 18 in. of sludge covered by supernate. The 42,000 gal of low level liquid waste were estimated to contain 30,000 Ci, with 97% of this total located in the sludge. The waste from the OHF tanks was successfully retrieved over a period of less than 3 weeks in June and July 1998. At the completion of the remediation, the State of Tennessee Department of Environment and Conservation agreed that *the tanks were cleaned to the maximum extent practicable using pumping technology.*

This work was completed as part of the Retrieval Process Development and Enhancements (RPD&E) Project under direction of the US Department of Energy's EM-50 Tanks Focus Area. The purpose of Retrieval Process Development and Enhancements is to understand retrieval processes including ongoing and existing technologies, gather data on these technologies, and relate the data to specific tank problems such that end users have requisite technical bases to make retrieval and closure decisions. This work was conducted as a partnership between RPD&E and the Oak Ridge National Laboratory's US DOE EM-40 Old Hydrofracture Facility remediation project team. The EM-50 Tanks Focus Area Retrieval and Closure task contributed to the success of the cold tests once the equipment was delivered to ORNL.

The borehole-miner extendible-nozzle technology was identified in 1995 for potential US Department of Energy (DOE) tank retrieval applications. The extendible-nozzle system is based on commercial borehole-miner technology developed in the 1970s and 1980s. Waterjet Technology, Inc.[1] has exclusive rights to this technology for environmental clean up applications. The borehole-miner technology has been identified as a means of acquiring low cost tank waste dislodging and conveyance capabilities. It consists of a semi-flexible, extendible, and erectable arm, which supports a payload at some distance away from the entry point in the tank for dislodging.[2] An integral jet pump system is used for conveyance. The arm and launching mechanism can be lowered through a relatively small opening for deployment. Once inside a tank, the arm can be remotely extended or retracted horizontally and raised or lowered.

1.1 Background

In fiscal year 1995, the borehole-miner extendible-nozzle system was identified as a potential commercial technology that could be deployed to dislodge and retrieve waste from underground storage tanks. In fiscal year 1996, Savannah River Site Tank 19 was identified as a potential initial application

1 Waterjet Technology, Inc., Kent, Washington.

2 Extendible arm links range from 2 in. to 12 in. in cross section. These links have been designed to support large payloads. For example, an 8-in. cross-section system can support an 800-lbm payload at an extension of 20 ft.

for the extendible-nozzle demonstration. The extendible nozzle would be deployed to break up and mix the hard zeolite heel remaining at the bottom of the tank. Based on this need, an extendible-nozzle system was designed for deployment in Tank 19. The design was completed through the 90% design. At that point, Savannah River Site priorities were reordered to push deployment back. Also, a sample of the top of the zeolite sludge surface was taken in Tank 19 that indicated that at least the surface was soft, thus eliminating the need for a 3000-psi retrieval system. Therefore, another site at Oak Ridge National Laboratory was selected for extendible-nozzle deployment in fiscal year 1998.

In fiscal year 1997, design of the extendible-nozzle system for deployment in a tank farm of horizontal underground storage tanks was initiated, the system was constructed, and the borehole-miner extendible-nozzle system was delivered to Oak Ridge National Laboratory. In fiscal year 1998, the borehole-miner equipment required to support high-pressure system operation was delivered to ORNL. This equipment included a high-pressure pump to power the extendible nozzle, the pump skid, instrumentation, and valving required to support system operation. The EM-50 supplied borehole-miner equipment was integrated with the ORNL balance-of-plant, and cold tests were conducted. Then the integrated equipment was moved to the Old Hydrofracture Facility site, installed, and operated to remediate the tanks. After remediation, the equipment was disassembled for storage.

1.2 Objective

The objective of this task is to document borehole-miner activities associated with system design, integration, deployment, operation, and disassembly to enable the system to be deployed during remediation of tanks at other waste sites.

1.3 Prior Borehole-Miner Development

To support borehole-miner deployment, Pacific Northwest National Laboratory (PNNL) conducted laboratory and scaled testing of the extendible-nozzle system to establish its operating regime (Bamberger et al. 1998 and 1999). Experiments have been completed to define the extendible-nozzle range of performance. The nozzle coefficient of discharge (C_D) was evaluated and found to be 0.971 ± 0.006 for a Reynolds number between 5.7×10^5 and 1.3×10^6. This data enhances the understanding of the performance of the extendible nozzle and enhances the ability to design the extendible nozzle by providing information about the reaction force from the nozzle onto the arm.

Stationary-jet experiments have been completed to determine extendible-nozzle performance over a range of stand-off distances (5 to 50 ft), nozzle diameters (0.281 to 0.406 in.), and nozzle pressures (up to 3000 psi). Integrated-dislodging experiments have been completed to determine the efficiency of the nozzle for dislodging simulants with a range of physical properties from soft sludge wastes (shear strengths from 2.5 to 150 kPa) to hard saltcake waste (shear strengths to 19 MPa). Integrated dislodging and retrieval experiments in a scale-model of a horizontal tank (8-ft diameter, 22-ft long) were conducted to provide design and operational guidance for deployment at Oak Ridge. Videos were prepared that show the extendible-nozzle system in operation.

1.4 OHF Facility

The ORNL OHF site includes five liquid low-level waste tanks that have been non-operational for almost 20 years. The OHF Tanks Content Removal Project was conducted to remove the current liquid and sludge contents from each of the five horizontal underground storage tanks. The goal was to remove 95% of the existing sludge and supernate. The extendible nozzle was used to remediate these tanks by using supernate to dislodge and mix the settled sludge. The waste slurry was transported via pipeline to the Melton Valley Storage Tank Facility for final disposition.

Construction details and riser information[1] for the OHF tanks are summarized in Table 1.1 (LMERP 1996). Four of the tanks are between 42 and 44 ft in length; the fifth tank is 23.8-ft long, approximately half the length of the other tanks. The tanks range from 8 to 10.5 ft in diameter and are buried from 4.1 to 5.6 ft below grade. For Tanks T1 through T4, the average distance from the central riser centerline to the end riser centerline is 16.8 ft. The average distance from the end riser centerline to the tank end is estimated to be 4.9 ft.

1.5 OHF Waste Characteristics

The OHF waste consists of sludge and supernate as shown in Table 1.2.[2] The sludge and superate are categorized as low-level mixed waste. The sludge is also characterized as transuranic waste. The tanks contain about 29500 Ci of radioactivity; 97% of this total is located in the sludge. Chemical characterization of the waste is summarized in reports by Francis and Herbes (1997) and Keller et al. (1997).

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1 Distances from central riser centerline to end riser centerline was provided via personal communication from G.F. Boris, May 19, 1997.

2 Personal communication via email from G.F. Boris, Bechtel Jacobs Company, LLC, Oak Ridge, Tennessee, November 3, 1998.

Table 1.1 OHF tank configurations

Tank	Tank Diameter, ft	Tank Length, ft	Shell Thickness, in.	Tank Lining	Riser Diameter, in.		Riser Distance from Center Line of Central Riser, ft		Distance from Riser to End of Tank ft	Central Riser Offset from Tank Center ft	Distance Below Grade, ft
					North South	Center	N	S			
T1	8.0	44.1	5.46	none	27	18	17.1	14.1	6.5	3.1 (S)	4.7
T2	8.0	44.1	5.62	none	27	18	17.2	14.3	6.3	3.1 (S)	5.6
T3	10.5	42.3	2.36	Rubber	27	18	17.8	17.8	3.4	0	4.1
T4	10.5	42.3	6.10	Rubber	27	18	18.3	17.4	3.3	0	4.1
T9	10.0	23.8	4.55	none	27	18	7.3	7.0	4.8	0	4.4

Table 1.2 OHF waste volume

Tank	Diameter, ft	Sludge, gal	Supernate, gal	Total, gal
T1	8.0	1497	10780	12187
T2	8.0	1556	10631	12187
T3	10.5	3115	1962	5077
T4	10.5	2309	14789	17098
T9	10.0	1141	4929	6070

2. Conclusions and Recommendations

2.1 Conclusions

An extendible-nozzle water-jetting system, shown in Figure 2.1, was designed, constructed, and deployed at Oak Ridge National Laboratory to remediate five horizontal underground storage tanks containing sludge and supernate at the ORNL Old Hydrofracture Facility site. The tanks were remediated in fiscal year 1998 to successfully remove ~98% of the waste. The tanks contained up to 18 in. of sludge covered by supernate. The 42,000 gal of low-level liquid waste were estimated to contain 30,000 Ci, with 97% of this total located in the sludge. At the completion of the remediation, the State of Tennessee Department of Environment and Conservation agreed that *the tanks were cleaned to the maximum extent practicable using pumping technology.* This deployment was the first radioactive demonstration of the borehole-miner extendible-nozzle water-jetting system.

The extendible nozzle is based on existing borehole-miner technology used to fracture and dislodge ore deposits in mines. Typically borehole-miner technology includes both dislodging and retrieval capabilities (where dislodging is accomplished using the extendible-nozzle water-jetting system, and retrieval is accomplished using a jet pump located at the base of the mast) that are deployed as an integrated system through one borehole or riser. Note that the extendible-nozzle system for Oak Ridge remediation only incorporated the dislodging capability; the retrieval pump was deployed through a separate riser.

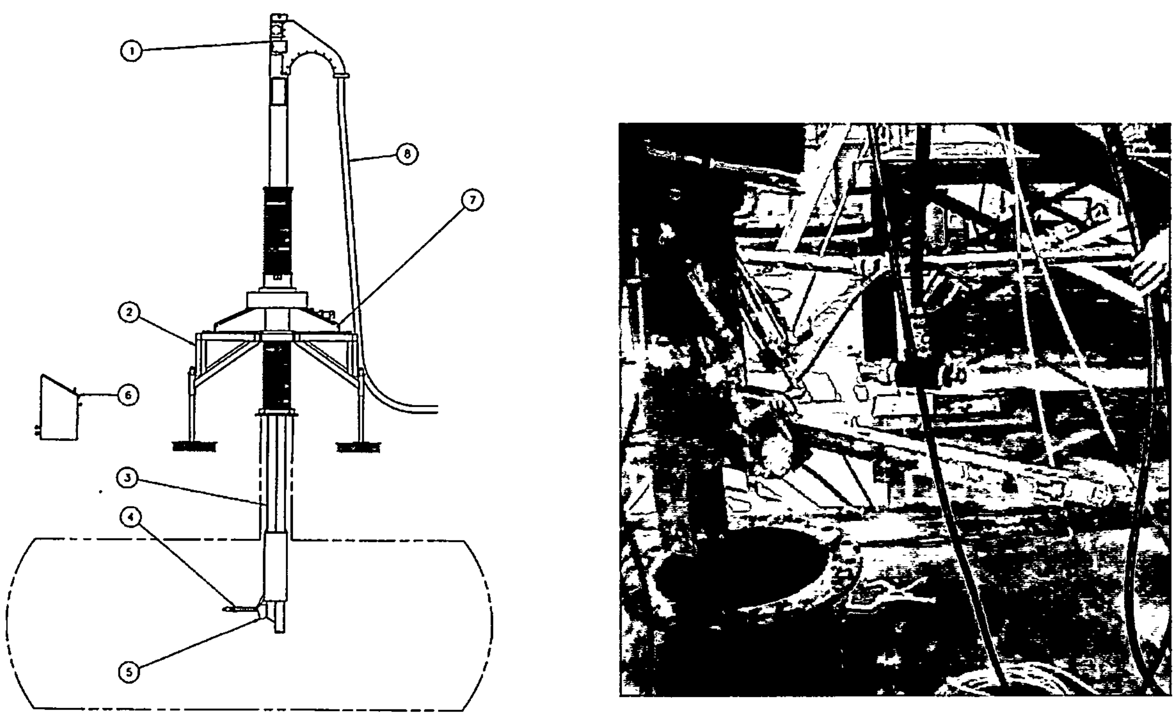

Figure 2.1 Borehole-miner extendible-nozzle sluicing system

The extendible-nozzle arm extends up to 10 ft from the center of the mast, extends downward at angles from the horizontal to nearly vertical, and rotates 360 degrees about the mast. The extendible nozzle can operate at water pressures up to 3000 psi; however, for deployment at Oak Ridge, the maximum operating pressure was limited by the high-pressure pump to ~1500 psi and most operations occurred at ~400 psi.[1] The extendible-nozzle design was improved during the design phase. The design moved the arm actuator from beneath the elbow to above the elbow, thereby shortening the lower mast length by ~2.5 ft. The new design simplifies construction and operation considerably. The current nozzle design 1) covers the entire area beneath the nozzle from vertically downward to horizontal and eliminates the need for separate spray nozzles to clean beneath the mast, 2) eliminates an additional line from the pump to the extendible nozzle and valves and controls associated with operation of these separate spray nozzles, and 3) allows the nozzle to operate along the horizontal tank centerline. The extendible nozzle, as configured during the acceptance tests, is shown in Figure 2.1.

Pacific Northwest National Laboratory supplied ORNL a complete extendible-nozzle system; ORNL provided the balance-of-plant equipment to support the tank remediation. The extendible-nozzle operating system includes the high-pressure pump and pump skid to power the nozzle; the valving, instrumentation and control system to monitor pump performance; the hydraulic power unit to control the extendible-nozzle motion, and the extendible nozzle including the mast and support platform. These components were integrated by PNNL and provided to support extendible-nozzle operation. In addition, a visualization system developed by PNNL and Sandia to track nozzle location in the tank in real-time during operation was also supplied.

The extendible-nozzle visualization system is an operator aid to be used during extendible-nozzle in-tank operation of the extendible nozzle because of the mist produced during sluicing. During operations, the operator cannot view the nozzle position because in-tank cameras may cloud from mist generated during extendible-nozzle operation. The extendible-nozzle visualization system provides the operator guidance on nozzle position relative to the tank. The visualization system provides a 3-dimensional animated model of the extendible nozzle and the tank in which it is deployed. Position and orientation information from the extendible nozzle is fed to the software via the input/output model so that the three-dimensional model accurately depicts where the extendible-nozzle and its spray stream are in relation to the tank. The software can also warn of impending collisions between the nozzle and the tank infrastructure or any in-tank hardware that are modeled and included in the tank model.

2.2 Benefits

The extendible-nozzle system provides DOE with a commercially developed, demonstrated technology that has been successfully applied to hazardous waste tank remediation needs. Current sluicing methods use high-volume, low-pressure jets to erode solids. The potential of current methods to erode tough materials is minimal, and based on previous sluicing operations, layers of heel material remain at the bottom of the tank. The borehole-miner extendible-nozzle system fills this void.

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[1] During the cold test, the pressure relief valve was tripped. It was reset to open at 1500 psi. It was later determined that the valve was not correctly reset. This limited the maximum operating pressure during remediation of the OHF tanks.

The extendible nozzle operates at increased jet pressure, significantly reduced flow rate (when compared to conventional sluicing) and stand-off distance, and can be positioned to impinge directly upon the area to erode, significantly improving system performance. The extendible-nozzle technology may significantly improve retrieval by dislodging sludge heels, fracturing saltcake, and decreasing the time and water required to provide safe transport of the variety of materials in the waste storage tanks.

Specific benefits of the extendible nozzle are as follows:

- Enhanced sluicing capabilities resulting from high-pressure, low-volume waterjet at small stand-off distances.
- Designed to operate with either water or recycled slurry as the jet dislodging fluid.
- High-pressure waterjet provides increased waste removal volume per unit volume of water.
- Extreme simplicity of design and operation directly relates to a lower cost system and lower operating costs compared with conventional rotary joint robotics arms.
- Can be used to deploy end effectors or manage cable/hose systems.
- Complete retraction into a compact tool housing for installation and storage through a relatively small hole.
- Demonstrated performance for radioactive sludge remediation.

2.3 Recommendations

Based on the successful field deployment at ORNL and extensive laboratory testing to evaluate 1) dislodging of challenging simulants, 2) single and multiple-riser deployment, 3) integrated dislodging and retrieval, and 4) field deployment demonstrating multiple-riser deployment, an integrated single-riser borehole-miner extendible-nozzle tank remediation should be conducted. The extendible nozzle has potential in this application in terms of simple deployment, ease of adjustment for multiple riser applications (the borehole-miner system deployed at ORNL was operated in four tanks over a period of 2½ weeks), and the capability to rapidly dislodge and retrieve waste. Additional demonstrations may be warranted to 1) show improved reliability, 2) improve the reliability of the visualization system, and 3) demonstrate use of the system at higher operating pressures and for dislodging of harder sludges.

3. Old Hydrofracture Facility Remediation System

The remediation system selected for OHF sludge mobilization and waste transfer is a sluicing and pumping system. Supernatant is pumped and sprayed through a high-pressure nozzle to mobilize and resuspend the sludge. The mixture is pumped out of the tank being sluiced into Tank T9, which is used to recycle or mix the slurry. From Tank T9 the mixture is pumped and sprayed back into the sluice tank and recirculated until the solids content is increased to a specified level, at which time it is pumped to the Melton Valley Storage Tanks (MVST). The tanks will be sluiced sequentially.

The remediation system consists of four main systems (CDM V1 1998):

- Sluicing system, borehole-miner extendible-nozzle sluicer supplied by PNNL
- Pumping system to remove tank contents, mix and transfer the material to MVST
- Ventilation system to provide negative pressure on the tanks to prevent the release of unfiltered air to the atmosphere
- Instrumentation and control system to provide monitoring and control of all primary and ancillary systems.

In addition, PNNL and Sandia National Laboratory supplied a visualization system that displayed the position of the extendible-nozzle arm in real time.

The OHF site plan, Figure 3.1, and the process flow diagram, Figure 3.2, show the location of the underground tanks, the equipment skids and process piping and valving. These drawings were developed by CDM Federal Programs Corporation and describe the system 100% configuration.[1]

3.1 Sluicing System

The sluicing system consists of the sluicer pump that provides high-pressure fluid, the borehole-miner extendible-nozzle high-pressure sluicing nozzle, and associated valving, monitoring and control systems. This system was funded by EM-50 and provided by staff at PNNL. Equipment documentation and test reports were supplied to ORNL to support system installation and operation.[2]

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[1] CDM Federal Programs Corporation. 1997. *Oak Ridge National Laboratory Old Hydrofracture Facility Tanks Contests Removal Project 100% Configuration, Volume 1.* Document Control No. 5151-011-DS-BBLS, CDM Federal Programs Corporation, Oak Ridge, Tennessee

[2] J.A. Bamberger. 1998. *Borehole Miner Extendible-Nozzle System Equipment Documentation and Test Reports*, Pacific Northwest National Laboratory, Richland, Washington.

3.1.1 Borehole-Miner Extendible-Nozzle Sluicer

The borehole-miner extendible-nozzle sluicer design was developed by PNNL and Waterjet Technology, Inc. to meet ORNL specifications for remediation of the OHF tanks. [1] The sluicer specifications are listed in Table 3.1.

Table 3.1 Extendible-nozzle specifications

Description	Specification
Maximum slurry line working pressure	3000 psi (20.6 MPa)
Design flow rate	150 gpm (0.0095 m^3/s)
Maximum arm extension	10 ft (3 m) from mast centerline
Arm range of motion Rotation Azimuthal	 ± 180 degree 90 degree (horizontal to vertically downward)
Platform vertical range	30 in. (76 cm)
Weight	6250 lbm (2835 kg)
Maximum arm extension rate	10 in./s (25.4 cm/s)
Minimum launch angle rate	9 degree/s
Mast rotation speed	0.012 to 1.2 rpm
Maximum arm rinse working pressure	150 psi (1.0 MPa)
Maximum spray ring working pressure	250 psi (1.7 MPa)
Exposed materials. Materials exposed to waste are stainless steel (300 series, 15 to 5 pH), hard chromium plate, nickel plate, polyurethane enamel-coated carbon steel, polyurethane, neoprene, polyethylene, nylon.	

The extendible-nozzle components are shown in Figure 3.3. The nozzle assembly consists of a support platform (2) and mast (1 and 3) that extends below grade into the tank. Inside the mast is a segmented, flexible arm through which the high-pressure hose passes. The exit nozzle is located on the distal end of the arm (4). The arm is made rigid by four tensioned steel cables passing through the segments. While tensioned, the arm can be deployed radially to a distance of 10 ft (3 m) from the mast centerline, and also from a horizontal position to vertically downward. In addition, the mast and nozzle assembly can be rotated ±180 degree to give complete coverage of the tank. Movement and tensioning of the arm are accomplished hydraulically, and the arm's position and extension are measured by potentiometer-type encoders.

[1] Waterjet Technology, Inc. 1997. *Extendible Nozzle and Hydraulic Power Unit Operation and Maintenance Manual,* WTI Technical Communication No. 499, Waterjet Technology, Inc., Kent, Washington.

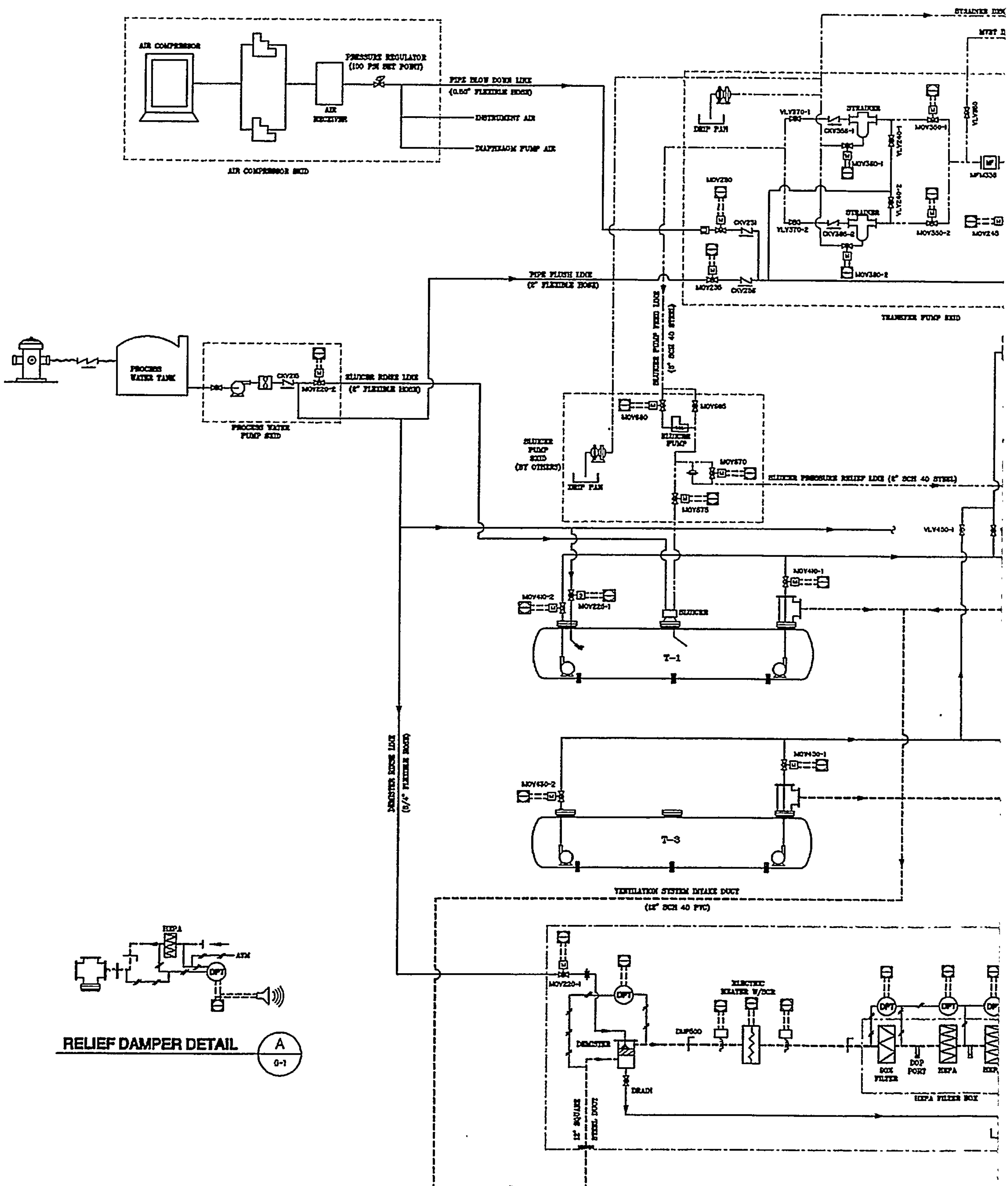
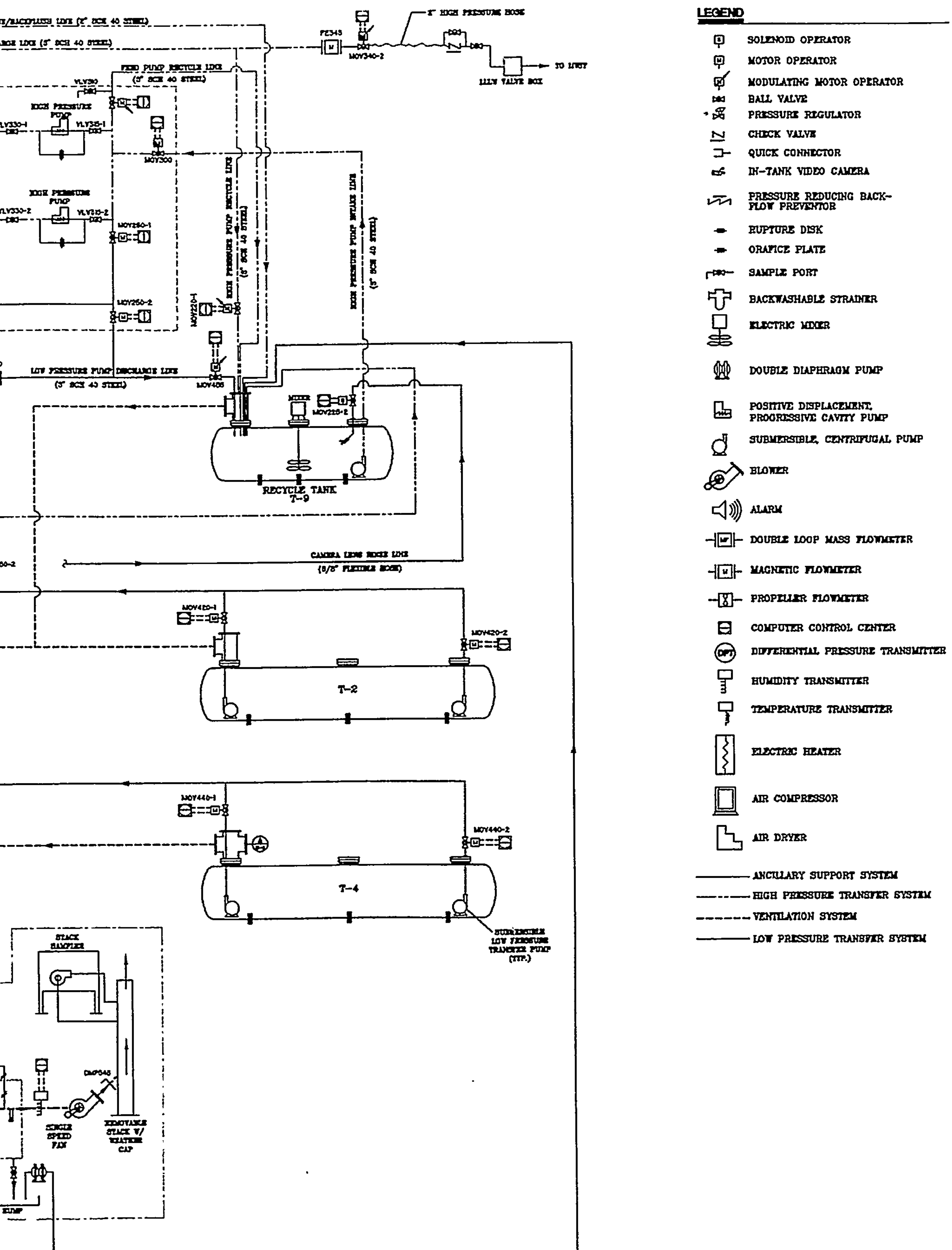


Figure 3.1 Old hydrofracture tank conte



ts removal project pipe and duct plan

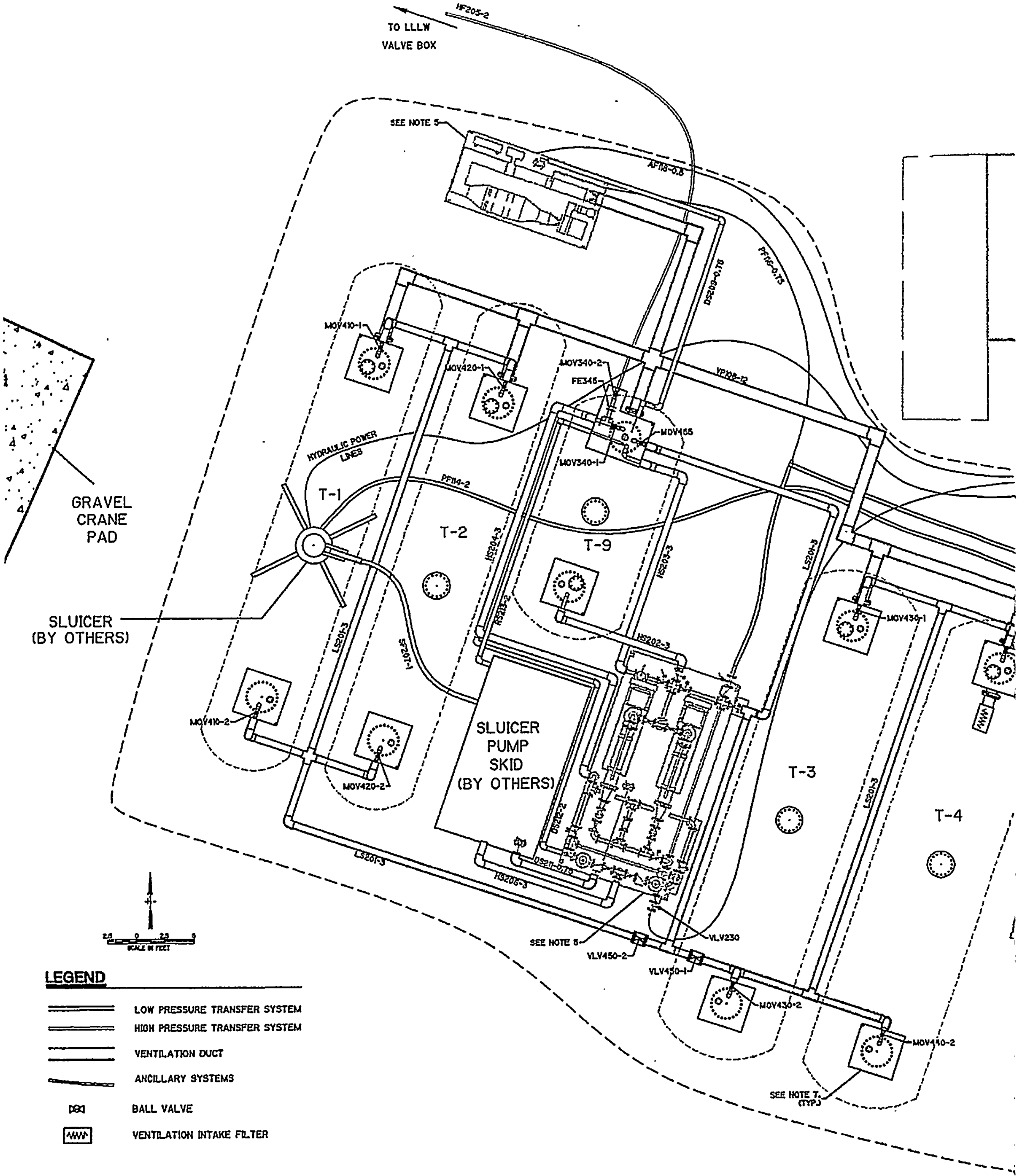
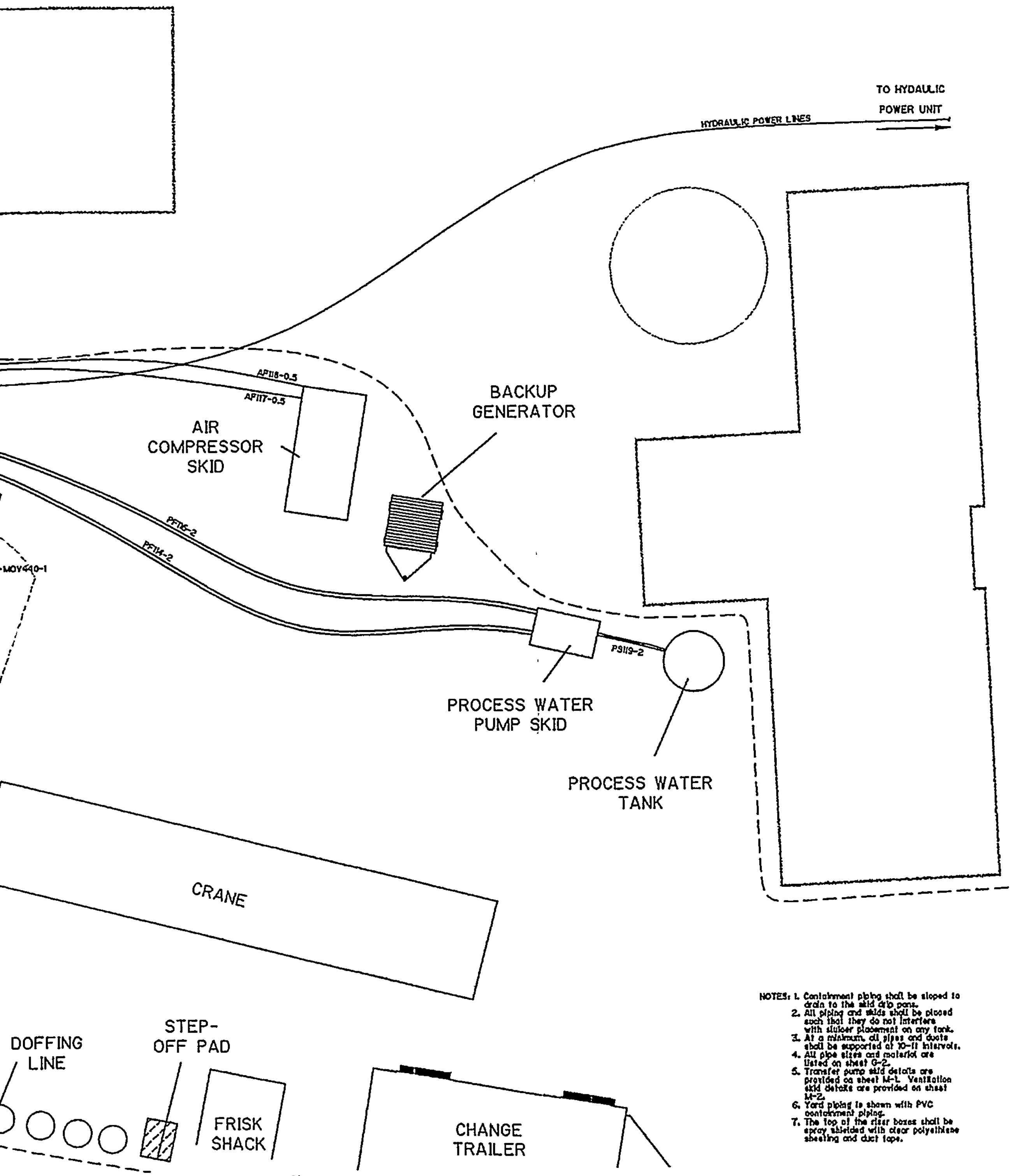


Figure 3.2 Old hydrofracture tank conte



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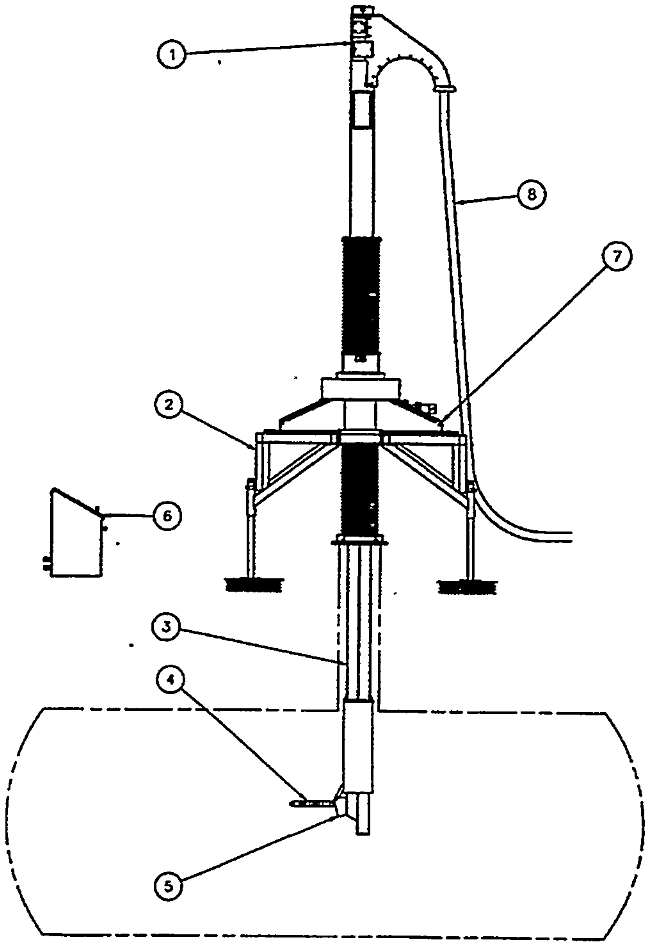

Figure 3.3 Extendible nozzle components

Legend: 1) top mast assembly, 2) platform assembly, 3) lower mast assembly, 4) arm assembly, 5) launch assembly, 6) control console, 7) bridge mount, and 8) containment hose assembly

3.1.1.1 Arm

The arm, shown in Figure 3.4, consists of small metallic links that are held together with tensioning cables. The arm links mesh together by cylindrically shaped bearings and bearing sockets (pivot points). The 3000 psi (20.6 MPa) water hose runs through the center of the arm links. The arm is anchored to the tensioning assembly, which incorporates a linear actuator that puts a tensile load on the arm cables, thus drawing the arm links together and providing a controlled arm stiffness. The arm is extended and retracted into the mast by a hydraulic motor-driven chain and tie rod system. This chain moves the tie rod and arm tensioning assembly up and down within the mast tube. The arm, anchored to the tensioning assembly, goes up and down. The arm launch mechanism controls the arm angle by means of linear hydraulic actuators. The arm has an azimuthal range of motion from vertically downward to horizontal. The arm is kept from kinking at the elbow by a series of roller and chain guide surfaces within the launch mechanism.

3.1.1.2 Mast

The mast is approximately 29 ft in length and is made up of two sections by a bolted flange joint. The top and bottom mast sections are constructed with 5-in. x 10-in. rectangular tubing and are each 14.5-ft long. The bottom mast section contains the arm, arm tensioning assembly, and launch mechanism. Hydraulic hoses are used as conduits between the top and bottom section of the mast. This eliminates the need for hydraulic joints inside the tank, with the exception of the hose termination points at the actuators and waterjet nozzle. The top mast section is designed to prevent rain water from entering the mast shell. A lifting shackle to carry the weight of the mast and mast mount assemblies is located at the top end of the mast. A fulcrum is located as the bottom of the mast so that the mast can be pinned to a support structure and put in a lay down position. A safety stop is welded to the mast to eliminate the possibility of the mast contacting internal tank components in the event that the mast is dropped during installation or slips at the bridge mount clamp.

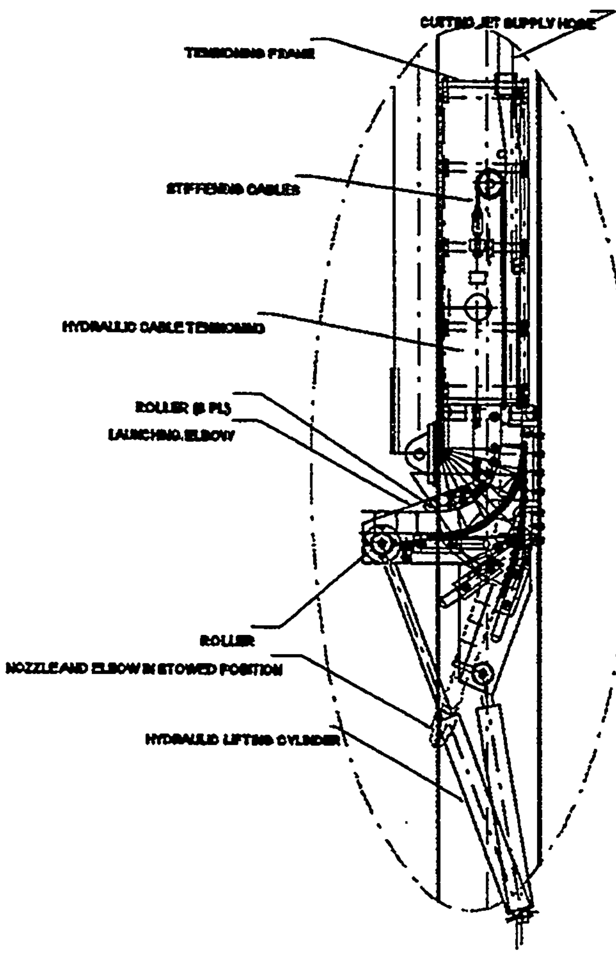

Figure 3.4 Details of the arm and launch assembly

The arm and tensioning mechanism are moved up and down in the bottom mast section by a length of rigid pipe. The hydraulic oil and high-pressure water hoses required to move with the arm tensioning assembly (as the arm is drawn in and out of the mast) run from the bottom mast section to the top mast section within this pipe. This pipe extends from the arm tensioner, through the mast, to the extension actuator, which is located inside the top mast section above the bridge. The arm extension actuator is a hydraulic motor.

3.1.1.3 Mast Mount

The mast support mount consists of a bridge mount assembly that is bolted to a portable platform over the tank riser and supports the mast assembly at the desired elevation over the tank floor. The OHF tanks are different diameters and their depths below grade differ. The extendible nozzle is designed to be launched along the center line of the tank; however, the platform legs can be adjusted to position the extendible nozzle either above or below the tank centerline. The bridge mount provides a rotary motion to the mast about its axis, providing the required 360 degree (±180 degree) sweeping motion to the nozzle. The rotary motion is created by a hydraulic motor powering a turntable. There are provisions for electronic position monitoring of the mast clocking angle. The vertical elevation of the mast relative to the tank and ground level is set manually with the adjustable platform legs. The adjustment is made by changing the extension of Acme screw leg sections, visible in Figure 3.5.

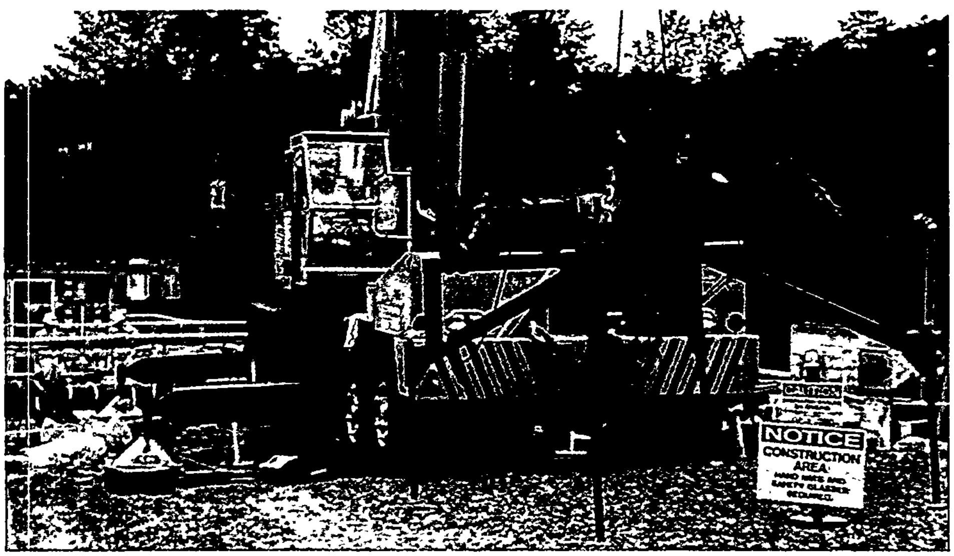

Figure 3.5 Mast mount assembly showing adjustable legs.

3.1.1.4 Bellows Containment

To ensure that no radioactivity will escape through the mast, the mast mount assembly includes a bellows-type expanding containment cover, shown in Figure 3.6, which encloses the portion of the mast that will be exposed to tank waste. A breather tube is vented into the riser to allow air flow in and out of the cover as it is extended and retracted. The cover is made of polyurethane and nylon. A clamp-on cover plate is used to close the end of the containment cover during storage. A second bellows cover is located between the bridge mount and riser flange. An interface flange is located at the bottom of the cover to attach to the riser. This interface has an internal 150-psi (1.0-MPa) spray ring to rinse the mast as it is removed from the tank. During transfers from tank-to-tank, the bottom of the second bellows is sealed to enclose the extendible-nozzle components.

3.1.1.5 Extendible Nozzle Weight

The bridge mount and stand are estimated to weigh 3600 lbm (1361 kg). The combined weight of the mast and bridge mount is estimated to be ~6350 lbm (2880 kg), distributed over an area 8 ft x 8 ft (2.4 m x 2.4 m) on the surface. The maximum force load that is transferred to the supporting surface (ground) as a result of the jet thrust moment is ~1060 lbm (481 kg) (at maximum jet thrust with the moment load taken on one leg of the stand). The mast weight is estimated to be ~2750 lbm (1247 kg). Lifting shackles to carry the weight of the bridge mount during installation and removal are incorporated in the bridge mount structure.

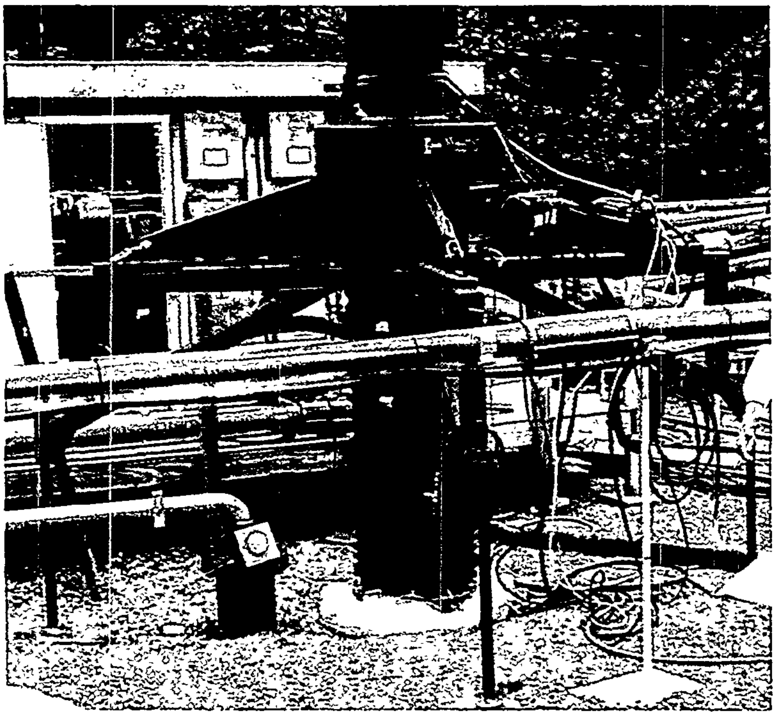

Figure 3.6 Bellows containment

3.1.1.6 Containment Hose

A double-conduit coaxial hose is used to feed the high-pressure water to the inside of the upper mast. The outer shell is a 900-psi working pressure, 3600-psi burst pressure hose. In the event of a hose burst, the maximum pressure in the shell is estimated to be less than 100 psi.

3.1.1.7 Controls

The control system for the extendible arm consists of a hydraulic power unit (HPU), a control console, and a network of hydraulic and electrical circuits.

3.1.1.7.1 Hydraulic Power System (HPU)

The hydraulic power unit [1]consists of a positive displacement, pressure-compensated pump, driven by a 20-hp electric motor. The motor control box is contained on the skid with the HPU. The three phase, 330 Vac power to drive the motor and the 110 Vac to drive the control relays contained within the motor control box are supplied through cords extending from the motor control box. An E-Stop (emergency stop) exists on the motor control box.

3.1.1.7.2 Control Console

The control console performs the following functions:

- performs hydraulic distribution between the HPU and the extendible-arm mast
- provides four independent stations for controlling and monitoring the four independent motions permitted by the extendible-arm assembly
- provides user-defined automatic shut off points for mast rotation control
- provides a circuit that allows the user to disable all motions at the mast while maintaining pressure in the arm stiffening circuit
- provides isolated outputs for external monitoring of mast rotation, arm angle, and arm extension length
- provides transducer output for external monitoring of system input hydraulic pressure
- provides a pressure switch connected to the tension pressure port of the tensioning cylinder.

The extendible-arm assembly has four mechanical motions: arm tensioning, angle positioning, arm extension, and mast rotation. Each of these four motions is accomplished with a single independent hydraulic manifold. Each manifold is supplied with a joystick-operated, manual, flow control valve. The four joysticks are the interface between the operator and the motion. During sluicing, the position of the extendible nozzle was controlled manually using the control console shown in Figure 3.7. The system hydraulic, fluid, and electrical connections are shown in Figure 3.8.

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[1] S.A.S. Fluid Power, Inc., Renton, Washington.

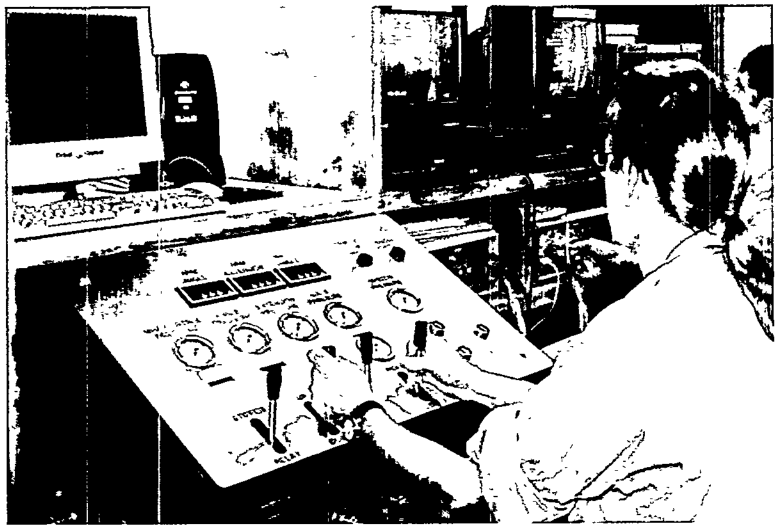

Figure 3.7 Extendible-nozzle control console

3.1.1.8 Visualization System

The extendible-nozzle visualization system is an operator aid for the extendible-nozzle system. During in-tank operation, the mist from the extendible nozzle may make it difficult to see the position and orientation of the nozzle using remote video cameras. The extendible-nozzle visualization system provides a computer-generated image of the tank with the extendible nozzle to give the operator a view of in-tank operations.

The extendible-nozzle visualization system consists of a Silicon Graphics O2 low-end work station, and I/O (input/output) module that connects to the extendible-nozzle control console and software (called Squirt). The system provides a three-dimensional animated model of the extendible nozzle and the tank in which it is working. Position and orientation information from the extendible nozzle is fed to Squirt via the I/O module so that the three-dimensional model accurately shows where the extendible nozzle and its spray stream are in relation to the tank. In addition, Squirt can warn of any impending collisions between the nozzle and the tank infrastructure or any modeled items in it. A schematic of the visualization system is shown in Figure 3.9.

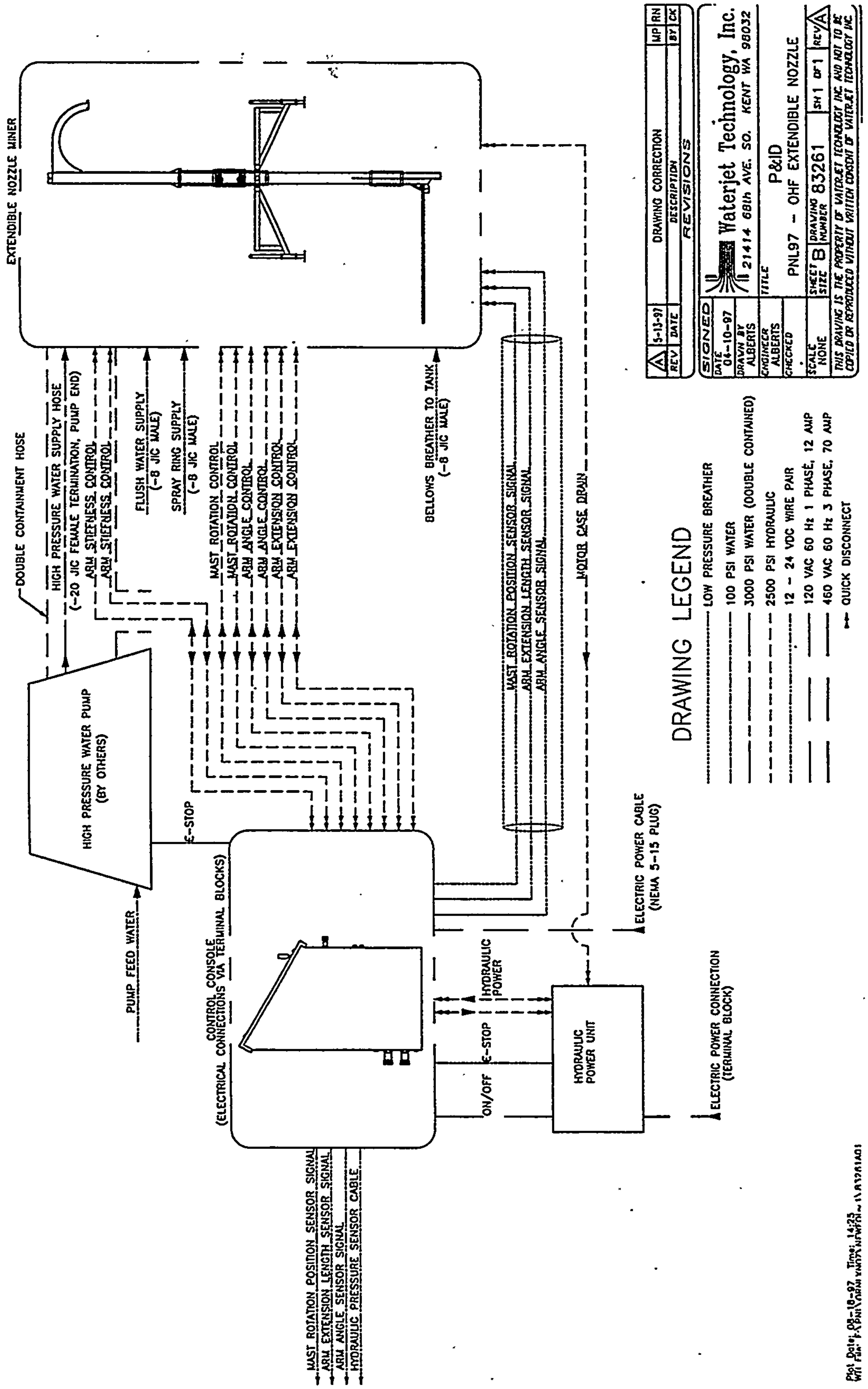

Figure 3.8 Extendible-nozzle fluid, hydraulic, and electrical connections

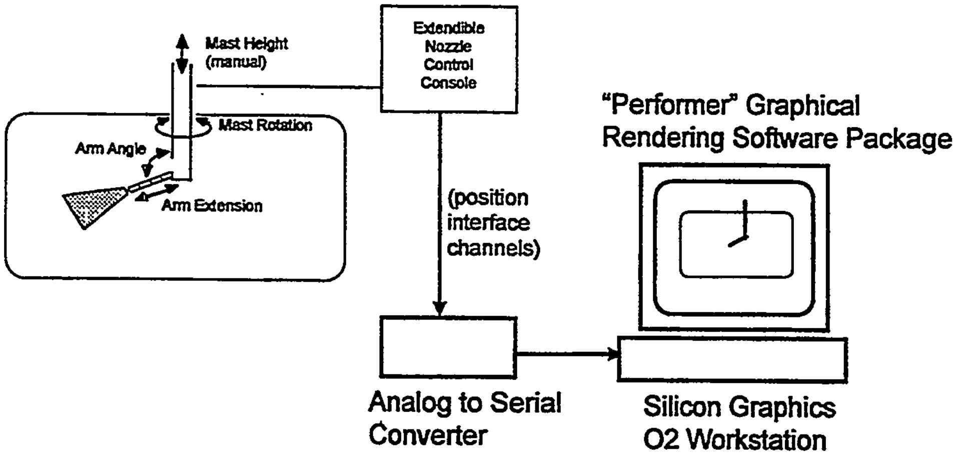

Figure 3.9 Visualization system.

3.1.2 Sluicer Pump Skid

The sluicer pump skid includes the high-pressure pump, variable-speed drive, valves, and instrumentation to remotely control and monitor the pump pressure. The high-pressure pump skid layout is shown in Figure 3.10.

The pump, a National-Oilwell[1] horizontal, triplex plunger pump, type JWS-340, provides up to 1500 psi maximum operating pressure. The pump is a well-servicing piston pump applicable for slurry transport. The pump was powered by a 200-hp Reliance Electric[2] motor with a variable-frequency drive. Two pulsation dampeners on the suction (Hydril Model IP-2.5-3600) and discharge (Hydril Model IP-2.5-1400) were used to limit pressure fluctuations in the system. The high-pressure pump skid is shown in Figure 3.11.

1 Job No. 7567-664315, New Iberia, Louisiana.

2 Cleveland, Ohio.

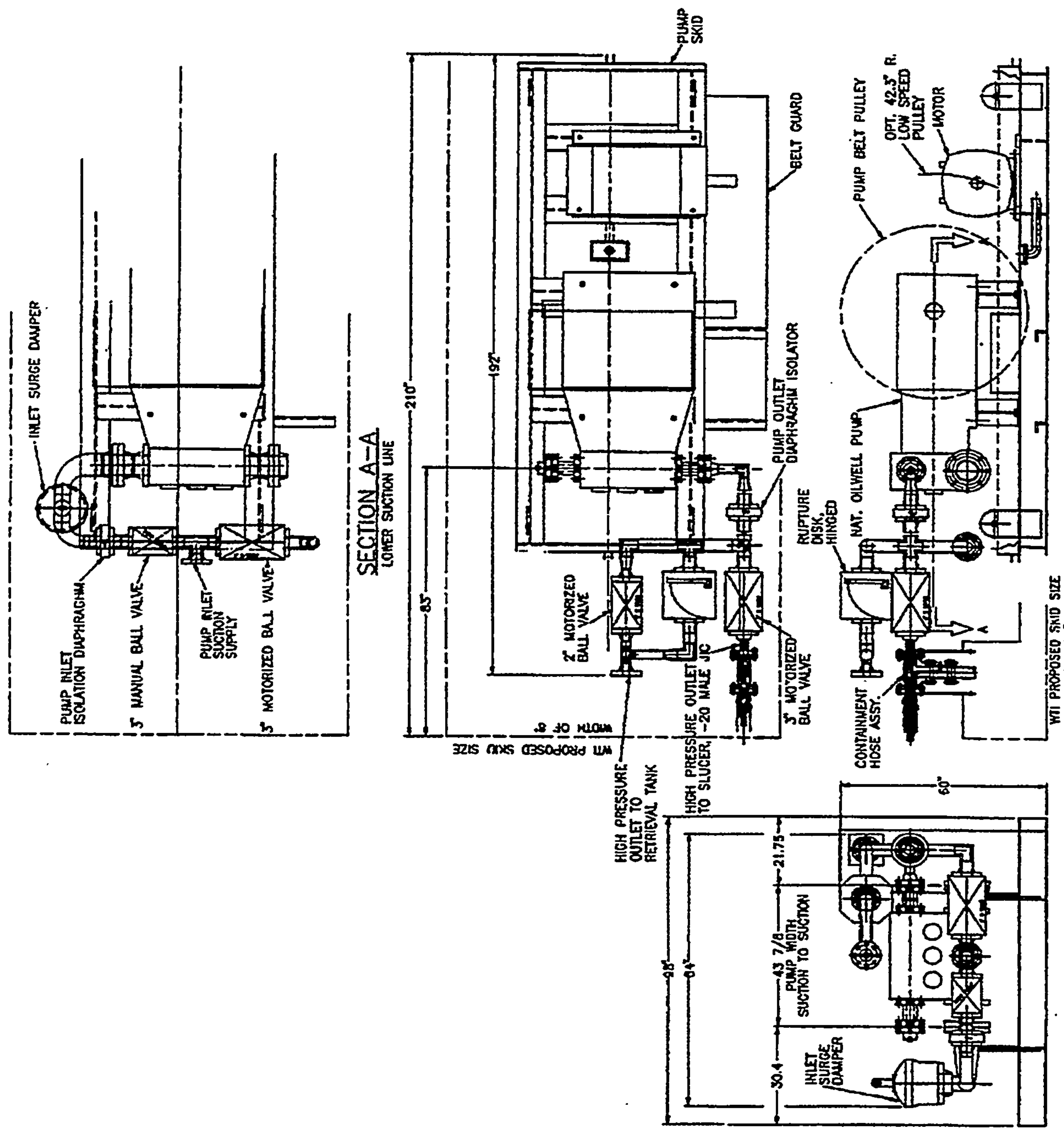

Figure 3.10 High-pressure pump skid

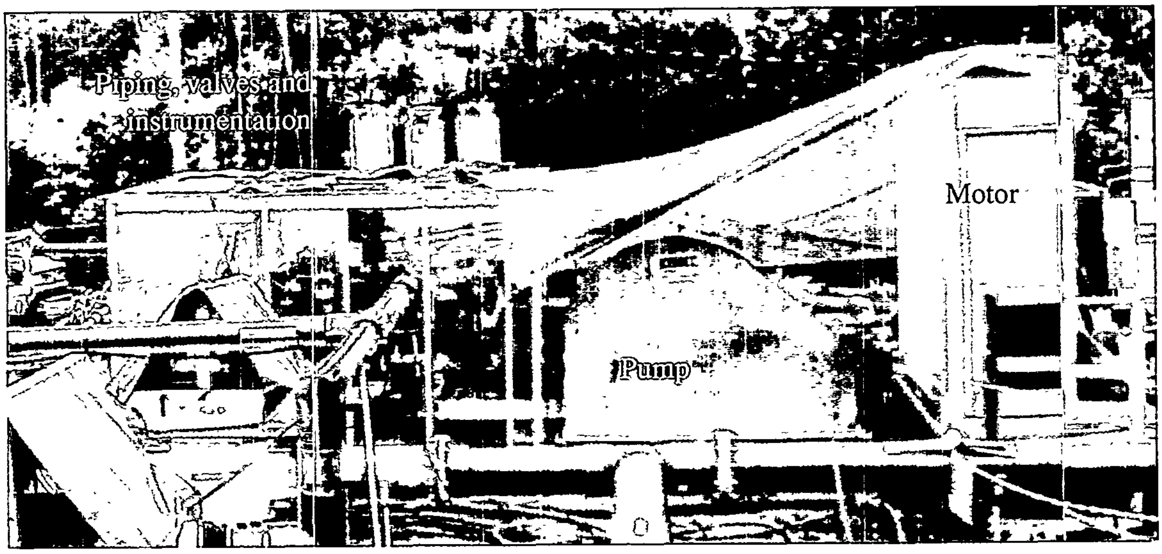

Figure 3.11 High-pressure pump skid

The skid included four plug valves[1] (one 3-in. ANSI 600 lb, one 2-in. ANSI 1500 lb, and two 3-in. ANSI 1500 lb) with electric actuators. The valve operating conditions are listed in Table 3.2.

Table 3.2 Valve operating conditions

Valve Number	Description	Valve Type	Nominal Size , in.	Actuator	Maximum operating pressure, psi	Test pressure. psi
MOV660	sluicer pump intake valve	plug	3	motor	250	375
VLV665	sluicer pump bypass valve	plug	3	motor	1500	2250
MOV670	sluicer pressure release valve	plug	2	motor	1500	2250
MOV675	sluicer pump discharge valve	plug	3	motor	1500	2250

Instrumentation provided included a rupture disk,[2] a manual reset relief valve (750 to 2500 psi),[3] and two pressure transmitter, switch and chemical seal combinations.[4]

1 Serck Audco Valves, Houston, Texas.

2 RLS Reverse Buckling Disk, BS&B Safety Systems, Tulsa, Oklahoma.

3 Oteco, Inc. Houston, Texas.

4 Eads Company, Garland, Texas. Low-pressure combination: Wilka chemical seal, 30 psi pressure switch and 0 to 200 psi pressure transmitter. High-pressure combination: Wilka chemical seal, 1600+ psi pressure switch and 2000 psi pressure transmitter.

3.1.3 System Procurement and On-Site Assistance

PNNL worked with the ORNL team to ensure that the EM-50 Tanks Focus Area (TFA) provided equipment met the OHF remediation needs. The equipment was provided to meet the OHF schedule and in specific instances, PNNL provided on-site assistance to ensure that the equipment integrated with the balance-of-plant. A summary of the unburdened cost of the equipment and services provided is summarized in Table 3.3.

Table 3.3 Equipment and services

Equipment	Vendor	Cost, $	
Extendible nozzle	Waterjet Technology, Inc.		$116,000
High-pressure mud pump system	National Oilwell		$78,500
Pump		$71,500	
Suction stabilizer		$ 3,500	
Discharge dampener		$ 3,500	
Variable-frequency drive	National Oilwell		$22,500
Starter panel		$18,600	
Remote control		$ 3,200	
Motor		$ 700	
Valves	Bill Poole Products		$36,000
Plug valves		$ 5,500	
Actuators		$15,500	
Battery backup system and installation	Piping Resources	$15,000	
Piping manifold design and fabrication	Waterjet Technology, Inc.		$30,000
Pump skid drip pan	XL Associates		$ 4,500
Instrumentation			$10,500
Relief valve	Oteco	$ 3,100	
Rupture disks	B&S Safety Systems	$ 2,000	
Pressure switches and transmitters		$ 5,400	
Equipment Total			**$298,000**
On-site Technical Assistance	**Vendor**	**Cost, $**	
Extendible nozzle	Waterjet Technology, Inc.	$ 6,500	
High-pressure pump	National Oilwell	$ 5,500	
Technical Assistance Total			**$12,000**

3.2 Pumping System

The primary components of the pumping system are:

- Low-pressure transfer pump to transfer contents from the sluicing tank to the mixing tank (Tank T9)
- Mixer in Tank T9 to maximize slurry mixing
- Low-pressure feed pump (200 psi progressive cavity Moyno pump) to lift contents from the mixing tank and feed to the high-pressure pump
- Strainer to remove larger particles from the feed to the nozzle
- Process water system used to flush the lines after transfer and provide other process water needs at the site
- Associated piping and valves including tank drop legs and riser modifications
- Containment piping, riser confinement boxes and confinement skid enclosures.

The transfer pump skid is shown in Figure 3.12.

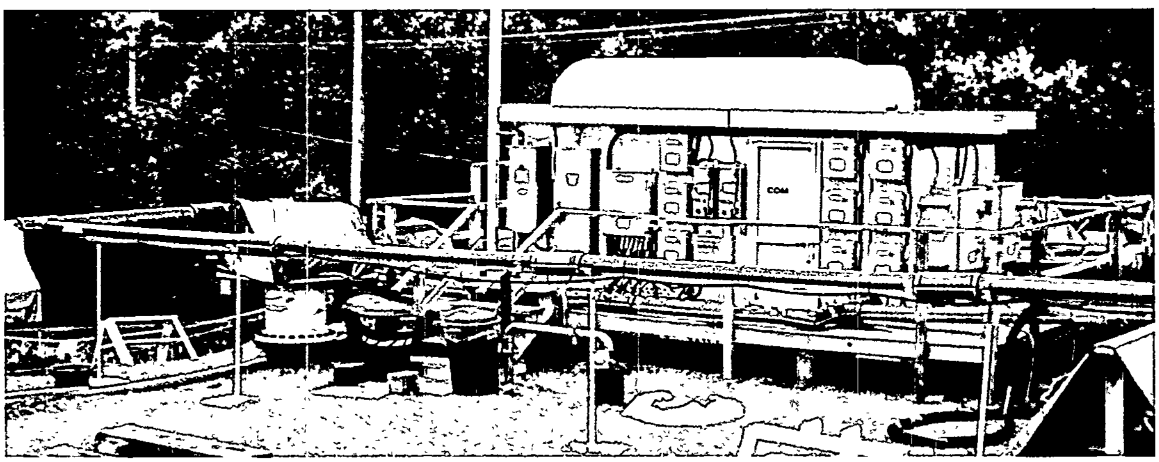

Figure 3.12 Transfer pump skid

3.3 Ventilation System

The primary components of the ventilation system are:

- High-efficiency particulate air (HEPA) filter system on the air intake to minimize treatment HEPA loading and minimize discharges to atmosphere in the event of a ventilation system shut down
- Demister to remove water vapor from the air stream
- Heater to reduce the relative humidity of the air stream
- Primary and secondary HEPA system to filter air discharged from the ventilation system
- Single-speed fan to drive the air flow, and
- Discharge stack and associated stack monitoring.

The ventilation skid is shown in Figure 3.13.

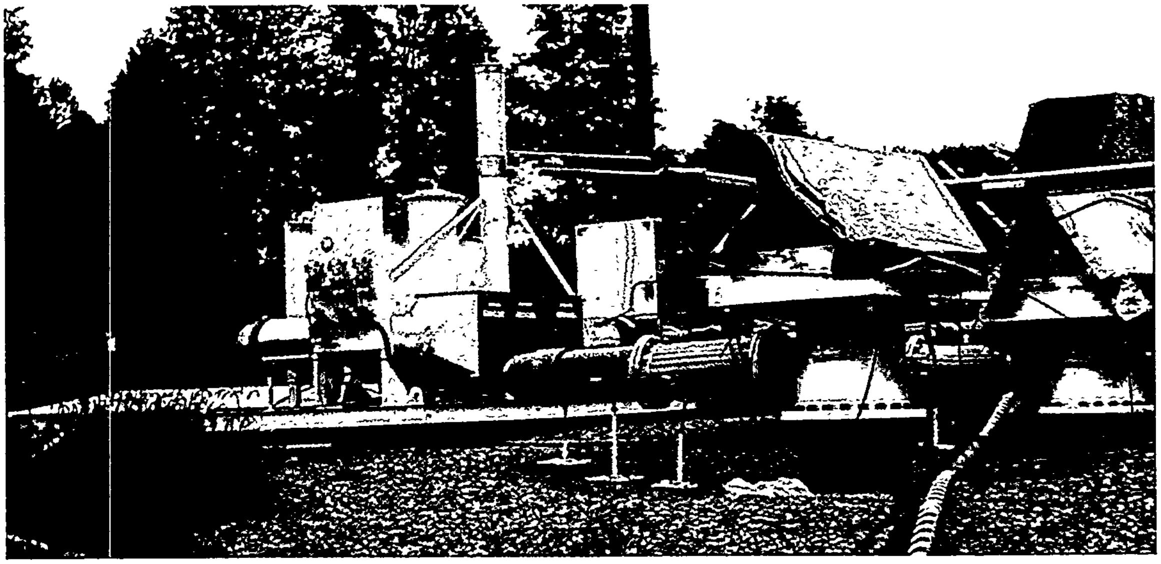

Figure 3.13 Ventilation skid.

3.4 Instrumentation and Controls

To minimize any leaks or line clogging from the radioactive waste, an extensive system of monitoring, instrumentation, and controls was implemented. The monitoring systems include pressure indicators and switches, flowmeters, tank liquid level indicators, video systems, and liquid sensors in skid drip pans. Information from each of these monitoring devices was connected to the control system for operational monitoring.

The control system includes a PC-based computer control panel with a programmable logic controller (PLC) that allowed remote control of all system components, including most of the valves. The PLC did not include the hydraulic controls for the sluicing nozzle.

3.5 Operational Strategy

CDM Federal Programs Corporation developed checklists and work instructions to ensure the successful remediation of the waste during sluicing operations. These plans are documented in Volume 2 of the *Old Hydrofracture Facility Tanks Contests Removal Action Operations Plan at the Oak Ridge National Laboratory, Oak Ridge, Tennessee* (CDM V2 1998). The checklists are summarized in Table 3.4. The pre- and post-operational plan steps are documented in the following sub-sections. Individual Work Instructions were developed for use during waste remediation. These topics are listed in Table 3.5.

Table 3.4 Operations plan checklists

Checklist	Title
4.1a	System leak test low-pressure transfer pipe test
4.1b	System leak test high-pressure pump intake line test
4.1c	System leak test high-pressure pump discharge line test
4.2.1	Instrumentation and controls test, field instrumentation and equipment tagging verification
4.2.2	Instrumentation and controls test, PLC, workstation and panel audit
4.2.3	Process I/O verification test
4.2.4	Instrumentation and controls test, PLC workstation and panel failure
4.2.5.1	Instrumentation and controls test, loop 205 process water pump and loop 210 process water flow test
4.2.5.2	Instrumentation and controls test, loop 220-2 sluicer rinse valve
4.2.5.3	Instrumentation and controls test, loop 225-1 recycle tank camera lens rinse valve
4.2.5.4	Instrumentation and controls test, loop 225-2 old hydrofracture tank camera lens rinse valve
4.2.5.5	Instrumentation and controls test, loop 230 pipe blow down valve
4.2.5.6	Instrumentation and controls test, loop 235 pipe flush valve
4.2.5.7	Instrumentation and controls test, loop 245 high-pressure pumps discharge header flush valve
4.2.5.8	Instrumentation and controls test, loop 250-1 high-pressure pumps suction header flush valve
4.2.5.9	Instrumentation and controls test, loop 250 low-pressure pumps discharge line flush valve
4.2.5.10	Instrumentation and controls test, loop 300 recycle tank discharge valve
4.2.5.11	Instrumentation and controls test, loop 305 high-pressure pumps intake line pressure and recycle valve
4.2.5.12	Instrumentation and controls test, loop 320-1 high-pressure transfer pump 1
4.2.5.13	Instrumentation and controls test, high-pressure transfer pump 2
4.2.5.14	Instrumentation and controls test, loop 330 high-pressure transfer line pressure
4.2.5.15	Instrumentation and controls test, loop 340-1 high-pressure recycle valve
4.2.5.16	Instrumentation and controls test, loop 340-2 MVST discharge valve
4.2.5.17	Instrumentation and controls test, loop 345 MVST discharge flow
4.2.5.18	Instrumentation and controls test, loop 350-2 strainer valve 1
4.2.5.19	Instrumentation and controls test, loop 350-2 strainer valve 2
4.2.5.20	Instrumentation and controls test, loop 360-1 strainer drain valve 1
4.2.5.21	Instrumentation and controls test, loop 360-2 strainer drain valve 2
4.2.5.22	Instrumentation and controls test, loop 421-1 old hydrofracture tank 1, pump 1
4.2.5.23	Instrumentation and controls test, loop 410-2 old hydrofracture tank 1, pump 2
4.2.5.24	Instrumentation and controls test, loop 410 tank 1 pump discharge valve 1
4.2.5.25	Instrumentation and controls test, loop 410-2 tank 1 pump discharge valve 2
4.2.5.26	Instrumentation and controls test, loop 420-1 old hydrofracture tank 2, pump 1
4.2.5.27	Instrumentation and controls test, loop 420-2 old hydrofracture tank 2, pump 2

Checklist	Title
4.2.5.28	Instrumentation and controls test, loop 420-1 tank 2 pump discharge valve 1
4.2.5.29	Instrumentation and controls test, loop 420-1 tank 2 pump discharge valve 2
4.2.5.30	Instrumentation and controls test, loop 430-1 old hydrofracture tank 3, pump 1
4.2.5.31	Instrumentation and controls test, loop 430-2 old hydrofracture tank 3, pump 2
4.2.5.32	Instrumentation and controls test, loop 430-1 tank 3 pump discharge valve 1
4.2.5.33	Instrumentation and controls test, loop 430-2 tank 3 pump discharge valve 2
4.2.5.34	Instrumentation and controls test, loop 440-1 old hydrofracture tank 4, pump
4.2.5.35	Instrumentation and controls test, loop 440-2 old hydrofracture tank 4, pump 2
4.2.5.36	Instrumentation and controls test, loop 440-1 tank 4 pump discharge valve 1
4.2.5.37	Instrumentation and controls test, loop 440-2 tank 4 pump discharge valve 2
4.2.5.38	Instrumentation and controls test, loop 445 bubbler system air pressure
4.2.5.39	Instrumentation and controls test, loop 445-1 recycle tank level (bubbler system)
4.2.5.40	Instrumentation and controls test, loop 445-2 old hydrofracture tank level (bubbler system)
4.2.5.41	Instrumentation and controls test, loop 445-3 old hydrofracture tank level (bubbler system)
4.2.5.42	Instrumentation and controls test, loop 450 low-pressure transfer flow
4.2.5.43	Instrumentation and controls test, loop 455 low-pressure transfer throttling valve
4.2.5.44	Instrumentation and controls test, loop 495 recycle tank pump
4.2.5.45	Instrumentation and controls test, loop 600 sluicer control console power
4.2.5.46	Instrumentation and controls test, loop 605 sluicer control console system on
4.2.5.47	Instrumentation and controls test, loop 610 sluicer control console emergency stop
4.2.5.48	Instrumentation and controls test, loop 615 sluicer system hydraulic power
4.2.5.49	Instrumentation and controls test, loop 625 sluicer system pressure
4.2.5.50	Instrumentation and controls test, loop 630 sluicer arm control pressure
4.2.5.51	Instrumentation and controls test, loop 635 sluicer extension pressure
4.2.5.52	Instrumentation and controls test, loop 640 sluicer mast pressure
4.2.5.53	Instrumentation and controls test, loop 645 sluicer arm range
4.2.5.54	Instrumentation and controls test, loop 650 sluicer arm extension
4.2.5.55	Instrumentation and controls test, loop 655 sluicer mast angle
4.2.5.56	Instrumentation and controls test, loop 660 sluicer pump intake valve
4.2.5.57	Instrumentation and controls test, loop 663 sluicer pump intake pressure
4.2.5.58	Instrumentation and controls test, loop 665 sluicer pump
4.2.5.59	Instrumentation and controls test, loop 665a sluicer pump bypass valve
4.2.5.60	Instrumentation and controls test, loop 668 sluicer pump discharge Pressure and loop 670 sluicer pressure release valve
4.2.5.61	Instrumentation and controls test, loop 675 sluicer pump discharge valve
4.2.5.62	Instrumentation and controls test, loop 700 radiation monitor – recycle tank
4.2.5.63	Instrumentation and controls test, loop 705 radiation monitor – hydrofracture tank
4.2.5.64	Instrumentation and controls test, loop 710 radiation monitor – pumping skid
4.3.1	Support system test, compressed air system inspection
4.3.2	Support system test, process water test

Table 3.5 OHF work instruction list

Work Instruction	Title
1	Sluicing system setup and configuration
2	Sluicing system startup and operation
3	Transfer of slurry to MVST
4	Normal system shut down
5	Line flushing sequence
6	Emergency system shut down
7	Line leak response
8	On-line strainer flushing
9	Process water strainer back flushing
10	On-line strainer switching
11	Strainer basked changeout
12	Sluicer mast placement
13	Installing and moving in-tank camera
14	OHF riser spool and submersible pump installation
15	Switching high-pressure pumps
16	Rupture disk replacement
17	Ventilation system filter changeout
18	Ventilation system mist eliminator wire mesh pad replacement
19	Installing the in-tank mixer
20	Manual sluicing and transfer without using Tank T9

3.5.1 OHF Daily Pre-Operational Checklist

The OHF daily pre-operational checklist includes the following items:

Main Distribution Panel

- Place all breakers (except spares) in the ON position.

Air Compressor Skid

- Place main power switch to the ON position.
- Check e-stop button to make sure it is pulled out.
- Place hand switch to the LOCAL position.
- Check sight glass on both air dryers. If pink, the desiccant is spent and must be replaced.
- Record tank gauge pressure, ___ psi. Pressure should be between 100 and 175 psi. Report problems as necessary.
- Record discharge regulator, ___ psi. Pressure should read 100 psi. Report problems as necessary.

Transfer Pump Skid

- Check radiation alarm on for transfer pump skid radiation levels. Ensure no alarms are present. Report problems, if any.

- Motor starters
    - Submersible pumps
        - Place main power switch to the ON position.
        - Place hand switch to the REMOTE position.
        - Pull e-stop buttons out.
        - Make sure submersible pump power cables are connected securely to the appropriate motor starters.
    - Mixer
        - Place main power switch to the ON position.
        - Place hand switch to the REMOTE position.
        - Pull e-stop buttons out.
    - Recycle pump
        - Place main power switch to the ON position.
        - Place hand switch to the REMOTE position.
        - Pull e-stop buttons out.
- Check connection to and from bubbler cabinet. Report problems as necessary.
- Place all fail safe (MOV) hand switches on the skid to the REMOTE position.
- Place main power switch on both variable frequency drive (VFD) starters to the ON position. Place hand switches to the REMOTE position. Check and report any panel alarms. Press RESET button as necessary.
- Check oiler on air supply line to diaphragm pumps for proper oil level and operation.
- Check skid secondary containment for leaks and spills. Report problems as necessary.
- Check the skid for equipment problems (such as loose electrical connections, improper pipe and pump alignment, and deviations from nominal operating conditions). Report problems as necessary.

Sluicer Pump Skid

- Place sluicer pump VFD to ON position.
- Place all MOV hand switches to the REMOTE position.
- Place sluicer pump SLCP665 hand switches to the REMOTE position.
- Check skid secondary containment for leaks and spills. Report problems as necessary.
- Check the skid for equipment problems (such as loose electrical connections, improper pipe and pump alignment, and deviations from nominal operating conditions). Report problems as necessary.
- Lubricate the grease fittings on the Teel[tm] rotary gear pumps.
- Check oil level at the power end of the plunger pump and adjust if necessary.
- Check plunger packing for excess leakage.
- Check stuffing box, adjusting nut for tightness.
- Check for leakage between the fluid cylinder and frame.

Borehole Miner

- Inspect system for hydraulic and water leaks.
- Inspect electrical and hydraulic connections.

- Inspect bellows for tears or unusual wear.

System Risers

- Check system piping leading to and from risers for leaks and alignment. Report problems as necessary.
- Check riser for collected water. Report problems as necessary.
- Check riser MOV actuators, flowmeters, and rinse connections. Report problems as necessary.

Potable Water Pump Skid

- Place main power switch to the ON position.
- Place motor starter hand switch to the REMOTE position.
- Check e-stop button to make sure they are pulled out.
- Place all hand switches on the skid to the REMOTE position.
- Place VLV 200 and VLV 201 to the open position.
- Check skid for leaks or mechanical problems. Report problems as necessary.
- Record number of gallons in potable water tank, ___ gal.

HPU Unit

- Check oil level and adjust as necessary.
- Walk down hydraulic lines and check for leaks. Report problems as necessary.
- Oil pressure indicator on top of unit should read OK. Report problems as necessary.
- Check e-stop button to make sure it is pulled out.

Ventilation Skid

- Verify ventilation system is operating.

Generator

- The generator fuel level was checked daily. Note: during operations no power outages occurred; therefore, the generator was never started during hot operations.

Control Room

- Place two 10-amp circuit breakers in the PLC to the ON position.
- Turn on power to both in-tank cameras.
- Turn on site camera.
- Turn on OMI computer and printer.
- From the OMI, press the FLOW TOTALS button and record the total flow readings for:
  - MVST flow, ___ gal
  - Low-pressure transfer flow, ___ gal.
  - Process water flow, ___ gal.
  - Ventilation line flow, ___ cu. ft.
- Plug in sluicer control unit
- Turn on sluicer visualization computer and log on to main screen.
- Energize sluicer control unit. Manipulate sluicer functions while monitoring the sluicer in-tank camera. Verify that changes in sluicer arm angle, arm extension, and mast rotation register

correctly on the sluicer control unit light emitting diodes (LEDs), OMI readouts and visualization system.

Signatures

- Operator
- Field Operations Superintendent.

3.5.2 OHF Daily Post-Operational Checklist

The OHF daily post-operational checklist includes the following items:

Transfer Pump Skid

- Check radiation alarm on OMI for transfer pump skid radiation levels. Ensure no alarms are present. Report problems, if any.
- Place main power switch on both VFD starters to the OFF position.
- Check skid secondary containment for leaks and spills. Report problems as necessary.
- Check the skid for equipment problems (such as loose electrical connections, improper pipe and pump alignment, and deviations from nominal operating conditions). Report problems as necessary.
- Check connection to and from bubbler cabinet. Report problems as necessary.

Sluicer Pump Skid

- Place sluicer pump VFD to the OFF position.
- Check skid secondary containment for leaks and spills. Report problems as necessary.
- Check the skid for equipment problems (such as loose electrical connections, improper pipe and pump alignment, and deviations from nominal operating conditions). Report problems as necessary.

Borehole Miner

- Inspect system for hydraulic and water leaks.
- Inspect electrical and hydraulic connections.
- Inspect bellows for tears or unusual wear.

System Risers

- Check system piping leading to and from risers for leaks. Report problems as necessary.
- Check riser for collected water. Report problems as necessary.
- Check riser MOV actuators, flowmeters, and rinse connections. Report problems as necessary.

Potable Water Pump Skid

- Place main power switch to the OFF position.
- Place the process water holding tank valve to the CLOSED position.
- Check skid for leaks or mechanical problems. Report problems as necessary.
- Record number of gallons in potable water tank, ___ gal.

HPU Unit

- Walk down hydraulic lines and check for leaks. Report problems as necessary.

Ventilation Skid

- Verify that the ventilation system is operating.

Generator

- To be determined.

Control Room

- Turn off power to both in-tank cameras.
- Turn off site camera.
- From the OMI, press the FLOW TOTALS button and record the total flow readings for:
    - MVST flow, ___ gal.
    - Low-pressure transfer flow, ___ gal.
    - Process water flow, ___ gal.
    - Ventilation line flow, ___ cu. Ft.
- Unplug sluicer control unit.

Signatures

- Operator
- Field Operations Superintendent.

3.5.3 Work Instructions

All operations were conducted based on the work instructions listed in Table 3.5.

4. Borehole-Miner Extendible-Nozzle Operations at the Cold Test Facility

The purpose of the cold tests was to demonstrate performance of the pumping and sluicing system, fine-tune operating instructions, and train personnel to perform the work associated with system installation and operation.

4.1 Equipment Installation

The borehole-miner extendible-nozzle sluicer was delivered to ORNL in August 1997, and the sluicer pump skid was delivered in December 1997. Logbook entries documenting equipment installation and operations at the cold test facility were initiated in November 1997.

4.1.1 Installation

A detailed list of PNNL activities associated with design, construction, delivery and installation of the sluicing system is provided in Appendix A. Several difficulties were identified during system installation that may have impacted the system operation. These items and their resolution are listed in Table 4.1.

The arm retraction problem described above, that was identified January 29, 1998, was later identified as a hose management problem. The hose was wrapped tightly around the mast and legs and could not move sufficiently to allow retraction. This is visible in the photograph taken 4/9/98, shown in Figure 4.1. Later when the mast cover plate was removed, the distortion to the containment hose was observed, as shown in Figure 4.2.

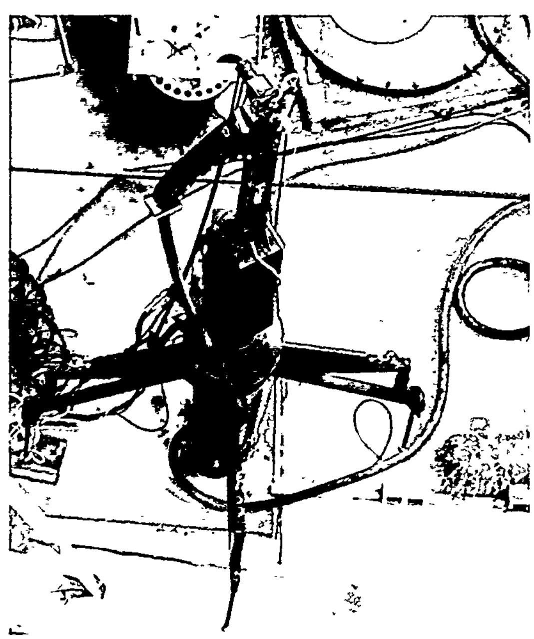

Figure 4.1 View of extendible-nozzle double-containment hose showing pinch points

Table 4.1 System installation problems and solutions.

Date	Item	Resolution	Date Completed
1/2/98	The extendible nozzle top bellows can diametral clearance is not adequate	Waterjet Technology, Inc. (WTI) provided an enlarged bellows adapter flange.	3/13/98
1/8/98	Mast does not rotate	Solenoid is acting as if it is in an alarm mode. It was reset.	1/15/98
1/28/98	ORNL requested a backup power supply for valve actuators	1/29 provided specifications for the fail safe actuator system. System was procured and installed.	2/23-25/98
1/29/98	Extendible nozzle won't retract past 96 in. of arm extension.	WTI went to ORNL to debug the mast extension and retraction problem.	2/22/98
1/30/98	Mast does not rotate	ORNL had not connected the wires to the position sensors. When they made these connections the mast rotated.	1/30/98
2/9/98	Sluicer pump suction gasket leak	2/10-19/98 National Oilwell staff on site at ORNL to fix pump suction leak.	2/19/98
2/13/98	The actuators that control the angle of the extendible nozzle are no longer connected to the arm	2/23/98 Provided replacement rod ends. Installed with and adhesive (loctite) applied on the threads.	2/27/98
3/2/98	Adapter flange and the valve flange grooves did not align, so the last gasket could not be installed	Remachined the groove.	3/11/98
3/30/98	The pressure relief valve was allowing flow through it	ORNL checked with the valve vendor and Waterjet to investigate how to correct the valve setting. Note: It was later determined during hot operations that the pressure relief valve was not correctly reset. This problem caused ORNL staff to limit the sluicer pump operating pressure.	3/31/98
3/30/98	The extendible arm could be extended but not retracted	Waterjet provided info regarding how to check if this is a hydraulic problem or a mechanical problem. The hose retraction was solved by increasing the hydraulic pressure in the controls. Note: This problem was eventually fixed by changing hose management practices to ensure that enough slack was provided in the hose to ensure it could move within the mast.	4/1/98

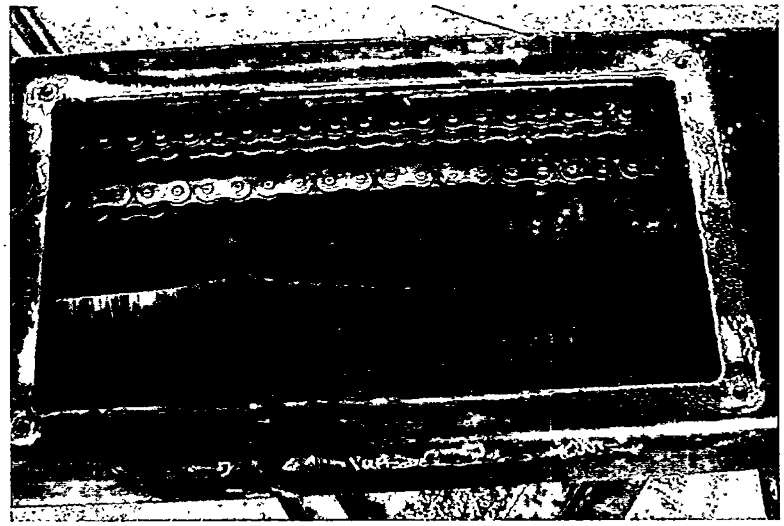

Figure 4.2 Containment hose distortion

4.1.2 Cold Test Facility Components

The cold test system included two ~7900-gal tanks (8-ft diameter and 21-ft long), shown in Figure 4.3. One was used as the sluice tank; the other was used as the recycle tank. The cold test facility view of the borehole miner and the sluicer pump ise shown in Figure 4.4.

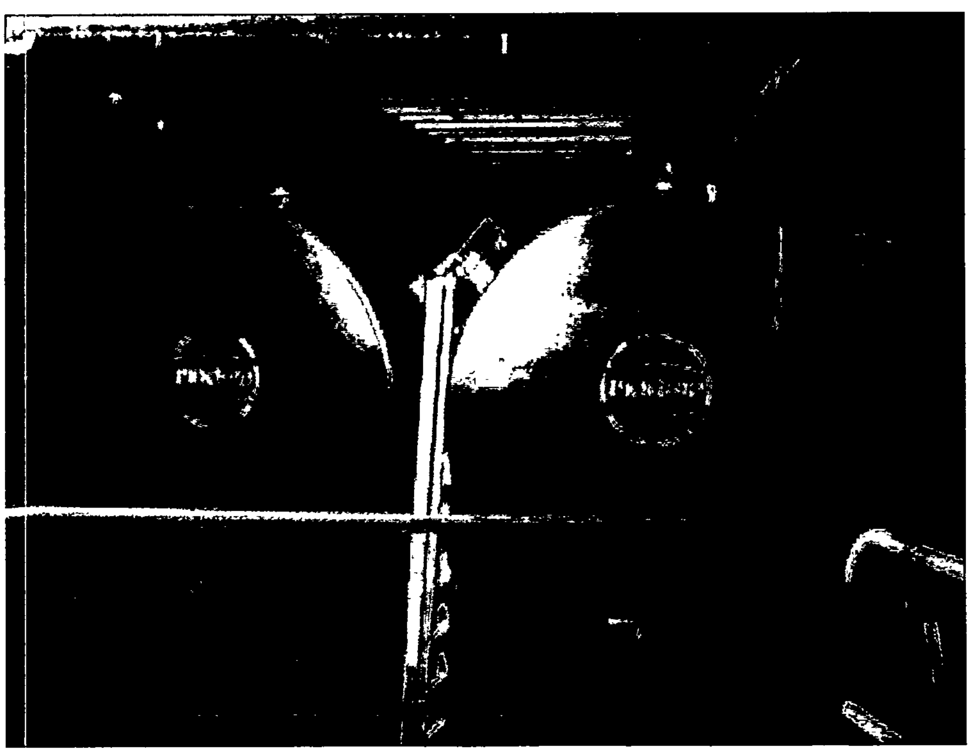

Figure 4.3 Sluice and pump tanks used during the cold tests.

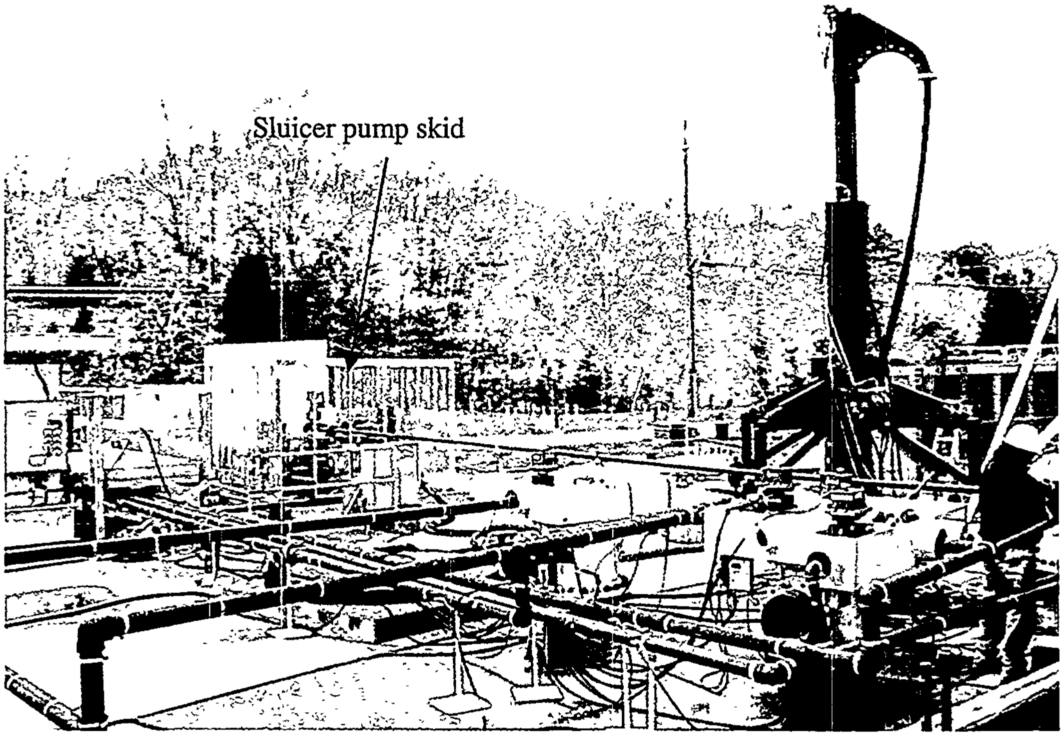

Figure 4.4 Borehole-miner extendible-nozzle sluicer installed at the cold test facility.

4.2 Cold Tests

The cold test goals were to

- evaluate the operational status of the full sluicing and pumping systems as well as individual components of the system
- train the field operators
- demonstrate readiness of both the system and the crew to proceed to the OHF site and conduct the tanks contents removal action.

The cold tests were conducted by CDM Federal Programs Corporation in accordance with their cold test plan.[1]

4.2.1 Evaluate System Operation

A series of tests were conducted with a waste simulant to evaluate the operational status of the full sluicing and pumping systems as well as individual components of the system. The results of these tests were evaluated by ORNL staff and published in a letter report.[2]

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[1] CDM Federal Programs Corporation. 1997. *Cold Test Plan for the Old Hydrofracture Tank Contents Removal Project at the Oak Ridge National Laboratory, Oak Ridge, Tennessee,* draft. Document Control No. 5151-0150DR-BBPK, CDM Federal Programs Corporation, Oak Ridge Tennessee.

[2] Babcock, S.M., B.E. Lewis, and C.A. Provost. 1998. *Interim Report on the Cold Tests for the Old Hydrofracture Facility Tank Contents Removal Project,* TTP OR16WT51, 3RBA, B2, Oak Ridge National Laboratory, Oak Ridge, Tennessee.

4.2.1.1 Simulant

Pulverized kaolin[1] suspended in water was used as the sludge simulant. Prior to installation of the sluicing and pumping equipment, 8000 lb of dry kaolin clay was deposited in the sluice tank. Following installation of the equipment, approximately 4000 gal of water was added to yield ~15 wt% slurry after mixing.

4.2.1.2 Test Conditions

The 0.310-in.-diameter nozzle was used during the sluicing tests. The sluicer pump was not installed at the time of the sluicing tests, so the borehole miner was powered by the Moyno pumps. The pressure during the tests ranged from 180 to 200 psi; flow rates ranged from 25 to 40 gpm.

4.2.1.3 Test Observations

The initial sluicing operation was performed over 6 hours. This test represented a difficult condition because initially the sluicer jet was used to hydrate and move a large mound of dry kaolin that was initially deposited in the sluice tank. Subsequent tests with mixed simulant required 1 to 2 hours of sluicer and pump operations. Based on tests conducted at PNNL with the sluicer system operating at a higher pressure (1000 psi), increased jet pressure is expected to improve the efficiency of the process by reducing the time required to hydrate and mix the dry kaolin (Bamberger et al. 1998). Higher pressures can be obtained when the sluicer pump is integrated into the system. Operations with the mixed slurry were successful at the lower operating pressure (200 psi) and could be powered by the Moyno pump.

In all tests, the amount of sludge remaining in the tank was based on the suction limit of the submersible retrieval pumps. These pumps are capable of retrieving wastes to within 3 to 4 in. from the bottom of the tank. The remaining slurry could be diluted to ensure that little sludge remains in tank after pumping operations.

In summary, the system components have performed as designed. The tests demonstrated that the borehole miner is an effective tool in dislodging dense materials even at relatively low pressures.

4.2.1.4 Water Addition

During operations, supernate and mixed slurry are used for the high-pressure sluicer jet. The only other water added is during line flushing and sluicer or camera rinsing operations. Line flushing is accomplished at the completion of each sluicing batch or each shut down of the pumps to prevent solids from settling in the line. Clean water is used for the flush and rinse processes. Sluicer rinsing is initiated prior to retracting the sluicer from the tank. Camera rinsing is used to clean the camera lens if it becomes coated with sludge during the sluicing process. During the cold tests, detailed records of volumes of rinse water were not maintained. However, water usage was estimated to be in the range from 250 to 500 gal. Water usage was reported during the system operation at OHF; see Section 5.

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[1] EPK pulverized kaolin, Feldspar Corporation, Edgar, Florida.

4.2.2 Evaluate Sluicer Pump Operation

The sluicer pump startup operations were initiated at the end of March, 1998. The chronology of events is summarized in Appendix A, Table A.1. The pump was operated over the period from March 31 to April 7, 1998 in the local and remote control configurations. A readiness review was completed April 7, 1998 and the team was informed April 8, 1998 that the system was approved for installation at OHF. A series of plots shown in Figures 4.5 through 4.10 summarize the pressure history of the sluicer pump during this period. The maximum operating pressure obtained was ~1300 psi.

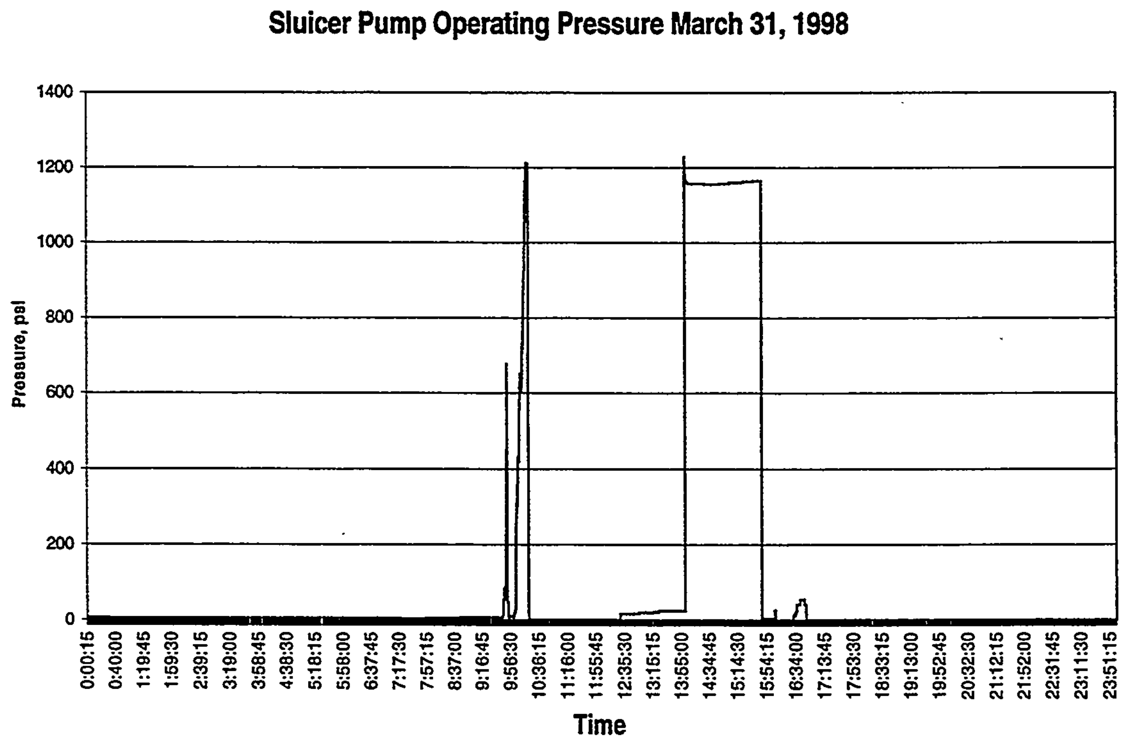

Figure 4.5 Sluicer pump operating history March 31, 1998

4.2.3 Operator Training

Operators were trained by the lead engineer. Training consisted of a detailed discussion of the system components and included their operation, maintenance, and control strategy. Six staff attended the 3.5-hr training session, excluding the instructor. The operators also practiced the activities listed in Table 4.2 during the cold test facility operations.

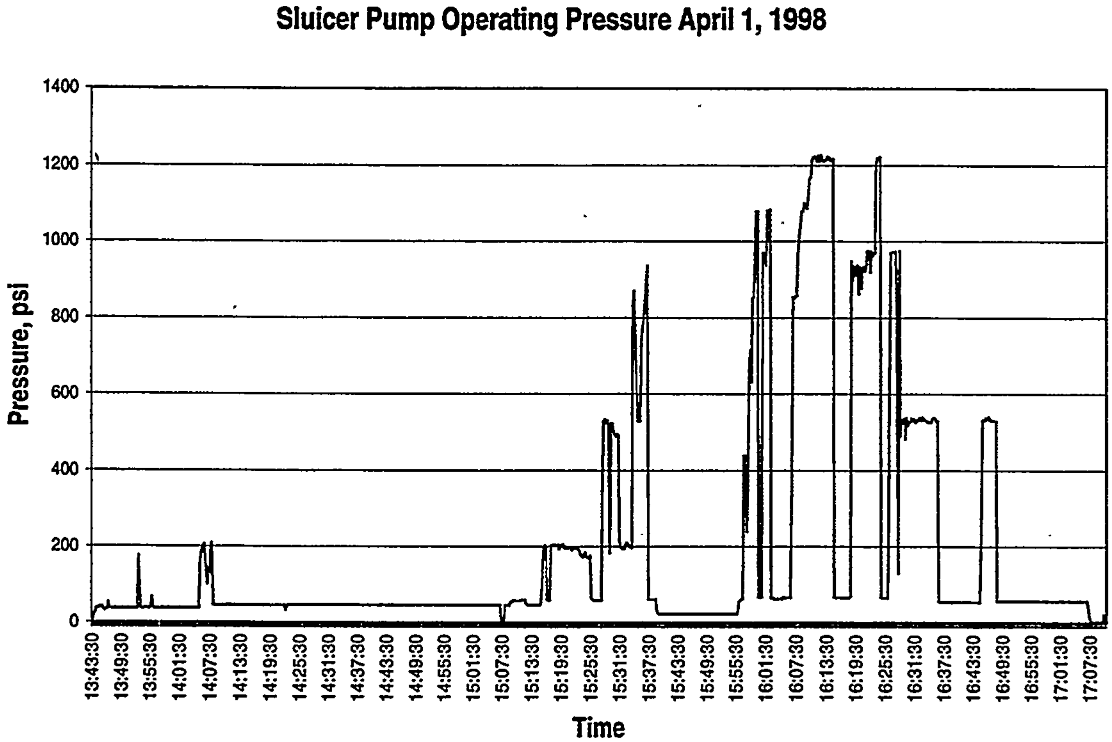

Figure 4.6 Sluicer pump operating history April 1, 1998

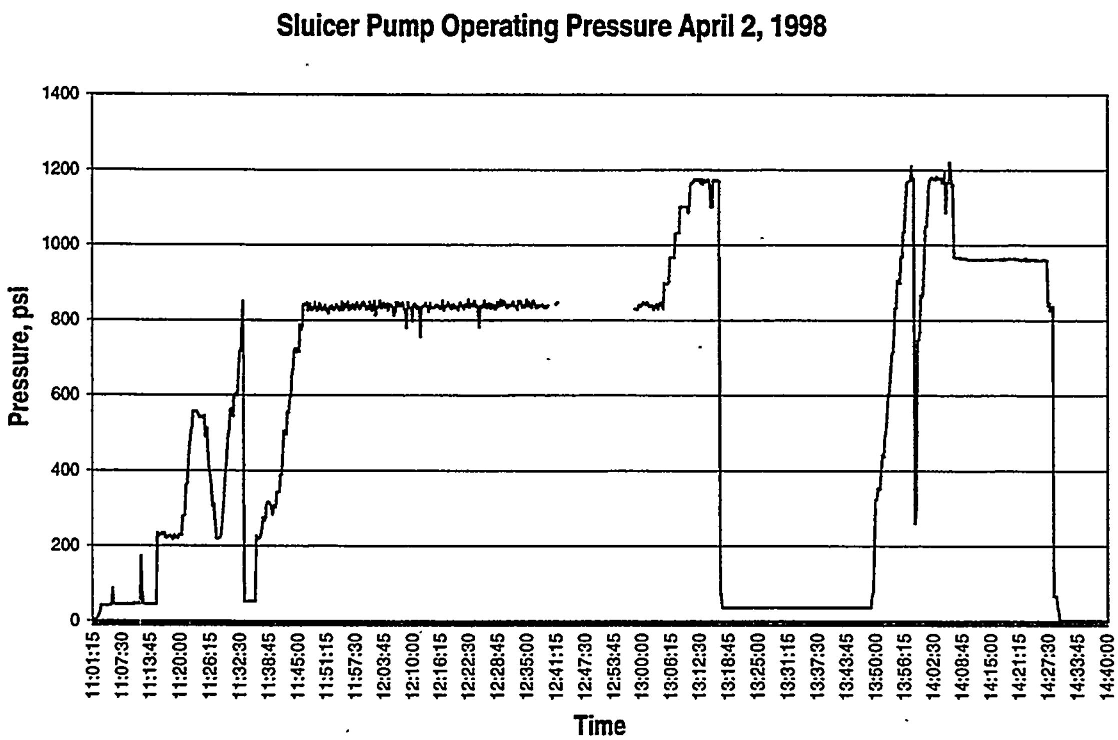

Figure 4.7 Sluicer pump operating history April 2, 1998

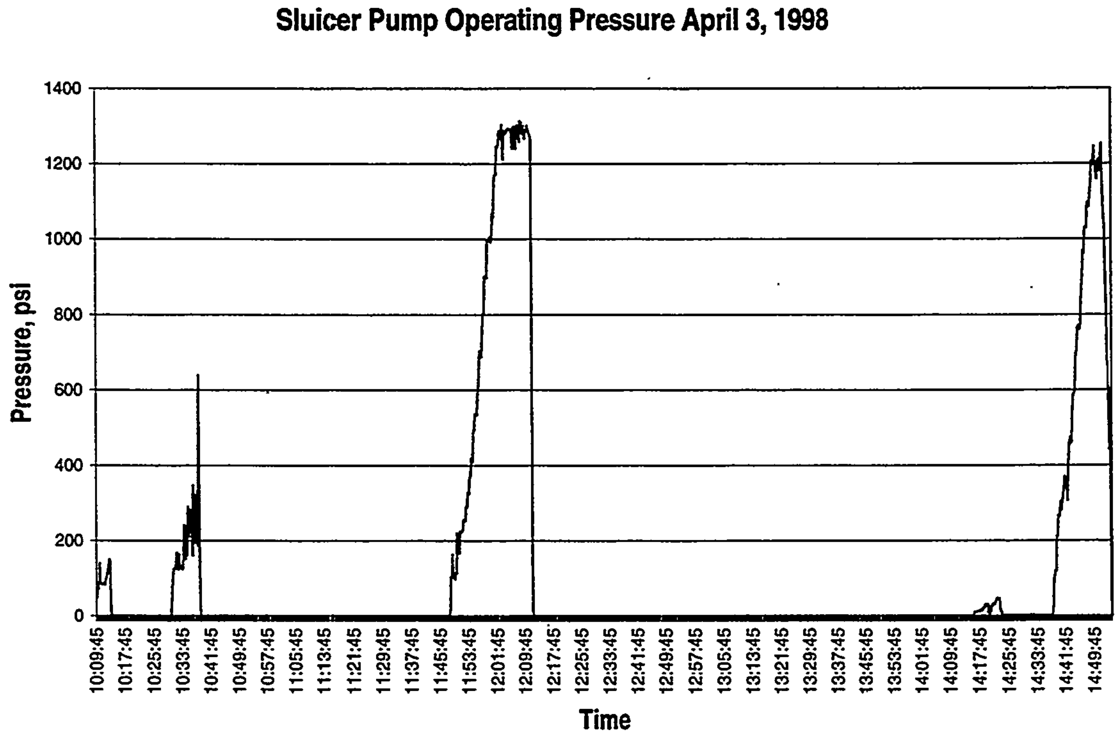

Figure 4.8 Sluicer pump operating history April 3, 1998

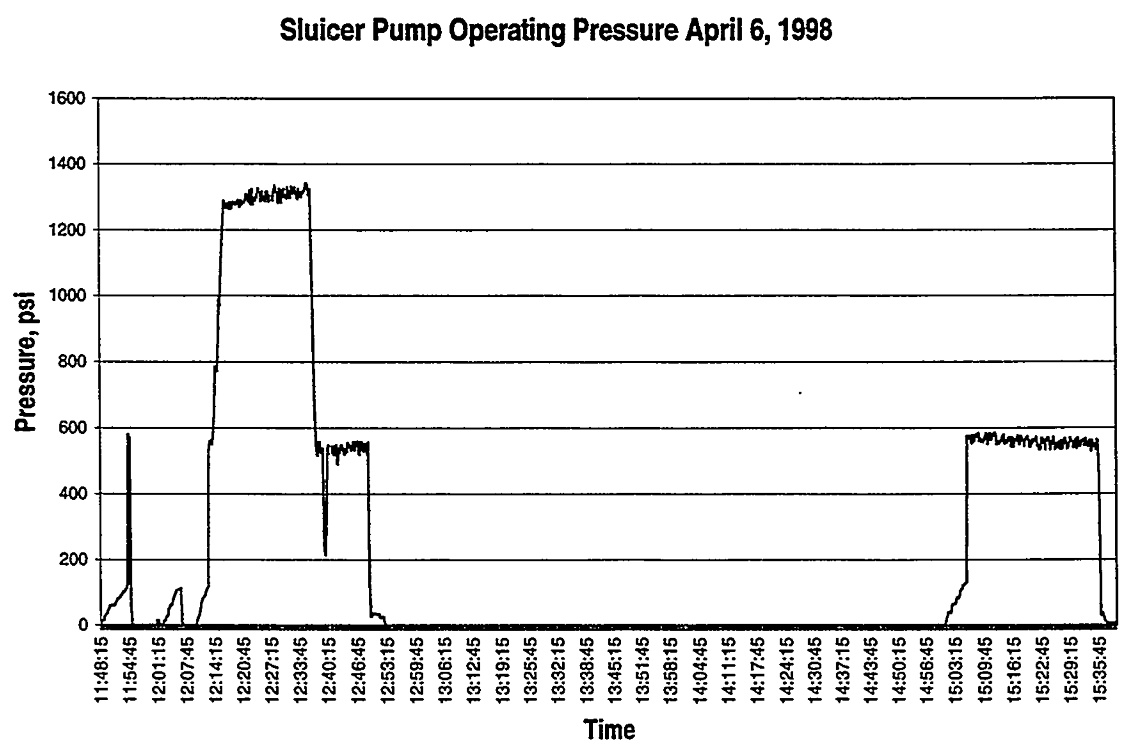

Figure 4.9 Sluicer pump operating history April 6, 1998

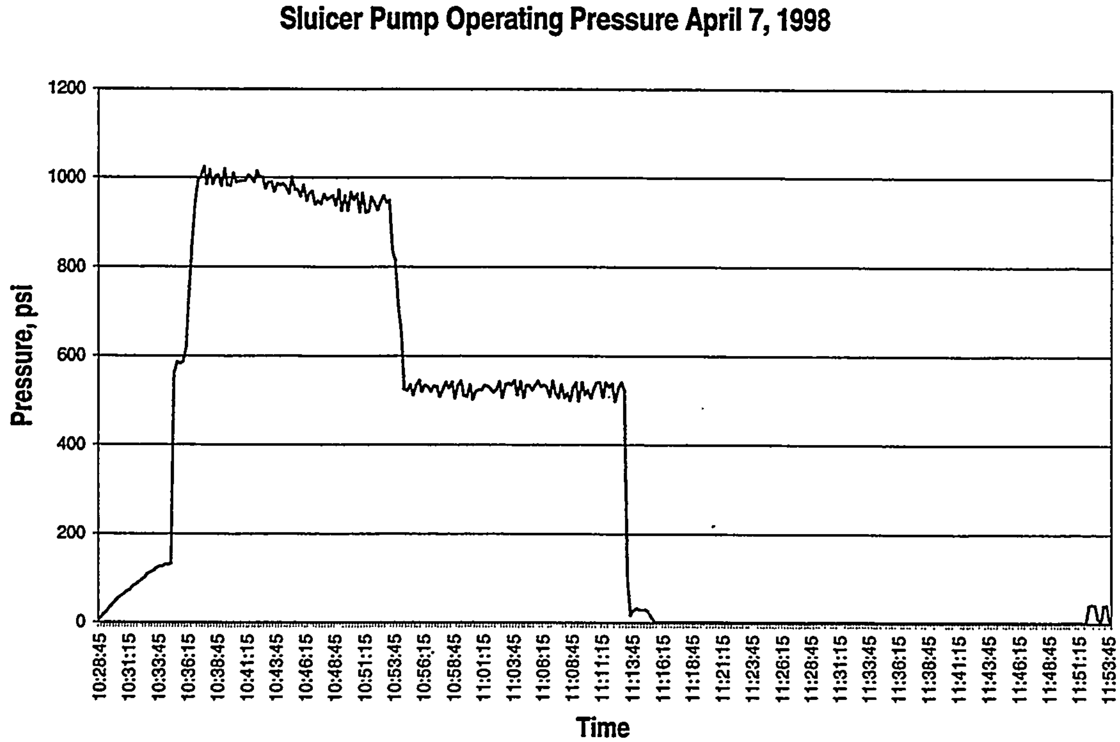

Figure 4.10 Sluicer pump operating history April 7, 1998

Table 4.2 Operator training activities

Task	Personnel	Duration	Manhours
Sluicing operations	5	3 da	120 hr
Sluicer rinsing with process water	6	1 hr	5 hr
Air drying pipes	5	1 hr	4 hr
Replace rupture disk	5	2 hr	10 hr
Emergency shut down	6	2 hr	12 hr
Strainer clogging	6	1 hr	6 hr
Switching HPP pumps	5	1 hr	5 hr
Pre- and post-operational checklist	5	2 hr	10 hr
Removing/relocating sluicer*	5	3 da	120 hr
Removing/relocating camera*	5	1 da	40 hr
Lowering submersible pumps	4	0.5 hr	2 hr
Strainer basket replacement	4	2 da	64 hr
*Does not include the three-person hoisting and rigging crew.			

4.2.4 Health and Safety Issues

Activities that have the potential for worker radiation exposure include 1) strainer change out, 2) bagging the end of the borehole miner for transfer between tanks, and 3) rupture disk replacement.

5. Borehole-Miner Extendible-Nozzle Deployment at OHF

On April 8, 1998, the readiness review team approved the team to move equipment from the cold test facility to the Old Hydrofracture Facility site. From April 8 through June 28, 1998, equipment was installed at OHF and its operation verified. The details of these activities are summarized in Appendix A, Table A.2.

5.1 Equipment Installation at OHF

The OHF site riser spools (white boxes) and the tank risers where the borehole-miner extendible nozzle is installed are shown in Figure 5.1. The variable-height submersible pumps are adjusted manually.

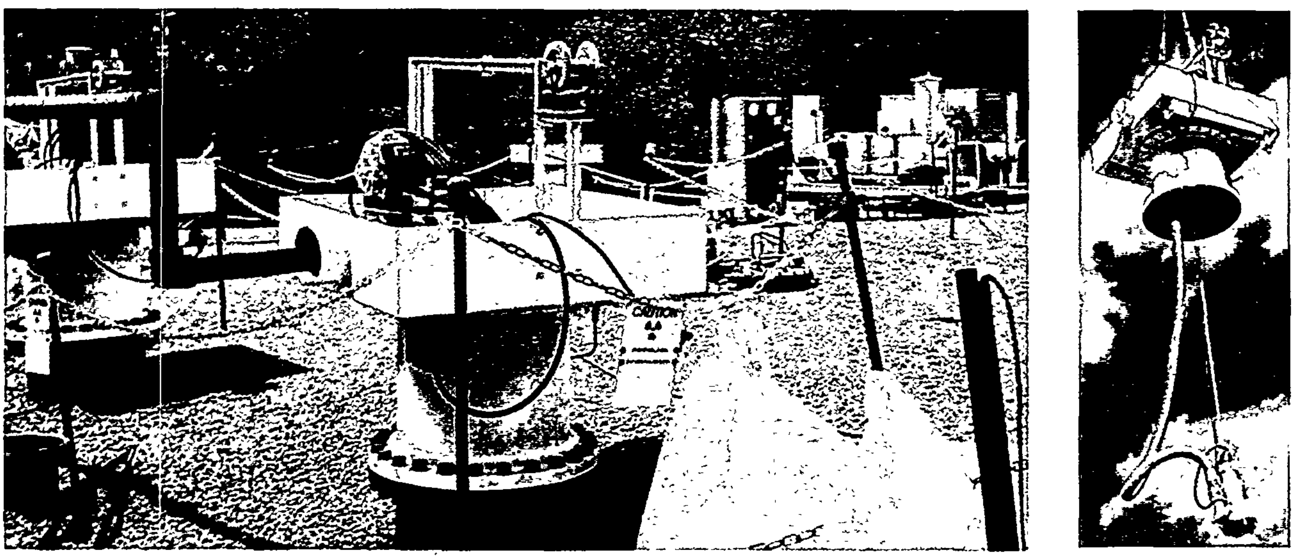

Figure 5.1 OHF site riser spools, tank risers, and the variable height submersible pump

The extendible-nozzle mast, shown in Figure 5.2, was transported to the OHF site via truck. The mast and platform can be installed separately or hoisted as an integral unit, as shown in Figure 5.3. The 0.38-in. diameter nozzle was installed on the borehole-miner extendible-nozzle system when it was deployed to sluice the OHF tanks. The orientation of the extendible nozzle above and below ground is depicted in Figure 5.4. Remote cameras, shown in Figure 5.5, were used to observe transfers in both the sluice and recycle tanks.

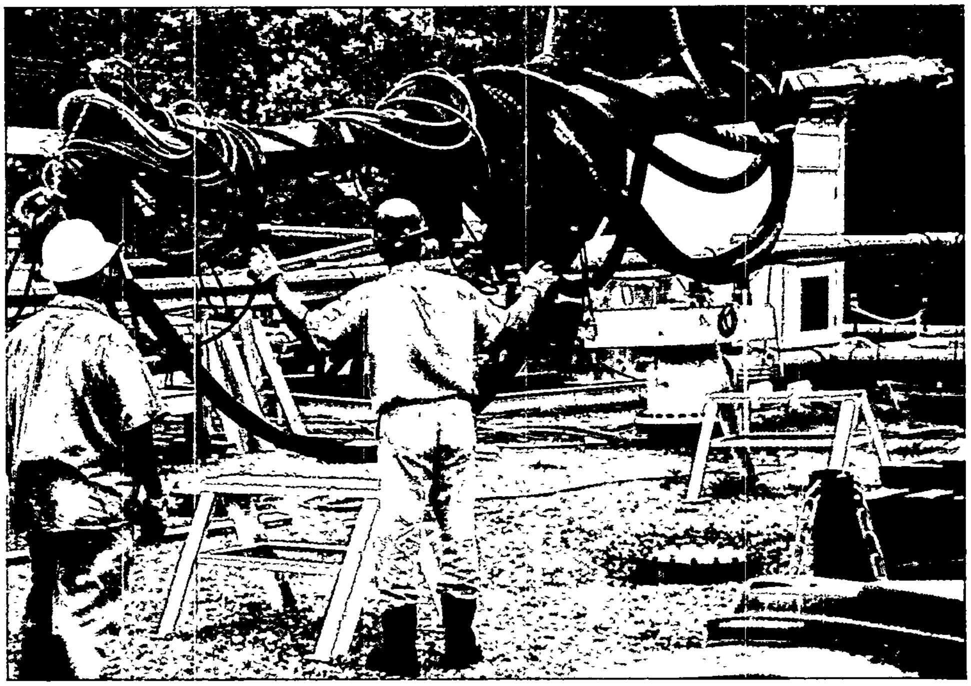

Figure 5.2 Transporting the extendible-nozzle mast from the transfer truck

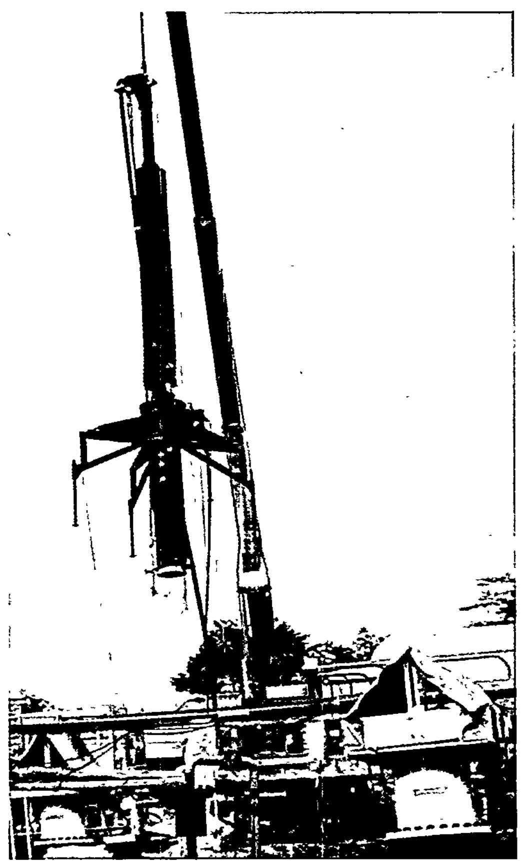

Figure 5.3 Transporting the extendible-nozzle and base via crane

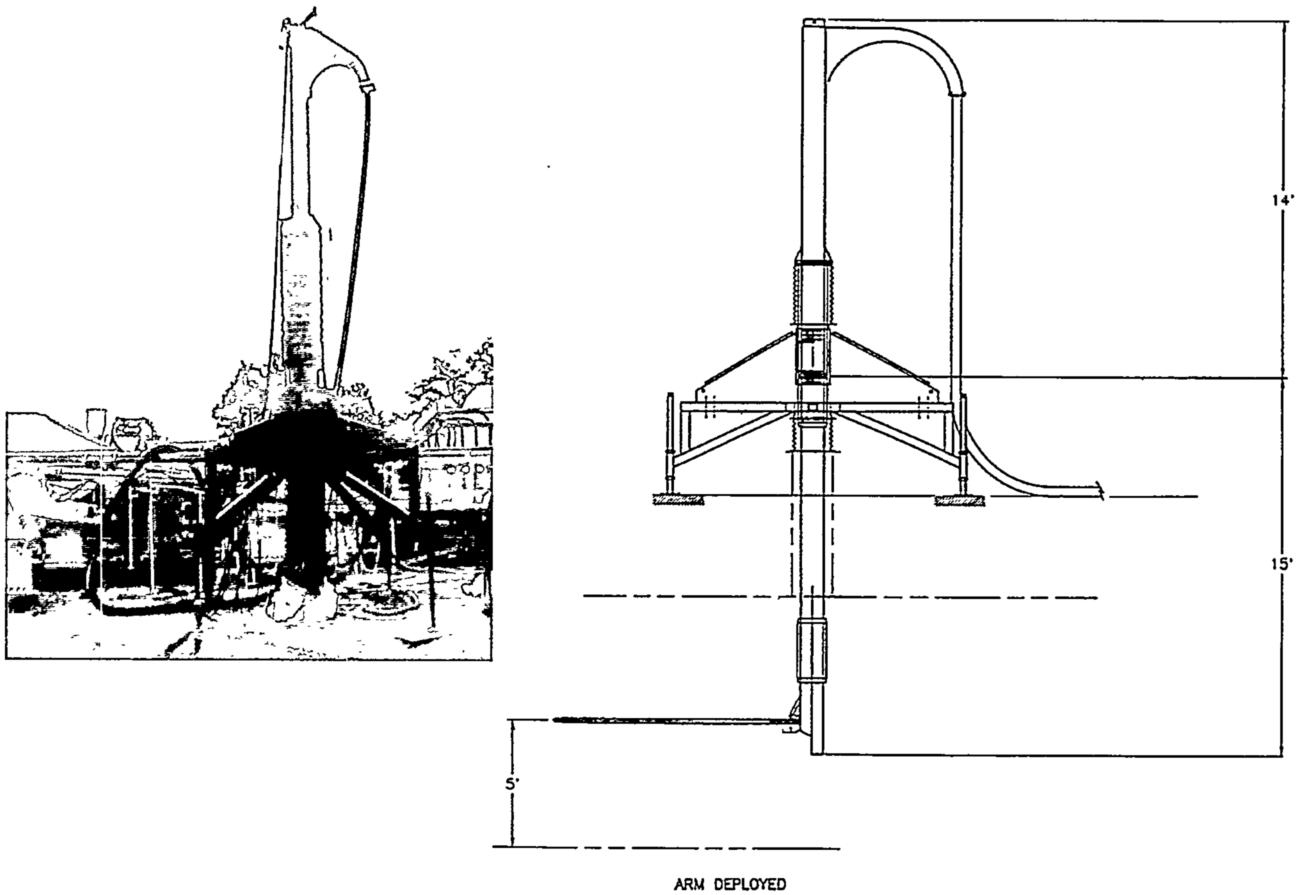

Figure 5.4 Extendible-nozzle as deployed in the OHF tanks

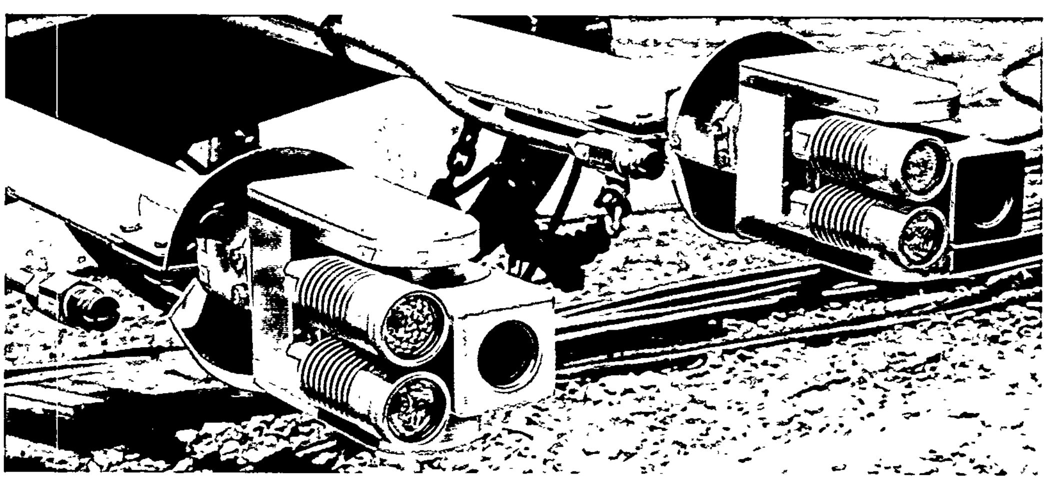

Figure 5.5 Remote cameras

5.2 Tank Cleaning Operations

Based on lessons learned during the cold tests, operations were conducted with four operators: one instrumentation and controls engineer, two operations technicians, and one operating engineer to oversee and direct the operation, but not actively operate the equipment.

All sluicing was conducted using the following approach. The process was started at low pressure (around 50 psi) and when systems were confirmed operational, the 200-psi Moyno pump speed was increased to achieve 170 to 190 psi. When the high-pressure sluicer pump was used, the pressure was raised to approximately 400 psi.

During retrieval operations, two approaches for nozzle movement were used.

- Fixed arm angle and extension: establish a fixed target using the in-tank camera; map the target via arm angle, extension, and mast rotation; execute sluicing with a fixed arm angle and extension. Reinspect the target area, repeat as necessary or assign a new target.
- Fixed arm extension and mast rotation: vary the arm angle to push a sludge pile toward a retrieval pump.

The retrieval operations were initiated in the evening to take advantage of cooler ambient temperatures at night. The heat caused the retrieval pumps to overheat and trip. Based on this scenario, the retrieval pumps were alternately operated in one end of the tank and then the other. The extendible nozzle was oriented to point toward the retrieval pump in operation.

5.3 Waste Retrieval Summary

To ensure that water additions associated with sluicing and waste transfer operations during OHF remediation were adequately documented, CDM[1] cataloged the operations. The information that follows is excerpted from their analyses.

This section describes the work performed to sluice and transfer the material in the OHF tanks to the MVSTs, the status of the equipment at the end of the sluicing, and the total volumes transferred. The information on sluicing is presented in chronological order.

5.3.1 Sluicing Tanks T3 and Tank T9

Beginning June 26, 1998, supernate was transferred from Tank T1 to Tank T3 to meet the 10% solids goal stated in the Operations Plan. Using tank level formulas and bubbler tube data, approximately 5,832 gal of supernate were received in Tank T3 from Tank T1. In addition, approximately 4,000 gal of supernate were transferred from Tank T2 to Tank T3 on June 28, 1998.

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[1] CDM Federal Programs Corporation. 1998. *Final Report Old Hydrofracture Facility Tanks Contents Removal Action Oak Ridge National Laboratory, Oak Ridge Tennessee,*5151-015-FR-BCFJ, CDM Federal Programs Corporation, Oak Ridge, Tennessee for US Department of Energy Office of Environmental Management, Oak Ridge National Laboratory, Oak Ridge, Tennessee under contract 95B-99425C, August.

While attempting supernate transfers, the in-tank submersible pumps did not perform as expected. During trouble shooting activities, the following observations were made:

- The submersible pumps were drawing more current than expected.
- The 15-amp circuit breakers in the submersible pump motor starters were tripping.
- The heater strips in the submersible pump motor starters were tripping.
- The submersible pumps stopped pumping in several cases (especially when used at elevated temperatures and partially submerged conditions). The most probable cause was activation of the submersible pump's internal thermal overload protection.

The following operational and equipment changes were made to address these noted problems:

- The circuit breakers in the motor starter were increased from 15 amps to 20 amps.
- The heater strips were adjusted from 105% to 115%.
- System operations were moved from the daytime to nighttime to take advantage of cooler operating temperatures.

The contents of Tanks T3 and Tank T9 were sluiced on June 28-29, and 23,500 gal of waste and process rinse water was transferred to MVST. The sluicer pump operating pressure during sluicing is shown in Figure 5.6. Excluding a pressure spike, the maximum operating pressure was ~ 190 psi. Although sluicing and transfer were successfully completed, several problems arose during sluicing, including the following:

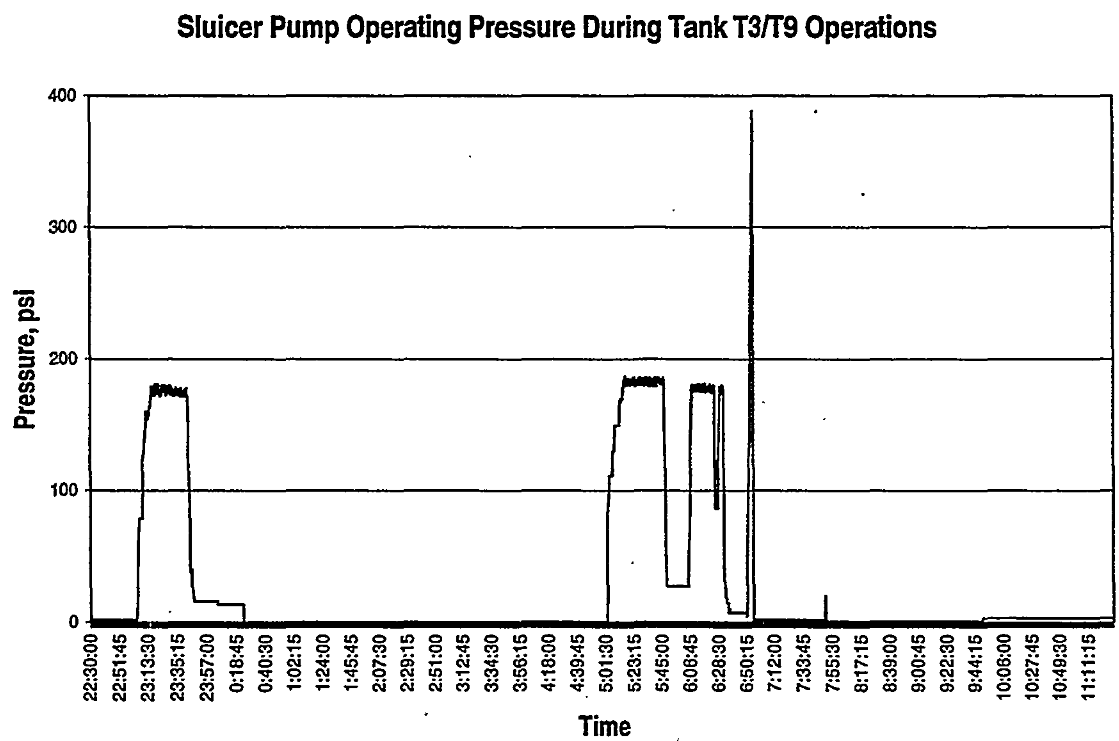

Figure 5.6 Sluicer pump operation during remediation of Tank T3

- A sudden increase in discharge pressure from high pressure pump HPP320-2 and intake pressure to the sluicer pump led the team to believe that a rupture disk had been blown. The team replaced the rupture disk, but encountered difficulties that ultimately lead to the spread of contamination inside the transfer pump skid. It was later determined that the rupture disk had not failed, and that the unusual pressure observations could be attributed to the failure of the mechanical pressure relief valve on the sluicer pump skid.
- A signal transmitter board for the radiation meter malfunctioned and required repair.
- A high differential pressure developed across strainer STR355-1 leading the team to believe it had become clogged. The team switched strainers and continued sluicing. The strainer was eventually unclogged through a process of flushing and maintenance performed on discharge valve MOV 360-1.
- The submersible pumps continued to experience some shut downs because of to thermal overloads, especially when operated unsubmerged or for extended periods of time.

5.3.2 Sluicing Tank T4

Excess supernate (supernate not required to meet the 10% solids goal stated in the Operations Plan) was transferred from Tank T4 to Tank T3. Using tank level formulas and bubbler tube data, 3,640 gal of excess supernate were received in Tank T3. This occurred after Tank T3 had been inspected and approved by Tennessee Department of Environment and Conservation personnel.

The first attempt to sluice Tank T4 was conduced on July 1-2, 1998, after the ruptured disk in HPP 320-2 was replaced. No flow was obtained at the sluicer nozzle. It was determined that the mechanical pressure relief on the sluicer skid had tripped (also discussed earlier). Because of these problems, sluicing was suspended until July 7, 1998.

The second attempt to sluice Tank T4 was conduced on July 7-8, 1998. During this attempt, the submersible pump in Tank T9 failed. Sluicing activities were cancelled so that the team could consider options to deal with the failure of the submersible pump in Tank T9. Two major options were discussed to deal with this problem: pump replacement or sluicing without using Tank T9 as the recycle tank. The team decided to attempt sluicing without using Tank T9, and a work instruction was a written and approved for this purpose (Work Instruction 20).

The third attempt to sluice Tank T4 was conducted on July 10-11, 1998. Although sluicing was conducted, attempts to transfer waste to MVST failed because of apparent valve alignment problems in the low-level liquid waste (LLLW) line. The OHF process lines were flushed with process water, and sluicing operations were discontinued while Waste Management personnel performed trouble shooting on the transfer line.

The fourth and final attempt to sluice Tank T4 was conduced on July 13-14, 1998. The contents of Tank T4 were sluiced, and 13,421 gal of waste and process rinse water were transferred to MVST. The sluicer pump operating pressure during sluicing is shown in Figure 5.7. Excluding a pressure spike, the maximum sustained operating pressure was ~ 195 psi. Although sluicing and transfer were successfully completed, problems arose with the potentiometers on the sluicer hydraulic controls, which limited operation of the borehole miner. Also, the strainer discharge valve MOV 360-1 failed to open.

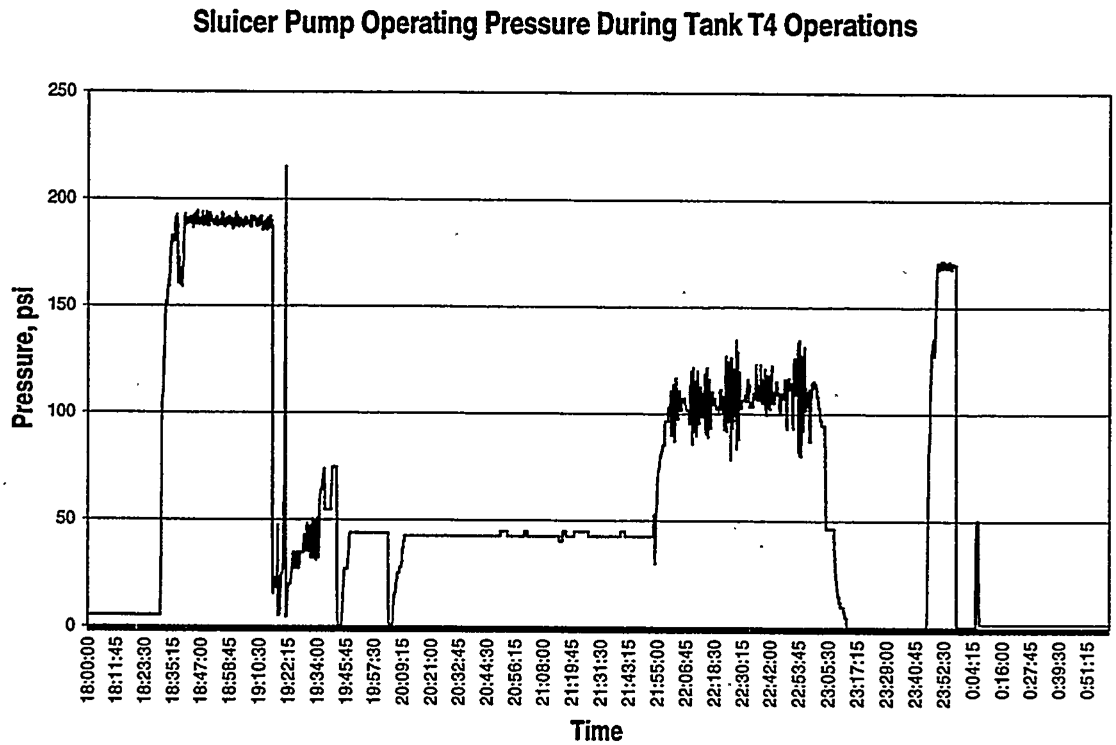

Figure 5.7 Sluicer pump operation during remediation of Tank T4

5.3.3 Sluicing Tank T2

Difficulties were encountered while moving the borehole miner into the center riser of Tank T2 (and subsequently into Tank T1). Two metal tubes (approximately 3/4 in. in diameter) were welded vertically in the riser, which made borehole-miner removal and placement difficult.

The contents of Tank T2 were sluiced on July 15-16, 1998, and 10,137 gal of waste and process rinse water were transferred to MVST. The sluicer pump operating pressure during sluicing is shown in Figure 5.8. The maximum sustained operating pressure was ~ 180 psi. Some of the excess supernate stored in Tank T3 was used to help in the sluicing activities. Although sluicing and transfer were successfully completed, several problems arose during sluicing, including the following:

- The rupture disk in HPP320-1 failed and the team switched to HPP320-2 to conduct the remaining sluicing activities.
- The borehole-miner extendible nozzle failed to remain straight when extended. It is believed that one of the cables controlling the extendible nozzle stiffening function had failed or was no longer connected. (This was not verified visually).
- Several of the LEDs on the sluicer control unit were no longer functioning, due to the sluicer potentiometer problem discussed during Tank T4 operations.

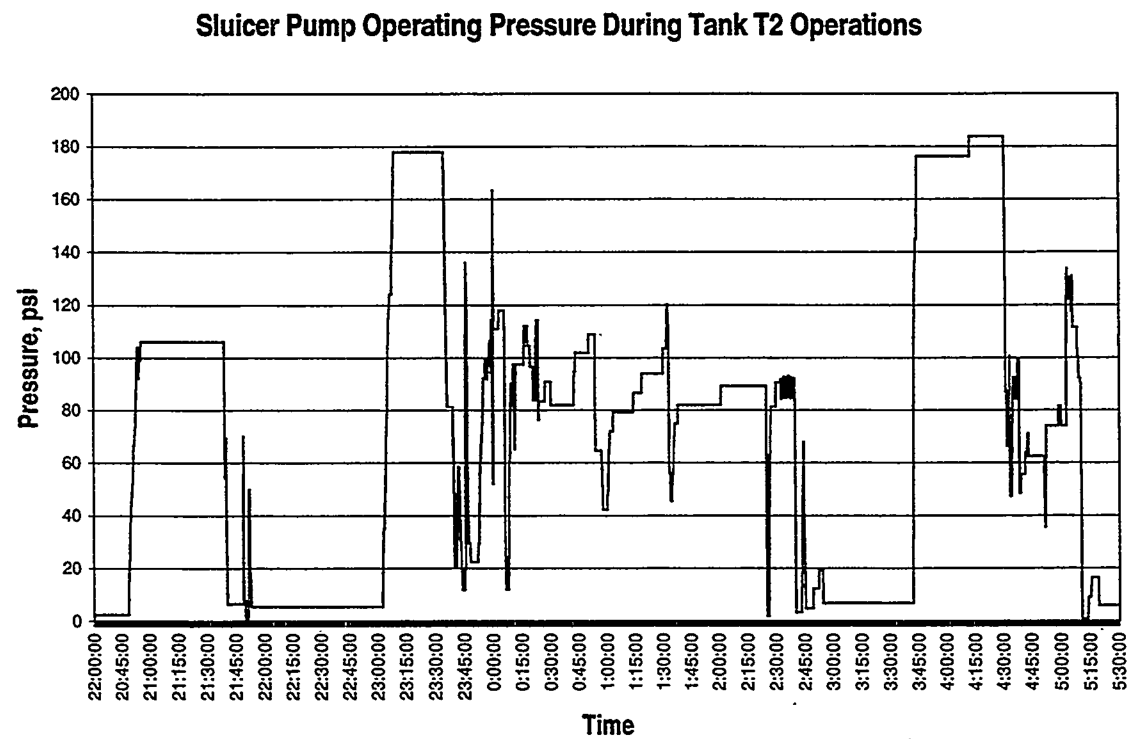

Figure 5.8 Sluicer pump operation during remediation of Tank T2

5.3.4 Sluicing Tank T1

The contents of Tank T1 were sluiced on July 18-19, 1998, and 13,389 gal of waste and process rinse water were transferred to MVST. The sluicer pump operating pressure during sluicing is shown in Figure 5.9. Excluding a pressure spike, the maximum sustained operating pressure was ~ 170 psi. The remaining excess supernate stored in Tank T3 was used to help in the sluicing activities. Although sluicing and transfer were successfully completed, several problems arose during sluicing, including the following:

- One of the hydraulic connections controlling the borehole-miner extendible nozzle angle function leaked because of a torn gasket. Sluicing activities were temporarily halted and the fitting was replaced.
- At the end of sluicing, the hydraulic control unit shut down (possibly because of low oil level) and prevented continued operations of the borehole-miner extendable nozzle.
- Waste Management personnel encountered problems with MVST valve alignments. The problems delayed sluicing for several hours.

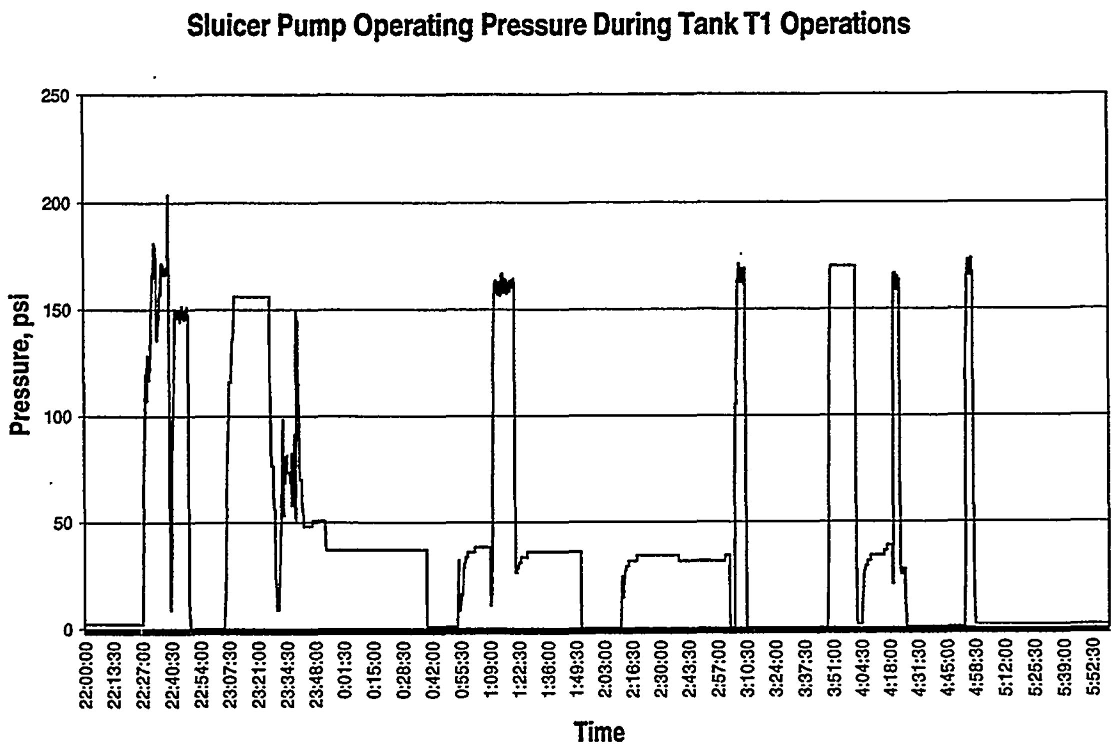

Figure 5.9 Sluicer pump operation during remediation of Tank T1

5.3.5 Equipment Status at Completion of Remediation

At the completion of the sluicing effort, the following equipment was not working:

- Borehole Miner: There were several equipment malfunctions associated with the borehole miner:
    - A hydraulic hose connected to the mast developed a leak. Ultimately, the hydraulic power unit shut down, apparently as a result of low hydraulic oil.
    - An arm tensioning cable apparently malfunctioned.
    - The LEDs on the control unit were not functioning (potentially caused by a malfunction of potentiometers on the borehole miner).
- Tank T9 Submersible Pump
- HPP320-1 Rupture Disk (currently installed disk is ruptured)
- MOV360-1
- MOV675 remote operation (will close manually)

5.4 Fluid Transfers to MVST

The total volume of material transferred to MVST from OHF and received by Waste Management at MVST is summarized in Table 5.1.

The difference in the two totals (82 gal) is small and is likely attributable to slight differences in the methods for measuring the volumes in the OHF tanks (relatively small tanks) and the MVSTs (relatively large tanks). The MVSTs are measured by indicators that record tank level. These data are then used to calculate total volume based on the tank size. The margin of error in this method of measuring tanks the size of the MVST tanks could easily account for the slight discrepancy.

Table 5.1 Comparison between measurements of fluid transferred to MVST and fluid received by MVST

Transfer	MVST Total Sent for Sluicing Event		MVST Waste Management Total Received	
	Increment, gal	Total, gal	Increment, gal	Total, gal
T3 - T9 6/28-29	23, 676 - 662	23,014	14,810 + 1,516 + 1,555 + 1,641 + 1,598 + 1,613 + 454 + 313	23,500
T4 7/13-14	38,418 - 25,099	13,319	26,661 - 13,240	13,421
T2 7/15-16	49,191 - 38,548	10,643	37,870 - 27,733	10,137
T1 7/18-19	62,594 - 49,444	13,150	46,212 - 37,861 W28 46,213 - 41,175 W27	13,389
Total	Sent	60,365	Received	60,447
			Delta	82

5.5 Process Water Use Analysis

A total of 6,427 gal of process water was used during the sluicing and flushing activities for flushes between transfers and after the final transfer, rinsing the cameras, and for other planned activities. An additional 1905 gal was used for unplanned activities resulting from equipment and MVST valve alignment problems. The total process water used was 8332 gal. This volume was quantified in the following manner:

- process flow totalizer reset on June 25, 1998, at 0000 hours
- assume integration average error factor for the process flow totalizer is 0.0953 gal/min
- assume final process flow total is 11,710 gal at 1,455 hours on July 20, 1998
- integration error factor is applied over 24 days, 14 hours, and 55 minutes (35,455 min x 0.09953 gal/min) 3,378 gal
- total process water used: 11,710 gal - 3,378 gal = 8,332.

The following activities occurred during sluicing, which resulted in additional process water being used. This volume was in addition to the volume planned for flushing between transfers and a final flush. The total of these amounts is 1,905 gal, which is included in the final total of 8,332 gal.

- Process water was used to test replacement of the rupture disk. This was later determined to be unnecessary because the high discharge pressures for the high-pressure pump were caused by the tripping of the mechanical pressure relief valve on the sluicer. See Work Instruction 15, dated July 2, 1998, for backup. Total process water used was 18 gal.
- Additional process water flushing was conducted on July 2, 1998, when no flow was observed at the borehole-miner extendable nozzle while attempting to sluice. It was later determined that the mechanical pressure relief valve on the sluicer had tripped. See Work Instruction 5, dated July 2, 1998, and logbook entries on July 2, 1998, for backup. Total process water used (2,851 gal - 2,340 gal) was 511 gal
- Additional MVST line and system process water flushing was conducted July 10-11, 1998. An MVST transfer could not be conducted on this date because Waste Management personnel encountered difficulties in aligning valves on the transfer line to MVST. See Work Instruction 5, dated July 11, 1998, and logbook entries on July 10-11, 1998, for backup. Total process water used (5,369 gal - 4,503 gal) was 866 gal.
- Because of valve alignment problems on July 10-11, 1998, an MVST test transfer was conducted prior to sluicing on July 13, 1998. See logbook entries on July 13, 1998, for backup. Total process water used (6,366 gal - 6,056 gal) was 310 gal.
- Because of valve alignment problems on July 10-11, 1998, an MVST test transfer was conducted prior to sluicing on July 15, 1998. See logbook entries on July 15, 1998, for backup. Total process water used (7,734 gal - 7,657 gal) was 77 gal.
- Because of valve alignment problems on July 10-11, 1998, an MVST test transfer was conducted prior to sluicing on July 18, 1998. See logbook entries on July 18, 1998, for backup. Total process water used (9,656 gal - 9,533 gal) was 123 gal.

5.6 Press Coverage

The OHF tank contents removal project was covered by two local newspapers, the Oak Ridger and the Knoxville News Sentinal. The articles follow.

5.6.1 TRU-Waste Closer to Final Destination

by Larisa Brass
Oak Ridger staff
Friday July 28, 1998

About 60,000 gallons of transuranic waste has flowed a little closer to its final resting place. The waste, stored in underground steel tanks at the Old Hydrofracture Facility just over the ridge from Oak Ridge National Laboratory, was transferred to safer storage tanks in Melton Valley. Worries that the tanks might be leaking caused the project to become a high priority one, according to Ralph Skinner, DOE team leader for Melton Valley watershed clean up. The tanks were drained in June and July. The waste, which originated from lab experiments and weapons production in the 1940s and 1950s, was originally stored in gunnite tanks near ORNL's cafeteria.

In the 1960s and 70s, said Skinner, the waste was pumped deep into the ground, where a high pressure water stream had created cracks in the bedrock in the hydrofracture process. The waste seeped into the cracks. Five steel tanks collected the solid residue. There were about 50,000 gallons of liquid and 10,000 gallons of sludge remotely pumped to new tanks. The waste contained metals like mercury, cadmium and lead and radioactive materials like cesium-137, strontium-90, uranium and plutonium. A total of 30,000 curies of radioactivity was present in the waste. "That's pretty hot," said Skinner.

The removal process involved use of a high-pressure nozzle to spray water into the tanks and loosen the material. A vacuum then pumped the waste --the consistency of a "real, real thin pancake batter" -- to the new tanks, he said. Eventually, the water will be removed by an evaporation process and the waste will be treated and packaged at a yet-to-be-built treatment facility. Foster Wheeler Environmental Corp. has a contract with DOE to build the processing plant by 2003. If all goes as planned, the waste will finally make its way to the Waste Isolation Pilot Plant in New Mexico. The amount of TRU waste pumped out of the tanks is a "fraction" of all that exists on the Oak Ridge Reservation, said Skinner. Draining the hydrofracture tanks was part of a "continual process," he said, to "remediate a number of old, inactive abandoned tanks" under the Federal Facilities Agreement. Pumping all the TRU waste from old tanks to new should be finished in one to two years, he said.

5.6.2 DOE Moves Radioactive Waste to Safe ORNL Site

By Frank Munger,
News-Sentinel Oak Ridge bureau
Knoxville News Sentinal
August 12, 1998

OAK RIDGE -- The Department of Energy says it has successfully relocated 60,000 gallons of radioactive waste to a safer location at Oak Ridge National Laboratory until the materials can be disposed of permanently. The project, which took place in June and July, cost about $10.3 million, according to Ralph Skinner, a clean up manager in DOE's Oak Ridge office. There were concerns about the condition of five underground tanks where the wastes were previously stored at the Old Hydrofracture Facility, a waste-disposal operation shut down in 1980. The tanks contained 50,000 gallons of liquid waste and about 10,000 gallons of sludge. In addition to radioactive cesium, strontium, uranium and plutonium, the wastes included toxic mercury, lead and cadmium.

Although officials said there were no known leaks at the site, there were no barriers around the aging tanks and any leakage likely would have reached nearby White Oak Creek. The creek feeds into the Clinch River and downstream reservoirs. John Julius, DOE's project manager, said an electrical system used to prevent corrosion of the carbon-steel tanks no longer worked, and that raised the priority for moving the wastes to another storage site.

A team of companies used a remote-controlled pumping and sluicing system to remove the wastes, which were transferred by pipeline to newer tanks at the Melton Valley Storage Site about 300 yards away. Skinner said the stainless-steel tanks at Melton Valley are contained in a steel-lined vault for extra protection.

He said federal authorities believe the wastes will be safely housed there until they can be processed and packaged for disposal – work currently scheduled for 2003. Plans calls for the nuclear wastes to be sent to the Waste Isolation Pilot Plant in New Mexico.

The waste-relocation project at ORNL incorporated some new technologies, including a high-pressure water nozzle developed for clean up projects at DOE's Pacific Northwest lab in Washington state. "Once we overcame the technical glitches – some difficulties mechanically with the system – it worked very well," Skinner said. "Once it was set up, the whole thing happened in just a few weeks."

5.7 Lessons Learned from Deployment at ORNL OHF

The design, fabrication, installation, cold testing, and deployment of the extendible-nozzle borehole-miner system at ORNL OHF involved DOE, contractors, and subcontractors. The team players are acknowledged at the beginning of the document. The integration of the team went smoothly at times and experienced difficulty as schedules began to change caused by procurement, fabrication and installation delays. The initial interactions and interfaces between the US DOE Tanks Focus Area and ORNL EM-40 were documented in a Memorandum of Understanding. The implementation of this MOU did not always proceed smoothly. The Bechtel Jacobs team served as integrators and intermediary between CDM Federal Programs Corporation, operators of the sluicing system and Retrieval Process Development and Enhancements staff, developers and suppliers of the borehole-miner extendible-nozzle equipment. In the end, the diligence and dedication of all parties contributed to the successful deployment of the system.

6. Equipment Status

On July 29, 1998, a final rinse of the sluicing and pumping system was performed, satisfying the requirement for system flushing. Disassembly of the OHF sluicing and pumping system was initiated on August 6, 1998 and completed on August 28, 1998. The logbook entries associated with these activities are summarized in Appendix A, Table A.7.

6.1 Disassembly of Equipment

The following activities were performed.

1. The secondary containment pipe was removed by cutting. Some of this pipe was declared non radiologically-contaminated and disposed of as construction waste. The remainder was determined to be radiologically contaminated and was placed in lined B-25 storage boxes for disposal.

2. Transfer piping was cut (using a hand-held reciprocating saw) into 5.5-ft lengths. Absorbent pads or other absorbent materials were placed in the open end of each pipe, then the pipe-end was bagged and taped. The pipe sections were placed in lined B-25 boxes for disposal. Pipe openings into the risers or the pump skids were closed with bolt-on flanges or screw-in pipe plugs.

3. All electrical and instrumentation cables (except the power feed for the ventilation skid and the frisk shack. change trailer lights) were disconnected and cut or coiled. Electrical cables within the radiological zone were placed in lined B-25 boxes. Electrical cables outside the radiological zone were segregated. Recyclable or re-usable cable was coiled and placed on pallets. Other cable was placed in 55-gal drums.

4. All air and water hoses were disconnected, coiled, and placed in 55-gal drums.

5. The remaining water in the 2500-gal polytank and the 5000-gal tanker was drained into the OHF pond. A total of approximately 5500 gal was drained into the pond.

6. The borehole miner mast was removed from the stand, wrapped in a plastic sleeve and two layers of Herculite plastic, taped, placed on the stands between tanks T1 and T2, and covered with a tarpaulin. The stand was encased in plastic around the lower bellows and placed adjacent to the mast. The hydraulic hoses were disconnected and coiled and placed in 55-gal durms. The hydraulic power unit and the control unit were left in place. The flange-end of the hose was disconnected from the sluicer pump, bagged and taped, and coiled on Herculite plastic adjacent to the mast.

7. The cameras were removed from the tanks, wrapped in plastic and two layers of Herculite plastic, encased in a tarpaulin, taped and placed on the wooden platform at the north end of the transfer skid.

8. The wooden and plastic tents erected over the riser boxes were dismantled and placed in B-25 boxes. A hole was drilled in each riser box and in the four corners of the sluicer pump skid to allow for drainage of rain water.

9. The emergency generator and portable toilet were rental properties and were returned. The air compressor and water pump skids were placed in storage in the sea/land container adjacent to the control trailer.

10. The shower was placed in a sea/land container for storage. The shower basin was upended to drain rain water and left on-site.

11. The MVST containment box was disconnected from the MVST valve box. The valve box connection was sealed with a bolt-on flange. The containment box end was bagged and taped and transported to the OHF site. There, the pipe attaching the box to the flange connection was cut off and both pieces were placed in a lined B-25 box. The transfer hose was flushed with water and placed in a lined B-25 box.

12. The control trailer was largely left intact. Tables, chairs, and cabinets were left as is. The programmable logic controller cabinet, computers, visualization system, camera operators, and VCRs were left in place. The visualization system has since been returned to PNNL. Project documentation, including controlled copies of documents and equipment manuals, were left in the cabinet.

13. The change trailer and frisk shack were cleaned out and left in-place for use by future projects.

14. The sluicer pump skid, transfer pump skid, and riser boxes were left in-place. The ventilation system was left plumbed into the tanks.

15. Tools and unused supplies were stored in the two sea/land containers and in a trailer located at the Field Operations Facility.

6.2 Equipment Contamination

The borehole miner and sluicer pump skid are contaminated with radioactive waste. The contamination levels are low enough that the equipment could be shipped to another location for future deployment.

7. Deployment Possibilities for the Borehole-Miner Extendible-Nozzle Sluicer

The extendible-nozzle sluicer system expands the range of tank cleaning technology by permitting remote cleaning in challenging environments.

- Increased jet pressure permits dislodging of solidified materials with compressive strengths up to 3000 psi. The system readily dislodges settled sludges with shear strengths of ~25 psi; typical sludges have shear strengths of <1 psi.

- The extended arm and ability to position the nozzle increases the effective stand-off-distance by the arm extension length (10 ft). This increase in reach provides a significant increase in the volume covered by the extra extension of 10 ft.

- The arm extension allows cleaning areas in shadows created behind piping or other in-tank hardware that would deflect the jet if it did not extend past them.

- The extendible nozzle operates using available supernatant or fluid; therefore, no dilution or excess waste generation is required and the product can be reclaimed for reuse.

- The extendible nozzle is fully contained (the arm retracts into the mast; the mast is covered by a bellows) and can be moved by crane from tank to tank without spread of contamination.

- The extendible nozzle is portable; the mast length can be customized for a range of tank riser diameters and insertion depths, and the system can be transported by truck from site to site.

- When deployed at Oak Ridge, operations in each of the four tanks to be cleaned took less than 1 day. With previously used sluicing technology, operating times of weeks were expected per tank.

7.1 Principal Applications

The extendible nozzle's initial application was the remote clean out of radioactive waste from underground storage tanks. This challenging environment benefited from

- the system's extendible nozzle (increased cleaning radius) high-pressure, low-flow-rate jet
- ability to extend, retract, and position the arm past in-tank components
- the ability to operate with no dilution (using available supernatant)
- the ability to move readily from tank to tank by retracting the arm and containing it in the flexible bellows
- the decreased operating time per tank (from days to hours)
- enhanced product recovery (98% of waste retrieved).

This deployment arena is quite large and imminently challenging because many tanks contain in-tank hardware and piping that must not be damaged during cleanout. However the presence of this hardware impedes jet penetration to areas shielded by the components. By extending the nozzle and positioning it, cleaning in these areas is enhanced significantly over other sluicing approaches.

7.1.1 Additional Nuclear Waste Remediation Applications

Weapons, space, medical, and research programs led by the U.S. government have created a legacy of nuclear waste. A part of this legacy is 273 underground tanks that contain millions of gallons of radioactive waste and 7 calcine vaults. The tanks, which were built from the 1940s to the 1980s, have capacities ranging from 13,000 to over 1,000,000 gallons (up to 80-ft diameter). The waste in these tanks is classified as high-level waste, transuranic waste, and mixed waste. Several of the tanks are approaching the end of their design life. Sixty-eight tanks are known or suspected to have leaked waste to the surrounding soils at the Hanford Site (67 tanks) and Savannah River Site (1 tank). As the tanks age, the possibility of waste escaping to the environment increases. To minimize the risk of waste migration and/or exposure to workers, the public, and the environment and to meet the regulations entered into by DOE, the waste must be retrieved and the tanks closed. The extendible nozzle with its ability to operate at large stand-off-distances was specifically selected to remediate these tanks. A summary of the tanks at DOE sites are listed in Table 7.1.

Table 7.1 Tanks and vaults for potential borehole-miner extendible-nozzle sluicer deployment

Site	Hanford	Idaho	Oak Ridge	Savannah River
Number of tanks/ calcine vaults	177	11/7	34	49
Waste volume (millions of gallons)	54	2/1	0.6	33
Total curies (million curies)	198	2/50	0.2	534
Tank design	Single and double shell	Single shell	Single and double shell	Double shell
Material	Carbon steel	Stainless steel	Gunite, carbon steel	Carbon steel
Waste forms	Salt cake, sludge, viscous liquid	Sludges and viscous liquid	Sludge	Saltcake, sludge
Other problems	In-tank hardware, potential leakage	In-tank cooling coils, corrosion	Large chunks of gunite in waste in some tanks	

7.2 Other Applications

Other applications that benefit from the same enhancements include remote clean out of

- gasoline storage tanks (at gas stations and at fuel storage facilities)
- chemical storage tanks
- railroad tank cars
- vessels including crude oil tankers.

7.2.1 Underground Storage Tanks

In 1984, Congress directed the US Environmental Protection Agency to develop regulations for underground storage tank (USTs) systems; many underground storage tanks are Federally regulated in 40 CFR Part 280. EPA's Office of Underground Storage Tanks (OUST) developed the Federal regulations, which delegate UST regulatory authority to approved State programs. There are currently 24 states with approved UST programs.

The extendible nozzle is well suited to clean common underground storage tanks (for gasoline, water, sewage, etc). Millions of these tanks are located throughout the country beneath service stations, farms, and industrial sites. The majority of the tanks are constructed with 22-in. entry ways that are sufficiently large to insert the 12-in. diameter extendible-nozzle mast. Commonly sized tanks range from 4 to 10 ft in diameter, 10 to 60 ft in length, and hold 1 to 50,000 gal. Many tanks accumulate sludge over time and must be scheduled for routine cleaning. The extendible nozzle will not damage these fiberglass or steel tanks during cleanout. The product/solids can be retrieved without dilution, and the downtime during tank cleaning will be significantly reduced from conventional jet cleaning cycles.

7.2.2 Tank Cars

Tank car applications are similar to horizontal underground storage tanks. Maximum diameter is approximately 10 ft in length to provide volumes up to 50,000 gal. Tank cars are cleaned as specified per product transported, especially when car service is changed from one product to another, with the US tank car inventory ~300,000 units.

7.2.3 Vessels

Shipping vessel hulls are compartmentalized. The extendible nozzle can be used to clean out each of the compartments sequentially. Facilities for vessel cleaning and refurbishment are mainly located over seas.

The extendible nozzle system can be used to clean tanks or other vessels that will accept a 1-ft-diameter mast. This includes all tanks with entry way access (~22-in. diameter entry) and many older tanks such as rail tank cars that include access ports with diameters of 18 in.

7.3 Potential Applications

Potential applications include both larger and smaller and more restrictive tank cleaning configurations. The current system pressure limitation is 3000 psi operating pressure; the arm links are sized to contain a 1-in.-diameter hose; and the nozzle extension is 10 ft. The system is contained within a mast with a 1-ft cross section. The current system design could be modified to fit other applications requiring smaller mast diameter, longer arm extension or a change in operating pressure.

The extendible nozzle could also be deployed to clean crevices or penetrations, such as pipe lines that branch out from the vessel walls.

7.4 Summary

The extendible nozzle is an *environmentally friendly* tool to clean large tanks and containers because

- It is remotely operated and therefore removes humans from exposure to dangerous chemicals and work in confined spaces.
- It is fully contained and therefore limits spread of hazardous tank contents when the system is moved from one tank to another.
- It can operate without dilution, thereby reducing waste generation and enhancing product recovery.
- It can operate in tanks filled with piping and other obstructions without damage to the equipment.

- It can both dislodge and retrieve from one tank riser, thereby reducing deployment time.

This system can be deployed to readily clean nuclear waste tanks, gasoline tanks, tankers, and chemical processing and storage tanks including:

- 273 underground storage tanks contain millions of gallons of radioactive waste and 7 calcine vaults
- millions of underground storage tanks located throughout the country beneath service stations, farms, and industrial sites
- 300,000 or more underground storage tanks
- shipping vessel hulls compartments.

Many underground storage tanks require monitoring and may require periodic cleaning and inspection as a part of the Federally mandated programs. The extendible nozzle provides a timesaving, robust method of cleaning and removing solids from tanks without product dilution or generation of additional waste.

8. References

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Appendix A

Event Chronology

9. Appendix A Event Chronology

To document activities associated with borehole-miner extendible-nozzle system activities, log entries from PNNL and CDM activities are provided.

9.1 PNNL Activity Chronology

FY97

10/18 ORNL has agreed that the extendible nozzle be deployed to dislodge waste from the Old Hydrofracture tanks.

10/21-23 PNNL met with the OHF team at ORNL. Lynn Whitehead, Facility Manager, and Gregory Boris provided a tour of the OHF site.

11/22 PNNL set a trip to ORNL for early December for Judith Bamberger, Dan Alberts, and Mike Rinker to revise the extendible nozzle and sluicer pump specification and to develop a Memorandum of Understanding between ORNL and PNNL.

12/3-4 PNNL and WTI visited ORNL to discuss the specification and redline it. Rinker and Bednarz discussed the Memorandum of Understanding.. Participants included Judith Bamberger, Dan Alberts and Mike Rinker and ORNL staff Clay Bednarz, Greg Boris, Lynn Whitehead, Scott Babcock, Marshall Johnson and Bechtel representative Andy Kelsey.

12/6 PNNL hosted an Extendible Nozzle Demonstration for Bechtel's Andy Phelps. He was interested in total remediation of the tanks and recommended considering how much more than the 95% of the waste could be removed from the tanks using the extendible nozzle system.

12/10 PNNL Rinker sent draft Memorandum of Understanding between TFA and ORNL to Bednarz for review.

12/13 PNNL specification for extendible nozzle was sent to team for review.

12/18 PNNL Bamberger sent redline copy of spec to team for review.

12/19 TEAM telecon with ORNL, CDM, PNNL regarding spec comments.

12/20 PNNL specification updated and forwarded to procurement to get a quote from WTI.

12/20 PNNL Rinker authorized WTI to begin converting the extendible nozzle system at the Savannah River Site 90% design point into the 50% design for ORNL.

1/3 PNNL Rinker requested MOU comments from Bednarz.

1/3 PNNL set extendible nozzle 50% design review tentatively for week of March 3, 1997.

1/7 ORNL Bednarz replied to Rinker that he read the MOU and has comments.

1/17 WTI requested ORNL OHF site tank drawings.

1/26 ORNL to send site drawings to PNNL and WTI.

2/5-6 Meeting at WTI to discuss extendible nozzle and water supply system specifications. Clay Bednarz and Greg Boris from ORNL and Charles Callis from CDM (ORNL's subcontractor) visited WTI February 5 to meet with WTI management, to tour the facility, and get an overview of WTI capabilities. Chris Provost from CDM joined the group at PNNL February 6, 1997 to view the extendible nozzle, discuss the water jetting system and water supply system specifications, and discuss testing.

2/10 PNNL initiated a weekly telecon with ORNL.

2/12 ORNL Boris provided riser flange and tank loading information.

2/21 PNNL Bamberger provided pump motor specifications and system sizes to ORNL for range of 1000 to 3000 psi and 150 to 250 gpm. ORNL recommended 1500 psi system. PNNL is awaiting information from ORNL regarding the motor size that their electrical system will support.

2/25 Schedule for 50% design review set.

3/5 PNNL extendible nozzle 50% design review.
3/7 Completed 50% design review at PNNL. Participants included JA Bamberger, MW Rinker, GR Kiebel, CA Bednarz, GF Boris, CR Callis, CA Provost, and D Callow.
3/14 Plan is to hold 90% design review at ORNL in conjunction with the CDM balance of plant 50% design review. Date set at April 23-25, 1997.
3/17 PNNL requested information on valves and controllers from CDM Provost.
3/24 WTI modified design to move actuator above the arm rather than below the arm. This changes the range of motion to ~0 to 90 deg and shortens the length of the mast. CDM agreed that this is a big improvement.
3/24 CDM Provost requested information for maximum particle size acceptable for extendible nozzle to size their grinder.
3/28 CDM Provost provided comments on extendible nozzle specification.
3/28 WTI recommended that maximum particle size be 30 to 40% of nozzle diameter. Dave Summers, UMR, concurred. Bamberger recommended 1/8 in.
3/28 CDM provided comments on extendible nozzle specification.
4/1 PNNL TWP schedule shows delivery of extendible nozzle 7/15/97.
4/2 Telecon: discussed the double containment hose.
4/3 Visualization system interface 0 to 10 V vs 4 to 20 mA, telecon, ORNL, CDM, PNNL. System interfaces defined.
4/4/ CDM Provost said hydraulic line length required is 275 ft.
4/22-23 90% extendible nozzle design review and CDM 50% balance of plant review held at ORNL.
4/22- Appropriation request approved for sluicer pump, initiated 4/21.
4/25 PNNL pump specification completed. ORNL Boris provided comments.
4/25 WTI has the WJS request for proposal (RFP).
4/25 PNNL Bamberger finalized the sluicer pump specification and transmitted it to procurement for release.
4/30 PNNL RFP for sluicer pump sent out to ~ 10 vendors suggested for pump procurement.
5/2 PNNL sluicer pump RFP sent to vendors, 4 vendors submitted refusals to bid.
5/16 PNNL Completed 90% extendible nozzle design review. Several open comments have been closed. WTI still has outstanding items.
5/19 PNNL pump responses to PR 299668 due today.
5/19 ORNL Boris provided distance between OHF risers.
5/28 PNNL sent out sluicer pump RFP Rev 1 to prospective offerors, offer due 6/11.
6/04 PNNL received pump quote for $298800.
6/4 WTI extendible nozzle delivery date set for Aug 11 at ORNL.
6/4 PNNL Visualization system arrived at PNNL from Sandia. It works.
6/10 PNNL received pump quote for $405,365
6/11 Responses to PNNL pump PR due today.
6/17 PNNL requested review of pump specification by Dave Summers, University of Missouri Rolla.
6/26 PNNL receives quote requiring 40% down for a used pump.
6/30 PNNL used pump procurement in progress.
7/11 Pump identified and being procured.
7/11 PNNL valves identified and purchase requisition is being completed. 4 week lead time for both valves and actuators.
7/14 PNNL submits valve PO to vendor.
7/18 PNNL, ORNL Telecon with Advanced Sciences, Inc. (ASI) to obtain additional information on sluicer system operation to be included in the OHF Safety Analysis Report (SAR).
7/22 PR completed for valves, QA requirements.
7/24 PNNL pump procurement of a reconditioned pump fell through.
7/25 PNNL Visualization System Operation and Maintenance Manual distributed.

7/28 PNNL recommended potential Gardner Denver pump.
7/31 WTI submitted acceptance procedure to PNNL for review.
8/4-5 WTI extendible-nozzle acceptance test and demo at PNNL.
8/11 ORNL Boris reports that the extendible nozzle equipment was received in Oak Ridge in good condition sometime this morning. The shipment included the nozzle, platform, mast and hydraulic power supply.
8/13 WTI provided extendible nozzle packing list to ORNL and PNNL.
8/13 PNNL Extendible Nozzle CNTR Milestone 1A5 due 8/30/97. The milestone was completed with delivery of extendible nozzle.
8/15 National Oilwell provided quote for the pump package.
8/16 PNNL recommended variable speed drive for the pump.
8/20 ORNL, CDM, WTI, PNNL concur to procure suction stabilizer for the pump skid.
8/20 National Oilwell provided Rev 1 of quote.
8/21 PNNL procurement ready to authorize pump procurement with National Oilwell.
8/22 PNNL PO for National Oilwell pump.
9/15 PNNL Valves: Vendor called with an alternative - Kitz ball valve. They are foreign made, but the vendor believes they can comply with QA requirements.

FY 98

10/1 PNNL discussed pump skid details with National Oilwell.
10/8 PNNL pump and its integral skid are completed.
10/16 PNNL directed WTI to design pump skid piping, valving and instrumentaion.
10/17 PNNL equipment status: The National Oilwell Pump ship date is November 5, 1997. Valves are being procured from Bill Pool Products, Inc. No ship date has been established. Instrumentation is to be shipped the first week in November. The non-fragmenting rupture disk will ship November 13. The manual reset relief valve has a similar ship date. WTI will integrate the instrumentation and valves with the pump.
10/20 PNNL PO to Bill Poole Products.
10/21 PNNL PO faxed to Bill Poole Products.
10/23 PNNL reforwarded the message to WTI sent Friday, October 17 authorizing WTI to start work on the pump skid.
10/27 ORNL Clay Bednarz requested to PNNL Mike Rinker that ORNL complete the final integration of the high-pressure pump skid components for the OHF remediation.
10/29 ORNL made the decision to integrate the valves with the pump at Oak Ridge rather than have RPD&E do the integration at WTI.
10/30 Pump Skid Welding, ORNL Greg Boris agrees that B31.1 should be followed in fabrication of the high-pressure pump skid. Bamberger spoke with Bob Farmer in the PNNL mechanical engineering group and he agreed.
11/3 ORNL Greg Boris requested pump skid drawings.
11/4 PNNL Rod Jones provided input on piping code requirements for pump skid.
11/5 PNNL Visualization system packed for shipment to CDM.
11/7 ORNL Clay Bednarz and PNNL Judith Bamberger witnessed pump test at National Oilwell.
11/7 PNNL Rod Jones provided review of pump skid piping.
11/10 ORNL Clay Bednarz to PNNL Mike Rinker: "I agree with your write-up on the scope and deliverables for the high-pressure pump integration. Oak Ridge will integrate the high-pressure pump skid once PNNL has delivered the equipment and completed drawings." *Note: this approach was not implemented. PNNL and WTI fabricated the pump skid and ORNL did final integration.*
11/10 ORNL Greg Boris getting estimates to fabricate pump skid at ORNL.
11/14 National Oilwell shipped the JWS 340 pump to WTI.
11/15 PNNL PO final sent to Bill Poole Products.

11/17 National Oilwell shipped the discharge dampener to WTI.

11/20 Valves procured from Bill Pool Products shipped to WTI.

11/20 ORNL Greg Boris reported that protective clothes required at the OHF site would be similar to a level B dress out. Respirators may be required if cutting or welding, etc. is performed, as well as medical approval to wear a respirator, a respirator fit test and respirator training

11/21 ORNL respirators are the MSA Ultrawin and the MSA Comfo II.

11/21 PNNL Judith Bamberger, and WTI Rick Stagi, and Joe Maloney, completed the 40 hour Hazardous Waste Operations and Emergency Response training offered at the Hanford Site. This training satisfies the training requirements of 29 CRF Part 1910 Hazardous Waste Operations and Emergency Response. This training is sufficient for us to work at the OHF site in an "advisory" role.

11/21 Valves are being procured from Bill Pool Products, Inc. The ship date is 11/20/97 for delivery 11/21/97.

11/21 The National Oilwell Pump was delivered to WTI 11/19/97. It is now being fabricated at the welders.

11/21 Valves were delivered to WTI.

11/24 The low and high-pressure manifold instrument trees and non-fragementing rupture disk were delivered to WTI.

11/24 PNNL requested tentative dates to visit ORNL to assist with system integration.

11/25 XL Associates pump drip pan changed from galvanized to stainless.

11/25 The Oteco manual reset relief valve was delivered to WTI.

11/26 ORNL Greg Boris requested that spares for long-lead-time bellows should be ordered.

11/26 WTI Joe Maloney inspected the valves. Two 3-in. 600-lb valves and actuators were supplied instead of two 3-in. 1500-lb valves and actuators.

12/3 ORNL Greg Boris requested gasket information for the clamp flange for the riser sealing surface.

12/4-8 WTI extendible nozzle setup at ORNL- Rick Stagi, WTI on site at ORNL.

12/8 XL Associates delivered the pump drip pan to ORNL.

12/8 WTI reported that the pump skid construction was completed with two leaks identified. ORNL Clay Bednarz requested that the skid be shipped to ORNL.

12/12 Serck Audco shipped a replacement valve to ORNL.

12/15 ORNL H Elkins signed for the Serck Audco valve that Serck Audco provided as a replacement for the improperly supplied valve.

12/17 WTI recommended gasket material for the 18 in. riser cover, McMaster Carr Catalog Number 8568K24, ¼-in. neoprene sheet, 33-in. wide, Shore A Firm 55-65, attach with contact cement.

12/17 WTI provided information to ORNL for extendible-nozzle water line attachment. The water line that provides spray to clean the nozzle while it is retracting attaches at the top of the mast as shown on Drawing 83030, items 47, 48, 51.

12/18 National Oilwell sent pump manuals to ORNL and PNNL.

12/18 ORNL reports that the pump motor nameplate rating was 250 HP. ORNL sized the power disconnect box and cables for a 200 HP motor The pump skid was completed by WTI 12/8/97 and shipped to ORNL.

12/19 ORNL reported that the conductor size for pump drive/motor was not adequate.

12/22 CDM replaced the NEMA 1 float switch (Square D Class 9037, Type HG-33) on the hydraulic skid with a NEMA 4 switch suitable for outdoor use.

12/29 National Oilwell will replace the pump conductor cable with 1200 ft of 4/0, THHN, stranded black power wire.

12/30 ORNL Conrad Wyzor reports that the #2 ground wire supplied with the pump was adequate.

1 /2 ORNL and WTI reported that the extendible nozzle top bellows can diametral clearance was not adequate. The top bellows can should be replaced with a larger one.

1/2 National Oilwell agreed to replace the power cable to the pump motor. The cable is being replaced with 1200 ft of 4/0 THHN stranded black power wire. The wire will be shipped January 2, 1998. ORNL specified that the #2 ground wire supplied originally is adequate and does not need to be replaced.

1/5 ORNL Greg Boris reported action items on PNNL pump skid: 1) unbolt suction piping from pump suction manifold and check for alignment and gasket condition; 2) fabricate spray shield that covers the pump, valves and piping; 3) send back power cable to National Oilwell; 4) procure conduit for power cable to high-pressure pump motor; 5) address the location or modification of the VFD enclosure to account for its indoor rating; 6) complete assembly of VFD and motor electrical connections; 7) check on interference of top bellows with stand on borehole miner.

1/6 ORNL Greg Boris reported that they checked the alignment of the flanges on the pump skid today. They are pretty well lined up.

1/6 ORNL Greg Boris reported that the replacement Serck Audco valve was located. ORNL is still looking for pulsation dampener charging hose assembly.

1/6 ORNL Greg Boris reported that 1) the electric cable replacement to arrive 1/7 (a day later than promised), 2) National Oilwell fixed the Hydril pulsation dampener and shipped it back to ORNL, 3) inlet piping was realigned, it will be tested when pressurized.

1/7 ORNL to return extra valve to Serck Audco via Consolidated Freightways -- freight collect.

1/8 ORNL replaced the NEMA 1 rated hydraulic power unit float switch HG33 with NEMA 4 rated switch HW33.

1/8 ORNL reported that the extendible nozzle mast does not rotate.

1/9 The replacement wire was received at ORNL. ORNL will return the unused wire to National Oilwell freight collect.

1/9 The discharge dampener was returned to National Oilwell and Hydril for repair, returned to ORNL and has been reinstalled.

1/12 ORNL requested that WTI Rick Stagi trouble shoot the mast rotation problem.

1/12 ORNL requested that WTI supply gasket for the 1500 psi valve.

1/12 ORNL requested information regarding the permissible distance between the VFD and the pump motor. The permissible separation is 250 ft. This is referenced in the pump manual under the panel tab, Section 3.2.2.4.

1/14 ORNL reported the motor that is used to rotate the mast is not operating. ORNL staff disconnected the motor from the mast. The mast rotates manually within the turn table. Plans are to test the hydraulic motor for the mast rotation after it has been removed from the gear box. This will tell us if there is an hydraulic power problem.

1/14 DOE-OR Jacquie Noble-Dial and ORNL Clay request PNNL assistance to fix the mast rotation problem associated with the motor that is not functioning.

1/14 WTI shipped a revised part number WTI #84585C flange to ORNL for installation.

1/15 Crisis at ORNL, motor not functioning.

1/15 ORNL Greg Boris, WTI Rick Stagi, and PNNL JA Bamberger discussed reasons that the motor would not fully function and how to evaluate them.

1) An alarm switch is activated. The borehole miner has a mechanical stop to limit the mast from rotating more than 1 revolution. An electronic stop activates prior to the mechanical stop. Rick provided info to determine whether an alarm condition exists.

2) Solenoid is acting as if it is in an alarm mode. The solenoid is normally closed to permit rotation. If the solenoid is in the open position, rotation would not occur in that direction. Rick provided information to determine whether this is condition exists.

3) Potentiometer position. Because the potentiometer was disconnected, care must be taken to reconnect it in the same rotation position, otherwise the span for mast rotation may not match that of the potentiometer.

1/15 ORNL Greg Boris reported that the mast rotation problem was fixed. He requested that WTI not come to ORNL.

1/16 PNNL requested information for the cold test schedule at ORNL.

1/20 ORNL Greg Boris requested welder certification(s) for the welder(s) that performed the welding on the sluicer pump skid and the weld inspections/certifications for the actual welds for the readiness inspection.

1/21 ORNL Greg Boris reported that the WTI flange adapter was received along with some bolts. The gaskets have not yet been located.

1/26 EM-50 Retrieval Technology Integration Manager Pete Gibbons requested schedule from Jacquie Noble-Dials. The status is that PNNL is addressing ORNL needs via phone, no visit required.

1/26 ORNL Boris reports that conduit must be used for the pump skid electrical wiring.

1/27 CDM is conducting operator training this week. They have pumped slurry through the nozzle using their Moyno pumps and have moved the nozzle around, out and in, etc.

1/27 PNNL JA Bamberger reported that gaskets were delivered to ORNL 1-21-1998 at 9:53 AM and received by E MCReynold.

1/27 PNNL JA Bamberger sent information for valve installation and actuators to G Boris and called to discuss options for the fail safe actuators.

1/28 ORNL requested that PNNL provide a backup power supply for valve actuators. Greg Boris stated that the readiness assessment team would require this capability and need to prove it works prior to going to the field.

1/28 ORNL Greg Boris reported that conduit for wire for sluicer pump skid was not yet ordered.

1/28 PNNL provided gaskets for pump skid arrived at Cold Test Facility.

1/28 PNNL offered to Pcard the conduit for ORNL.

1/29 ORNL Greg Boris reported that the extendible nozzle won't retract more than to 96 in. extension.

1/29 PNNL reported that the spare parts list is located in Section 2.4 of the Extendible Nozzle and Hydraulic Power Unit Operations and Maintenance Manual.

1/29 PNNL JA Bamberger and Piping Resources provided specifications for the fail safe actuator system for Greg Boris and Chris Provost to review.

1/30 ORNL Greg Boris reported that Conrad Wyzor and he agree that the list looks good (Chris thought it looked acceptable too).

1/30 PNNL Gary Kiebel spoke with CDM Joe Larosa who indicated that the I/O module reads position data from the extendible nozzle control system. Apparently, the interface between the extendible nozzle position loop and the i/o module had been wired so that the polarity of the voltage was reversed, causing the cerealbox output to read a steady -1 indication. Joe also discussed calibration of the visualization system channels so that the range of motion of the model matches the range of motion of the actual joint. Joe will report back with calibration progress.

1/30 WTI worked with ORNL and CDM to resolve the mast rotation problem. The mast rotation problem was solved. ORNL had not connected the wires to the position sensors. When they made these connections, the mast rotated. WTI assisted with the trouble shooting via phone.

1/30 PNNL is working with ORNL to provide fail-safe battery back up power supplies for the valves. Piping Resources, the vendor that supplied the actuators, can provide the systems and install them. ORNL expects that this would occur the week of February 9.

2/2 ORNL reported the bypass valve was installed last week. The pipe fitters weren't able to tighten the bolts on the flange. They needed the required torque to apply to these bolts.

2/2 PNNL reports that National Oilwell can provide startup assistance for both the pump end and VFD, at ORNL. A PO was initiated for this work.

2/2 WTI (Joe Maloney) was sent to ORNL to debug the mast extension and retraction problem. (As of Monday 2/2, the problem has been corrected.)

2/3 PNNL QA requirements state that Equipment Marking and Identification Requirements for the extendible nozzle include: 1)Total weight of the water jet system needs to be clearly and permanently marked on the units on etched or stainless steel plates, 2) Etch or engrave the Battelle Purchase order number on the WJS, 3) label or hang a tag on any equipment components that may contain hazardous materials (ie hydraulic fluid). WTI will verify if these items were completed.

2/4 ORNL Greg Boris reported that it is acceptable for Piping Resources to install the cables/conduit between the pump valve actuators and the backup system boxes. Greg is working with Conrad Wysor to determine where the boxes will be mounted and how power will be provided to the valve actuators and pump motor. A good assumption is that the boxes will be located on a stand attached to the other end (motor end) of the pump skid.

2/4 ORNL Greg Boris reported that the plan is to locate the VFD on the motor skid. This will simplify installation at OHF. A NEMA 4 enclosure is required with heating. This will allow easier field wiring and minimize conduit runs at the OHF site. Also the lifting lugs must be evaluated to determine whether they must be reinforced or replaced..

2/4 WTI Joe Maloney reassembled the arm yesterday and had it placed back in the stand. Everything was functioning properly including extension, retraction, and rotation.

2/4 ORNL Greg Boris requested WTI to recommend patch material/glue to use if bellows repair is required.

2/6 ORNL Greg Boris requested information for charging the pulsation dampeners.

2/9 National Oilwell provided information for charging the pulsation dampeners: low-pressure charge at 127 psi, high-pressure charge at 1000 psi.

2/9 CDM Chris Provost pressurized the low-pressure pump inlet to determine whether the alignment of the inlet piping was adequate. Upon pressurization with water, the inlet to the pump housing itself started leaking at 150 psi. At 200 psi, there was a spray coming out and the gasket appeared to be coming apart in pieces.

2/9 National Oilwell (Joe Bodin) will be at ORNL tomorrow (~2 pm) to trouble shoot the high-pressure pump, replace the suction gasket, and charge the pulsation dampeners.

2/9 ORNL Clay Bednarz called to report that the pump suction manifold was leaking..

2/9 PNNL JA Bamberger started a new PO to provide National Oilwell assistance during startup.

2/10-19 National Oilwell Joey Bodin on site at ORNL to fix pump suction leak.

2/11 National Oilwell removed the pump suction manifold this morning (he could not complete it yesterday because crafts left at 3:30 and they requested that he not remove it himself) and took it to a local machine shop to determine the trueness of the surface.

2/11 ORNL Greg Boris requested lifting design capacity for the lifting lugs on the pump skid. ORNL is changing the skid to include the VFD.

2/12 National Oilwell provided design calculations for the lugs. Each lug is rated for 7500 lb. The VFD weight is 850 lb for the 200V4151 controller panel. The skid calculations do not include valves or piping, just the pump and motor.

2/13 ORNL Greg Boris reported to PNNL and WTI the actuators that control the angle of the extendible nozzle are no longer connected to the arm. This was verified at the Cold Test Facility by inspecting the arm with the remote camera. The actuators still extend and retract; they are just not connected to the arm. The reason that the actuators are not attached to the arm has not been identified. Dan verified that these actuators are connected to the arm via slip rings.

2/16 ORNL Greg Boris reported that mast was removed from the tank. The failure of the arm angle movement was due to the threaded pistons having pulled out of the rod ends that are attached to the launch mechanism. This threaded connection was partially stripped on both the rod ends but the piston threads looked like they might be okay.

2/16 ORNL Greg Boris requested that WTI Joe Maloney provide two replacement rod ends (about $10 each)

2/17 ORNL has elected to house the variable frequency drive on the pump skid. The initial location for the variable speed drive was in the control room. This alternate location was selected to minimize the wiring connections both at the Cold Test Facility and at OHF. This relocation has caused several additional changes including: 1) increasing the skid length to hold the VFD, 2) providing a heater to ensure that the VFD does not operate below 32 F, 3) constructing a housing (NEMA 4 rating) for the VFD, 4) evaluating the lifting lug capacity of the skid (7500 lb/lug) to ensure that it is adequate for the increased load, and 5) providing isolation dampeners to isolate the VFD from the pump and motor.

2/17 National Oilwell has been at ORNL for the past week supporting replacement of the pump suction manifold. The original manifold had a single cork gasket that surrounded the inlet. This seal began to leak at 150 psi and the gasket broke at 200 psi. The pump maximum inlet pressure is 300 psi based on the hydro test condition. The seal is being replaced by three separate O-rings, one for each of the three pistons. National Oilwell is providing a new inlet suction manifold configuration.

2/17 Dan Alberts, WTI, Joe Maloney will send badges to Greg Boris with PO and skid weights.

2/18 PNNL Bamberger requested confirmation that ORNL can support Ralph Hart working over the weekend to install the backup power supply. ORNL site support for weekend work is not strong.

2/18 PNNL Bamberger reports that Fed Ex did not pick up Piping Resources packages; the truck was too small. So the shipment will arrive Friday 2/19.

2/18 ORNL Greg Boris confirms that Ralph Hart will arrive Monday, even though Friday was preferable.

2/19 PNNL Bamberger confirms with Boris, ORNL, that Piping Resources will be at ORNL 2/23 to install the backup power supply.

2/19 Les Lestelle, National Oilwell, called to report that the JWS-340 pump has completed its hydro test. The test included 1 hr of pressurization to 320 psi, followed by an additional hour of pressurization to 240 psi. (This pressure is above the 200 psi maximum operating pressure for the pump inlet).

2/20 CDM Chris Provost requests permission to use Waterjet Technology, Inc drawing 83257 in the Operations Plan for the OHF sluicing system.

2/20 Video conference held to discuss OHF status: participants included DOE Oak Ridge, Jacquie Noble-Dials, Ben Lewis, Clay Bednarz, etc: DOE Richland, Lance Mamiya; TFA Steve Schlahta, Pete Gibbons, Mike Rinker, Judith Bamberger.

2/20 ORNL Greg Boris reported with the help of Joe Bodin from National Oilwell today, ORNL was able to add the oil to the pump, charge the surge suppressors with nitrogen, level the pump and attempt to bump the motor to check for proper rotation. All went well, except that the motor wouldn't turn. The electricians and electrical engineer are trouble shooting this right now. The electrical boxes for the valve actuators were delivered to the cold test area this afternoon. The electricians will be in tomorrow to hang these on the pump skid platform. This will be ready for the valve vendor to wire when he shows up on Monday.

2/20 National Oilwell reiterated that pump safety signals for low and high oil level and low oil pressure need to be included in the PLC.

2/23 PNNL Bamberger requested input from WTI regarding fixing extendible-nozzle snap rings.

2/23 PNNL Need to tag the Gov't equipment: Property tag WD27577-- National Oilwell pump property tag WD27578-- WTI Extendible Nozzle System

2/23-25 Piping Resources worked with ORNL to install the battery back up system for the valves.

2/24 National Oilwell completed integration of the new suction manifold into the high-pressure pump. The pump was pressurized to 320 psi for 1 hr, followed by 1 hr at 240 psi (above the maximum suction inlet pressure of 200 psi). National Oilwell also pressurized the suction dampeners.

2/24 ORNL is designing an electrical box/junction for the controls from the pump (low oil pressure, low oil level and high oil level) to interface them with the CDM Programmable Logic Controller.

2/25 ORNL Greg Boris replied that Bob Carroll and Steve Shock from CDM looked at the rod ends yesterday afternoon. They concluded that they could use the Loctite alone. There was no need for the shims - they can tighten the rod ends until they hit the shoulder on the piston arm. It will be difficult to drill into the piston arm due to its strength, so they didn't think it feasible to do the set screw or cotter pin.

2/25 Les Lestelle, National Oilwell reported that there are three pump safety switches that need to be integrated into your pump control strategy; also Joey Bodin needs to align the sheaves prior to pump operation. He was not able to complete this activity when he was at ORNL fixing the suction manifold.

2/25 Piping Resources worked with ORNL to install the battery back up system for the valves. The boxes were installed and how to complete the wiring was discussed. Greg Boris chose to have ORNL electricians install hard conduit to run from the valves to the backup system instead of the flexible cable that Ralph Hart provided. Greg also chose to have ORNL electricians do most of the wiring. Ralph explained how the boxes were to be connected and integrated with the PLC. Ralph worked at ORNL Monday and Tuesday. Today (Wed) he visited with relatives prior to flying home tonight. Greg and Ralph discussed status at noon today to make sure there were no loose ends.

2/26 ORNL Boris reported that Mark Matthews provided an initial review of the electrical system on the pump skid. Items to correct were identified. CDM and ORNL met to discuss integration of the pump controls into the CDM PLC.

2/26 Weights for pump skid and components were supplied to ORNL.

2/26 ORNL Boris identified interface requirements to allow interface between CDM PLC and the pump interlocks.

2/27 ORNL Boris reported that the new rod ends were installed using Loctite. The extendible nozzle was reinstalled into the cold test tank.

2/27 ORNL Boris guesstimated a weight for the skid as about 20,500 pounds. This was based on Steve Rose's measured weight of the skid during the initial placement in the drip pan (18,000 pounds prior to ORNL adding the platform and assorted equipment on the one end). The platform, VFD, house and control panels add about 2,500 pounds.

3/2 ORNL Boris reported that staff identified that the adapter flange and the valve flange grooves did not align, so the last gasket could not be installed.

3/3 Midyear reviewer information was sent to ORNL.

3/3 ORNL Boris reported that relay boxes for pump control have arrived.

3 /4 ORNL Boris reported that both flange grooves were measured.

3/4 PNNL Bamberger reported on tolerances for machining.

3/5 WTI Alberts recommended shaving a bit off the adapter flange groove. ORNL Boris said it can be done at ORNL instead of sending to WTI.

3/10 Piping Resources forwarded a revised wiring diagram for battery backup system to PNNL and ORNL.

3/10 ORNL installed an electrical box/junction for the controls from the pump (low oil pressure, low oil level and high oil level) to interface them with the CDM Programmable Logic Controller. This was completed with the exception of exchanging one tie in. CDM has begun the electrical tie in.

3/10 After the variable speed drive was added to the pump skid, ORNL reevaluated the capacity of the skid lifting eyes. The capacity was very close to the permissible lifting weight. ORNL will perform a pick with the crane to measure the weight of the skid to verify that the lug capacity is adequate.

3/10 ORNL Boris reported that adapter flange groove enlarged, was still not right, so it was taken back to the machine shop.

3/11 ORNL Boris reported that the adapter flange is being installed. CDM had to purchase new bolts for the flange. The ones provided by WTI were too short.

3/12 ORNL Boris reported that all the piping has been installed.

3/13 WTI will provide a replacement for the bellows adapter. The replacement bellows adapter is about 16.5 inches on the I.D. over the lower most 1-3/8 inch portion of it. This increased diameter is intended to clear the interfering weld bead on the mast clamp of the bridge mount. Unfortunately, this will require that the fixturing clamps on the bridge mount be moved or rotated slightly. These are mounted with #10 screws. WTI should have this part ready to send you in 1 to 2 weeks. WTI will also send the stainless tags with the weight and P.O. number on them. ORNL will receive these early next week. They will come with steel rings so ORNL can hang them on existing fasteners or other convenient features. WTI is sending one for the mast and one for the bridge mount.

3/16 ORNL Boris reported that pump skid wiring should be completed today.

3/16 CDM Provost forwarded the sluicer pump start up procedure for review.

3/17 ORNL Boris reviewed sluicer pump start up procedure and had no comments. PNNL Bamberger forwarded procedure to National Oilwell for review.

3/17 PNNL Bamberger requested that WTI provide patch kit materials for bellows. Initial request made by ORNL Boris 2/4.

3/17 WTI Maloney sent the labels for the extendible nozzle equipment to JR Barnet 3/13. When they arrive, please fasten them to the extendible nozzle and the platform. The bellows manufacturer is providing some sheets of material to WTI. WTI will send them to ORNL with some adhesive. So the bellows "repair kit" is on the way.

3/19 CDM requested a “plug” for extendible nozzle use during pressure test at ORNL.

3/19 WTI Alberts replied that the fitting on the end of the hose is an Aeroquip FJ9372. And recommended that a 3000 psi cap be procured at a local shop.

3/19 National Oilwell Les Lestelle reported that the startup procedure is adequate.

3/19 ORNL Boris reported that the electricians "cycled the valves." All of the valves work.

3/19 ORNL Boris reported that they successfully tested the four valve actuators on the sluicer skid (using local controls). They all worked with a time of 30 to 45 seconds for full travel (open to closed or vice versa). Conrad Wysor also tested the interlocks that were installed for the pump motor (low oil pressure, high and low oil level). The high and low oil level wiring required a change, but they all work. ORNL may try tomorrow morning to disconnect the motor from the VFD and check the interlock function with the VFD powered up. The next step is for CDM to tie in their PLC control cables and for ORNL to actuate these from their PLC.

3/23 ORNL Boris reported that CDM wired in the sluicer skid controls to their PLC. As of this morning, the remote cycling of the valve actuators on the sluicer skid was not working. Conrad Wysor was on his way out to help in resolving the situation. Boris spoke with Mark Mathews about inspecting the skid and he said he had planned to do this Saturday but was tied up on another job. His plan now is to do this this morning. Boris will let PNNL know what deficiencies he finds.

3/23 PNNL authorized National Oilwell to provide support at ORNL during pump startup.

3/24 ORNL Boris reported that three of the sluicer skid valve actuators are working via remote control from CDM's PLC. The fourth one will require a minor programming change in the PLC logic. They expect that this will be performed today or tomorrow. Mark Mathews has inspected the skid electrical and has sent us a list of items that need completed. These are mostly grounding issues. Some additional fusing is also required. The Plant and Equipment division (P&E) buyer was trying to get these yesterday for installation today. The rest of the fixes will be completed hopefully by tomorrow. Boris asked Mark M. to reinspect Wednesday or Thursday, but his schedule is pretty tight right now. Boris will coordinate with him regarding progress making the corrections. In talking with Mark, the wiring inside the vendor-provided fail safe boxes was discussed. Mark may make ORNL do some additional wiring changes because none of the neutral wires in the boxes were white in color. This is not only a national, but international standard and code requirement. If he does make ORNL do this, it may cost an addtional day for rewiring.

3/24 ORNL Boris reported that Chris Provost, Jacquie and he met this morning to discuss National Oilwell support for the pump start. They decided that it was best that they are on-call such that when ORNL knows for sure that they will start the pump, National Oilwell will be notified the day before. This means that you may receive a call Thursday for them to be here Friday or Friday for them to be here Saturday.

3/24 ORNL Boris reported that ORNL will require about a day of rewiring the fail safe boxes to follow national code on neutral wire color.

3/25 PNNL Bamberger lines up Gary Kiebel to visit ORNL 3/30 to work with CDM's Joe La Rosa to set up the visualization system and calibrate it.

3/25 ORNL Boris confirms that CDM removed a mass flow meter from between the outlet of the ORNL medium-pressure pumps and the inlet to the sluicer pump that powers the extendible nozzle. Bamberger also found out that CDM had issued a revised "finalized" cold test plan in November 1997. PNNL did not receive one.

3/25 ORNL Boris sent Section 4.4.3 Sluicer Pump Test 4.5 Sludge Pumping Test 4.6.1 Routine Startup Operation and Shutdown and Work Instrumentation 1 Sluicing System Startup to PNNL. PNNL requested a copy of the finalized test plan to be provided during the readiness review. Bamberger requested that ORNL also add my name to the distribution list for the OHF Tank Cleanout Plan, that is equivalent to this Cold Test Plan.

3/25 ORNL Boris reported that the operations plan has been drafted and not reissued pending the outcome of the cold test..

3/26 ORNL Boris reported that the electrician completed the punch list from Mark and the neutral wire changeout. Boris talked to Mark, and he will try to go out to reinspect this afternoon. CDM has started and completed checking out the PLC interaction with the controls (loop tests) that were identified in the cold test plan. THey found a minor problem with one of the fail safe boxes, but this can be remedied quickly (tomorrow morning) and will not stop ORNL from proceeding with the cold test. (Note: there is a switch in each fail safe box which we can set the position of the fail safe, either open or close. The problem is that with the fail safe switch set to open, the valve fails closed, and vice versa.)

ORNL is trying to set up the hoisting and rigging crew to remove and replace the borehole miner so they can perform the leak test on the high-pressure side tomorrow morning. They are going to the cold test site right now to perform the removal. The problem may come in putting the miner back in tomorrow after our leak test. They are pretty well tied up all day. Unless there is a cancellation, they can do this after 3 pm tomorrow. This would mean that we wouldn't be able to start the pump until late tomorrow evening or Saturday morning. Boris is going to call National Oilwell to let them know that they should be here tomorrow afternoon to assist in the startup, which may slip to Saturday morning.

3/27 ORNL Boris reports that the third inspection of high-pressure pump skid set up at a test site near Bldg 7600. Inspection done 03/26/98 by M. E. Mathews. All inspection findings have been satisfactorily corrected.

3/27 ORNL Boris reported that ORNL was attempting to leak test the high-pressure side of the pump out through the borehole miner. The hydrostatic pump either is too small or has a malfunction that prevented ORNL from developing enough pressure to do the leak test. Boris called several people to see if we could get a replacement pump quickly, but was unsuccessful. ORNL has decided to proceed on with starting up the sluicer pump, initially with clean water, and leak test the system using the sluicer pump. Close attention to the interface flange will be paid during the initial testing (the bulk of the spray shield is in place and in the event of leakage, will prevent it from leaving the pump skid area). ORNL will be able to slowly bring the system pressure up to 1500 psi. They are currently awaiting the rigging crew to place the miner back into the test tank and the arrival of the pump vendor to initiate the pump startup.

3/27 ORNL Boris reported while they had the nozzle out of the tank today, he took a look at the rod ends to see if the piston arm had backed out of the rod ends at all. Neither looked like this had happened. However, the rod ends had turned slightly (at the ball joint) such that they were no longer in the position in which they were installed (i.e., not parallel to the mast, just turned slightly). It looks like the corrections we made are holding for now.

3/27 ORNL Boris reported late this afternoon when they tried to get the pump to run, they encountered a fault code on the VFD. This prevented any operation of the pump motor and thus they could not start the testing. ORNL contacted Conrad Wysor and he came back to the site (from home), but indications were that the control board in the VFD was not working. ORNL called Reliance Electric, the manufacturer, however, all technical support offices were closed for the day/weekend. Boris did talk to an office in California, but the information he required to be able to help me entailed a complete check out of the electrical supply and VFD. This will require an electrical engineer and electrician. Boris also tried calling our P&E electrican and his supervisor at home to see if they could get some help this weekend, but didn't succeed.

3/30-31 PNNL Kiebel at ORNL to fix visualization system. He traveled to Oak Ridge National Laboratory (ORNL) from 3/29/98 through 3/31/98 for the purpose of determining why the ORNL personnel could not complete the calibration of the extendible-nozzle visualization system according to the procedure provided in the Operations and Maintenance Manual (OMM). This trip was undertaken after several telephone conferences between myself and the lead technician at ORNL that were able to resolve several earlier problems, but not a final one. The problem was simple, but subtle. It is an idiosyncrasy of the user interface software for the visualization system that the "enter" key must be pressed after a new value is typed into an entry field for the change to take effect. It is possible to move to another field without doing so (typically by selecting it with the mouse). In this case, the new value remains on the display, but is not recognized by the software. The need to press the "enter" key following entry of new values is stated in several places in the OMM, but, unfortunately, not in the section on input calibration.

3/30 WTI Alberts reported that the replacement adapter is still in fabrication, WTI is waiting for the repair materials for the bellows patch kit; he also stated that it is OK to use a simple figure that has no equipment internals or schematics of the system.

3/30 ORNL Boris reports that Conrad Wysor, the electrical engineer, came out again this morning and worked through the problem in starting the VFD/motor. It ended up that an analog signal being sent out of the VFD to the PLC was causing the problem (I may have messed up this description, but the problem was wiring and has been fixed). The sluicer pump motor was then able to be started. In trying to bring the pump up to a higher speed, it was not developing a pressure above 27 psig. ORNL thought it might be that they had blown the rupture disk or the pressure relief valve was set incorrectly. They found that the pressure relief valve was allowing flow through it. ORNL checked with the valve vendor to investigate how to correct the valve setting. They still couldn't get this corrected. ORNL spoke with WaterJet late this afternoon and got some direction on setting the valve and will try this tomorrow morning. Also early this morning while the visualization system was being calibrated (with the help of Gary Kiebel from PNNL), it was found that the extendible arm could be extended but not retracted. This was operated incrementally until the arm was fully extended and couldn't be retracted. Joe Maloney (WaterJet) also told ORNL how to check if this was a hydraulic problem or a mechanical problem. This will be attempted tomorrow sometime after they test the pressure relief valve.

3/30 ORNL Bednarz requested WTI support at ORNL during the remainder of startup. PNNL Rinker authorized WTI to provide support.

3/31 ORNL Boris reported that after their discussion late yesterday with the WaterJet engineer (Joe Maloney), they were able to set the pressure relief valve this morning. Using water only, they then started the sluicer pump and developed operating pressure. The starting pressure at the lowest speed (set in the VFD software) was about 200 psig. The suction inlet pressure was about 25 psig or so. They incrementally brought the discharge pressure up to about 1200 psi, using the local controls on the VFD. The suction pressure was about 14 psig at this maximum. They could not achieve a higher discharge Pressure because the VFD only allowed them to run the motor at a certain speed. They also could not reach a point where the Moyno pumps were starving the sluicer pump. The National Oilwell technician was pleased with the operation but would like to run the pump a little longer. The next step was to add more water and run the entire system remotely from the PLC. This was being set up right now and should occur this afternoon.

3/31 ORNL Boris requested information on the acceptance tests for the extendible nozzle, sluicer pump skid, and instrumentation. PNNL Bamberger faxed the information to Boris.

3/31 ORNL Boris reported that as a result of their morning tests, they reset the low intake pressure switch to 14.5 psi and tested it to see that it would work. They also tested the high outlet pressure switch and found it functioning properly. They attempted to operate the sluicer pump from the PLC and encountered a problem. They traced the wires and will get Conrad Wysor out to the cold test tomorrow morning to help rectify this problem (he was at his Bechtel Jacobs Company team meeting this pm).

3/31 ORNL Boris reported that they exchanged hydraulic lines. This did not permit the mast to retract.

3/31 WTI Alberts gives CDM permission to use extendible nozzle figures.

4/1 WIT Maloney at ORNL to provide extendible nozzle support during startup.

4/1 ORNL Boris reports that Joe Maloney (WaterJet) has looked at the borehole miner system and has increased the hydraulic pressure on the arm extension controls. This resulted in the arm being able to be retracted and extended with no problems. He will be around for a few days to help in the cold test operations. Conrad Wysor and CDM have figured a fix for the remote operation problem on the sluicer skid. This will require adding a relay to the controls for the start/stop operation. They are working right now to get this change accomplished.

4/2 ORNL Boris reports that they have successfully started and stopped the sluicer pump from the PLC. They could adjust the speed from the PLC, however the speed shown on the PLC didn't match up very well with the actual pump speed. This is being looked at this morning. The borehole miner arm is still operating well. Joe Maloney is still here to assist as needed on the system.

9.2 ORNL Activity Chronology

Logbook entries were summarized to provide a chronology of borehole-miner extendible-nozzle operations at Oak Ridge National Laboratory.[1], [2] Borehole miner installation and operation during cold testing is summarized in Table A.1. Activities associated with borehole miner installation at the OHF site are listed in Table A.2. The listings in Tables A.1 and A.2 only include activities that pertain to components of the borehole-miner extendible-nozzle system supplied by EM-50. Activities describing set up of the balance-of-plant equipment were not included. Borehole-miner extendible-nozzle operation during remediation of Tanks T3 and T1 is described in Table A.3. Remediation of Tanks T4, T2, and T1

[1] OHF Site Log Book #1, OHF Tank Contents Removal Project, Lockheed Martin Energy Systems Contract# 5151-015, Start Date 11/23/97, Completion Date 7/7/98, DCN# 5151-015-FL-BBTJ.
[2] OHF Site Log Book #2, OHF Tank Contents Removal Project, Lockheed Martin Energy Systems Contract # 5151-015, Start Date 7/7/98, Completion Date 8/31/98, DCN 5151-015-FL-BCDP.

are summarized in Tables A.4 through A.6, respectively. The tables that summarize remediation include activities that pertained to system operation and water addition. Activities associated with borehole-miner extendible-nozzle disassembly are listed in Table A.7.

Table A.1 Logbook entries related to borehole miner-extendible-nozzle operation during installation and cold testing

Date	Time	Entry
12/2/97	15:15	Greg is concerned about the connection of the sluicer to the riser for the cold test. He will contact Pacific Northwest National Laboratory to determine if we need an additional gasket.
12/4/97	07:01	Begin plumbing pump skid.
	12:50	Late entry. John Ellis (structural LME) on site to look at pump skid to take measurements. He will investigate possible problem with placing skid at OHF site.
12/5/97	07:03	Work with sluicer representative to get ready for setting up the sluicer base.
	09:15	Chris Provost and Rick Stagi (Waterjet Technology technical representative) on site.
	11:00	Team discusses plan for sluicer base and mast placement. Team will plan to start work on hoisting and rigging of sluicer equipment on Saturday morning instead of this afternoon.
12/6/97	07:01	Plan for the day. Set sluicer skid and mast.
	7:45	Team measures sluicer mast length that will hang below the sluicer base support ring. Distance of 17 ft 4 in. from point at which mast assembly rests on sluicer platform assembly to bottom of launch assembly.
	08:08	Begin to hoist and rig sluicer platform assembly on top of the Tank T1, 18-in. riser.
	08:21	Sluicer platform assembly set in place and centered over riser. Team raises adjustable legs on sluicer platform assembly so that the bottom of the launch assembly does not touch the bottom of the tank. One final measurement: 2 ft 7.5 in. from the bottom of the sluicer assembly to the tank floor. Distance from bottom of tank to point at which sluicer assembly joins with sluicer platform assembly base is 19 ft 11.5 in. This distance is composed of 8-ft Tank T1 diameter; 5 ft from top of tank to top of Tank T1 flange; 6 ft 1.5 in. from top of Tank T1 flange to point at which sluicer assembly joins with sluicer platform assembly base..
	08:45	Begin to hoist and rig sluicer assembly onto sluicer assembly platform base.
	09:11	Team encounters difficulty lowering assembly into assembly platform base. Assembly will not lower fully into place. Team lacks several in. for a proper fit.
	09:45	Team attempts to lower assembly several times into base with no success of mast ~hour or so.
	11:08	Team has decided that the sluicer assembly is not perfectly round and is sticking --locking up with the assembly platform base. Rick Stagi (Waterjet Technical representative) recommends we sand the imperfection on the sluicer assembly so that it will fit into base correctly.
	11:18	Team begins sanding. After sanding is complete, team greases sluicer assembly arm in the area where sanding was conducted to help prevent rusting.

Date	Time	Entry
	11:48	Sluicer assembly now fits properly with and into assembly platform base.
	13:54	Rick Stagi continues to set up the borehole miner system (hydraulic unit, control unit, etc.).
12/7/97	07:01	Rick Stagi (Waterjet technical representative) on site.
	07:41	Complete setup of borehole miner system.
	07:51	Rick Stagi is still working on hydraulic and power hookups for the borehole miner system.
	16:25	Late event. Sluicer control unit, sluicer hydraulic unit and hydraulic lines/power connection are now complete.
12/8/97	09:28	Greg Boris on site. He has another list of concerns from Mark Matthews (regarding electrical inspections).
	10:02	Brad Alsobrooks (CDM Federal) on site to set up borehole miner sluicer modeling system.
	10:52	Brad Alsobrooks gave Jim LaForest passwords for the extendible-nozzle visualization system. They are listed in the logbook and are contained in project file.
12/11/97	13:10	P&E on site to mark 1-ft intervals on sluicer feed hose.
12/15/97	10:30	High-pressure pump skid arrived. Waiting for P&E to unload the skid off the truck.
	14:00	High-pressure pump skid was unloaded.
01/05/98	08:30	Meeting conducted to discuss details including hydraulic power unit.
	13:00	Greg Boris on site to look over PNNL skid to help resolve some connection problems.
01/07/98	07:05	Plan of day is to transfer hydraulic oil from HPU to the process water pump and test the motor valves.
	09:15	Got pump from Jeff Barnett (hand pump) to pump oil from HPU to put a valve on the HPU.
	16:53	Jim LaForest called Mike Yost of SAS (who manufactured the HPU) for the sluicer system. Mike provided information how to replace the switch on the HPU unit verbally. All that is required is to unscrew the existing switch after tank has been drained.
1/08/99	11:00	Filled HPU with hydraulic fluid to replace fluid used for process water pump.
	11:30	Switch was replaced on HPU.
	12:00	Powered up all components of the borehole miner system. Team intends to test control of sluicer inside of tank. Attempted to rotate sluicer arm but system HPU shut down. Called Rick Stagi (Waterjet Technology) and he indicated the problem was in the HPU and to trouble shoot the HPU unit.
	12:45	Electrical trouble shooting of the HPU determined that the level switch that was installed had not been adjusted. Team will adjust the switch.
	13:10	Retested HPU and determined all lines were working except right/left arm movement of the borehole miner arm. Pretest suspended.

Date	Time	Entry
	15:01	Late entry. At 13:30, the team detached the hydraulic level switch to test the sluicer control system. The following functions work correctly: stiffen and relax, up and down, out and in. The right and left controls did not work. Therefore the team cannot get sluicer rotation.
	15:10	Late entry. The team called Rick Stagi of Waterjet to discuss problem with arm rotation. He provided instruction on how to adjust the flow control and pressure control settings on the sluicer control unit.
	15:14	Team conducts test with sluicer control unit and adjusts flow control and pressure controls as recommended by vendor representative (Waterjet Rick Stagi). The arm is still not working correctly.
	15:50	The team is setting the low-level switch on the HPU unit in accordance with verbal instructions from Rick Stagi.
01/09/98	15:30	At approximately 14:15, Chris, Bob, and Keith tested sluicer mast rotation, energized the HPU, confirmed pressure 1500 psi, tested arm extension and angle and both functioned properly. Tested mast rotation, 1500 psi on both right and left rotation, but got no movement of mast. Repeated activation of right and left control, noted rotation of motor into gearbox at the mast and noted rotation of mast at gearbox. Rotation was less than 1/2 revolution and it stopped (rotation) even if controller was activated. No rotation of the main gear was noted. Contacted Rick Stagi (Waterjet) informed him of problem, contacted Greg Boris (LMES) of problem. Disconnected power to HPU.
01/10/98	10:30	Crew reversed leads on analog signals from sluicer control panel to PNL, resulting in communication; however, the correct angle readings don't appear to be received at PLC.
01/17/98	11:30	Process water flow totalizer on OMI was accidentally reset to 0 gal; therefore, the total volume in the recycle tank is not known. Joe La Rosa disabled all the reset push buttons. The team will empty the recycle tank and refill to the desired volume needed to mix with kaolin in sluice tank.
01/21/98	14:20	Programmed transmitter on sluicer panel to transmit correct ranges to the PLC and the silicon graphics system.
01/22/98	14:46	Team completed transfer of water from recycle tank to obtain correct water to kaolin ratio.
	15:47	Team transferred 2179 gal of process water to recycle tank.
	16:25	Team starts transfer of process water from recycle tank to sluice tank. Team starts to add more process water to recycle tank. A total of 3014 gal has been transferred.
	17:16	Complete transfer of process water from recycle. A total of 3014 gal was transferred to the sluice tank.
01/23/98	18:40	Team set up to perform sluicing test checklist 4.5.2 perform manual sluicing operations; had difficulty dispersing kaolin at bottom of sluice tank. Postpone performing the test until after team can disperse kaolin from bottom of tank. Set up portable flow meter on the 1 1/2 S.S. sluicer line and maximum flow was 18 gpm. Team will trouble shoot to obtain higher pressure and increase flow through the sluicer. Team is transferring all liquids into sluicer tank.
	19:00	Team starts line flushing in accordance with instructions Work Instruction #14.
	19:15	Complete line flushing. Additional process water added to system. A total of 3953 gal has been added to date.

Date	Time	Entry
01/24/98	8:10	Late entry. 07:30 hrs transferred approximately 1000 gal water from sluice tank to recycle tank. 08:30 hrs conducted a test on the high-pressure pump HPP-320-2; unable to obtain any pressure above 62 psi. 09:00 checked rupture disks on HPP-320-2. Disk is ruptured. 09:10 checked disks on HPP-320-1 also ruptured. Team reviewed historical trends for HP discharge readings on the OMI. No readings above 195 psi were noted in the last two days. Team is unsure of disks that were ruptured. This explains the low-pressure readings yesterday from the high-pressure pumps. Team will replace rupture disks.
	17:05	Team tested automatic sluicing sequence and it works properly. Discovered rupture disks do not break when modulating valve 340-1 is partially open before starting the sequence. Joe La Rosa rewired analog signals from sluicer control panel to PLC and visualization system. It appears the proper signals are received at the PLC and visualization system; however, the software is not functioning properly.
01/25/98	8:15	Plan for today is team training of the closed loop sluicing system.
	08:30	Transferred water from sluice tank to recycle tank.
	08:40	Lowered sub pump in sluice tank.
	08:45	Began aligning system components to begin sluicing from HPP3 per Work Instruction #1.
	09:45	Finished aligning system to begin sluicing.
	09:55	Began sluicing sluice tank. Began sluicing the tank manually. Sluiced all the clay from around the sluice tank sub pump.
	12:45	Stopped sluicing for the day. Began transferring all the water from the recycle tank to the sluice tank. For more information refer to videotape date 1-25-98.
01/26/98	08:15	Team initiated sluicing operation. System was configured in accordance with Work Instruction #1. Mast angle LED readout of the hydraulic system console is not working.
	08:30	Sluicer mast seemed to be moving much slower than yesterday. Team will trouble shoot to determine reasons for mast LED and movement working improperly.
	10:35	Mast angle LED began working. Team began sluicing the tank again.
	11:35	Stopped sluicing operations. Team was successful in suspending all kaolin solids in the water and pumped all the water to the recycle tank. Team will begin pumping all the water from the recycle tank back into the sluice tank.
	13:00	Finished pumping water from recycle tank to the sluicer tank.
01/27/98	09:00	Conducting training on sluicer arm.
	11:18	Team practices sluicing operation in accordance with Work Instructions 1, 7, 14.
	16:19	Team starts transfer of all slurry from the recycle tank to the sluice tank.
	16:20	Finish transfer of water to sluice tank.

Date	Time	Entry
01/29/98	16:55	Team went over plans for tomorrow's training: removing/relocating the sluicer mast arm.
01/30/98	07:25	Late entry from yesterday. Team attempted to retract sluicer arm but was unable to retract past 96 in. Team tried a variety of methods to retract sluicer arm; also team called vendor, Rick Stagi of Waterjet. Team intends to remove sluicer mast from base to check for obstructions today.
	11:45	P&E crew finished extracting mast arm from tank. Team lay mast on stands so as to trouble shoot extension arm.
01/31/98	07:40	Team will work on Waterjet mast.
02/02/98	14:40	Joe Maloney from WTI arrived today to work on sluicer mast. He has determined the collar inside the mast was hitting a bolt or interference. Greg Boris has been assisting Joe on this trouble-shooting problem.
	17:35	Joe Maloney of Waterjet made adjustments to the chain drive on the borehole miner. He has to make some more adjustments, and it is expected that the borehole miner will be repaired tomorrow.
02/03/98	07:30	Joe Maloney of Waterjet will continue working on Waterjet sluicer arm.
	09:30	P&E crew arrives to lift Waterjet sluicer mast to move the collar up so Joe can attach the screws back on.
	10:00	P&E finished with hoisting mast. They will return at 12:30 hrs to install mast back into stand and tank.
	13:30	Team finishes installing Waterjet mast; began hooking up lines and finish installing bolts to see if Waterjet sluicer is fixed.
02/04/98	07:30	Continue working on sluicer.
02/05/98	12:30	P&E crew arrives to lift sluicer mast to install bolts on base.
	14:00	Team determines that bolts won't work. They remove the bolts to have the machinists make flush ones. Will try to install them again tomorrow.
02/06/98	07:30	Team will continue training on camera and sluicer. Team will also install new brackets on sluicer and lift it to see if it will lift the unit.
	12:30	P&E crew arrives to pick up sluicer mast and install flush brackets on base.
	13:35	P&E take a break, after team has completed lifting mast and stand correctly.
	13:50	Initial totalizer reading FE210 is 12815 gal.
	14:30	Finish totalizer reading is 12833 gal.
	16:05	Sergio installed sluicer mast rinse hose.
02/07/98	7:30	Continue training on sluicer. Late entry. Chris Provost talked with Joe Maloney from Waterjet. He informed Chris he saw no problem with screws team used on brackets that were put in on Friday.
	8:45	Team began work construction #2. Sluicer Mast Placement.
	10:00	Team has completed practice run Sluicer Mast Placement. Team will debrief and comment.

Date	Time	Entry
	12:20	Team finishes second time, practice in full dress out.
02/09/98	07:30	Connect bellows mount to sluicer.
02/10/98	09:00	Completed repair on bellows on the sluicer.
	15:00	Joey Bodin of National Oilwell is on site to repair gaskets on sluicer pump skid.
02/11/98	07:25	Plan for the day is to repair sluicer pump.
	08:00	Rigging crew arrived to remove manifold from sluicer pump and camera from sluicer tank.
	08:45	Rigging crew is finished with their tests.
	08:50	Joey Bodin and Sergio went to have a part made for the sluicer pump.
	10:30	Sergio and Joey returned, part will be ready today around 3:00 pm.
02/12/98	07:30	Plan is to replace manifold and finish repairs on sluicer pump.
	07:40	It was determine by the machine shop that the manifold alignment was off by 1/100th in. Machine shop aligned the manifold. Rigging crew arrived and Joey Bodin, OHF team and rigging crew replaced the manifold on the sluicer pump. Team and rigging crew also replaced camera.
	08:05	Manifold is in place for Joey to complete work.
	08:20	Chris Provost and team plan to conduct hydrostatic test on sluicer high-pressure pump.
	08:40	The sluicer pump was hydrostatically tested and still leaked around the manifold. Joey Bodin will try using a cork gasket to seal the manifold.
	11:00	Joey Bodin determined that a new plate needs to be machined after the new gasket failed the leak test. Arrangements are being made to have a new plate manufactured.
	15:30	Late entry. Jim LaForest accompanied Joey Bodin to machine shop in Clinton to provide specifications for manifold plate.
02/13/98	07:30	Conduct sluicing tests.
	09:05	In the process of manipulating the sluicer, it was found that the arm angle control was not working. Team checked all electrical and hydraulic lines and found no problems.
	09:15	It was determine that connections between the arm and the hydraulic pistons were not on the sluicer. The connections had fallen off. Began transferring liquid from recycle tank to the sluice tank.
	09:30	It was determined that no parts may have fallen off the sluicer, but rather the coupling between the hydraulic piston and arm angle manipulator may have come loose.
	10:40	Completed line flushing and used 801 gal of water during process.
02/16/98	07:30	Remove sluicer from tank for repairs.
	08:20	Riggers have arrived to remove sluicer from tank.

Date	Time	Entry
	09:45	Completed removing sluicer from tank.
	10:30	Completed reconnecting lines to sluicer to repair and test sluicer.
	11:00	Completed etching wrenches to use with sluicer.
02/17/98	13:45	Joey Bodin called and said he expected the manifold head to be finished by tomorrow afternoon and wanted to have the riggers lined up by Thursday.
	14:00	Greg Boris came to the site to take measurements on the sluicer for Waterjet.
	14:50	Rick Sally helped Greg Boris with sluicer rod.
02/18/98	13:00	Electricians perform work on sluicer pump skid.
	13:40	Team completed engraving pressure hoses for sluicer.
02/19/98	07:30	Joey Bodin from National Oilwell here to install manifold on sluicer pump.
	08:15	Riggers on site to help install manifold on sluicer pump.
	11:00	Hydro test on sluicer pumps successful. Tested at 320 lb for 1 hr and 240 lb for 30 min.
02/20/98	07:29	Plan to level sluicer pump and take off housing from water jet stand.
	09:40	Riggers on site to level sluicer skid and take collar off water jet mast.
	12:40	Joey Bodin continues working on sluicer skid.
02/23/98	07:55	Safety topic: watch out when working on sluicer skid. Team will not work on sluicer skid until LMES is finished with it.
	10:00	Team measures dimensions of skids to determine where to place them at OHF site.
02/24/98	15:00	LMES continues working on sluicer skid, having repaired mast arms.
02/25/98	15:03	Mark Matthews (electrical inspector) inspected sluicer pump skid. He will transmit information about any problem via email to Greg Boris.
02/26/98	07:30	LMES working on sluicer pump.
02/27/98	07:30	Plan to pipe sluicer pump into system.
	08:30	Greg Boris is on site to repair piston rods that adjust arm angle and the borehole miner. Conducted pre-operational checklist.
	11:40	Put sluicer back into tank. Riggers assisted in replacing sluicer. Had problems getting new bolts for brackets into their holes. Team had to use old bolts on one bracket. Holes need to be tapped.
03/02/98	14:00	Team continues piping in sluicer pump.
03/03/98	07:30	Plan to finish piping sluicer pump into the system.
	10:15	Completed piping the sluicer pump into the system.
03/10/98	07:30	Plan to begin work on wiring sluicer pump skid .

Date	Time	Entry
	07:50	Bob Carroll sent the 1500-lb flange back to the machine shop to be cut down. Bob also called Greg Boris to inform him of the situation.
	14:30	Greg Boris, Bob Carroll, and Jim LaForest completed a conference call meeting with Omar Naji (CDM Federal Instrumentation). They discussed and resolved problems with wiring the sluicer pump skid into the system.
03/11/99	07:30	Plan to wire the sluicer pump skid.
	13:00	Work continuing on sluicer skid.
03/12/98	07:30	Plan to connect 1500-lb flange to sluicer and tie into system.
	07:45	Bolts provided by LMES for the 1500-lb flange were not threaded long enough and were such that the heads would not fit against the flange when tightened down. To resolve the problem, new threaded bolts were cut to tie the flange to the system. Chris Provost (CDM) and Greg Boris (LMES) were called and appraised of the situation.
	11:45	Completed installing 1500-lb flange and tying the sluicer pump skid into the sluicer water intake hose.
	14:15	Test sluicer manipulator with the HPU and everything is operating properly except the stiffen/relax manipulation. All were working slowly at first due to the cold temperatures (~15 F) but began to operate faster as each control was used.
03/13/98	07:30	Plan to wire the sluicer pump.
	12:30	Electricians are back to wire sluicer pump skid.
03/13/98	07:30	Plan to wire the sluicer pump.
	12:30	Began prep work for wiring the sluicer pump skid to the PLC.
03/18/98	07:30	Plan for Jim, Rick, Sergio, and Jay to practice on sluicer and camera moving with P&E crew. Late entry. Task performed Tuesday, March 17. Prepared cables for sluicer pump skid tie in.
03/19/98	13:00	Tested sluicer pump skid valves locally and all worked on local cycle.
03/20/98	07:30	Plan to wire sluicer pump skid to PLC.
	10:00	Began laying wire for sluicer pump skid to be connected to the PLC.
	12:30	Began landing wire on sluicer pump skid.
03/21/98	11:30	Continued wiring sluicer pump skid to the PLC.
	12:05	Closing log book. Some team members staying to work on wiring.
03/23/98	07:30	Plan to finish sluicer pump skid wiring to the PLC.
	10:00	Tested valve MOV 675 and the valve works properly. Team will now wire the other valves on the sluicer pump skid by the same configuration.
	11:30	Mark Matthews inspected the sluicer pump skid wiring. Greg Boris has a list of things that need to be corrected.

Date	Time	Entry
	13:20	All MOVs are working on the sluicer pump skid except MOV 665. It doesn't work through the PLC because it was not programmed into the OMI yet. MOV 665 does work locally.
03/24/98	07:30	Plan to test fail safes and wire sluicer pump into the PLC.
	09:30	MOV 665 on the sluicer pump skid is now working properly. All MOVs on sluicer pump skid are now working. Workers from LMES are also mounting a Plexiglas housing on the sluicer pump skid.
	13:00	All wiring is complete from the PLC to the sluicer skid.
03/25/98	07:30	Plan to work on punch list for sluicer pump wiring.
	12:30	Gary Kiebel of PNNL was contacted to help with calibrating the visualization system. Joe La Rosa explained the steps that were used to calibrate the system. Gary Kiebel said that it was done correctly. Kiebel felt the problem was in the software. Kiebel will fly to ORNL at the end of the week or the first of next week.
03/26/98	09:05	Jim LaForest talked to Greg Boris and received permission to run the instrumentation control loop testing on the sluicer skid once the electrician had completed work on laying conduit.
	09:15	Electrician finished laying conduit on the sluicer skid. Electrician completed his work. No lock out tag outs remain on the sluicer skid. Team will apply power to the sluicer skid to test the control loops.
	10:52	Greg Boris informed that MOV 675 fail safe is not working correctly.
	11:29	Sluicer pump related test cannot be performed until Mark Matthews inspects skid.
	13:21	Hoisting and rigging crew arrives. Team removes sluicer from sluicer base and lays it on its stand. The team plans to install a slurry fitting on the end of the sluicer so that we can leak test the high-pressure side of the sluicer pump.
	13:45	Sluicer removed at this time.
	15:23	Team is moving all slurry into the sluice tank in preparation for further cold test operation.
03/27/98	07:30	Plan to flange leak test the sluicer pump skid, prepare the sluicer tank to test the sluicer pump.
	07:50	Mark Matthews has approved the electrical equipment on the sluicer pump skid and Joey Bodin from National Oilwell will be here this afternoon. Plan is now to start cold test on the sluicer pump skid.
	10:26	Began transfer of excessive supernate in the sluicer tank to the dumpster.
	10:52	Transferred a total of 1700 gal of supernate to the dumpster from the sluicer tank.
	11:15	Team has been attempting to leak test the discharge side of the sluicer pump skid, but the air driven hydraulic pump is not functioning properly. Team is now attempting to find a new test pump or repair the pump that is not functioning properly.
	14:55	Completed replacing sluicer mast into tank with rigger's assistance.
	15:30	Joey Bodin from National Oilwell is on site to help with the startup of the sluicer pump. Joey Bodin checked the alignment of the sluicer pump skid sheaves. Minor adjustments were made so the drive belt is now properly oriented.

Date	Time	Entry
	15:40	Late entry. At approximately 12:00 Greg Boris, Chris Provost, and Jim LaForest decided to proceed with cold test without the leak testing of the high-pressure side of the sluicer pump. The team will observe the high-pressure side for leaks during operations during the cold test. Team will fix air driven hydraulic pump and perform leak test at OHF once the piping has been installed.
	16:35	Joey Bodin is fitting up the water spraying system of the sluicer pump.
	16:56	Team checks rotation of sluicer pump. Attempt to start pump in local but VFD has "F3" fault reading. Team attempts trouble shooting but no progress is made. Team calls Conrad Wysor (LMES electrical engineer) for advise.
	18:20	Conrad Wysor arrives on site and team trouble shoots the system. The most likely cause is a faulty regulator board in the VFD. Team is attempting to place an order for a spare board at this time.
	19:45	Greg Boris called vendor (Reliance) no luck trouble shooting over phone. Greg is going to attempt to get vendor to investigate problem.
03/31/98	07:25	Plan to work on problem with the sluicer pump skid.
	08:05	Conducted pre-operational checklist. Problems encountered included sluicer arm extension isn't working. Late entry. On Monday, March 10, the electrical problem on the sluicer skid was corrected, but when tested, it would only generate 27 psi of pressure. Also the visualization system is now working. It was determine that the arm extension of the sluicer is not working.
	08:25	Late entry. More details on yesterday's activities. Sluicer mast extension is not working correctly. It will not retract the sluicer arm. Waterjet was contacted and will fix it at a date to be determined. Team attempted to run sluicer pump using clear water pumped into the recycle tank. Was able to get 30 psi on the sluicer pump. Team determined that the mechanical relief valve had activated.
	09:10	Pressure relief valve (mechanical) on sluicer pump skid was reset. Relief pressure on valve was set at 1500 psi.
	09:15	Team conducts training on sluicer visualization system by Gary Kiebel.
	09:30	Team conducts pre-operational check on sluicer pump skid. Joey Bodin of National Oilwell conducted the training.
	09:50	Start running sluicer pump skid in the local. Greg Boris, Joey Bodin, Jim LaForest, Chris Provost on site. Pump ran OK! Maximum pressure was obtained at 1200 psi. Other settings were: Sluicer pump intake pressure 14 psi Sluicer pump discharge Pressure 1200 psi Moyno pump intake 23 psi Moyno pump discharge Pressure 17 psi Moyno speed at 100 %

Date	Time	Entry
	11:09	Greg Boris directed the team to switch the hydraulic lines at the HPU/control unit for the extension function to see if we can retract the sluicer arm. Team watched lines at local control unit.
	12:08	Attempted to retract sluicer arm with hydraulic line switched at sluicer control unit. Arm did not retract. Informed Greg Boris of LMES that test was not successful. He instructed CDM Federal to reconnect hydraulic line to the original position.
	13:00	Team placed sluicer pump VFD in remote position. Pump started locally without receiving signal from PLC. Once team noticed this, the pump was stopped by pressing the sluicer pump E-Stop button. Called Greg Boris to inform him of the situation. Also informed Greg Boris that the low-pressure switch for the sluicer pump has been jumpered to deactivate the shut off. Greg is trying to get Conrad Wysor to help trouble shoot problem and to be present during a test of the local interlocks. Team is on "STANDBY" waiting for Conrad Wysor before finishing the cold test.
	15:00	Also at the direction of Greg Boris, Joey Bodin, and Chris Provost, the team will change the set point of this shutoff from 30 psi to 14 psi.
	15:25	Team starts to change set point. Sluicer skid is locked out. Pressure switch was reset.
	15:35	Team tested pressure switch reset. Pressure switch relay shut down sluicer pump at ~ 14.3 psi. Greg Boris said current setting is OK!
	16:25	Team attempts to start sluicer pump in the "REMOTE" position. Pump does not respond from the PLC. Team is beginning to trouble shoot sluicer skid.
	17:19	Team decides that we need to get help from Conrad Wysor. Greg Boris will contact Conrad Wysor to arrange for his support.
04/01/99	07:30	Sluicer arm is broken. P&E crew plan to pull sluicer out of tank.
	10:21	Joe Maloney increased SAS pump system pressure from 1500 psi to 2100 psi.
	10:26	Joe Maloney and Greg Boris have had a discussion and have decided to set all sluicer control settings at 2100 psi.
	10:30	Crew has finished going over Work Instruction #16 rupture disk replacement and has practiced placement of people to replace blow out rupture disk on the sluicer pump.
	13:15	Sergio replaced fitting (hydraulic) for the sluicer arm extension at the secondary containment interface flange.
	13:55	Conrad Wysor and Greg Boris, Joe La Rosa and CW Hickman installed a 120 V relay to allow the PLC to communicate with the sluicer pump VFL for remote operations from the OMI. Signal is operational.

Date	Time	Entry
	15:25	Team continues to test sluicer pump in accordance with the Cold Test Plan. Sluicer pump will now run remotely but will not respond to pump speed changes from the PLC. Conrad Wysor and Joe La Rosa troubleshoot problem. Team determines that a lose wire in PLC cabinet was causing a problem. Now the PLC/OMI can control sluicer pump speed but is not responding correctly. For example, we request 20% for OMI and the pump runs almost full open (~ 80 %) Conrad Wysor and Joe La Rosa trouble shoot and determine the VFD is expecting 0 to 20 ma and the PLC is supplying 4 to 24 ma. Conrad reprograms the sluicer VFD to expect the PLC input. System is now running well.
	16:50	Team attempts to maximize pump (sluicer) flow. Pump speed / Inlet Pressure / Outlet Pressure 45% / 16.1 psi / 1094 psi 48% / 15.5 psi / 1173 psi 50% / 15.0 psi / 1223 psi 52% / 15.0 psi / 1230 psi 54% / 15.0 psi / 1230 psi During this test (high pressure) (HPP 300-1) pumps were at 100%.
	17:00	Team has decided there is excess supernate in the system. Team will transfer all (almost) slurry into the sluice tank so it can settle over night. Tomorrow we will transfer supernate to the dumpster so that we can increase the percent solids in the system.
04/02/99	07:30	Plan to continue cold tests and work on minor technical problems with the OMI sluicer pump interface and punch list items.
	11:00	Manually started system including submersible pump, high-pressure pumps, and sluicer pump.
	11:15	Team starts a test of feedback signals from the sluicer VFD to the OMI. Team will test speeds of 25% through 50% to see if the signal feedbacks are obtained.
	11:45	Feedback test is complete. Both speed checks were successful.
	11:55	System is ramped up with current settings as follows: Pump / Speed / Intake Pressure / Discharge Pressure HPP 320-1 / 90% / / 40 psi SLCP 665 / 50% / 20.9 psi / 850 psi Team to run system at this speed for approximately 1 hour to test sustained operation of the system.
	13:05	System has run at the provisional settings for 1 hr and 14 min. Joey Bodin, National Oilwell is comfortable with system/sluicer pump.
	13:20	Joey makes minor adjustment by tightening the bolts to the sluicer pump stuffing box.

Date	Time	Entry
	13:22	Team attempts to maximize sluicer pump speed to establish upper operating limits of system. However, the pump speed does not respond to commands from the OMI to increase pump speed above 60%. Joe La Rosa is trouble-shooting problem now to determine cause.
	15:10	Joey Bodin (National Oilwell) has recharged the sluicer dampeners. Intake dampener recharged from 100 psi to the required 127 psi. The discharge dampener was recharged from 1000 psi to 1500 psi.
	16:14	Team attempts to start system using the OMI auto sluicing sequence button. Team discovered that the low-pressure shutoff switch on the sluicer pump is deactivating both when the pump is running or not. This would require the team to reset the VFD for low pressure while the system was running and with pressure greater than 14 psi. Team wants the low-pressure switch to activate only when the pump is running. Greg Boris, Joey Bodin, and Jim LaForest will contact Conrad Wysor for advice to fix the problem.
	17:02	Team attempts to calibrate sluicer extension. The calibration is not working correctly. Team believes that there may be a problem with the signal we are receiving. Will attempt to contact vendor representative.
	17:38	Team starts to flush system in accordance with Work Instruction #5. Starting flow reading is 7135 gal.
	17:46	Complete low-pressure transfer. Flow reading is 7424 gal.
	17:57	Completed low-pressure feed system flushing. Flow total reading 7619 gal.
	18:03	Completed high-pressure pump system flushing. Process water flow total reading is 7783 gal.
	18:07	Completed strainer flushing. Process water flow totalizer is 7903 gal.
	18:15	Complete sluicer and sluicer pump flushing. Process water flow totalizer 8071 gal.
	18:19	A total of 756 gal was used.
04/03/98	07:30	Plan to work on interface with sluicer pump.
	08:29	Started Work Instruction #2 sluicing system startup and operation. Starting mapping sluicer limits within the tank.
	08:35	Began startup sequence for sluicing.
	08:40	Started submersible pump in the receiver tank.
	08:42	Started ramping up HPP 320-1.
	08:51	Started ramping up SLCP 665.
	09:20	During operation of system, the team notes large variations in the intake pressure of the sluicer pump. Team shuts down system to perform trouble shooting.
	10:00	Joey Bodin from National Oilwell performs check on sluicer pump. The following items were checked: pulsation dampeners, recharged the inlet pulsation dampeners to 175 psi, recharged the outlet pulsation dampeners to 1500 psi, checked the mechanical pressure relief valve, and the piston valves inside the sluicer pump. All items were OK.

Date	Time	Entry
	11:00	System was brought back on line and there was still no change in the pressure fluctuations.
	11:20	Called Les Lestelle (National Oilwell) and he advised adjusting the pressure on the dampeners to 50% of operating pressure. Team will experiment with the optimal setting to reduce fluctuations.
	12:00	Team looks at system operation and determines that the pressure in the pulsation dampeners needs to be decreased to reduce cavitation on the input side of the sluicer pump. Current settings are 1500 psi for the discharge pulsation dampener and 75 psi for the inlet pulsation dampener.
	13:00	Team returns from lunch and runs system. No significant problem noted on pumps.
	15:08	Team continues to operate system. System seems to run well with the inlet sluicer pump pressure between 80 and 120 psi.
	15:10	Team shuts down system and conducts line flushing in accordance with Work Instruction #5 line flushing sequence.
	15:30	Conrad Wysor (LMES), Joe La Rosa, Chris Provost and Greg Boris determine and agree to a connection for the sluicer pump intake low-pressure alarm. Team will install new relays and make alterations in accordance with the drawing approved by Conrad Wysor.
	16:08	Team began electrical work for sluicer low intake pressure fault. Greg Boris and Joe La Rosa are supervising.
	16:16	Joe Maloney (Waterjet) has performed a test on the sluicer arm extension pot. Joe and Greg Boris will order a new one and replace.
	16:30	Late entry. During the last system shut down, the team blew the rupture disk in HPP 320-1. It was determined that the sluicer pump and high-pressure pumps must be ramped down before shut down. Also the high-pressure pumps must be shut down prior to the sluicer pump. The rupture occurred when the team shut down the sluicer pump causing back pressure in the high-pressure pump. The team replaced the rupture disk in accordance with Work Instruction #16 rupture disk replacement.
	17:00	Stopped electrical work on low-pressure intake switch on sluicer pump because of rain Will continue work tomorrow.
04/04/98	10:00	Completed wiring on sluicer pump skid. Items that were added included 1) a remote reset for function loss on the VFD, 2) disabled low-pressure shut down when pump is not running, 3) timer delay on the low-pressure shut down.
	13:12	Started system in accordance with Work Instruction #2 sluicing system startup and operation.
	13:20	Ramped system up. The following settings were noticed at the peak sluicer pump output pressure. Pump — Speed — Intake Pressure — Discharge Pressure HPP 320-1 — 65% — — 18 psi SLCP 665 — 64% — 139.2 psi — 1280 psi MOV 340-1 — 20% open — MOV 305 — 10% open

Date	Time	Entry
	13:40	Noticed some knocking in the sluicer pump and reduced sluicer pump speed with the following settings. Pump Speed Intake Pressure Discharge Pressure HPP 320-1 51.1% 180 psi SLCP 665 45% 140.2 psi 650 psi MOV 340-1 26% open MOV 305 16% open
	15:20	System is in attended mode. Team began work on transfer of slurry to MVST using Work Instruction #3 transfer of slurry to MVST.
	15:32	Conducted transfer. Team needs to change process setting because the high-pressure pumps behaved erratically. Team will make adjustments to the Work Instruction and try again.
	16:25	Transfer of slurry to MVST successful. Changes made to Work Instruction.
	16:38	Team tests failure scenarios successfully as outlined: a) sluicer tank submersible pump failure, b) recycle tank submersible pump failure, c) sluice tank Hi-Hi failure, d) high powered pump failure, e) sluicer pump failure, f) ventilation skid lower failure.
	17:30	Began rinse out of lines per Work Instruction #5 line flushing sequence. Began with 8724 gal from flow totals on the OMI.
	18:15	Completed line-flushing sequence. Ended with 9704 gal from flow totals on the OMI.
04/06/98	08:30	There was a meeting attended by Jim LaForest, Chris Provost, Charles Callis, Joe La Rosa and Judith to discuss the readiness review.
	10:15	Began lifting sluicer from tank to change nozzles on the sluicer with help of the hoisting and rigging crew.
	11:05	Completed changing nozzle.
	11:15	Completed Work Instruction #1 sluicing system setup and configuration and began Work Instruction #2, sluicing system startup operations.
	12:30	Completed work Instruction #2 sluicing system startup operation and began a partial MVST transfer in accordance with Work Instruction #3 transfer of slurry to MVST.
	14:15	Late entry. The size of the new nozzle placed on the borehole miner sluicer earlier this morning was 0.28-in. in diameter.
	14:30	Started system up in accordance with Work Instruction #1 sluicing system setup and configuration and began operations in accordance with Work Instruction #2 sluicing system startup and operation.
	15:25	Completed operations and performed a MVST transfer in accordance with Work Instruction #3 transfer of slurry to MVST.
	15:35	Began line-flushing sequence in accordance with Work Instruction #5 line flushing sequence.
	17:08	Line flushing complete. Starting process flow total was 10,172 gal. Ending flow total was 10,717 gal.
04/07/98	10:37	Sluicer pump on line and operating at approximately 1000 psi.

Date	Time	Entry
	11:00	Beginning transfer of slurry in accordance with Work Instruction #3 transfer of slurry to MVST. The current totalizer flow for MVST is 10894 gal.
	11:12	Completed transfer of slurry to MVST. The flow total reading is 10990 gal after process was aborted. Rinsing transfer line current flow total reading for process water flow was 10782 gal. Rinsing is complete and the process water flow total reading is 10946 gal.
	11:36	Beginning line flushing in accordance with Work Instruction #5 line flushing sequence. The process water flow total is 10946.
	11:53	Completed line flushing. Process water flow total is 11484 gal.
04/08/98	10:30	Team was informed that the readiness review team had given approval to move to OHF site.

Table A.2 Borehole-Miner Extendible-Nozzle Installation at the OHF Site

Date	Time	Entry
04/08/98	10:30	Team was informed that the readiness review team had given approval to move to OHF site,
	10:45	There was a team meeting to discuss preparations needed to make the move to the OHF site.
	12:30	Preparation work began to make the move to OHF.
	12:41	Began transferring excess supernate from the recycle tank to the dumpster.
	13:30	Began transferring remaining slurry from the sluicer tank to the recycle tank.
	17:15	Tested all fail safe valves and all valves failed in the correct position; however MOV 675 did not open completely and the motor continued to try to open the valve.
04/09/98	07:30	Plan to sluice out the sluicer tank.
	08:35	Beginning sluicing operation in Work Instruction #1 sluicing system setup and configuration and Work Instruction #2 sluicing system startup and operation. Team will clean as much kaolin from the sluicer tank as possible.
	09:00	Began flushing line in accordance with Work Instruction #5 line flushing sequence. Starting MVST flow total was 15044 gal; flushed lines to the dumpster. Ending MVST flow total was 15072 gal.
	09:30	Hand tested MOVs on the sluicer pump skid. MOV 675 will not open completely and will only close about one quarter of the way to the closed position. MOV 660 will not function in the local position.
	11:05	Retested MOV 660 and found that it does work in the remote position.
	12:30	Began taking down piping to the sluicer pump skid.
	13:35	Riggers came and assisted in removing the sluicer from the tank.
04/10/98	08:00	Plan to depipe sluicer skid and sluicer riser.
	11:30	Completed depiping the recycle line to sluicer tank. Completed disconnecting sluicer discharge hose.
	17:30	Completed disassembling sluicer tank riser.
04/17/98	09:00	Change out fittings on hydraulic lines for sluicer.
04/18/99	14:00	Completed prepping the sluicer pump skid for move to OHF site.
04/20/98	17:30	Crew at cold test site has finished sluicer pump skid.
04/21/98	14:30	Hoisting and rigging crew loaded sluicer pump skid for transport to OHF site.
	15:00	Prepped wiring from sluicer control unit for moving.
	16:00	Loaded pan for sluicer pump skid for movement and moved it to OHF site.
	19:15	Completed moving sluicer pump skid to OHF.

Date	Time	Entry
04/29/98	17:00	Crew completed running wires back into sluicer pump skid.
	18:30	Crew sets wire from sluicer pump skid to main distribution panel A.
	19:00	Piping crew has completed piping into Tank T1 and Tank T2 manifolds; also completed piping into sluicer pump intake.
05/01/98	19:30	Crew continued to pipe in sluicer pump and pump skid.
05/02/98	12:00	Crew unrolled wire from sluicer skid to PLC.
	19:40	Crews completed rolling out all discrete cables and analog cables for sluicer pump, HEPA skid, transfer skid and potable water.
05/03/98	15:20	Keith and CW have continued wiring on PLC and pump skid.
05/12/98	16:27	Team started test on sluicer pump feed line.
	17:07	Late entry. Team started a leak test on the sluicer pump feed line. The test was conducted by closing VLV 370-1 and VLV 370-2. A blind flange was place at the end of the sluicer feed line next to MOV 660. The blind flange was fitted with a 0 to 600 psi pressure gauge and a bleed valve. Water was pumped into the system from the small pipe on the process water skid. The line was bled to remove air at the blind flange and by loosening the bolds on the flange leading to VSV 370-1 and –2. The flanges and threading were soaped completely and no leaks were noted. However, the pressure drop of 65 psi was unacceptable. The team inspected the system and found that the "C" locks that hold in the valve stops for VSV 370-1 and -2 were not installed correctly. Team reinstalled the locks.
	19:45	The sluicer pump feed line was pressurized to 300 psi. Team will redo the leak test for this line tomorrow.
05/13/98	11:32	Late entry. Team conducted leak test on the sluicer feed line. The joints were soaped and no leaks were observed.
05/19/98	16:15	Team conducted pre-operational testing of the sluicer MOVs. All MOVs were operated open and close in the local position.
05/22/98	07:30	Tailgate meeting topic: Moving the sluicer to the OHF site. Plan to move sluicer and hoses to OHF site.
	09"1 0	P&E crew has finished setting the HPU and sluicer control unit plus hoses around the OHF trailer.
	18:10	Talked with Lynn Whitehead about draining the secondary containment in the sluicer pump skid because it is full of rain water.
05/23/98	16:10	The range of pressure transmitter 305 at the intake of the high-pressure pumps has been changed to 0 to 100 psi.
05/27/98	15:00	Crew has finished installing sluicer into Tank T3.
	17:45	All fail-safe batteries have been turned on to charge up.
05/28/98	16:55	Team received permission from Lynn Whitehead to discharge rain water in the sluicer pump skid and the riser boxes onto the ground.

Date	Time	Entry
	17:15	All riser boxes and sluicer pump have been drained today and plastic tents have been installed over all risers. Team completed all lines from HPU to sluicer borehole miner, which has been installed in Tank T3.
05/29/98	11:00	Power was turned off to the system to tie in the HPU unit and sluicer control unit.
	14:30	Team completed wiring of sluicer control unit and HPU unit.
	15:50	Team has completed all hydraulic and electrical connections to the sluicer control unit and HPU. Team will check functioning of borehole miner. Team turns on camera and observed that the borehole miner nozzle has been extended without any explanation (i.e. the power of the sluicer control unit had not been activated.) The team retracted the nozzle to 0 in. The sluicer control displayed an extension of 74 in. before it was retracted. The team noticed approximately 6 in. of sludge covering the borehole miner nozzle. Lynn Whitehead the FM was informed. Greg Boris the technical lead was called. Team members do not know why the nozzle was extended without the sluicer control unit being activated. Team members noted that the connection of hydraulic noses was more difficult than those made at the cold test site. It could be that the hydraulic lines are exposed to more heat and direct sun at the OHF site. Greg Boris will call the vendor (Waterjet) to discuss.
05/30/98	11:30	Team completes required tests for sluicer operation. The sluicer pump would not start initially because of high oil level switch. Team drained oil from crankcase until high-level switch reset. Pump was run to 50% and shut down on oil level switch (assumed low). Team verified oil level with dipstick and the level is just below the medium point of the operational range. Team discussed problem with Greg Boris and has decided to add oil to the ¾ point on the dipstick. All other sluicer pump operations OK.
		Late entry. Entered in logbook 18 July, 1998. Bubbler readings for tanks taken on 30 May 1998 before sluicing operations commenced. Tank — Condition — Level — Volume T1 — May 30, 1998 — 5.8 ft — 12312 gal T2 — May 30, 1998 — 5.7 ft — 12106 gal T3 — May 30, 1998 — 2.0 ft — 3466.3 gal T4 — May 30, 1998 — 6.1 ft — 15881.5 gal T9 — May 30, 1998 — 4.6 ft — 5893 gal
	13:50	Team resets sluicer pump. When the sluicer pump reached 54%, the sluicer shut down on low oil level. Team checks dip stick and it shows the oil level right at the top of the operating range. Team will call vendor for advise.
	15:05	Team discusses problem with oil level switch with Les Lestelle of National Oil well and Greg Boris from Bechtel Jacobs. Les Lestelle is concerned about the oil switch out plug being clogged. Jim LaForest checked the plug and it was not clogged. Les Lestelle said that we should go to the dipstick for oil level and therefore we need to adjust the switch level. Jim LaForest changes the switch level as directed by Les Lestelle. Team will run the pump again later to confirm proper operation.

Date	Time	Entry
05/31/98	15:30	Team finishes installation of the drip pan pump and solenoid valve on sluicer pump. Team tests pump switch combination and it did not work correctly. Team will trouble shoot problem tomorrow.
06/1/98	16:20	Installed float assembly for flood alarm on sluicer skid.
06/02/98	16:20	P&E crew have been on site to install Plexiglas around sluicer skid.
06/03/98	07:30	Perform test on sluicer pump feed line.
06/05/98	10:10	Greg Boris arrives to make some valve adjustments on the sluicer skid.
	12:00	Greg Boris completes adjustments and exits site.
06/13/98	07:40	Bechtel Jacobs work performed over the last 2 days includes: 3) replace valve position of MOV 660.
	12:25	Late entry. Talked to Greg Boris about MOV 660. He tested valve yesterday and it is now working correctly. Greg Boris agreed that we should retest sluicer pump skid piping and MOV 660 to make sure it does not leak.
	16:00	Team completes sluicer test to determine if the work on replacing MOV660 inspected piping and valves on sluicer skid. The lines were soaped. No leaks were noted. Lines are OK!
	16:08	The team noted a problem with PT663 during the pressure test. It read 313 psi locally but 200 psi from the OMI. Team will have to trouble shoot problem.
06/14/98	16:48	Attempted to run the sluicer pump several times. In each case the pump has shut down on low oil level. Called Les Lestelle of National Oilwell and he instructed me to adjust the low oil level switch in the level switch housing group so that the low level switch contact engages at a lower point.
	16:49	Called Greg Boris of Bechtel Jacobs to inform him of Les Lestelle's recommendation and he agreed with the conversation. Jim LaForest adjusted the switch.
	17:08	Team runs sluicer pump up to 52% speed and the low-level switch did NOT trip. This is as high as the pump can be run because the process water supply is being used to feed the system.
	17:35	Attempted to restart the sluicer pump 5 times; however, it shut down on what appears to be low oil pressure. Team called Les Lestelle from National Oilwell for advice. He recommended lowering the low-pressure oil switch to 0 psi and see what operating pressure we obtain. He will try to send us another pressure gauge with a 0 to 20-psi range instead of a 0 to 50-psi range. Tom called Greg Boris and he agreed with the approach.
	18:30	Attempted what Les Lestelle Recommended. The pump ran on the second attempt. However, at start read slow ~0.55 speed for 10 sec or so, then picks up to 25% speed. The oil pressure stays at 0 psi and shoots up to 20 to 22 psi. Will call Les to inform him.
	18:40	Talked to Les Lestelle. He thinks the problem is with the time delay on the oil pressure switch. He recommended increasing the delay to 60 s from its current setting of 25 s. He also recommends resetting the low pressure cut off for the oil at 5 psi.

Date	Time	Entry
	18:45	Called Greg Boris and he concurs with Les Lestelle's recommendation.
	18:55	Team ran sluicer pump two times with the current settings. All sluicer pump systems OK!
	19:43	Team tears down temporary discharge piping for sluicer pump skid and connects sluicer pump line SF 207-1.
	19:50	Team connects MVST discharge line (2-in. flexible hose) and secondary containment to MOV 340-2.
06/15/98	14:08	Team tests borehole miner extension to 10 ft in both ends of Tank T3. Greg Boris was supervising testing. Borehole miner working well.
	18:00	Team tested system fail safes. The following fail safes are currently not working. MOV 660, 665, 670, 675, 455, 305, and 350-1. The team realizes that the batteries of MOV 455, 305, and 350-1 are not working because they require charging. Team will let them charge overnight. All the sluicer fail safes are controlled by UPS system. The team performed trouble shooting on the fail safes and determined that something is wrong with the UPS system. The system are getting power but no power light on the systems are activated. Team informed Greg Boris about the problem and he will call the vendor.
06/16/98	07:18	Plan to trouble shoot fail safes.
	14:00	Team conducts a test transfer of process water to the MVST. Waste Management called and the correct LLLW valves were aligned. A total of 181 gal were pumped before the MVST tank observed water in the storage tank. The high-pressure pump (HPP 320-2) was run at a pump speed of 21% and a maximum of 30 psi. Transfer was successful.
06/17/98	09:00	Late entry. Yesterday MVST transfer test was performed at 50 gal/hr and required approximately 4 min.
06/22/98	12:48	Team completes local and remote operation of all system valves. All MOVs are working correctly except MOV 305 is not working in the remote position.
06/25/98	07:30	Crew will be getting site in shape for the 1st sluicing operation on Saturday, 6/27/98.
	12:18	Began rewiring fail safe power for valves MOV 660, 665, 670, and 675. Tested backup power from generator. Did not work. Changes to fail safe power for MOV 660, 665, 670, and 675 relocated to HEPA skid. Thursday ,25 June, 1998 completed fail safe power for MOV 660, 665, 670, and 675 all working. CW is waiting for Greg Boris to check wiring.
	15:40	CW and Joe La Rosa verified operations of valves MOV 660, 665, 670, and 675 in local and remote positions. Joe placed valves in fail safe positions and CW turned power off to verify that with emergency power, the valves operate to fail safe positions. All valves operated correctly.
06/26/98	07:20	Plan to complete supernate transfer from two tanks; riggers will be helping on this transfer. Conduct pre-ops for system to sluice on Saturday.
	08:15	Team has completed pre-operational checklist and are set up for supernate transfer from Tank T1 to Tank T3. The plan is to transfer 5490 gal from Tank T1 to Tank T3 and transfer 3600 gal from Tank T2 to Tank T3.
	08:32	Jim LaForest has called Lynn Whitehead, Facility Manager, regarding starting supernate transfer.

Date	Time	Entry
	08:37	Team performs level calculations for Tank T1 and Tank T3. Tank levels and volumes are obtained from bubbler readings at OMI. Tank Condition Level Volume T1 Current 5.9 ft 12500 gal T1 Subtract 5490 gal 3.6 ft 7010 gal T3 Current 2.1 ft 3634 gal T3 Add 5490 gal 4.0 ft 9124 gal
	09:00	Begin transfer from Tank T1 to Tank T2 video recordings on transfer has wrong time on it. It is 1 hr behind.
	09:06	LPP 410-2 shut down Tank Condition Level Volume T1 Current 5.5 ft 11720 gal T3 Current 2.3 ft 4300 gal
	09:08	Pump is reset, restarted. It did not restart.
	09:10	Team conducted blow down on line leading to Tank T3 by closing MOV 410-2 and opening MIV 230 and MOV 250-2.
	09:15	Team sends Rick Sally and Tom Lewis to look at circuit breaker and motor starter.
	09:17	Team determined that circuit breaker 13-15-17 on Panel H has been tripped. Team resets breaker, personnel leave area for trailer.
	09:21	Time has been changed on video to show correct time on tape.
	09:24	Restarted transfer from Tank T1 to Tank T3.
	09:34	Team notices reduced flow into Tank T3, stopped pump.
	09:35	Team restarts pump.
	09:38	Team noticed reduced flow, stopped pump.
	09:39	Team restarted pump; pump did not start.
	09:41	Team conducts blow down.
	09:43	Team stopped blow down
	09:45	Team has checked breaker; it has not tripped.
	09:53	Team has pulled pump out of water and forced air through the pump in Tank T1.
	09:54	Team lowers pump back into water to original position.
	09:56	Team closed MOV 410-2 and bumped pump and pump is working.
	10:00	Team restarted pump, current volume in Tank T1 is 10065 gal and in Tank T3 is 5799 gal.

Date	Time	Entry
	10:08	Team notices low flow, shut pump down and reset.
	10:10	Pump restarted and it is pumping.
	10:13	Pump has stopped pumping, shut pump off. Blow down pump in Tank T3.
	10:15	Restart pump.
	10:20	Pump has stopped, blow down pump in Tank T3.
	10:26	Pump has restarted and it is pumping.
	10:30	Stop pump and blow down pump in Tank T3. Rick goes out on site; he will lower Tank T1 pump and raise Tank T3 pump.
	10:37	Tank T1 pump lowered approximately 1 ft. Tank T3 pump raised approximately 1 ft.
	10:45	Restart pump.
	10:52	Stop pump, blow down lines.
	10:54	Restart pump
	10:57	Stop pump and check level of tanks through bubblers.
	11:00	Restart pump.
	11:03	Stop pump, blow down volume in Tank T3.
	11:08	Restart pump in Tank T1.
	11:09	Stop pump. Team finished transfer. Tank Condition Level Volume T1 Final 3.4 ft 6480 gal T3 Final 4.0 ft 9096 gal
	11:20	Team began moving camera from Tank T1 to Tank T2.
	12:05	Team set up for transfer from Tank T2 to Tank T3. Target for Tank T3 is 14820 gal; however target for Tank T2 is 7410 gal. Transfer will continue until either of these limits is reached.
	12:10	Team started submersible pump in Tank T2. Tank Condition Level Volume T2 Initial 6.0 ft 12636 gal. Pump 4 in Tank T2 has shut down; fail alarm.
	12:15	Rinsing camera in Tank T2.
	12:25	Begin transfer with pump.
	12:27	Pump stops, tripped breaker at Panel H.
	12:35	Reset breaker and started pump again.

Date	Time	Entry
	12:37	Pump fails.
	12:45	The power connection for pump 4, Tank T2 has been moved to the motor starter pump 3, Tank T2.
	12:54	Start pump.
	12:56	Pump stops.
	13:00	The power connection for pump 4, Tank T2 has been moved to the motor starter pump 2, Tank T1.
	13:09	Start pump.
	13:11	Pump stops.
	13:13	Start pump.
	13:24	Pump stops, Rick goes no site to check breakers.
	13:30	No breakers tripped; reset breakers, also lower Tank T2 pump and raise Tank T3 pump 1 ft each.
	13:46	The power connection for pump 4, Tank T2 had been moved to the motor starter pump 1, Tank T1.
	13:55	Restarted pump.
	14:02	Pump stopped.
	14:08	Rick checked; breakers not tripped.
	14:20	Rick lowers pump in Tank T1 1.5 ft.
	14:23	Team begins executing Work Instruction #12 sluicer mast placement to move camera from Tank T1 to Tank T9. Current process water flow is 150 gal
	14:35	Team has completed rinsing camera; final water flow total is 174 gal. A total of 24 gal to rinse camera.
	14:50	Joe La Rosa comments for day. About 1 month ago, Joe discovered that the visualization system displays opposite rotation of sluicer actual movement. Approximately 6/1/98, Joe spoke to Gary Kiebel about the problem. No solution has been given to CDM to date. Yesterday and today messages were left on Gary Kiebel's voice mail, but still no response. Today, Joe shared the problem with Greg Boris; Greg's decision was to hold off on the matter, unless Gary calls with a solution.
	16:23	Riggers have unloaded three barrels of denaturing material and also helped in moving camera from Tank T2 to Tank T9. Camera move complete. Team has not finished supernate fluids transfer because of problems with breakers and pumps.
	16:40	Joe La Rosa spoke to Omar Naji and Tony Scudieri about the submersible pump problems. They said a 15-amp breaker is too low for the 11-amp submersible pumps. Recommend using a 20-amp breaker.
06/27/98	10:20	Plan to replace 15-amp breakers with 20 amp breakers on motor starters for submersible pumps and finish supernate transfers.

Date	Time	Entry
	13:08	Team begins set up for transfer from Tank T2 to Tank T3; 1200-gal transfer is planned. Tank Condition Level Volume T2 Current 4.5 ft 9301 gal T3 Current 5.0 ft 12390 gal T3 Target 13600 gal
	13:29	Team starts submersible pump 4 in Tank T2.
	13:37	Submersible pump 4 in Tank T2 stops. We have a pump failure. CW Hickman investigates failure.
	13:52	Team blows down lines to all four tanks.
	13:57	Team stops blow down.
	14:08	Attempted to restart pump. No start obtained. Master switch on motor starter was reset.
	14:09	Team restarts submersible pump 4 in Tank T2.
	14:12	Pump is stopped. Transfer of supernate is complete.
	14:42	Team resets heaters from 1107 to 1157.
	14:44	Team resumes transfer of supernate from Tank T2 to Tank T3 to test new heater settings. The team will transfer supernate back and forth between Tank T2 and Tank T3 to test new settings on the motor starter heaters.
	14:54	Team stops submersible pump 4 in Tank T2.
	14:56	Team plans power test for submersible pump 6 in Tank T3 into its motor starter.
	15:00	Submersible pump 6 approximately 2 ft. Current setting is approximately 3.8 ft above the bottom of the tank.
	15:05	Team begins transfer of supernate from Tank T3 back to Tank T2.
	15:08	Team starts submersible pump 6 in Tank T3. Tank Condition Level Volume T3 Current 5.8 ft 15065 gal
	15:20	Submersible pump 6 stops pumping; however, OMI still shows a run status.
	15:22	Submersible pump 6 starts pumping again. Team believes that the thermal overload protections are going bad.
	15:23	Team stops submersible pump 6.
	15:24	Team restarts submersible pump 6.
	15:28	Submersible pump 6 stops pumping but pump 6 has not failed on the OMI.
	15:30	Submersible pump 6 automatically restarts.
	15:31	Team stops submersible pump 6 for 0 ms

Date	Time	Entry
	16:00	Team hooks up submersible pump 6 into the submersible pump 3/7 Tank T2/T4 motor starter.
	16:01	Team starts submersible pump 4.
	16:05	Pump continues to run.
	16:15	Submersible pump 4 fails. A total of 14 min before failure. The heater in starter submersible pump 3/7 Tank T2/T4 has tripped.
	16:24	Team starts submersible pump 6 in Tank T3 to get levels of supernate at required levels.
	16:25	Pump stops but is fixed.
	16:28	Team stops submersible pump 6.
	16:29	Team restarts submersible pump 6. Pump rotates internally but does not produce flow.
	16:30	Team stops submersible pump 6. Tank Condition Level Volume T2 Current 3.5 ft 6714 gal T3 Current 5.8 ft 14932 gal
	16:38	Team moves pump 6 to motor starter submersible pump 3/7 Tank T2/T4 from disposal 4/8 Tank T2/T4 because the pump would not produce flow from the other starter. The target levels of the correct supernate level is 13600 gal in Tank T3.
	16:49	Team stops submersible pump 6. Supernate level and desired level corresponding Tank T2 and Tank T3 readings. Tank Condition Level Volume T2 Current 4.0 ft 8030 gal T3 Current 5.4 ft 13580 gal
	17:48	Team decides to run a test to see if the submersible pump will run better if there is additional head pressure for the pump to push against. Submersible pump 4 in Tank T2 will be run while the valve MOV 420-2 is closed ¼ of the way. Because there are non-modulating valves, the team is taking off the actuator and manually adjusting the valve.
	17:58	Team starts submersible pump 4.
	18:07	No flow was obtained.
	18:05	Submersible pump 4 was moved to motor starter submersible pump 3/7 Tank T2/T4.
	18:09	Submersible pump 4 starter MOV 420-2 was adjusted to 100% open. No flow was obtained.
	18:20	Submersible pump 6 was moved to starter submersible pump 2/6 in Tank T!/T3. Pump started, it rotates but does not produce flow.
	18:23	Team puts actuator back on MOV 420-2. Team was unable to run test because submersible pumps will not produce any flow.
06/28/98	05:25	Plan to trouble shoot the submersible pumps.

Date	Time	Entry
	05:45	Team performed a single source lock out on the submersible pump starter boxes and tested the female and male connections for the submersible pumps and motor starter boxes and there was NO evidence of corrosion of other problems.
	05:55	Late entry. On 27 June, 1998 at approximately 1600 hours it was noted that the air temperature as recorded by the temperature sensor on the HEPA skid was approximately 98 F. This would coincide with the temperature inside the tanks. The temperature as recorded at this time is 69.1 F.
	05:56	The team started submersible pump #6 shut down. MOVs 430-2 and 420-2 were fully open during the test.
	06:01	MOV 420-2 was moved to 25% open.
	06:06	MOV 420-2 was closed to approximately 12.5% open.
	06:09	Additional measurements were taken.
	06:25	Submersible pump #6 shut down at approximately 06:22 and then restarted approximately 2 minutes later.
	06:27	Team shut down pump #6.
	06:28	Team started sub pump #4 to transfer supernate from Tank T2 to Tank T3. MOV 420-2 is fully open.
	06:30	MOV 420-2 was closed to 25% open.
	06:32	MOV 420-2 was closed to approximately 12.5% open.
	06:33	Team observed that the pump was making a grinding sound (submersible pump #4).
	06:36	The current air temperature as recorded on the sensor inside the HEPA skid is 68.7 F.
	06:58	The team shut down pump #4 and air was blown through the lines. Transfer of supernate from Tank T2 and Tank T3 was completed. MOV 420-2 was fully closed.
	07:00	The level in Tank T2 and Tank T3 is as follows: Tank Condition Level Volume T2 Current 4.1 ft 8106.4 gal T3 Current 5.4 ft 13627.8 gal
	07:45	The heater strips on each of the motor starters (total of 6) were adjusted to 115% operating level.
	08:00	Team completes tasks for the morning and will return at 19:00.

Table A.3 Borehole-Miner Extendible-Nozzle Remediation of Tank T3 and Tank T9

Date	Time	Entry
06/28/98	19:20	Plan operations in Tank T3.
	20:50	Completed pre-operational checklist and Work Instruction #1 sluicing system setup and configuration.
	21:02	Paul Taylor from Chemical Technology division begins denaturing activities according to Work Instruction for denaturing.
	21:25	Began adding uranyl nitrate to Tank T9.
	21:31	Completed transferring denaturing material to Tank T9.
	21:39	Began adding uranyl nitrate to Tank T3.
	21:40	Opened valve from site to MVST and closed valve in LLW line to Bethel Valley.
	21:45	Completed transferring material to Tank T3.
	22:21	Denaturing activities are completed.
	22:40	Completed pre-job briefing for sluicing operations.
	22:43	Current temperature observed according to HEPA skid sensor is 77.5 F
	22:45	The tank volumes and levels are as follows Tank Condition Level Volume T3 Current 5.4 ft 13730.2 gal T9 Current 5.1 ft 6662.1 gal
	22:47	Began work Instruction #2 sluicing operations.
	23:35	Work Instruction #2 sluicing system startup and operation does not allow for not using the sluicer pump. Team decided it was not necessary to use the sluicer pump and received permission not to use the sluicer pump from Greg Boris and Lynn Whitehead. Work Instruction #2 sluicing system startup and operation was modified to allow for discretion of the POS to not use the sluicer pump. Modifications were red lined and signed by the POS, Jim LaForest, Lynn Whitehead, and Greg Boris.
06/29/98	00:14	Team will begin conducting a partial transfer to MVST using Work Instruction #3 transfer of slurry to MVST. Team will be transferring approximately 10,000 gal of the total 20400 gal in Tanks T3 and Tank T9 combined. Starting MVST flow total is 662 gal. Contacted MVST representative, Houston, and they are ready to receive the transfer.
	00:22	Began transferring material to MVST.
	00:27	MVST observed flow from the transfer. MVST flow totalizer reading was 960 gal.

Date	Time	Entry
	00:52	Flow totalizer reading for flow to MVST is 2177 gal. MVST reading for flow received was 1730 gal. See table for transfer readings. Time / CDM Flow Totalizer / CDM Flow Sent / LLLW Flow Received 0 min / 662 gal / 0 / 0 30 min / 2177 / 1555 / 1730 60 / 3749 / 3087 / 3240 90 / 5362 / 4700 / 5470 120 / 6960 / 6298 / 7010 150 / 8569 / 7907 / 8620 180 / 10183 / 9521 / 10260 210 / 11811 / 11149 / 11940 240 / 13428 / 12766 / 13520 270 / 14347 / 13685 / 14500 279 / 14667 / 14005 / 14810
	01:04	When team executed step of Work Instruction #3 transfer of slurry to MVST, MOV 340-2 fluctuated greatly causing high-pressure readings on pressure gauge PIT 330 (discharge high-pressure pumps). To prevent high fluctuations like this in the future, the starting transfer rate was changed from 30 gpm to 5 gpm in the work Instruction. Approval for this change was received from Greg Boris, Lynn Whitehead, and Chris Provost, and Work Instruction was modified. Also the turning parameters for the PID controller in the PLC were modified as follows. The gain was changed from 500 to 300 and the integral remains at 65 milliseconds.
	03:55	Transfer time 240 min. See above.
	04:24	Submersible pump #5 shut down at 0.5 ft set point. Transfer time 270 min. See above.
	04:40	Transfer was stopped. Line flushing sequence for MVST line in accordance with Work Instruction #3 transfer of slurry to MVSTwas begun. Starting flow total for process water flow was 359 gal.
	04:49	Rinse process was completed. Transfer time 279 min. See above. Process water flow total was 685 gal.
	04:51	Began sluicing system start up in accordance with Work Instruction #2 sluicing system startup and operation.
	04:58	Began sluicing Tank T3.
	06:45	Began bringing sluicer pump on line.
	06:55	Sluicer aborted due to low intake pressure on the sluicer pump. Began sequence to bring sluicer pump back on line.
	07:08	Began normal system shut down in accordance with Work Instruction #4 normal system shut down. Process water flow total was 689 gal when line-rinsing portion of Work Instruction began.

Date	Time	Entry
	07:10	Process water flow total was 711 gal when rinsing was stopped.
	07:12	Began flushing lines in accordance with Work Instruction #5 line flushing sequence. Process water flow total is 711 gal.
	07:20	Complete line flushing of the low-pressure transfer system. Process water flow totalizer reading is 925 gal. Began low-pressure feed system flushing.
	07:25	Completed low-pressure feed system flushing. Process water flow total is 975 gal. Began high-pressure system line flushing.
	07:29	Completed high-pressure system line flushing process water flow total reading is 1006 gal. Began strainer flushing sequence.
	07:33	Completed strainer flushing sequence. Process water flow total is 1071 gal. Beginning sluicer and sluicer pump flushing sequence.
	07:46	Completed sluicer and sluicer pump line flushing sequence. Process water flow total is 1224 gal. Began blowing lines down with air.
	07:57	Completed blowing down lines with air.
	08:02	Began realigning valves to use HPP 320-1.
	08:14	Completed verifying operation of all sluicer pump skid valves. Radiation field in sluicer pump skid was 20 mR./hr.
	08:16	Performing process water flush of strainer #1. No flow was going through the strainer. Maximum strainer differential pressure was approximately 66 psi. Team believes strainer is clogged.
	08:29	Team is conducting a manual transfer using HPP 320-1 with help from Greg Boris and Lynn Whitehead.
	08:37	Began transfer of material to MVST.
	08:41	MVST observed flow from transfer.

Time	CDM Flow Totalizer	CDM Flow Sent	LLLW Flow Received/Interval	Total LLLW Flow Received
0 min	14689 gal	0 gal	0 gal	0 gal
30	16288	1599	1516	
60	17946	3257	1555	
90	19606	4917	1641	
120	21265	6576	1598	
150	22932	8243	1613	
157	23355	8666	454	

Date	Time	Entry
	08:58	Late entry. Switched from HPP 320-2 to 320-1 at 08:02 and used work Instruction #4. Some changes had to be made with the Work Instruction with approval from Greg Boris and Lynn Whitehead.
	11:10	Shut down mixer in Tank T9. Slurry level was below mixer blade level.

Date	Time	Entry
	11:14	Shut down Tank T9 submersible pump. Completed material transfer. Started MVST line flush in accordance with Work Instruction #3 transfer of slurry to MVST. Process water flow total was 1312 gal.
	11:24	Rinse process was completed. Totals for rinse as follows. Time CDM Flow Totalizer CDM Flow Sent LLLW Flow Received 167 min 23676 gal 8987 gal 313 gal. Process water flow total was 1678 gal.
	11:27	Rinsed cameras in the tanks. Process water flow total was 1738 gal.
	11:30	Team conducts process water strainer back flush on strainer #1 in accordance with Work Instruction #9 process water strainer backflushing
	11:43	Stopped back flush of strainer #1. Back flush was not successful. Process water flow total was 1843 gal.

Table A.4 Borehole-Miner Extendible-Nozzle Remedation of Tank T4

Date	Time	Entry
06/30/98	05:20	Plan to move sluicer and camera for sluice tank.
	08:00	Began performing Work Instructions #11 strainer basket changeout and #12 sluicer mast placement. As part of these work instructions rinses of the camera and sluicer had to be performed. Starting process water flow for Work Instruction #12 sluicer mast placement was 1897 gal and ending process water flow total was 1912 gal. Starting process water flow total for Work Instruction #11 strainer basket changeout was 1912 gal and ending process water flow total was 1957 gal.
	09:20	Began camera and sluicer movement in accordance with Work Instructions #11 strainer basket changeout and #12 sluicer mast placement.
	10:45	Completed camera and sluicer movement.
	16:10	Team prepares for transfer of supernate from Tank T4 to Tank T3. Calculations are performed for transfer of excess supernate from Tank T4 to Tank T3. 4919 gal will be transferred from Tank T4 to Tank T3. Tank Condition Level Volume T3 Current 0 ft 0 gal T4 Current 6.1 ft 15935 gal T4 Target 10970 VLV 450-1, 450-2, MOV 430-1 and 440-1 are closed. MOV 430-2 and 440-2 are open.
	16:37	Team starts submersible pump 8 and begins transfer.
	16:51	Team stops transfer from Tank T4 to Tank T3. The dry well monitor for Tank T3/T4 has displayed a high level alarm. Readings approached 6000 mR/hr at the OMI.
	16:58	Called Lynn Whitehead to inform him. The HP (Tom Lewis) has gone out to investigate the situation.
	17:03	Team investigates problem and determines that the local dry well sensor is only reading 10 mR/hr while the OMI is reading approximately 4776.9 mR/hr. The high readings corresponded to a heavy rain event. The HP has pulled the mouth up out of the dry well and conducted a survey. The HP is reading approximately 10 mR/hr while the OMI is showing 4982 mR/hr. Something is wrong with the sensor. The team tries to reset the meter but the meter is still reading high levels. Tank Condition Level Volume T3 Current 736 gal T4 Current 14495 gal Total 15231 gal
	17:15	Team restarts transfer to Tank T3. The team will trouble shoot the radiation meter in the dry well.
	17:40	Team stops pump.

Date	Time	Entry
	17:45	Team lowers pump approximately 2 ft.
	17:58	Team restarts submersible pump 8.
	18:15	Team stops transfer of supernate. . Tank Condition Level Volume T3 Current 2.1 ft 3640 gal T4 Current 4.6 ft 10931 gal
	19:30	Team conducts process water strainer backflush in accordance with Work Instruction #9 process water strainer backflushing. Starting process flow reading is 1998 gal. Final reading after three flushing attempts is 2174 gal. The team determined that the strainer flush did not work yesterday because MOV 360-1 was not working from the REMOTE position. MOV 360-1 was phased in the LOCAL OPEN position to finish the required steps in Work Instruction #9 process water strainer backflushing. The strainer is no longer clogged. Team will fix MOV 360-1.
07/01/99	16:45	Plan to replace rupture disks in accordance with Work Instruction #15 switching high-pressure pumps.
	18:10	Late entry. Regarding radiation readings. The team determined the signal from the digital rate meter to the OMI was inaccurate. Team switched inputs at the digital rate meter so that sluice tank dry well detector is on input one and transfer pump skid is on input two. Signal two from the rate meter to the OMI was disconnected. Cannot monitor the transfer pump skid from the OMI. Team must go to the rate meter in the frisk shack to determine pump skid levels. At 17:45 team finished cleaning up hydraulic fluid that was spilled when reconnecting hydraulic lines to the sluicer. Lynn Whitehead said to scoop the area with a shovel and put it in a bag. There was approximately 3 oz. of fluid. Team also had to replace the valve for the sluicer pump skid diaphragm pump and completed this work at approximately 17:30.
	18:35	Team could not replace rupture disk and had to exit area to get spreader bar to complete the task. As they exited, it was determined that Sergio Salcido and Tom Lewis were contaminated. Levels were 20,000 on company clothes and 500 on hair for Sergio; skin contamination was <100 above background.
	20:05	Chemical Technology division representatives arrived to perform denaturing.
	20:22	Submersible pump in Tank T4 was lowered to the bottom of the tank.
	20:25	Late entry. It was determined that MOV 360-1 was not opening completely, which is why it was thought that strainer #1 could not be cleaned. It was not opening either locally or remotely. It would only open 10%. Team removed the actuator from the valve and tested the actuator locally and remotely from PLC. Actuator worked properly. It was thought then that something was lodged in the valve causing it to not open. Actuator was put back on the valve and manipulated repeatedly. MOV 360-1 finally started working properly and now opens and closes completely. Team decided to use strainer and programming changes for automatic sluicing were made. Also on June 30, 1998, Joe La Rosa made a change in the programming to allow a timer during a MVST transfer so that every 30 min a flow total will come up to show flow total for the MVST transfer.

Date	Time	Entry
	20:35	Greg Boris stated that sluicing operations could still be performed despite the contamination problem during the rupture disk change.
	20:40	Chemical Technology division began transferring uranyl nitrate in to Tank T4 through the south riser.
	20:53	Completed transfer of uranyl nitrate into Tank T4. Initial tank volumes of Tanks T4 and Tank T9 are as follows. . Tank Condition Level Volume T4 Current 4.5 ft 10728.5 gal T9 Current 1.0 ft 671.4 gal
	21:24	Began transferring material from Tank T4 to Tank T9 using low-pressure pump system.
	21:45	Submersible pump 8 stopped on a thermal over load during the transfer. Team switched to submersible pump 7 to complete the transfer.
	21:51	Starting mixer in Tank T9 to mix material and uranyl nitrate.
	22:07	Conducted prejob briefing for finishing changing rupture disks. Main concerns were that PPE has now been upgraded and new RWP has been written for the job.
	22:23	Discontinued transfer from Tank T4 to Tank T9. Blowing air through lines to reduce field for team to change rupture disk.
	22:37	Late entry. At 22:30 submersible pump shut down due to thermal over load and team switch to submersible pump 8 to continue transfer.
	22:50	Completed changing rupture disk.
	23:15	Tested the rupture disk after replacement and the disk leaked. Team then tried loosening the rupture disk and realigning it. Team then tested the disk again and it still leaked. Team then changed the disk in the holder that was previously in the line and replaced the disk again. Disk was retested and it did not leak. During the process, it was determined that the contamination had been spread beyond the transfer pump skid. As a result, PPE requirements were upgraded. Team HP technician found contamination on the walkway around the skid.
07/02/98	01:15	Completed rupture disk replacement.
	01:45	Began sluicing operations.
	02:05	While trying to start up the system, it was found that no flow was going to the sluicer.
	02:12	System was shut down in accordance with Work Instruction #4 normal system shut down.
	02:19	Began line flushing in accordance with Work Instruction #5 line flushing sequence. Beginning process water flow total is 2340 gal.
	02:22	Completed low-pressure transfer line flushing. Process water flow total is 2478 gal. Beginning low-pressure feed system flushing.

Date	Time	Entry
	02:25	Completed low-pressure feed system flushing. Process water flow total was 2543 gal.
	02:35	Additional test flushes were performed. Process water flow total was 2629 gal. Begin high-pressure system line flushing.
	02:40	Completed high-pressure system line flush. Process water flow total was 2693 gal. Performed flushes of the strainers while trouble shooting the rupture disk. Flow total is part of that flushing.
	02:42	Began sluicer and sluicer pump flushing. Process water flow total was 2694 gal.
	02:45	It appears water went through strainer discharge valves 360-1 and 360-2. No water was flushed through the sluicer.
	02:50	Performed the sluicer rinse again. No water was pushed through the sluicer. Process water flow total is now 2851 gal after trouble shooting.
	04:00	Team conducted trouble shooting and determined that mechanical pressure relief valve on the sluicer pump skid has tripped. This is why we could not get flow through the borehole miner. Greg Boris will call vendor.
07/07/98	17:20	Plan to change out relay for transfer pump skid diaphragm pump and sluice.
	18:21	Completed changing relay and testing diaphragm pump on transfer pump skid. Began conducting pre-operational checklist and Work Instruction #1 sluicing system setup and configuration..
	19:30	Completed pre-operational checklist and Work Instruction #1 sluicing system setup and configuraiton valve alignments.
	19:40	Tank Condition Level Volume T4 Current 1.5 ft 2180.4 gal T9 Current 7.3 ft 10257.9 gal
	19:45	Logbook #1 closed.
	19:47	Logbook #2 opened.
	20:10	Conducted pre-job briefing for sluicing operations. System is aligned for using HPP 320-1 and strainer #2.
	20:25	Began Work Instruction #2 system startup and operation.
	20:40	Aborted sluicing sequence due to insufficient pressure on the intake side of the high-pressure pump.
	20:46	Maximum pressure obtained using submersible pump Tank T9 was 8 psi. Team will attempt to build pressure using the process water pump. Starting process water flow total is 3402 gal.
	20:49	Obtained approximately 70 psi using the process water pump.
	20:50	Opened MOV 300 to flush water through submersible pump in Tank T9. Ending process water flow total is 3436 gal.
	2051	Using air to blow down line to submersible pump in Tank T9.
	20:55	Using material in Tank T4 to flush through the submersible pump in Tank T9.
	21:00	Blowing air through submersible pump 8 and submersible pump in Tank T9.

Date	Time	Entry
	21:36	Power light on mixer motor starter box is blown. Still unable to create pressure with submersible pump in Tank T9. Team is discussing possible alternative options.
	21:50	Team is shutting down operations for the day. Conducting Work Instruction #4 normal system shutdown. Rinsing borehole miner. Process water total is 3442 gal.
	21:55	Completed Work Instruction #4 normal system shut down.
	21:56	Starting Work Instruction #5 line flushing sequence. Starting flow total is 3443 gal. Performing low-pressure feed system flushing.
	22:00	Completed low-pressure feed flush. Process water total is 3492 gal. Beginning high-pressure pump line system.
	22:01	Completed high-pressure pump system process water flow total is 3496 gal. Starting strainer flushing.
	22:03	Completed strainer flushing, process water flow total is 3546 gal. Beginning sluicer and sluicer pump system flush.
	22:08	Completed sluicer pump and sluicer system flush. Process flow total is 3620 gal. Begin low-pressure transfer line system flush.
	22:13	Completed low-pressure transfer line system flushing Process water flow total is 3715 gal.
	22:29	Beginning additional rinse on strainer line, Process water flow total is 3716 gal.
	22:33	Tried to push air through strainer #1 and then process water and it appeared that 360-1 is not opening.
	22:35	Completed line flushing sequence. Process water flow total is 3800 gal.
07/08/99	10:20	Plan to trouble shoot problems with the submersible pump in Tank T9 and test alternate methods for sluicing.
	12:15	Completed testing all valves in the transfer pump skid. MOV 235 will not close completely. It stays open approximately 5%. MOV 360-1 will not open. MOV 305 only opens approximately 90%. MOV 250-2 only opens 90% also.
	12:20	Replaced relay for 410-1 that was borrowed for use in the VFD for HPP 320-1 yesterday.
	12:32	Completed checking all valves on the risers. MOV 440-1 seemed to be just short of closing completely. No significant problems with the other riser valves.
	12:40	Tested sluicer pump skid valves. MOV 675 does not close.
	12:45	Tested all valves on process water skid. All process water skid MOVs worked correctly.
	14:18	Tested amperage for submersible pump in Tank T9. Also tested mixer phases.
	14:45	Test submersible pump in Tank T9to determine pressure produced by the pump. The pump only generated about 2 psi. Tried to recycle through Tank T9 through MOV 300 and back through 455 and there was no flow.
	14:50	Attempting to rinse water through MOV 300 then through the submersible pump in Tank T9. Process water pump flow total is 3869 gal.
	14:55	Completed rinsing through the pump. No pressure was observed. Process water flow total is 3943 gal.

Date	Time	Entry
	14:58	Attempting to generate flow with submersible pump in Tank T9 once again. Still not getting any pressure generated by the pump.
	15:58	Ending flow totals from OMI for the day MVST Flow Low Pressure Transfer Flow Process Water Flow Ventilation Line Flow 24218 gal 50619 gal 3989 gal 22,056,570 cu.ft. There will be a meeting in the morning to discuss options for continuing sluicing and dealing with the problem with the pump in Tank T9.
07/10/98	07:00	Started mixers in Tank T9. This is in preparation for waste operations transfer of liquid from Tank T9 to Tank T4 with air operated pump. Upon starting mixer, levels in tanks are as follows. Tank Condition Level Volume T3 Current 2.3 ft 4158 gal T4 Current 1.3 ft 1912 gal T9 Current 7.4 ft 10410 gal
	07:15	Confirm ventilation system is on and air compressor is on. Air compressor shows 120 psi at tank and 100 psi at regulator.
	09:30	Stop mixer.
	13:30	Restart mixer. Tank levels are as follows. Tank Condition Level Volume T3 Current 2.3 ft 4158 gal T4 Current 1.3 ft 1912 gal T9 Current 8.1 ft 11445 gal Pipe fitters have added valve and "T" connection to OHF air compressor to provide additional air to transfer pump if needed. "T" installation is complete and valve is closed.
	14:00	Pipe fitters test system with process water and found leak on discharge side. Work stopped to get new fitting.
	14:45	Fittings repaired and pumping started from Tank T9 to Tank T4.
	15:36	Team continues to transfer material from Tank T9 to Tank T4.
	15:38	Greg Boris and Chris Provost have reviewed the new Work Instruction #20 (manual sluicing and transfer without using Tank T9). All their comments have been incorporated. Greg Boris has approved the Work Instructions. Greg Boris is also approving for the FM (Lynn Whitehead) in his absence.
	17:35	Team starts to fill 2000 gal process water tank. Starting level is approximately 1180 gal.
	18:28	Team stops filling process water tank. Current level is 2500 gal.

Date	Time	Entry
	19:00	Waste Management stops transfer to Tank T4 from Tank T9. Final tank levels are as follows: Tank Condition Level Volume T3 Current 2.3 ft 4178.2 gal T4 Current 5.1 ft 12569.8 gal T9 Current 0.0 ft 0.0 gal
	22:25	Team initiates Work Instruction #2 sluicing system startup and operation.
	22:40	Team begins operating borehole miner.
	23:06	Team switched from submersible pump 8 to submersible pump 7.
	23:50	Team begins manual transfer to MVST per Work Instruction #2 sluicing system setup and configuration.
07/11/98	00:03	Begin transfer
	00:15	Stop transfer, problem with sufficient flow rates.
	00:18	Team flushed MVST line, 4503 gal. Late entry: Final MVST flow total was 24388 gal.
	00:20	Team completed MVST rinse, were unable to flush 320 gal because of apparent blockage in MVST line. Final process water flow is 4520 gal.
	00:25	Greg Boris contacts waste management about blockage problem
	00:55	Waste Management checked valve alignments and team will try again to transfer. Starting flow total is 4523 gal.
	02:00	LSS Margie Skipper performed an emergency release of a lockout tag out #108358. Jim LaForest reissued another permit to Lock out VLV 710 #108363. Team tried to flush lines, MVST line and was not successful.
	02:50	Work Instruction #4 normal shutdown begun. Team conducting a flush of the sluicer starting process flow total is 5038 gal.
	02:55	Team has finished washing borehole miner. Final process flow total is 5043 gal. Team completed Work Instruction #4 normal system shut down.
	03:00	Begin line flushing per Work Instruction #5 line flushing sequence. Low-pressure transfer system flushing with process water: Process water flow 5043 gal. Final process water flow 5145 gal. High –pressure pump system flushing with process water Process water flow 5146 gal. Final process water flow 5210 gal. Strainer flushing with process water Process water flow 5210 gal. Final process water flow 5267 gal. Sluicer and sluicer pump flushing with process water Process water flow 5267 gal. Final process water flow 5369 gal.

Date	Time	Entry
	03:13	Line flushing is complete.
	03:40	Valve 340-2 was tested, and it is fully operational.
07/13/98	10:05	Team will conduct a flush of the MVST transfer line. Team will open MOV 235, 245, and 340-2 and start PWP 205. Starting flow total for process water is 5689 gal.
	10:09	Greg Boris has called Pete Peterson from WMRAD and he is ready for the test.
	10:14	Team starts process water pump.
	10:21	Team stops process water pump. Final process water flow total 6602 gal. WMRAD confirmed that they did receive flow from OHF.
	10:38	Greg Boris directed the flush with process water.
	16:15	Plan to transfer and sluice Tank T4 tonight.
	18:00	Team has completed pre-operational checklist and Work Instruction #1 sluicing system setup and configuration.
	18:12	Team is going to test MVST line with process water. Starter flow is 6056 gal.
	18:15	Team starts process water.
	18:20	Test complete. Flow total is 6366 gal.
	18:21	Team is conducting Work Instruction #20 manual sluicing and transfer without using Tank T9.
	18:36	Late entry: Prior to sluicing the level in tank t9 is 1173 gal.
	18:53	Team has switched from submersible pump 8 to submersible pump 7 and has switched to the north side of the tank.
	19:13	Starting MVST transfer 25099 gal.
	19:30	Borehole miner is not working correctly. It will not pivot around. It will just go up and down.
	19:40	Submersible pump 7 shut down. Restart submersible pump #8 to continue transferring.

Date	Time	Entry
	19:43	MVST flow total 26508 gal.

Time	Flow Total	OHF Differential	MVST Flow Total	MVST Differential
19:13	25099	NA	13249	NA
19:43	26508	1409	14484	1244
20:13	28055	1547	16647	2163
20:43	29697	1642	17844	1197
21:13	31329	1632	19551	1707
21:43	32961	1632	21264	1713
22:13	34272	1311	22498	1234
22:43	35461	1189	23751	1253
23:13	36662	1201	24964	1213
23:25	37044	NA	25279	NA

Date	Time	Entry
	20:00	Switched between submersible pump 7 and submersible pump 8 due to thermal over loads. 20:00 shut down 8 turned on 7 20:12 7 8 20:22 8 7 20:32 7 8 20:45 8 7 20:56 7 8 21:06 8 7 21:16 7 8 21:25 8 7 21:32 7 8 21:38 8 7 21:48 7 8 21:53 8 7 22:17 7 8 22:33 8 7 22:47 7 8 22:52 8 7 22:55 both pumps are on 23:05 shut down 8 23:20 both pumps are on
	23:22	HOO 320-1 off
	23:22	HOO 320-1 back on
	23:25	Both submersible pumps shut down.
	23:27	Starting to rinse MVST line with process water. Initial total 6395 gal.
	23:33	Finish MVST rinse. Final reading 6718 gal for process flow and 37373 for MVST total. Team is going to restart sluicing in accordance with Work Instruction #20 Manual Sluicing and Transfer Without Using Tank T9. Sluicing will be done with excess supernate that is in Tank T3. Initial level in Tank T3 is 4185 gal. This activity is executed from direction of Greg Boris.
	23:55	Began borehole miner rinse. Initial 6738 gal. Final flow total 6748 gal.

Date	Time	Entry
	23:57	Team is skipping to Work Instruction #5 sluicer pump flushing with process water steps only. Then the team will move back to Work Instruction #20 manual sluicing and transfer without using Tank T9 for MVST transfer. Greg Boris has given permission to do this.
07/14/98	00:05	Team completes sluicer pump flushing with process water steps. Final process flow reading is 6788 gal.
	00:10	Begin MVST line transfer 37375 gal.
	00:25	Finish MVST line transfer 38296 gal.
	00:26	Begin MVST line flush with process water – 6790 gal.
	00:33	Finish MVST line flush – final total 7113 gal. Final MVST total 38418 gal. Final transfer volume 13319 gal. MVST total 26661 gal for total transfer volume 13421 gal.
	00:35	Team conducts line flushing sequence per Work Instruction #5 line flushing sequence.
	00:36	Low-pressure transfer system flushing with process water Process water flow 7113 gal. Final process water flow 7249 gal. High-pressure pump system flushing with process water Process water flow 7251 gal. Final process water flow 7277 gal. Strainer flushing with process water Process water flow 7277 gal. Final process water flow 7345 gal. Sluicer and sluicer pump flushing with process water Process water flow NA gal. Final Process water flow NA gal.
	00:47	Flushing is complete
	14:00	Plan to move borehole miner and camera from Tank T4 to Tank T2

Table A.5 Borehole-Miner Extendible-Nozzle Remediation of Tank T2

Date	Time	Entry
07.14.98	14:00	Plan to move borehole miner and camera from Tank T4 to Tank T2.
	16:05	Team completes briefing regarding camera move (Work Instruction #13 installing and moving in-tank camera).
	17:05	Team completes camera move.
	17:30	Team conducts project briefing for movement of the borehole miner (Work Instruction #12 sluicer mast placement).
	18:52	Team completes move. Some difficulty was encountered in placing the borehole miner in the center riser. Two steel welded tubes were attached to the center riser. This made placement of the shroud difficult. See lab book for picture.
	20:12	Late entry. Team performed duties required in Work Instructions #11 and #12.
	21:23	Team completes work within the radiation zone. The following items were completed: 1) all hydraulic, water and electrical lines are connected; 2) the dry well monitor was moved to the dry well for Tank T1/T2; 3) The team tested the rotation function of the borehole miner. It is getting stuck every four degrees when it appears that the mast is rubbing against the two tubes noted earlier.
	21:28	Called Chris Provost, Greg Boris, and Charles Callis about borehole miner problem. Team is not sure whether it is the problem of it binding on the tubes mentioned earlier or if it is a problem with the rotation function. Greg Boris will check on this tomorrow.
07/15/98	17:20	Plan to sluice Tank T2.
	19:10	Completed pre-operational checklist, Work Instruction #1 and set up spill containment. Chemical Tech reps have arrived to perform the denaturing for Tank T2.
	19:20	Began to denature Tank T2.
	20:05	Team will conduct a MVST transfer test with process water. Beginning process water total is 7657 gal. Waste Management has been notified and is standing by.
	20:07	Denaturing was completed.
	20:08	Completed test transfer to MVST. Ending process water flow total was 8834 gal.
	20:10	Tank Condition Level Volume T2 Current 4.1 ft 8125 gal T3 Current 2.1 ft 3727 gal T9 Current 1.8 ft 1579 gal
	20:34	Conducted pre-job briefing for sluicing operations. Team will operate in accordance with Work Instruction #2o, Manual Sluicing.

Date	Time	Entry
	20:38	Began sluicing operations in accordance with Work Instruction #20.
	21:05	Team observed the arm on the borehole miner is angling to the side in relation to the mast. Also noted that HPP 320-1 is operating at a much higher speed, approximately 58% to maintain a pressure of 100 psi. Normal speed with this system configuration to maintain 180 psi is 23%.
	21:29	Team has decided to switch to HPP 320-2 for sluicing operations.
	21:34	Beginning system shut down in accordance with Work Instruction #4, normal system shutdown.
	21:37	HPP 320-1 ramped up to 100% during shut down and the team believes a rupture disk was blown.
	21:38	Team skips steps 4-8 because system will be restarted. Greg Boris gives permission to skip these steps.
	21:40	Begin line flushing per Work Instruction #5. Low-pressure transfer system flushing with process water. 21:42 Process water flow 7743 gal. Final process water flow 7811 gal. High-pressure pump system flushing with process water 21:44 Process water flow 7813 gal. Final process water flow 7831 gal. Strainer flushing with process water 21:45 Process water flow 7831 gal. Final process water flow 7893 gal. Sluicer and sluicer pump flushing with process water 21:47 Process water flow 7893 gal. Final process water flow 7930 gal.
	21:49	Completed line flushing sequence.
	22:50	Completed Work Instruction #4 switching high pressure pups.
	22:53	Begin sluicing operations in accordance with Work Instruction #20.
	23:22	Switching submersible pumps from 4 to 3.

Date	Time	Entry
07/17/98	23:29	Beginning transfer to MVST in accordance with work Instruction #20. MVST flow total 26508 gal. Time Elapsed OHF Flow Total OHF Differential MVST Flow Total MVST Differential 23:36 0 min 38548 gal NA 27733 gal NA 00:06 30 39670 1122 gal 28494 761 gal. 00:36 60 40961 2413 29643 1910 01:06 90 42339 3791 31078 3345 01:36 120 43723 5175 32469 4736 02:06 150 45265 6717 34032 6299 02:36 180 46703 8155 35488 7755 02:43 187 46830 8282 35642 7909 02:51 198 47136 8588 35842 8109
		Switched between submersible pump 3 and submersible pump 4. 00:12 shut down 3 turned on 4 00:47 4 3 01:09 3 4 01:34 4 3 01:55 3 4 02:10 4 3 02:20 Running both pump 4 and pump 3
	02:25	Team is no longer processing water through the sluicer and is transferring to MVST only.
	02:28	Team needs to check 225-2 and connection for rinse line to sluicer tank.
	02:37	Shutdown high-pressure pump 320-2.
	02:44	Terminated MVST transfer and began rinsing MVST lines. Process water flow total is 7993 gal MVST flow total for OHF is 4683 gal Waste Management flow total is 35642 gal
	02:52	Completed rinse of MVST. Process water flow total was 8309 gal MVST total flow for OHF was 47136 gal Waste Management flow total was 36842 gal

Date	Time	Entry
	03:10	Rinsed camera in Tank T2. Process water total start was 8310 gal. Ending was 8321 gal.
	03:15	Team will begin sluicing using excess supernate in Tank T3. Tank Condition Level Volume T2 Current 0.2 ft 70.1 gal T3 Current 2.1 ft 3714.9 gal T9 Current 2.0 ft 1853.6 gal
	03:18	Begin sluicing from Tank T3 to Tank T2.
	03:20	Stopped sluicing to open VLV 450-1, which has to be open to use supernate from Tank T3.
	03:37	Began sluicing operations again in accordance with Work Instruction #20. Began transferring supernate from Tank T3 to Tank T2.
	04:10	Stopped transferring supernate from Tank T3 to Tank T2 and continued sluicing.
	04:16	Rinsing camera in Tank T2. Process flow total is 8326 gal.
	04:17	Completed rinse of camera. Process water flow total is 8332 gal.
	04:18	Switching from submersible pump 4 to submersible pump 3.
	04:28	Began transferring to MVST Time Elapsed OHF Flow Total OHF Differential MVST Flow Total MVST Differential 04:28 0 min 47139 gal NA 35938 gal NA 04:58 30 48535 1396 gal 37235 1297 05:07 39 48876 1737 37568 1630 05:16 48 49191 2052 37870 1932
	04:35	Rinsed camera in Tank T2. Process flow total was 8333 gal.
	04:36	Completed rinse of camera. Process water flow camera was 8339 gal.
	04:41	Rinsed camera in Tank T2. Process flow total was 8339 gal.
	04:42	Completed rinse. Process flow total was 8342 gal.
	04:43	Switching from submersible pump 3 to submersible pump 4.
	04:48	Began running submersible pump 3 and submersible pump 4. Stopped sluicing operations and continued MVST transfer only.
	04:57	Rinsed camera in Tank T2. Process flow total was 8342 gal. Ending flow total was 8345 gal.
	05:07	Completed MVST transfer and began rinsing MVST lines. Beginning OHF MVST flow total was 48876 gal. Beginning Waste Management flow total was 37568 gal. Beginning process water flow total was 8347 gal.
	05:16	Completed flushing MVST line. Process flow total was 8664 gal. Ending MVST flow total was 49191gal. Ending Waste

Date	Time	Entry
		Management flow total was 37870 gal.
	05:16	Began normal system shut down. Beginning process flow total was 8665 gal.
	05:20	Completed normal system shut down. Process flow total was 8678 gal.
	05:23	Begin line flushing per Work Instruction #5. Low-pressure transfer system flushing with process water 05:26 Process water flow 8678 gal. Final process water flow 8863 gal. Low-pressure feed system flush 05:27 Process water flow 8868 gal. Final process water flow 8924 gal. High-pressure pump system flushing with process water Strainer flushing with process water 05:30 Process water flow 8924 gal. Final process water flow 8990 gal. Sluicer and sluicer pump flushing 05:33 Process water flow 8990 gal. Final process water flow 9044 gal. 05:37 Completed line flushing sequence.
	05:41	Began post-operational checklist.
	06:07	While conducting post-operational checklist, it was found that the actuator on MOV 340-2 was loose. The actuator was tightened.
	13:00	Plan to move borehole miner and camera. Waste Management is presently pumping with diaphragm pump from Tank T9 to Tank T1. Team cannot work on site when this crew is working.
	14:00	Camera has been flushed in accordance with Work Instruction #12. Rinsed sluicer mast in accordance with Work Instruction 11 in preparation for equipment move.
	14:45	Waste Management is ready to flush lines. Team will use potable water on borehole miner. Starting flow total is 9286 gal. Finish total is 9314 gal.
	15:10	Rinse camera in Tank T2. Starting flow is 9316 gal. Finish flow is 9319 gal.
	15:25	Rinsed lower camera ring in Tank T2. Starting flow is 9321 gal. Finish flow is 9336 gal.
	15:50	Team issues lock out and tag out permit #108367.
	16:12	Team conducts briefing with P&E crew for camera and sluicer move to Tank T1.

Table A.6 Borehole-Miner Extendible-Nozzle Remediation of Tank T1

Date	Time	Entry
07/17/98	16:12	Team conducts briefing with P&E crew for camera and sluicer move to Tank T1.
	17:40	Team has completed moving camera to Tank T1 and borehole miner to Tank T1.
	18:38	Begin filling potable water tank. Beginning level 1100 gal.
	19:41	Setup complete on equipment. Team has tested borehole miner, no problems.
07/18/98	17:00	System is aligned for using HPP 320-2 and strainer 2.
	19:39	Team completed pre-operational checklist and Work Instruction #1.
		Calculations to define flow totalizer errors for process water flow and MVST flow performed by Joe La Rosa. Three samples were taken for process water flow and three samples were taken for MVST. The samples were taken during a time period when no flow occurred through the flow meters and the totalizer reading through those meters were observed. The results are as follows:
		Process water flow totals / MVST flow totals Sample #1 07/14/98 19:00 7499.34 gal / 38442.07 gal 07/15/98 20:00 7656.16 gal. / 38470.12 gal Difference 156.82 gal/ 25 hr * 60 min/hr = 0.1045 gal/min / 28.05/25 hr *60 = 0.0187 gal/min
		Sample #2 07/11/98 8:00 5329.83 gal / 24400.00 gal 07/13/98 10:00 5686.04 gal / 24468.57 gal Difference 356.21 gal /50 hr * 60 min/hr = 0.1187 gal/min / 68.57/50 hr * 60 = 0.0228 gal/min
		Sample #3 07/02/98 10:00 2869.36 gal / 23858.83 gal 07/06/98 12:00 3238.66 gal / 24093.74 gal Difference 369.31 gal/98 hr * 60 min/hr = 0.0628 gal/min / 235.91 gal/98 * 60 = 0.0401 gal/min
		Average of three samples: Average process water flow error = 0.0953 gal/min Average MVST flow error = 0.0272 gal/min.
	19:56	Late entry. During the pre-operational check list, it was discovered that the hydraulic line labeled #7 was leaking. This line is the arm extension function line. It was discovered a gasket in a fitting was broken. Team wrapped the fitting in several layers of absorbent pads and plastic. At approximately 19:40, Chemical Tech representatives began denaturing procedure for Tank T1.

Date	Time	Entry
	20:14	Completed transferring uranyl nitrate for denaturing in Tank T1.
	20:23	Late entry. Bubbler readings for tanks taken on 30 May, 1998 before sluicing operations commenced. Tank Condition Level Volume T1 May 30, 1998 5.8 ft 12312 gal T2 May 30, 1998 5.7 ft 12106 gal T3 May 30, 1998 2.0 ft 3466.3 gal T4 May 30, 1998 6.1 ft 15881.5 gal T9 May 30, 1998 4.6 ft 5893 gal
	20:26	Data taken 18 July, 1998 Tank Condition Level Volume T1 Current 4.2 ft 8465.2 gal T3 Current 1.6 ft 2500.0 gal T9 Current 0.0 ft 5.7 gal
	20:50	Waste Management is having difficulty with their valve alignments for the MVST line. They are trouble shooting the problem.
	21:40	Waste Management is going to close a valve farther down their line and has given the go ahead to sluice and transfer. Conducted pre-job briefing for sluicing operations.
	22:06	Conducted a MVST line transfer test using process water. Beginning process water flow is 9533 gal. Beginning MVST flow is 49317 gal.
	22:10	Completed MVST transfer test. Ending process water flow is 9656 gal. Ending MVST flow is 49440 gal.
	22:11	Beginning sluicing operations in accordance with Work Instruction #2.
	22:23	Starting pump #2.
	22:45	Stopped sluicing by shutting down submersible pump and HPP 320-2. Team will lower submersible pump #2 in Tank T1.
	22:58	Resumed sluicing operations in accordance with Work Instruction #20 using pump 2.
	23:15	Switching from submersible pump 2 to submersible pump 1.

<table>
<tr><th>Date</th><th>Time</th><th>Entry</th></tr>
<tr><td></td><td>23:25</td><td>Beginning MVST transfer in accordance with Work Instruction #20.
MVST flow total.
<table>
<tr><th>Time</th><th>Elapsed</th><th>OHF Flow Total</th><th>OHF Differential</th><th>MVST Flow Total</th><th>MVST Differential</th></tr>
<tr><td>23:25</td><td>0 min</td><td>49444 gal</td><td>NA</td><td>41175 gal</td><td>NA</td></tr>
<tr><td>23:55</td><td>30</td><td>50744</td><td>1300 gal</td><td>42159</td><td>984 gal</td></tr>
<tr><td>00:25</td><td>60</td><td>52333</td><td>2889</td><td>43577</td><td>2402</td></tr>
<tr><td>00:37</td><td>72</td><td>52908</td><td>3464</td><td>NA</td><td>NA</td></tr>
<tr><td>00:55</td><td>90</td><td>53113</td><td>3669</td><td>44321</td><td>3146</td></tr>
<tr><td>01:06</td><td>101</td><td>53701</td><td>4257</td><td>44925</td><td>3750</td></tr>
<tr><td>01:17</td><td>restart</td><td>53701</td><td>NA</td><td>37861</td><td>NA</td></tr>
<tr><td>01:47</td><td>30</td><td>55322</td><td>1621</td><td>39430</td><td>1569</td></tr>
<tr><td>02:17</td><td>60</td><td>55862</td><td>2161</td><td>39942</td><td>2081</td></tr>
<tr><td>02:47</td><td>90</td><td>57433</td><td>3732</td><td>41392</td><td>3531</td></tr>
<tr><td>03:00</td><td>rinse</td><td>58027</td><td>4326</td><td>NA</td><td>NA</td></tr>
<tr><td>03:20</td><td>end rinse</td><td>58422</td><td>4721</td><td>42386</td><td>4525</td></tr>
<tr><td>04:00</td><td>restart</td><td>58424</td><td>NA</td><td>42469</td><td>NA</td></tr>
<tr><td>04:30</td><td>30</td><td>596 47</td><td>1223</td><td>43543</td><td>1074</td></tr>
<tr><td>05:00</td><td>60</td><td>60983</td><td>2559</td><td>44770</td><td>2301</td></tr>
<tr><td>05:24</td><td>84</td><td>62274</td><td>3850</td><td>46016</td><td>3547</td></tr>
<tr><td>05:41</td><td>rinse</td><td>62594</td><td>4170</td><td>46212</td><td>3743</td></tr>
</table></td></tr>
<tr><td></td><td>23:30</td><td>Switching from submersible pump 1 to submersible pump 2</td></tr>
<tr><td></td><td>23:51</td><td>Switching from submersible pump 2 to submersible pump 1</td></tr>
<tr><td>07/19/98</td><td>00:13</td><td>Switching from submersible pump 1 to submersible pump 2</td></tr>
<tr><td></td><td>00:37</td><td>System shut down because low-pressure pump shut down on a thermal over load. Transfer was interrupted. MVST flow was 52908 gal.</td></tr>
<tr><td></td><td>00:49</td><td>Restarted transfer to MVST using submersible pump 1.</td></tr>
<tr><td></td><td>01:00</td><td>Switching from submersible pump 1 to submersible pump 2.</td></tr>
<tr><td></td><td>01:06</td><td>Stopped MVST transfer for Waste Management to switch receipt tank.</td></tr>
<tr><td></td><td>01:11</td><td>Switching from submersible pump 2 to submersible pump 1.</td></tr>
<tr><td></td><td>01:17</td><td>Restarted MVST transfer into new tank. Restarted running totals in chart shown above.</td></tr>
<tr><td></td><td>01:23</td><td>Switching from submersible pump 1 to submersible pump 2.</td></tr>
</table>

Date	Time	Entry
	01:34	Switching from submersible pump 2 to submersible pump 1.
	01:49	Interrupted transfer to disconnect hydraulic line #7. The line has been leaking and hydraulic fluid level in HPU is dropping. Team is disconnecting quick disconnects at the sluicer to stop fluid from leaking.
	02:08	Resuming MVST transfer using submersible pump 2.
	02:15	Feedback for 340-2 is erratic.
	02:20	Switching from submersible pump 2 to submersible pump 1.
	02:34	Switching from submersible pump 1 to submersible pump 2.
	02:43	Team discovered the hydraulic line that was disconnected was arm angle and not arm extension as previously thought.
	02:44	Switching from submersible pump 2 to submersible pump 1.
	02:55	Running both submersible pump 1 and submersible pump 2.
	02:59	Stopped MVST transfer to continue sluicing Tank T1.
	03:03	Rinsing camera in sluice tank. Starting process flow total is 9681 gal.
	03:05	Completed camera rinse. Process water flow total is 9693 gal.
	03:07	Stopped sluicing operations to repair arm angle hydraulic line.
	03:09	Flushing MVST with supernate from Tank T3. Starting MVST flow is 58027 gal
	03:20	Completed MVST rinse. Flow total is 58422 gal.
	03:43	Completed repair of hydraulic line for arm angle.
	03:44	Started sluicing operations using supernate from Tank T3 to sluice Tank T1.
	04:00	Restarted MVST transfer using submersible pump 1.
	04:11	Using both submersible pump 1 and 2.
	04:24	Rinsing sluice tank camera. Starting process water flow total is 9699 gal.
	04:25	Completed camera rinse. Ending process water flow total is 9703 gal.
	04:29	Rinsing camera in sluice tank. Starting process water flow total is 9704 gal.
	04:31	Completed rinse of camera. Ending process flow total is 9709 gal.
	04:37	Stopped transferring from Tank T1 and continued transfer from Tank T3.
	04:49	Continuing to sluice Tank T1. Stopping transfer to MVST. Using supernate from Tank T3 to sluice T1.
	04:54	Sluicer control unit shut down. Team believes hydraulic fluid level is low. Continue to transfer to MVST.
	05:24	Completed transfer from Tank T3. Completed transfer of all tanks contents.
	05:25	Started flushing MVST line. Starting process water flow total is 9714 gal.
	05:41	Completed MVST line flush. Ending process water flow total is 10034 gal.

Date	Time	Entry
	05:43	Beginning normal system shut down. Rinsing borehole miner. Beginning process water flow total 10,035 gal.
	05:45	Completed Work Instruction #4 and borehole miner flush. Ending process water flow total is 10047 gal.
	05:46	Begin line flushing per Work Instruction #5. Low-pressure transfer system flushing with process water 05:46 Process water flow 10047 gal. Final process water flow 10412 gal. Low-pressure feed system flush. 05:55 Process water flow 10412 gal. Final process water flow 10487 gal. High-pressure pump system flushing with process water 05:56 Process water flow 10487 gal. Final process water flow 10506 gal. Strainer flushing with process water 05:58 Process water flow 10506 gal. Final process water flow 10564 gal. Sluicer and sluicer pump flushing. 06:01 Process water flow 10564 gal. Final process water flow 10635 gal. 06:04 Completed line flushing sequence.
	06:45	Complete post-operational checklist. Made last check with Waste Management on totals according to their instruments. Their totals for each tank were as follows: Tank W27 46213 gal Tank W28 46212 gal
07/20/98	09:30	Plan to flush lines.
	09:50	Jim LaForest spoke with Greg Boris; Greg instructed the team not to do a final water rinse through the system but to only blow air through the system. Contract required two rinses with the first rinse being performed on 7/19/98. Greg Boris said not to perform a second rinse.
	09:55	Team is moving bubbler tubes from tank to tank to record current levels in the tanks. Tank Condition Level Volume T1 Current 0.2 ft 111.0 gal T2 Current 0.3 ft 221.9 gal T3 Current 0.0 ft 0.0 gal T4 Current 0.4 ft 373.4 gal T9 Current 0.5 ft 227.8 gal
	10:12	Begin flushing lines with compressed air.
	13:45	Greg Boris said to do the last rinse since the state representative okayed the last tank.

Date	Time	Entry
	14:55	Completed complete system line flushing using Work Instruction #5 as a guide. Starting process flow total was 10845 gal. Ending process water flow total was 11710 gal.
	14:58	Performing line drying with air once again.
	15:15	Completed drying lines with air.
	15:30	Completed tasks for day.

Table A.7 Borehole-Miner Extendible-Nozzle System Disassembly at Old Hydrofracture Facility Site

Date	Time	Entry
08/05/98	19:00	Conducted pre-job meeting. Plan of the day is site set up and organization and start cutting secondary containment. H&S concerns are working in teams, power tool safety, contamination, and radiation exposure control, and emergency procedures.
	21:00	Completed prep work and site organization for secondary containment dismantling.
08/06/98	05:30	Transported dismantled secondary containment to frisk out area. Continued dismantling secondary containment.
	06:15	Site clean up and organization.
	06:20	Transported more secondary containment to frisk out area.
	19:00	Plan of the day is to continue cutting secondary containment, placing hydraulic lines in drums, clean up of spilled diesel fuel and oil from engine.
	20:00	Saw blade broke while cutting secondary containment; continued cutting joints with reciprocating saw.
	22:00	Started cutting secondary containment again. Continuing with rolling up hydraulic lines.
	00:30	Saw blade broke again.
	01:15	Transported cut plastic to frisk out area.
	02:00	Completed rolling up hydraulic lines.
	03:15	Transported cut plastic to frisk out area.
08/07/98	19:00	Plan of the day is to finish secondary containment, roll-up MVST transfer line into B-25 box and roll-up water and air lines.
	19:15	Completed rolling up MVST transfer line into B-25 box. Saw was broken while cutting secondary containment.
08/08/98	01:25	Completed rolling hose (air and water) into B-25 box. Completed cutting secondary containment.
	01:45	Site clean up and organization.
	02:15	Transported secondary containment to frisk out area.
08/12/99	19:15	Conducted pre-job briefing. Plan of the day is to cut piping and placing in B-25 boxes. H&S topic was contamination and exposure control, PPE, RWP requirements (are in using power tools.)
	21:30	Completed prep work for cutting piping.
	22:00	Started cutting piping.
08/13/98	05:00	Completed cutting piping for the day.
	06:15	Site clean up and organization
	20:15	Conducted pre-job meeting. Plan of the day is to continue cutting pipe. Discussed ways to perform the job safer and with

Date	Time	Entry
		less change to spread contamination. H&S topic was contamination control, spill control, limits for work in respirators.
	20:45	Bob Carroll and Dan Brown wen inside the area to determine course of action for cutting pipe tonight.
	23:00	It was decided to not proceed with pipe cutting tonight. It was determined team needed more hose to perform cutting. Crew performs some site organization.
08/14/98	18:30	All personnel working on site log in on attendance roster at front door of OHF trailer
	19:05	Donnie McCurry conducts H&S tailgate meetings with OHF crew at trailer. Discussed supplied air respirators for two crews and respirators for the other two crews. They will switch out each time in crews, go over tonight's activities with Bob Carroll, crews will continue cutting pipe around riser tonight.
08/15/98	04:10	Crew has completed cutting up two steel pipe runs. Crew has completed cutting pipe for the day: 21 links in B-25 box.
	04:30	Site clean up and organization.
	18:45	Conducted pre-job meeting. Plan of the day is to continue cutting pipe. H7S concerns were air line respirator hose awareness, awareness of 8/15/98 obstacles while in respirator, proper frisking when exiting the area.
	19:30	Team begins cutting pipe.
08/16/98	06:20	Team completes cutting pipe for the day. Site clean up and organization.
08/17/98	18:45	Conducted pre-job meeting. Plan for the day is to continue cutting piping. H&S concerns were spill containment, fatigue awareness, power tool safety.
	20:50	While cutting piping, there was a spill that splashed outside the containment bag. None hit the ground and was contained on theHerculite. Some did splash on one team member, Rick Salley. It was wiped off Rick Salley's tyveks, his shoe covers and outer gloves were changed, and he then exited the area.
	21:30	After a frisk out in the frisk trailer, Mr. Salley was taken to the PCM1 and it was found his boot was contaminated. The levels (as of 8/17/98) were approximately 28,000 dpm. An eyelet was cut from his boot and his shoestring removed. There was no there contamination found.
08/18/98	02:00	Team completes cutting pipe for the day.
	18:30	Plan for the day is to continue cutting and completing cutting pipe. H&S concerns topics were contamination control and discussion about the occurrence.
	19:00	Lynn Whitehead and Dan Brown went to the area where the secondary containment was placed. It was thought that some of the secondary containment was contaminated. They have to speak to the RCT supervisor to get confirmation that it is contaminated.
	21:00	Bob Carroll went into the area to assess the situation.

Date	Time	Entry
08/19/98	02:40	Completed cutting 3in. piping. While beginning loosening a union on the 1/2 in. piping from the sluicer pump skid diaphragm pump to the transfer pump skid water spilled from the union. It was determined there was pressure on the line. Work was stopped.
	03:00	Site clean up and organized.
	03:15	The tally of pipes for each day is as follows 12 August, 98 12 14 August 98 21 15 August 98 28 17 August 98 17 18 August 98 19
	16:45	Plan of the day is to cut wire and put in B-25 boxes, remove the valve box for the MVST line, and remove the sluicer and cameras from the tanks. H&S concerns were contamination control, power tool safety, heat exhaustion awareness, late entry - some team members came on site at approximately 14:30 and began cutting wire and disconnecting the MVST valve box.
	17:05	Other team members began cutting wire and placing it in B-25 boxes. Continued disconnecting the MVST valve box.
	17:55	Riggers brought in crane to set up for removing the sluicer and cameras.
	18:05	Team members stop cutting wire to prep for removing the sluicer and cameras.
	18:40	While moving the MVST valve box, the bag covering the box was torn and a small amount of liquid dripped in the clean area of the site. The union was retightened. Water spilled on 3 team members, Rick Salley, Miguel Naranjo, and Bob Carroll. All three were surveyed out by the RCT, Dan Brown and were clean.. The RCT began surveying the area and team members began deconning areas where contamination was found. There were no areas found along the road. One area was found next to the valves where the valve box was connected to the MVST line. It was thought that this was not caused by the OHF team. The highest reading on the OHF site was 30,000 dpm and was deconned. The area next to the MVST valves was 500,000 plus and was also deconned.
	19:45	Moving of the sluicer was postponed and team began work on cutting wire.
	18:00	Decon of area and surveys were completed.
08/20/98	07:35	Conducted daily pre-job briefing and safety topic. Plan of the day is to continue cutting wire and cut 1/2-in pipe from the sluicer pump skid to be transfer pipe skid, and general site clean up.
	08:00	Team begins cutting wire and prepping to cut pipe.
	08:50	While frisking out, Sergio Salcido, found contamination on his shirt and in his hair. Levels were 3000 dpm. Sergio Salcido and Bob Carroll go to the body count and lung count.

Date	Time	Entry
	09:15	The site SSHO, Jay Mitchell was instructed to shut all operations on site down per Charles Callis and Lynn Whitehead.
	10:50	Team completes task for the day. Site managers and RCT manager will discuss how to better improve contamination control.
08/21/98	08:05	Conducted daily pre-job briefing. Plan of the day is to cut 1/2-in. line from sluicer pump skid to the transfer pump skid, disconnect the hose from the sluicer pump skid to the sluicer, and cut extension from the MVST valve box. Also, some site clean up and organization and place wire in the B-25 boxes. H&S concerns are contamination control, heat exhaustion awareness, and respirator work safety.
	10:15	Completed cutting 1/2 in. pipe.
	13:05	Completed removing sluicer hose from sluicer pump. Will not cut extension from MVST valve box. Site clean up and organization.
	15:30	Completed placing wire in B-25 box.
	16:00	Completed tasks for the day.
08/22/98	07:40	Plan of the day is to cut extension off of MVST valve box, cut up pipe stands, clean up tasks. H&S concern is heat stress.
	08:50	Completed cutting extension from MVST valve box.
	10:40	Completed piping equipment for shipment to COM, PCI in California.
	10:50	Completed tasks for the day.
08/24/98	07:30	Plan for the day is to cut pipe stands, load scrap into B-25 boxes, remove airline hoses from contamination area, clean contamination area, move borehole miner, and cameras. .
	09:30	Completed cutting pipe stands, removing trash and leftover scrap.
	10:45	Completed removing air line hoses, removing Plexiglas from sluicer pump, and general area clean up.
	15:40	It was decided not to remove borehole miner today. Team realized the bellows does not come with the sluicer mast. Team will use plastic to cover the mast as it comes out.
	19:25	Completed removing cameras.
	19:30	Completed tasks for the day.
08/25/98	07:30	Plan to prep sluicer for movement tomorrow, general site clean up, move equipment to cold test and into sea/land containers with rigging support, cut 1/2-in. pipe and secondary containment that was left over.
	09:30	Completed cutting 1/2-in. pipe and left over secondary containment.
	11:30	Completed placing wood into B-25 boxes, also some PVC piping into B-25 boxes and other general site clean up
	15:30	Prepped trailers for loading equipment and other general site organization. Riggers arrive on site.

Date	Time	Entry
	19:30	Completed moving equipment to cold test. Completed loading compressor skid and process water skid into sea/land. Completed moving B-25 boxes and other site organization.
08/26/98	05:30	Plan for the day is to remove the borehole miner from the tank. Will have riggers here today. H&S topic was overhead loads and heat stress.
	06:45	Completed prep work for removing the sluicer.
	09:40	Completed removing and wrapping sluicer.
	11:30	Completed putting secondary containment into B-25 boxes and moving some back to site to cut in tomorrow.
	15:00	Completed some site organization and clean up.
08/27/98	06:50	Plan for the day is to cut up secondary containment, wrap sluicer stand, bolt down riser, and cut up other metal to place in B-25 boxes. Also, plan to declassify the site from a HAZWOPER area and other site clean up and organization.
	09:30	Completed cutting secondary containment and placing it in B-25 box.
	09:45	Completed wrapping sluicer stand.
	11:30	Completed placing metals and other materials into B-25 box and cutting metals.
	13:00	Completed some site organization.
	13:45	Waste Management rep inspected B-25 boxes for labeling purposes.
	14:30	Completed declassifying site from a HAZWOPER
	16:00	Completed site organization tasks for the day.
08/28/98	07:30	Plan of the day is to clean and organize site, cut some leftover pipe, and place trash and other items in B-25 boxes. Team will also return respirator equipment, HAZWOPER equipment and other organizational tasks.
	10:05	Completed cutting pipe, cleaning, and organizing contamination area.
	11:30	Completed placing items in B-25 boxes.
	14:30	Completed returning respirator equipment and HAZWOPER signs, and radios.
	15:30	Completed returning refrigerators and other site organization. Completed tasks for the day.
08/31/98	07:00	Team will complete inventory of all equipment on site today. Finish clean up, change out trailer, and field trailer today. Charles Callis will assist Jay on these duties.
	13:30	Jay turns in all badges to visitor control; also vehicle passes.
	14:05	Jay at K-25 to turn in all TLDs (thermo luminiscent dosimeters) from project at K-1020 Building.
	16:00	Jay at CDM Federal office in Oak Ridge. All tasks have been completed for the project. No further entries.

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