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1	1	WR Ash	<i>W. R. Ash</i>	8/24/94	S2-24	S Jenkins	<i>S Jenkins</i>	8/24/94	R1-51	3	
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RELEASE AUTHORIZATION

Document Number: WHC-SD-WM-TC-062

Document Title: Test Procedure - Pumping System for Caustic Addition Project

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**This document was reviewed following the
procedures described in WHC-CM-3-4 and is:**

APPROVED FOR PUBLIC RELEASE

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<p style="text-align: center;">APPROVED FOR PUBLIC RELEASE</p> <p>7. Abstract This test procedure provides the requirements for sub-system testing and integrated operational testing of the submersible mixer pump and caustic addition equipment by WHC and Kaiser personnel at the Rotating Equipment Shop run-in pit (Bldg. 272E).</p>		
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MASTER

Table of Contents

I INTRODUCTION

1.0	OVERVIEW	4
1.1	SYSTEM DESCRIPTION	4
1.2	SCOPE	4
1.3	OBJECTIVES	4
1.4	BACKGROUND	5
2.0	REFERENCES	5
3.0	RESPONSIBILITIES	7
3.1	ORGANIZATIONAL RESPONSIBILITIES	7
3.2	DATA RECORDING INSTRUCTIONS	8
3.3	CLARIFICATIONS AND EXCEPTIONS	8
3.4	TEST REPORT	8
4.0	SAFETY	9
4.1	CAUTIONS AND WARNINGS	9
5.0	DESCRIPTION	10
5.1	FACILITY DESCRIPTION	10
5.2	MIXER PUMP SYSTEM DESCRIPTION	10
5.2.1	PUMP AND MOTOR	10
5.2.2	ROTATIONAL DRIVE MECHANISM	10
5.2.3	PUMP SUPPORT COLUMN	11
5.2.4	PUMP STAND	11
5.2.5	75 HP VARIABLE SPEED DRIVE, VSD-AN-001	11
5.2.6	MIXER PUMP INSTRUMENTATION	12
5.2.6.1	POSITION CONTROLLER, M1890	14
5.2.6.2	POSITION CONTROLLER RESOLVER, RSLVR-1	14
5.2.7	EMERGENCY (E)-STOP, VSD-AN-001	14
5.2.8	241-AN-274 DISCONNECT SWITCH, DS-AN-004	14
5.2.9	SAFETY SWITCH RACK	15
5.2.10	1 HP MOTOR DISCONNECT SWITCH, DS-AN-002	15
5.2.11	75 HP MOTOR DISCONNECT SWITCH, DS-AN-001	15
5.2.12	INSTRUMENTATION TERMINAL BOX, TB-1	15
5.2.13	POWER TERMINAL BOX, TB-2	15

Table of Contents

5.2.14	2 HP MOTOR DISCONNECT SWITCH, DS-AN-003	15
5.2.15	CABLE SUPPORT SWING ARM	16
5.3	CAUSTIC INJECTION SKID DESCRIPTION	16
5.3.1	SKID HARDWARE	16
5.3.2	METERING PUMP	16
5.3.3	MOTOR AND SPEED REDUCER	16
5.3.4	VARIABLE SPEED DRIVE	17
5.3.5	CAUSTIC INJECTION SKID INSTRUMENTATION	17
5.3.5.1	YOKOGAWA FLOWMETER, FIQ-100	18
5.3.5.2	YOKOGAWA RECORDER	19
5.4	WATER FLUSH SYSTEM DESCRIPTION	19
5.5	PUMP CONTROL BUILDING, 241-AN-274	19
5.5.1	PUMP CONTROL BUILDING HVAC UNIT	20
6.0	REQUIREMENTS	21
7.0	TEST EQUIPMENT / HARDWARE	22
II PRE-TEST		
8.0	PRE-INSTALLATION PUMP CHECKS	23
9.0	PUMP INSTALLATION	24
10.0	ELECTRICAL SYSTEM HOOKUP	25
11.0	CALIBRATION	27
III SUB-SYSTEM & COMPONENT TESTS		
12.0	ACCEPTANCE TEST OF HVAC UNIT LOCATED IN PUMP CONTROL BUILDING	28
13.0	WATER FLUSH SYSTEM TEST	30
14.0	CAUSTIC INJECTION SYSTEM OPERATING TEST	31
15.0	CAUSTIC INJECTION SYSTEM ALARM TEST & DRAIN-DOWN TEST	34
16.0	MIXER PUMP ORIENTATION SETUP TEST	38
17.0	MIXER PUMP STARTUP, VARIABLE SPEED DRIVE TEST, AND ALARM TEST	40
IV SYSTEM INTEGRATED FUNCTIONAL TEST		
18.0	PUMPING SYSTEM RUN-IN TEST	43

Table of Contents

V POST-TEST MAINTENANCE

19.0	POST-TEST MAINTENANCE	47
------	---------------------------------	----

Figures

FIGURE 1 - PUMPING SYSTEM TEST SETUP AT 272-E	49
FIGURE 2 - MIXER PUMP SETUP IN TEST PIT AT 272-E	50
FIGURE 3 - CAUSTIC INJECTION SKID PIPING ISOMETRIC	51
FIGURE 4 - MIXER PUMP TURNTABLE ASSEMBLY - PLAN VIEW	52
FIGURE 5 - INSTRUMENTATION RACK LAYOUT	53
FIGURE 6 - POWER RACK LAYOUT	54

Appendix

CAUSTIC INJECTION SYSTEM TEST DATA SHEET	55
MIXER PUMP TEST DATA SHEET	56
SYSTEM INTEGRATED RUN-IN TEST DATA SHEET	58
CLARIFICATION/TROUBLESHOOTING SHEET(S)	60
EXCEPTION SHEET(S)	61

I. INTRODUCTION

1.0 OVERVIEW

1.1 SYSTEM DESCRIPTION

A caustic addition and entrainment system is to be installed at Double-Shell Tank (DST), 241-AN-107 for the purpose of increasing the hydroxide concentration of the waste. The result will be to bring the waste into compliance with Tank Farm operating specifications. The major components of the caustic addition system are:

- A 75 horsepower Hazleton rotating submersible mixer pump (S/N N-20801). The mixer pump will be installed in the central pump pit of 241-AN-107 and used as a platform to inject, mix, and entrain caustic material with the existing waste.
- A caustic injection skid containing a metering pump and monitoring system. The caustic metering pump will discharge caustic soda solution at a known flow rate. The monitoring system will track the quantity of caustic solution added over a given time period.
- A portable mixer pump control building containing electrical and instrumentation equipment for controlling system operation.

1.2 SCOPE

This test procedure provides the requirements for sub-system testing and integrated operational testing of the submersible mixer pump and caustic addition apparatus by WHC and Kaiser personnel at the Rotating Equipment Shop run-in pit (Bldg. 272E). Also, some equipment will be acceptance tested within this procedure. This test procedure satisfies work plans WHC-SD-WM-WP-208, "Tank 107-AN Caustic Addition Project Mechanical Systems Engineering Work Plan - ETN-94-0010", and WHC-SD-WM-ETP-021, "Engineering Task Plan for 107-AN Mixer Pump Caustic Addition Project - ETN-94-0069".

In this test, water will be the test fluid in place of caustic soda solution and tank waste.

1.3 OBJECTIVES

The objectives of this test are:

- To ensure the modified mixer pump and its associated instrumentation will function in harmony with the caustic injection system, prior to installation in Tank 107-AN.
- To ensure the mixer pump and caustic injection system can be properly controlled from the mixer pump control building, Electrical & Instrumentation Building (241-AN-274).

- To test the pumping system thru the operating sequence described for Tank 107-AN in Internal Memo WTPE-94-046, "Draft Operating Procedures for Caustic Addition to Tank 241-AN-107."
- Ensure that mixer pump rotation begins and ends on the edge of the defined non-indexing region, whose purpose is to prevent direct jet impingement on the tank thermocouple tree at full pump speed.
- To acceptance test the mixer pump control building, 241-AN-274, a CENRTC procured sub-system.
- To final acceptance test the caustic injection skid in accordance with the sub-system procurement specifications.
- For Tank Farms personnel to become familiar with the equipment, its set-up, and its operation, prior to installation in Tank 107-AN.

1.4 BACKGROUND

The 75 HP Hazleton pump was purchased in 1987 as a mixer pump for the AY/AZ tank farm and has been stored at 2101-M laydown yard since arriving onsite in January 1988. The pump is physically similar in design to the 150 HP Hazleton mixer pump that is currently installed at DST 241-AP-102 and the 150 HP Hazleton mixer pump that has been modified for use as the Hydrogen Mitigation Pump for DST 241-SY-101.

A run-in test of the mixer pump was performed in August 1993 to ensure satisfactory performance in view of the lengthy storage period and the modifications made to the pump. For more information see documents WHC-SD-WM-TP-178, "Run-In Test for Hazleton Rotating Submersible Mixer Pump S/N N-20801", and WHC-SD-WM-TRP-149, "Test Report for Hazleton Rotating Submersible Mixer Pump S/N N-20801".

The caustic injection skid is a procured piece of equipment built by and acceptance tested by Bran & Luebbe Company. The requirements for the caustic injection skid are found in WHC-SD-WM-RD-031, "Tank 107-AN Caustic Addition Pump Skid Requirements".

2.0 REFERENCES

- Drawings: (Obtain ECN printout and ECN's from Document Control for complete drawing information)
- H-2-85259, Sh. 1-19 (electrical, control and instrumentation building)
 - H-2-85261, Sh. 1, (mixer pump stand)
 - H-2-85262, Sh. 1, (run-in pit shield)
 - H-2-85263, Sh. 1, (mixer pump nozzle extensions)
 - H-2-85264, Sh. 1, 2, & 3 (mixer pump assembly and modifications)
 - H-2-85301, Sh. 5 & 6 (panelboard schedule, electrical)
 - H-2-85348, (caustic injection skid)

Hazleton Proprietary Drawings (mixer pump assembly and details, before modification):

E-20801, Rev. 2, "Elevation", Hazleton 5N SSB Pump/Mixer, Model #360-75-1800 (R), Order #T7N-XBB-423827, 3-19-87. 3 drawings

17490B, Rev. -, "Grease Arrangement", Hazleton 5N Type SSB Pump/Mixer, 12-21-87.

Bran & Luebbe Drawings (before modification):

A14343-201, Rev. 0, "Caustic Addition Skid General Arrangement", P.O. #WDV-XVV-333412.

A14343-301, Rev. 0, "Caustic Addition Skid Tank Details".

A14343-401, Rev. 0, "Caustic Addition Skid Base Frame Assembly", P.O. #WDV-XVV-333412.

A14343-402, Rev. 0, "Caustic Addition Skid Base Frame Details", P.O. #WDV-XVV-333412.

A14343-501, Rev. 0, "Caustic Addition Skid Isometric Details", P.O. #WDV-XVV-333412.

A14343-700, Rev. 0, "Caustic Addition Pump Skid Main Control Panel Enclosure Layout", P.O. #WDV-XVV-333412.

A14343-701, Rev. 0, "Caustic Addition Pump Skid Main Control Panel Electrical Schematic", P.O. #WDV-XVV-333412.

ECN(s): 161636 (run-in pit modifications)

CVI 22528: Hazleton Bulletin 48,049, "Operation & Maintenance Manual for 5N-Hazleton Type SSB/Mixing Pump", Barrett, Haentjens & Co., Hazleton, PA 18201, 1/21/88.

CVI 22578: Bran & Luebbe, Caustic Addition Pump System Operation and Maintenance Manual, January 1994.

CVI 22570: Eaton Corp., Variable Speed Drive Manual

CVI 22588: Butler Building Construction Manual

WHC Controlled Documentation:

WHC-SD-WM-TP-178, Run-in Test for Hazleton Rotating Submersible Mixer Pump SN N-20801, 8-20-93.

WHC-SD-WM-TRP-149, Test Report for Hazleton Rotating Submersible Mixer Pump SN N-20801, 2-07-94.

WHC-SD-WM-WP-208, Tank 107-AN Caustic Addition Project Mechanical Systems Engineering Work Plan - ETN-94-0010, 12-16-93.

WHC-SD-WM-ETP-021, Engineering Task Plan for 107-AN Mixer Pump Caustic Addition Project - ETN-94-0069, 12-08-93.

WHC-S-0198, Variable Frequency AC Drive - Procurement Specification, 05-24-93.

WHC-S-0199, Pre-Engineered Metal Building - Procurement Specification, 05-24-93.

WHC-SD-WM-RD-031, Tank 107AN Caustic Addition Pump Skid Requirements, 03-22-93.

WHC-SD-WM-DA-142, Structural Analysis of Mobile Building for 107-AN Caustic Addition Project, 01-25-94.

3.0 RESPONSIBILITIES

3.1 ORGANIZATIONAL RESPONSIBILITIES

WHC Facility Systems Group will supply the Test Director. The Test Director has overall responsibility and authority for the performance of this test and shall ensure that the test is performed in accordance with this document. The Test Director shall determine when this test is in progress, shall provide direction to test operators during performance of the test, work with shop personnel to ensure that housekeeping important to maintaining a safe work environment is performed, consult with cognizant engineers to determine course of action for unexpected technical problems, and ensure that only cognizant, qualified, and essential personnel have access to the test area. The Test Director is permitted to red-line the test procedure as field conditions may warrant within the intent of this test plan. If the test procedure is suspended, the test shall be restarted at a location in the procedure determined by the Test Director. As used in this document, "Test Director" shall be understood to include Test Director designees.

The Rotating Equipment Shop supervisor (or designee) shall have the authority to sign off pertinent steps during pump installation and pre-test.

Tank Farms Operations personnel responsible for installing and operating the pumping system in Tank 107-AN may participate in the performance of this test in a manner specified by the Test Director and offer suggestions for improvement.

WHC QA/QC shall verify the data recorded on the CAUSTIC INJECTION SYSTEM TEST DATA SHEET, MIXER PUMP TEST DATA SHEET, SYSTEM INTEGRATED RUN-IN TEST DATA SHEET. A QA/QC representative shall sign and stamp the DATA SHEET(S) upon completion of the applicable test.

WHC Facility Systems and Electrical Systems shall provide the lead pump and electrical cognizant engineers, who shall provide technical expertise during the run-in test, approve applicable acceptance criteria changes, identify and specify performance and measurement requirements, and after evaluation of the data approve acceptability of test activities and results.

3.2 DATA RECORDING INSTRUCTIONS

Throughout the test procedure, spaces are provided for the Test Director to initial and date the required steps. On some steps, cognizant engineer or QA/QC signature may be required.

3.3 CLARIFICATIONS AND EXCEPTIONS

Any problems or unexpected conditions encountered during testing of the mixer pump system and integrated operational test shall be recorded on clarification / troubleshooting sheets. The procedure step shall be referenced, the problem described, solution or course of action recorded, and sign-offs obtained from the Test Director and equipment cognizant engineer.

Any problems or unexpected conditions encountered during acceptance testing of the Pump Control Building or final acceptance testing of the caustic injection system (Sections 12, 14, and 15 herein) shall be recorded on exception sheets. The procedure step shall be referenced, the problem described, solution or course of action recorded, and sign-offs obtained from the Test Director, equipment cognizant engineer, and QA/QC representative.

3.4 TEST REPORT

The pump cognizant engineer shall issue the test report with the assistance of the electrical cognizant engineer and Test Director.

Results of the test shall be documented preliminarily in an internal memo, no more than three working days following completion of the integrated operational test, and finally in a test report issued no more than two months following completion of the testing. Included in the test report shall be a sketch of the test set-up, any necessary repairs or replacements prior to installation or during the test, discussion of problems encountered during testing and corrective actions taken, data sheets from the test, comparison to expected values, and recommendations/conclusions of the cognizant pump and electrical engineers.

4.0 SAFETY

Normal WHC/KEH safety requirements and safe practices followed by the 272E shop shall be in effect during this test procedure. This includes required eye protection for personnel inside the shop. Because this is a test, it is expected that troubleshooting will be required at some times. The Test Director has the authority to remove spectator personnel not essential to the test during troubleshooting and during performance of the test, if in his determination, their presence adds to the potential for injury.

Before starting the test procedure, the Test Director shall ensure that personnel conducting the test are familiar with the equipment and controls. The pumping system shall not be left unattended while it is operating.

4.1 CAUTIONS AND WARNINGS

- Review and follow the operating cautions as stated in Hazleton Bulletin 48,049, Section 3, Paragraph 3.7.
- Only a qualified Electrician is allowed to open, work on, and/or test within an energized electrical panel.
- The mixer pump manual position jog switch, SW1, is not to be operated while the mixer pump is rotating under control of the Autotech Corp. Position Controller. It is possible to instantaneously reverse the direction of the mixer pump rotation if this warning is not observed, which could cause mechanical and/or electrical failure of the pump system. This switch is to be used only if the mixer pump is not currently rotating. When using SW1, the operator must wait approximately 5 seconds after releasing the switch before reactivating it to prevent the above described problem.

5.0 DESCRIPTION

5.1 FACILITY DESCRIPTION

A sketch of the test setup is shown in Figure 1.

The 272E Rotating Equipment Shop pump pit is approximately 8' diameter by 50' feet deep with walls of precast concrete culvert. A 4' tall x 1/4" thick steel cylindrical shield (H-2-85262) has been installed at the bottom of the test pit in order to protect the pit walls from thrust delivered by the pump. Also, minor modifications have been made to the run-in pit (ECN 161636) that enable the mixer pump to be mounted over the center of the pit.

The water level in the pump pit can be lowered with a small, submersible sump pump (Peabody Barnes Model 3SEH-206) mounted between the cylindrical shield and the pit wall.

5.2 MIXER PUMP SYSTEM DESCRIPTION

5.2.1 Pump and Motor Assembly

Pump Manufacturer :	Barrett, Haentjens & Co. Hazleton, Pa.
Pump Serial Number :	N-20801
Pump Type :	SSB
Pump Size :	5N
Motor Manufacturer :	Reliance
Motor Model :	360-75-1800(R)
Motor Horsepower :	75 HP
Motor Speed :	1800 rpm (full speed)
Motor Frame :	365TY
Power Requirements :	460 volt, 3 phase, 60 Hz
Service Factor :	1.15
Flow :	950 gallons per minute
Total Dynamic Head :	115.5 ft

The modified mixer pump assembly weighs approximately 7,800 pounds.

5.2.2 Rotational Drive Mechanism

Mixer pump rotation is achieved via a 1 HP Reliance Duty Master Motor, 1200 rpm, 230/460 volt, 3 phase, 60 Hz, coupled to a Boston Gear Series FWA700, size 752, double reduction worm gear at a 600:1 reduction ratio. A ring and pinion gear drive provides the final coupling to the pipe column which supports the pump and rotates. Rotation is primarily controlled by an Autotech Corp. programmable position controller, Model M1890, and two Autotech Corp. logic cards with relay outputs, Model 1855L, which define the lower and upper limits of rotation travel. An Autotech Corp. position resolver, Model RL100, is coupled to the 1 HP motor and provides the electrical position signal to the controller. Two

Allen-Bradley, Model 802T, limit switches mounted on the pump top plate provide overtravel shutdown. The switch arm must be rotated 18° in order to activate the switch. Once activated, the switch arm must travel 7° in the opposite direction in order to deactivate the switch. Two adjustable timers provide approximately a 5 second delay at the end of each rotation. Approximately 2 minutes are required to rotate through 180 degrees. The rotational drive mechanism can be seen in Figure 4.

5.2.3 Pump Support Column

A 10.75" OD (schedule 40) pipe in 3 sections supports the pump and houses power cabling and instrumentation wiring. The length of the pump from the bottom of the mounting flange to the bottom of the discharge nozzles is 49' 11". The bottom of the discharge nozzles will be approximately 1' 3" above the pit bottom. The pump intake is located approximately 6 ft above the discharge nozzles.

5.2.4 Pump Stand

The mixer pump will rest on the pump stand fabricated for use in the Tank 107-AN pump pit. The pump stand is 14-3/4" tall and consists of angle iron and steel plate support bracing (see H-2-85261). Framework has been temporarily added to the run-in pit to allow the pump to be mounted in the center of the pit (see ECN 161636). The pump stand weighs approximately 500 lb.

5.2.5 75 HP Variable Speed Drive, VSD-AN-001

The variable speed drive is an Eaton Corp., Model AF 5000+, adjustable frequency AC drive, 75 HP nominal, 460 volt / 101.0 amps rated output, and 480 Vac / 3 phase / 60 Hz rated input. The drive is capable of operating the pump motor over its entire speed range. Control of the drive is achieved through the front panel mounted soft touch operator panel (S.T.O.P.), Model A-100. The S.T.O.P. is used for entering and viewing drive input characteristic parameters and for monitoring drive output operating parameters. The drives software is organized into 7 different modes which can be programmed to configure the drive for various operating characteristics. The 7 modes are as follows: (1) User mode, contains functions most likely to be needed by the user while operating the drive; (2) Setup mode 1, contains the primary setup and adjustment functions; (3) Setup mode 2, contains additional setup and adjustment functions. These are primarily functions that are related to optional features; (4) Setup mode 3, contains additional setup and adjustment functions similar to setup mode 2; (5) Command mode, contains the commands to unlock and lock the keypad, change the password, store and recall adjustment batches, and perform operator control functions; (6) Display mode, contains functions which display data for troubleshooting, etc.; (7) Factory mode, can be used by the user to verify factory setup functions, but the functions can only be changed using factory programming equipment.

This unit has non-volatile memory which means with no power applied to the unit the contents programmed into its operating memory will not be lost. Parameters that can be monitored during operation include, but are not limited to the following: motor speed, dc bus power, motor load, motor amps, and motor volts. The drive is interlocked with pump motor moisture, motor temperature, pump vibration, pump column unbalanced load (tension and compression), rotation overtravel, Tank 107AN high pressure, 241-AN Tank Farm area radiation, and pit 07A leak. If any one of these interlocks is activated the drive will decel and stop. The Eaton Corp. Drive has a "drive running" interlock output which is being used to enable both the rotational drive system and the caustic injection skid variable speed drive. This will prevent both the rotation system and caustic pump from operating if the 75 HP mixer pump is not operating. This component is located on the center power rack within the pump control building, 241-AN-274, (see Figure 6). Due to the extensive amount of information that is required for setup and control of this drive, refer to CVI file #22570 for further information.

5.2.6 Mixer Pump Instrumentation

See Figure 5 for physical layout of the instrumentation racks.

Mixer pump instrumentation monitors pump vibration, motor stator temperature, pump support column strain (tension and compression), and motor cavity moisture. Each of these instrumentation sub-systems have status indication within the pump control building and are interlocked to the mixer pump 75 HP motor. A hand-held digital thermometer will be used to measure pit water temperature. All of the instrumentation will be setup and calibrated by WHC. The following pump parameters will be measured during the test:

Parameter	Measuring Device / Manufacturer	Sensor Range	Display Range	Alarm Settings
Pump Motor Speed	VSD / Eaton Corp.	unknown	unknown	none
Pump Motor Power	VSD / Eaton Corp.	unknown	unknown	none
Pump Motor Current	VSD / Eaton Corp.	unknown	unknown	none
Pump Motor Voltage	VSD / Eaton Corp.	unknown	unknown	none
Pump Vibration	Accelerometer / Scientific Atlanta Model M99	0.1 to 80 g peak	0 to 1 in/s	¹ 0.65 in/s
Pump Motor Temperature	Resistance Temperature Detector (RTD) / Rosemount Series 78S	-148° to +752°F	32° to 410°F	50°F low 150°F high
Column Strain	Shear Beam Load Cell / Hottinger Baldwin Measurement Inc. Model USB	-2000 to +2000 lb	-199.9 to +200.0 lb (Value x 10)	+10 lb comp.; -10 lb tension; (Value x 10)
Motor Cavity Moisture	2 Electrodes in conjunction with Induction Relay / SL Auburn, Inc. Model F-050	N/A	Alarm only	Any moisture reading
Pit Water Temperature	Hand-held digital thermometer	unknown	unknown	none

1. Vibration limit has been dictated by the inertial effects of rotational motor stop/start. Manufacturer's recommendation of 5 mil maximum displacement corresponds to a velocity of 0.47 in/s. When alarm was set to this value during the pump run-in test (see References section), false alarms occurred during acceleration/deceleration of turntable.

Upon reaching the alarm settings in the above table, interlocks in the mixer pump control circuit will shut down pump operation. Shutoffs specific to Tank 107-AN not listed above are tank high pressure, area radiation, and pit 07A leak. The tank high pressure and area radiation alarm signals will need to be simulated because they will not be available at the 272E shop. See H-2-85259, Sheet 12, "75 HP Mixer Pump Interlock Elementary Diagram" for more information.

5.2.6.1 Position Controller, M1890

The position controller is an Autotech Corp., Model M1890, which has the following features: microprocessor controlled, 12 bit resolution, ratiometric converter, five digit LED display. The unit has the following parameters programmed into its operating memory which define its configuration: scale factor - adjusts for the difference between the resolver speed and the mixer pump rotation speed; preset number - loads a number into the controller which defines the starting tracking value; option number - defines the resolution and turn mode; decimal point position - defines how many places to the left the decimal point is to be set at; all segments lit - lights up all display segments to check if they all light. This unit has non-volatile memory which means with no power applied to the unit the contents programmed into its operating memory and the last software rotation position will not be lost. The display output units indicate the current angular position of the mixer pump. The input to this component is an Autotech Corp., Model RL100, resolver.

5.2.6.2 Position Controller Resolver, RSLVR-1

The position controller resolver is an Autotech Corp., Model RL100, axially shaft driven resolver. This component is used for generating an electrical position signal for the position controller. The resolver has a six wire configuration. The unit is mounted on the Boston gear box located on the pump top plate.

5.2.7 Emergency (E)-Stop, VSD-AN-001

This device is a Crouse-Hinds pushbutton station which is used as a stop interlock for the Eaton Corp. variable speed drive. There are three of these stations which will be located at the following locations in AN Tank Farm: (1) left of the Eaton Corp. variable speed drive, see Figure 6; (1) east outside wall of building 241-AN-274; (1) safety switch rack located at the central pump pit, 241-AN-07A, see Section 5.2.9. When this pushbutton is depressed the Eaton Corp. variable speed drive will decelerate and stop. The speed drive will need to be restarted from its control panel once any one of these pushbuttons is activated.

5.2.8 241-AN-274 Disconnect Switch, DS-AN-004

This disconnect switch is a Square D, Model H364DS, rated for 600 Vac, 200 amp, 3 wire, and is fusible. This switch is the main service feeder to building 241-AN-274. It is to be located on the south wall of instrument building 241-AN-271 and buss tapped to MCC-241-AN-271 when it is installed at "AN" tank farm. DS-AN-004 is not to be used for this test.

5.2.9 Safety Switch Rack

The safety switch rack is used for mounting the 1 HP motor disconnect switch (DS-AN-002), 75 HP motor disconnect switch (DS-AN-001), and the VSD-AN-001 emergency (E)-stop pushbutton. See drawing H-2-85259, Sheet 9, for the design of this rack. For the 272E test this rack can be temporarily supported as required.

5.2.10 1 HP Motor Disconnect Switch, DS-AN-002

This disconnect switch is a Square D, Model HU361DS, rated for 600 Vac, 30 amp, 3 wire, and is non-fusible. This switch is the field emergency shutoff for the 1 HP rotation motor, M2. This switch is located on the safety switch rack. See drawing H-2-85259, sheet 7, for the "Partial One Line Diagram".

5.2.11 75 HP Motor Disconnect Switch, DS-AN-001

This disconnect switch is a Square D, Model HU364DS, rated for 600 Vac, 200 amp, 3 wire, and is non-fusible. This switch is the field emergency shutoff for the 75 HP mixer pump motor, M1. This switch is located on the safety switch rack. See drawing H-2-85259, Sheet 7, for the "Partial One Line Diagram".

5.2.12 Instrumentation Terminal Box, TB-1

This box is a Hoffman, NEMA 4, enclosure which is used for terminating the instrumentation wires which exit from the pump top plate. This cabinet is located above the pump top plate and is mounted to the power and instrument rack assembly which bolts to the pump top plate. See drawing H-2-85259, Sheet 9, for the "Plan Pump Pit 241-AN-07A @ Tank 241-AN-107".

5.2.13 Power Terminal Box, TB-2

This box is a Hoffman, NEMA 4, enclosure which is used for terminating the 75 HP motor power wires which exit from the pump top plate. This cabinet is located above the pump top plate and is mounted to the power and instrument rack assembly which bolts to the pump top plate. See drawing H-2-85259, Sheet 9, for the "Plan Pump Pit 241-AN-07A @ Tank 241-AN-107".

5.2.14 2 HP Motor Disconnect Switch, DS-AN-003

This disconnect switch is a Square D, Model HU361DS, rated for 600 Vac, 30 amp, 3 wire, and is non-fusible. This switch is the emergency shutoff for the 2 HP caustic injection motor. This switch is located on the right-hand instrumentation rack in the pump control building, 241-AN-274. See drawing H-2-85259, Sheet 7, for the "Partial One Line Diagram".

5.2.15 Cable Support Swing Arm

The cable support swing arm was provided by the pump manufacturer Barrett, Haentjens & Company. The support arm will be used to suspend the pump power and instrumentation cables above the pump in order to prevent these cables from getting damaged while the pump is rotating. The swing arm is to be mounted to the west wall of the central pump pit, 241-AN-07A, adjacent to the pump assembly per drawing H-2-85259, Sheet 9. The cable support arm will not be used for the test at 272-E shop because there is no attachment point for the arm. For the 272E test the cables are to be routed as required in order to prevent damage.

5.3 CAUSTIC INJECTION SKID DESCRIPTION

5.3.1 Skid Hardware

The caustic injection skid is a procured piece of equipment built by and acceptance tested by Bran & Luebbe Co. The requirements for the caustic injection skid are found in WHC-SD-WM-RD-031, "Tank 107-AN Caustic Addition Pump Skid Requirements". Skid features include: pipes heat traced to help prevent freezing of 19 molar caustic soda, which has a freezing point of about 55°F; a 150 gallon tank for flushing of the pipes and hose; a 10 gallon drain tank; stainless steel floor to contain any leakage; bypass piping; and Kamvalok quick disconnect fittings.

5.3.2 Metering Pump

The metering pump is a Robbins & Myers progressing cavity pump, Model B1D, driven by a 2 HP AC motor. It is a positive displacement pump whose output is smooth and uniform at any speed. Since the flow rate is proportional to speed, with a variable speed drive the pump allows highly accurate metering. The rotation of the pump shaft is clockwise, when viewed from the driven end of the pump. The R & M pump is rated for 15 gpm @ 50 psi for caustic soda solution of specific gravity 1.5 and a viscosity of 25 centipoise. A mechanical seal option was chosen to prevent fluid leakage.

5.3.3 Motor and Speed Reducer

The 2 HP Reliance Electric AC motor has the following ratings: 2 HP, 1800 rpm, FJ145TC frame, 460 Vac, 3 phase, 3.4 amp, and 60 Hz. A Nord unicast speed reducer, size SK21FC-140TC-2.71, 624 rpm output, is connected between the pump and motor.

5.3.4 Variable Speed Drive

The metering pump speed controller is an Allen-Bradley Series Variable Frequency Controller, Model # 1333-YAB (2 HP, 460 VAC, 3 phase, 60 Hz). The speed of this drive is controlled by a Square D, class 9001, 3 wire, 10K ohm, external speed pot. This unit is capable of operating the metering pump speed at 0-100% of its rated speed. With the speed pot enabled all other speed control devices of the drive are disabled. The pump is started and stopped via pushbutton switches labeled "Pump Start" and "Pump E-Stop", respectively. The speed pot, start pushbutton, and stop pushbutton are located on the Caustic Injection Skid Instrument Cabinet, TB-3A, (see Figure 5). The drive has a main display to show drive running values, codes, and parameter values and a mode display to show the drive mode and control source. The drive must always be stopped to allow drive programming. There are 62 parameters that can be programmed to configure the drive. The drive can display output parameters which include but are not limited to the following: current, motor rpm, and frequency. The drive is configured from the factory and the memory is non-volatile so that no programming is required. See the Bran + Luebbe manual (CVI 22578) for complete information on this drive.

5.3.5 Caustic Injection Skid Instrumentation

Caustic injection skid instrumentation was calibrated at the vendor, Bran & Luebbe Co., before the skid's delivery. WHC QA has verified the calibration records. Readout for all instruments is given in the pump control building (241-AN-274), except for the combination Yokogawa totalizer/flowmeter readout and two pressure gauges that must be read on the skid. The following caustic injection skid parameters will be measured during the test:

Parameter	Measuring Device	Display Range	Alarm Settings
Discharge Line Pressure	Pressure Transducer	0 to 100 psig	lo - 25 psig hi - 60 psig
Heat Trace Temperature	Resistance Temperature Detector	0 to 200° F	lo - 120° F hi - 180° F
Discharge Flowrate	Magnetic Flowmeter	0 to 20 gpm	N/A
Total Volume of Caustic Pumped	Totalizer	N/A	N/A
Record of Pressure, Temperature, and Flow	Chart Recorder	N/A	N/A
Metering Pump Speed	Variable Speed Drive Potentiometer	0 to 100% Rated Speed	none
Skid Base Leak Detection	Adjustable Float Switch	Alarm Only	Trips when 1 to 3 inches of fluid present in drain pan

5.3.5.1 Yokogawa Flowmeter, FIQ-100

The flowmeter is a Yokogawa, model AM115, inline integral type magnetic flowmeter. This device is used to monitor the Robbins & Myers pump output. This flowmeter can monitor both flow and totalization. The flowmeter outputs a 4-20mA DC signal, proportional to the calibrated flow span of 0 to 20 gpm, to channel 1 of the Yokogawa 3 pen recorder. Bore size, volumetric flow span, meter factors and zero adjust must be set prior to operation. The unit was calibrated by the manufacturer and programmed by the vendor, so it should not require any further setup. The unit has non-volatile memory, with the power turned off the contents programmed into the unit remain. Flowmeter accuracy is 0.25% of span (below 50% of span) and 0.5% of rate (at indications more than 50% of span). This component is located on the Caustic Injection Skid discharge line. See Bran + Luebbe drawing A14343-701 for the electrical schematic. See CVI 22578 for complete information on this unit.

5.3.5.2 Yokogawa Recorder

The recorder is a Yokogawa, model 437003. The recorder has three input channels which are driven by 4-20mA DC signals. Channel #1 input is connected to the Yokogawa flowmeter, channel #2 is connected to the Telmar temperature transmitter, and channel #3 is connected to the Ashcroft pressure transmitter. There is a 250 ohm resistor placed across each recorder input which converts the 4-20mA signal to 1-5 VDC, which is what the recorder requires for an input. There are no external output signals from the recorder. All three recorder pens operate simultaneously. The unit was programmed at the vendor and should not require any further setup. The unit has non-volatile memory, with the power turned off the contents programmed into the unit remain. This component is mounted on the Caustic Injection Skid Instrument Cabinet, TB-3A. See Bran + Luebbe drawing A14343-701 for the electrical schematic.

5.4 WATER FLUSH SYSTEM DESCRIPTION

The mixer pump is equipped with a water flush system whose purpose is twofold; remove debris from the pump inlet screen and unclog discharge nozzles if necessary. The flush line piping terminates in a spray nozzle parallel to the pump suction inlet screen and with a smaller diameter pipe welded to the back elbow of each discharge nozzle. In the field, water is to be supplied by attaching a length of hose with a hose bib to the existing AN farm water supply piping (with appropriate backflow prevention measures). If necessary, a high-pressure pump may be placed in-line.

5.5 PUMP CONTROL BUILDING, 241-AN-274

The pump control building is a 10' W x 16' L x 10' H, mobile, sheet steel paneled building (aka "Butler Building"), bolted to a steel floor frame or skid. The steel floor frame has lifting eyes at each corner which give the capability to move the building at project's end so it may be used for other applications. A window is present on the side of the building opposite the door and a small, window mounted HVAC unit prevents overheating of the building's electronics. The building will be attached to a concrete pad located outside the AN Tank Farm, adjacent to the caustic injection skid.

Mixer pump controls, starter, variable speed drive, instrumentation read-out; caustic monitoring, metering pump controls, variable speed drive, annunciators; camera system (not to be tested herein), are to be located in the pump control building.

The pump control building was purchased to WHC-S-0199, "Specification for Procurement of a Pre-Engineered Metal Building".

5.5.1 Pump Control Building HVAC Unit

The air conditioner is a United Technologies Carrier Corp., Model XH. The cooling capacity of the unit is 17,100 btu/hr and the heating capacity is 16,300 btu/hr. The unit is controlled manually and has the following features: energy saver switch; exhaust (indoor / outdoor); temperature setting dial (2-14); control switch (off-fan-low cool-medium cool-high cool-low heat-high heat); on/off switch. The unit is located on the north wall of the pump control building, 241-AN-274. See drawing H-2-85259, Sheet 4, for the "Building 241-AN-274 Plan - Installation".

6.0 REQUIREMENTS

Below are the criteria that need to be met in order to have a successful test and to fulfill the objectives stated in Section 1.3:

- Caustic injection system parameters shall be recorded on CAUSTIC INJECTION SYSTEM TEST DATA SHEETS over an operating range of 25% to 100% of metering pump rated speed.
- Caustic injection system high pressure, low pressure, temperature, and drain pan high water level alarms shall be verified to operate.
- Mixer pump operating parameters shall be recorded on MIXER PUMP TEST DATA SHEETS over a wide operating range of pump speeds.
- The following are the expected, operating, and limiting instrumentation values for the mixer pump. The mixer pump was acceptance tested for this project in August 1993. Documentation is provided by WHC-SD-WM-TRP-149.

Parameter	Expected Value	Operating Range	Limits / Comments
Pump Motor Current	53 amps @ 100% VSD setting	0-65 amps	89 amps ¹
Pump Vibration	< 0.19 in/sec	< 0.28 in/sec	0.47 in/sec ²
Pump Motor Temperature	100-120°F	50°-140°F	150°F
Pump Support Column Unbalanced Load	< 10 lb ³	< 550 lb ³	± 2000 lb ³
Moisture (motor)	None	None	Any moisture reading is cause for concern
Bulk Water Temp.	60-90°F	< 90°F	140°F ⁴

1. Using water (specific gravity = 1) as the test fluid results in a power requirement below the full load amperage of 89 amps (not including a 1.15 service factor). The pump was designed for a fluid with specific gravity of 1.4.
2. Velocity values correspond to displacements of 2 mil, 3 mil, and 5 mil, respectively per manufacturer recommendation.
3. Instrument panel readout for unbalanced load must be multiplied by 10 to obtain the true value. For example, a reading of 0.7 lb corresponds to an unbalanced load of 7 lb.
4. The heat load from the mixer pump will be a maximum of 3183 BTU/min. (the equivalence of 75 HP). Based on a 30' water depth in the run-in pit, this will result in a 2 degree Fahrenheit (°F) temperature rise per hour or a total temperature increase of 14 °F for a 7 hour run-in. This is a conservative estimate as heat will be continuously dissipated through surface heat loss and heat transfer out through the walls of the pit.

Readings at or above the limits are cause for shutdown.

- Verification of proper mixer pump rotational control and orientation is required.
- The mixer pump variable speed drive shall be run through the operating range of speeds to determine if any critical speeds exist. Note: A critical speed exists when the pump is operated at a speed near one of the equipment's natural frequencies (resonance). This is indicated by increased vibration and/or unbalanced load readings.
- A minimum of 2 hours of continuous operation of the caustic addition pumping system (mixer pump and caustic injection operating in conjunction) is required for completion of the test. Continuous operation is defined as no shutdowns. If a shutdown does occur, its cause must be determined and corrective measures taken before restarting the test time at zero.
- Important system parameters shall be recorded on the SYSTEM INTEGRATED RUN-IN DATA SHEETS. This includes testing of the mixer pump variable speed drive at speeds less than 100%.
- Pump Control Building HVAC unit shall be acceptance tested. Record any exceptions on the exception sheets provided in the Appendix.

7.0 TEST EQUIPMENT / HARDWARE

Ancillary equipment needed to complete this test:

- Water hose capable of mating with a 2" PUREX nozzle.
- Flashlights (with powerful beam)
- Spotlight
- Portable temperature measuring devices (2). One must be capable of measuring water temperature.
- Short hose ($\approx$ 6 feet long), capable of mating with Kamvalock quick-couplings on caustic injection skid
- Hose ($\approx$ 2" dia) with PUREX connector on one end capable of mating with 2" nozzle on top of mixer pump, other end capable of mating with Kamvalock quick-coupling on caustic injection skid
- Digital voltmeter (480 VAC range possible)
- Clamp-on ammeter (100 A range possible)
- Pressure gauge rated for water service ($\approx$ 200 psi range)
- Area barricade ropes / tape
- 8' step ladder
- 3' portable fluorescent light tube
- Fire extinguisher, Class A-B-C

II. PRE-TEST

8.0 PRE-INSTALLATION PUMP CHECKS

Perform pre-installation checks in accordance with Section 2, paragraph 2.1 of Hazleton Bulletin 48,049 (CVI 22528). Perform preventative maintenance in accordance with Section 3, paragraph 4.2 of Hazleton Bulletin 48,049. These checks include those shown below. For more detail see the above-mentioned reference.

Either the Test Director or shop supervisor (or designee) shall sign and date the space provided after performance of each step.

- 8.1 Ensure that the gear locking mechanism on the top flange of the pump is in place.
-

- 8.2 Attach pump stand to 52" O.D. adapter flange with (4) 3/4" bolts, heavy hex, ASTM A307, Grade B, 3/4 - 10, 3-1/4" long, (4) 3/4" nuts, heavy hex, ASTM A563, Grade B, 3/4 - 10, and (4) 3/4" washers, spring lock, medium pattern, steel. Snugly tighten fasteners.
-

- 8.3 Snugly tighten all accessible fasteners on the pump assembly.
-

- 8.4 Ensure the pump and motor bearings and the oscillator rotating bearing are greased in accordance with Section 4 paragraph 4.4 of Hazleton Bulletin 48,049. Any grease fittings/lines shall be purged with Barrett, Haentjens & Co. recommended grease until clean, free flowing grease emerges.
-

- 8.5 Visually verify that there is no damage to the load cell mounted on the upper pump support column.
-

- 8.6 Visually verify that there is no damage to any external electrical cables on the pump assembly.
-

The next two steps may be performed after pump installation if necessary.

- 8.7 Install small, submersible sump pump between the cylindrical shield and the pit wall.
-

- 8.8 Pump out water in the test pit until the water level is nearly zero.
-

9.0 PUMP INSTALLATION

The pump will be installed in the pump run-in pit at 272E using a "CRITICAL LIFT" procedure in accordance with section 3.4 of DOE-RL-92-36 (Hanford Site Hoisting and Rigging Manual). The "CRITICAL LIFT" procedure is contained within shop work order 2H-93-00960F.

- 9.1 Notify QA/QC before performing the "CRITICAL LIFT". If QA/QC elects not to witness it, then the Test Director shall enter "QC notified - N/A" in the signoff space below.
-

After the pump is lowered in the pit, the following steps shall be performed to prepare the pumping system for operation. Sign and date the space provided after performance of each step.

- 9.2 Attach the pump stand to the pump pit support steel using (8) 1/2" bolts, long, heavy hex, ASTM A325, 1/2 - 13 UNC 2A X 1-3/4" long; (8) 1/2" nuts, heavy hex, ASTM A563, Grade B, 3/4 - 10; and (8) 1/2" washers, spring lock, medium pattern, steel. Snugly tighten fasteners.
-

- 9.3 Remove the gear locking mechanism on the top flange of the pump.
-

- 9.4 Reassemble and attach the rotating drive mechanism to the top of pump. This includes the gear reduction unit, resolver, and motor.
-

10.0 ELECTRICAL SYSTEM HOOKUP

Any part of the mixer pump electrical system that is not required or does not apply for this temporary setup can be eliminated from the system, which can include but is not limited to the following: field conduit, field handholes, concrete work, building anchoring, grounding grid, etc. Other specific equipment not to be included for the temporary test are noted in this section.

Cables and wires between the pump control building and pump, and the pump control building and caustic injection skid, are to be temporarily routed and not placed in conduit. Length of wires and cables to be fitted for the temporary installation and not the final installation. Routing to be done to prevent any type of hazard or damage. Follow the wire run data per H-2-85259, sheet 15.

- 10.1 Ensure that the pump control building frame is securely grounded to facility ground.

Electrical Cog. Engineer _____

- 10.2 Complete electrical connections between the pump control building and mixer pump per H-2-85259.

(The cable support swing arm assembly is not used for this temporary test. Route wires and cables to the pump as required and in a fashion to prevent any type of hazard or damage.)

Electrical Cog. Engineer _____

- 10.3 Complete electrical connections between the pump control building and caustic injection skid per H-2-85259 and drawings provided by Bran & Luebbe Co., A14343-700, -701.

Electrical Cog. Engineer _____

- 10.4 Ensure that the factory jumper installed between the Allen-Bradley variable speed drive control and signal wiring terminal block, terminals 16 and 17, is removed. Otherwise, the drive will be allowed to be started at any time.

Electrical Cog. Engineer _____

- 10.5 Ensure that all components are in their OFF or 0% position.

Electrical Cog. Engineer _____

- 10.6 Complete the main power service connection to the pump control building, 241-AN-274. The main service for this test will be the 272-E Test Center, 480 VAC, 125 Amp breaker. This breaker is located

in the right-hand top compartment of the test center, facing the front panel. The disconnect switch, DS-AN-004, is not to be used for this test. Use AWG #1 conductors and a #6 ground, type THWN wire or equivalent wire or cable. The service wires are to be connected to the pump control building terminal box, TBX-AN-3C. Route wires as required and in a fashion to prevent any type of hazard or damage.

Electrical Cog. Engineer _____

- 10.7 Temporarily setup the safety switch rack within 20 feet of the pump control building. Support the rack such that it will not tip over. Wires routed to this rack are to be temporarily routed and not placed in conduit. Length of wires to be fitted for the temporary installation and not the final installation. Follow the wire run data per H-2-85259, sheet 15.

Electrical Cog. Engineer _____

- 10.8 Power up the electrical system as required. Test and troubleshoot as necessary to verify that all components are powered up.

Electrical Cog. Engineer _____

- 10.9 Programming of the hardware is to be performed using the vendor manuals as a guide and values programmed into the hardware are to be per this procedure. The Electrical Cognizant Engineer shall sign off each portion of this step.

10.9.1 Eaton Corp. Variable Speed Drive (VSD-AN-001). _____

10.9.2 Autotech Corp. Position Controller (Position Controller M1890) and associated components. _____

10.9.3 Beta Products Annunciator Panel (ANN-001). _____

10.9.4 Caustic Skid Allen-Bradley Variable Speed Drive (VSD-AN-002). _____

10.9.5 Caustic Skid Yokogawa Flowmeter / Totalizer _____

10.9.6 Caustic Skid Yokogawa Chart Recorder _____

10.9.7 Caustic Skid Panalarm Annunciator _____

11.0 CALIBRATION

11.1 The following test instruments shall have a valid calibration stamp attached that indicates a calibration traceable to the National Institute of Standards and Technology. Note: Scales given are approximate, different scale values are acceptable.

11.1.1 Digital Voltmeter, (0 to 480V ac/dc scale)

MAKE/MODEL: _____ S/N: _____ CAL. DATE: _____ INIT.: _____

11.1.2 Clamp-on Type Ammeter (0-100 Amp AC scale)

MAKE/MODEL: _____ S/N: _____ CAL. DATE: _____ INIT.: _____

11.1.3 Temperature measuring devices

MAKE/MODEL: _____ S/N: _____ CAL. DATE: _____ INIT.: _____

MAKE/MODEL: _____ S/N: _____ CAL. DATE: _____ INIT.: _____

11.1.4 Pressure gauge (0-200 psi scale)

MAKE/MODEL: _____ S/N: _____ CAL. DATE: _____ INIT.: _____

11.1.5 QA/QC shall verify that the following instruments have been calibrated. Complete the following table.

INSTRUMENT	CALIBRATION DUE	VERIFIED BY
PS1 - 24 VDC Power Supply		
VM1 - Vibration Monitor		
ST1 - Strain Transmitter		
TT1 - Temperature Monitor		

Note: The instrumentation for the caustic injection skid was calibrated at the vendor and doesn't need to be recalibrated at this time. Recalibration can be done when the system is installed at AN Tank Farm.

III. SUB-SYSTEM AND COMPONENT TESTS

12.0 ACCEPTANCE TEST OF HVAC UNIT LOCATED IN PUMP CONTROL BUILDING

NOTE:
IF UNIT IS TURNED OFF, ALLOW 2 MINUTES BEFORE TURNING UNIT BACK ON.

- 12.1 Visually inspect unit to verify installation is to drawing H-2-85259, sheets 16 & 19, and manufacturer's recommendations. Note any inconsistencies below.

Electrical Cognizant Engineer _____
Mechanical Cognizant Engineer _____

- 12.2 Set HVAC control panel to the following settings:

MODE	OFF
TEMPERATURE	12
EXHAUST	CLOSED
ENERGY SAVER	ON
AIRFLOW	ADJUST AS DESIRED

- 12.3 Record temperature inside and outside pump control building.

Inside Temperature	_____ °F
Outside Temperature	_____ °F

- 12.4 Turn MODE switch to HIGH COOL and observe cooling operation. Listen for any unusual noises in fan and compressor operation. Record noteworthy observations below.

- 12.5 Turn MODE switch to MED COOL and observe cooling operation. Listen for any unusual noises in fan and compressor operation. Record noteworthy observations below.

- 12.6 Turn MODE switch to LOW COOL and observe cooling operation. Listen for any unusual noises in fan and compressor operation. Record noteworthy observations below.

- 12.7 Record inside temperature at which fan and compressor shut off.

Inside Temperature _____ °F

NOTE:

IF UNIT WAS OPERATING IN COOLING MODE PRIOR TO THE FAN-ONLY SETTING, ALLOW 2 MINUTES BEFORE SWITCHING BACK TO A COOLING MODE.

- 12.8 Turn MODE switch to FAN. This will provide air circulation without cooling. Observe operation for several minutes and record noteworthy observations below.

- 12.9 Move EXHAUST lever from CLOSED to OPEN. This setting will expel stale, smoky or odor-laden air from the room to the outdoors. Observe operation for several minutes and record noteworthy observations below.

- 12.10 When air exchange seems complete, move EXHAUST lever back to CLOSED.

- 12.11 Record temperature inside and outside pump control building.

Inside Temperature _____ °F
Outside Temperature _____ °F

- 12.12 Turn TEMPERATURE dial to a setting of 4.

- 12.13 Turn MODE switch to HIGH HEAT and observe heating operation for several minutes. Record any unusual observations below.

12.14 Turn MODE switch to LO HEAT and observe heating operation for several minutes. Record any unusual observations below.

12.15 Record inside temperature at which heating shuts off.

Inside Temperature _____ °F

12.16 Turn MODE switch to OFF. Verify unit is OFF.

12.17 Verify that the building interior lights are operational.

12.18 Verify that the building floodlight is operational.

12.19 Verify that the 120 Vac building receptacles are operational by plugging in an electrical appliance.

13.0 WATER FLUSH SYSTEM TEST

13.1 Attach one end of a hose to the water supply faucet and the other to the water flush line riser (a 2" PUREX nozzle atop the mixer pump flange). A pressure gauge shall be installed in-line at a field selected location.

13.2 Ensure the pump pit is dry down to the level of the discharge nozzles. If not, pump out water with shop submersible pump.

13.3 Turn water supply valve (faucet) on.

13.4 Record the pressure from the temporary pressure gauge.

- 13.5 Observe the performance of the water flush system. It is recommended that a high power flashlight be used to illuminate the bottom of the pit. Visually check for leakage, for a stream of water exiting at the level of the pump suction, and for a small stream of water exiting each discharge nozzle. Record observations below.

- 13.6 Turn water supply valve (faucet) off and remove hose.

14.0 CAUSTIC INJECTION SYSTEM OPERATING TEST

An isometric of the caustic injection skid piping (including valve labeling) is shown in Figure 3.

- 14.1 Ensure the pump pit is dry down to the level of the discharge nozzles. If not, pump out water with shop submersible pump.
- 14.2 Connect wires between terminal block locations 16 and 17 of the Allen-Bradley variable speed drive. This is necessary to allow the metering pump to operate without the mixer pump also operating, due to the electrical interlock between the two.
- 14.3 Verify that the roof mounted floodlight operates.
- 14.4 Verify that the floor mounted floodlight operates.

14.5 Verify that the Instrument Cabinet TB-3A GFI receptacle operates by plugging in an electrical appliance.

14.6 Verify that valve labels conform with those shown on Figure 3.

PUMP COG ENGINEER

14.7 Attach one end of the caustic addition hose to Kamvalock fitting, V-114, and the other to the caustic addition riser atop the mixer pump.

14.8 Attach short hose ($\approx$ 6 foot) to Kamvalock fitting, V-113B, at discharge of 150 gallon tank and the other end to Kamvalock fitting, V-113A, in the suction piping to the metering pump.

14.9 Run a hose from a water supply valve (faucet) into the 150 gallon tank. (If only one faucet available in shop, disconnect water flush system hose from faucet).

14.10 Set the valves as shown in the following valve lineup. See the isometric drawing of the caustic injection skid piping shown in Figure 3.

INITIAL VALVE LINEUP

V-100	CLOSED		PRV-105	N/A		V-110	CLOSED	
V-101	OPEN		V-106	CLOSED		V-112	CLOSED	
V-102	OPEN		V-107	CLOSED		V-113A	OPEN	
V-103	OPEN		V-108	OPEN		V-113B	OPEN	
V-104	OPEN		V-109	CLOSED		V-114	OPEN	

14.11 Fill 150 gallon tank approximately half full with water.

CAUTION:
**THIS IS A POSITIVE DISPLACEMENT PUMP. DO NOT OPERATE IT AGAINST A
CLOSED VALVE.**

CAUTION:
**DRY OPERATION IS HARMFUL TO THE PUMP! NEVER ALLOW THE PUMP TO
OPERATE WITHOUT LIQUID AS DRY OPERATION WILL CAUSE PREMATURE WEAR
OF THE STATOR AND POSSIBLE DAMAGE. THE STATOR IS LUBRICATED BY
THE LIQUID WHICH IS BEING PUMPED.**

- 14.12 Open valve V-100. This will allow gravity to fill the suction piping with fluid.
-
- 14.13 Momentarily start and stop metering pump and check direction of pump rotation. See pump nameplate for correct rotation. If rotation is in wrong direction, correct.
-
- 14.14 Turn on water faucet. Ideal flowrate is approximately 15 gallons per minute (i.e. 1/10th of tank is filled in 1 minute's time). It is not necessary to wait until tank is full before performing the next step.
-
- 14.15 Start the metering pump, and ramp up to 100% speed.
-
- 14.16 Adjust supply water flowrate to 150 gallon tank as necessary to keep the tank water level reasonably constant.
-
- 14.17 Observe the performance of the caustic addition piping. It is recommended that a high power flashlight be used to illuminate the bottom of the pit. Visually check for leakage and for a stream of water exiting near each of the mixer pump's discharge nozzles. Record observations below.
-
-
-

Note: If the pit water level is above that of the caustic addition discharge nozzles, turn off the metering pump, shut V-100, and use the shop submersible pump to pump down the pit. Then open V-100 before continuing.

14.18 Record the parameters shown on the CAUSTIC INJECTION SYSTEM TEST DATA SHEET.

14.19 Verify that the chart recorder is operating properly. Compare chart recorder outputs to digital display outputs and to the local instrumentation (pressure gauges). Note any discrepancies that may be a concern.

14.20 For metering pump speeds of 80%, 60%, and 40% full speed, record the parameters shown on the CAUSTIC INJECTION SYSTEM TEST DATA SHEET. If the LOW PRESSURE alarm annunciates, clear the alarm and continue operation as there are no harmful consequences.

14.21 Return the metering pump speed to 100% speed.

15.0 CAUSTIC INJECTION SYSTEM ALARM TEST AND DRAIN-DOWN TEST

15.1 Test the metering pump emergency stop.

15.2 Turn the metering pump back on and ramp up to 100% speed.

CAUTION:
THIS IS A POSITIVE DISPLACEMENT PUMP. DO NOT OPERATE IT AGAINST A
CLOSED VALVE.

Test the HIGH and LOW PRESSURE alarms.

- 15.3 Close valve V-104 gradually until HIGH PRESSURE alarm annunciates. Record the corresponding pressure, PD-101, below.

Pressure Display _____ psig

- 15.4 Fully open V-104, and reset panalarm annunciator.

- 15.5 Lower the metering pump speed until the LOW PRESSURE alarm annunciates. Record the % speed and discharge pressure, PD-101, below.

% Speed _____
Pressure Display _____ psig

- 15.6 Return the metering pump speed to 100% speed, and reset panalarm annunciator.

Simulate drain down of fluid from the system piping.

- 15.7 Turn water supply valve (faucet) off.

- 15.8 Shut off metering pump when 150 gallon tank is nearly empty.

- 15.9 Close V-100.

- 15.10 Open V-109 and V-110 to allow residual liquid in piping lines to drain into 10 gallon tank.

- 15.11 Record the water level in 10 gallon tank after all residual liquid has drained from piping. Estimate fluid level in tank (ex. 3/4 full, 1/2 full, etc.)

10 gallon tank fluid level _____

- 15.12 Open V-107 and drain water into skid pan. _____

- 15.13 Close V-107. _____

In order to test the float switch, FS-101, located in the skid's drain pan, the drain pan must be filled with water.

- 15.14 If desired, attach one end of a hose to the outlet of V-112 and run the other end to a drain or the pump pit. _____

- 15.15 Move water supply hose to drain pan, turn on water, and fill drain pan. _____

- 15.16 Verify FS-101 alarms before the water level exceeds the containment of the drain pan. _____

- 15.17 Turn water supply valve (faucet) off _____

- 15.18 Verify that the alarm silence pushbutton shuts off alarm horn. _____

- 15.19 Open V-112 to drain water from skid drain pan. _____

- 15.20 Verify that panalarm annunciator can clear alarm beacon. Must wait for FS-101 to clear. _____

The heat trace temperature is self-regulating. In order to test temperature alarms, the high and low alarm points must be temporarily changed.

15.21 Set the temperature display low alarm point 5 °F above the current temperature readout and verify that the Panalarm annunciator activates. Reset the alarm point to its original value and the annunciator.

15.22 Set the temperature display high alarm point 5 °F below the current temperature readout and verify that the Panalarm annunciator activates. Reset the alarm point to its original value and the annunciator.

15.23 Remove jumper between terminal block locations 16 and 17 of the Allen-Bradley variable speed drive. This is the normal configuration, which activates the electrical interlock between the two pumps.

16.0 MIXER PUMP ORIENTATION SETUP TEST

16.1 Rotate the mixer pump turntable ccw, via jog switch SW1, until limit switch LS2-CCW arm. During rotation, ensure there are no electrical cable and/or hose interferences, and observe the flexhoses which attach the caustic addition and water flush piping risers to the pump support column. Immediately stop rotation if a problem is seen.

16.2 Repeat the previous step except rotate cw until limit switch LS1-CW arm.

16.3 Orientate reference arrow on pump turntable, via jog switch SW1, to the 0° mark in order to set position controller to the reference angle. Lines corresponding to particular discharge nozzle angles are etched on the mixer pump adaptor flange and labeled as such.

Note: The position controller reference angle value does not have to be set to 0°. (In fact, it can't be due to software limitations). As long as it is noted and consistently used, one value is as good as another. The reference angle value for setup is chosen in step 16.6. A different reference angle will be chosen for operation. See Figure 4.

16.4 Set the Autotech Corp. Reverse Single Preset Module, RSPM, value to +01000.

16.5 Set the Autotech Corp. Forward Single Preset Module, FSPM, value to +24000.

16.6 Set the Autotech Corp. Preset Number value to 20.

16.7 Set the Autotech Corp. Position Controller Option Number to 241.

16.8 Verify that all the Autotech Corp. Position Controller lights are functioning.

16.9 Set the Autotech Corp. Position Controller Decimal Point position 2 places from the left.

16.10 Set the Autotech Corp. Position Controller Scaling Factor to 43.875.

CAUTION:

The mixer pump manual position jog switch, SW1, is not to be operated while the mixer pump is rotating under control of the Autotech Corp. Position Controller. It is possible to instantaneously reverse the direction of the mixer pump rotation if this warning is not observed, which could cause mechanical and/or electrical failure of the pump system.

16.11 Calibrate the position controller angle measurement vs. the measured angle marks etched on the mixer pump adaptor flange. Do this by rotating the turntable from 0° to 90° or 180° using jog switch, SW1. Repeat until the angle measurements consistently match up. Record the position controller scale factor below.

Position controller scale factor _____

16.12 Orientate reference arrow on pump turntable, via jog switch SW1, to the 90° mark.

Note: This and the next 4 steps set the reference angle and limits of turntable rotation during normal operation. The reference angle (defined as when arrow is at 0° mark on flange) shown on the position controller display is indirectly set to 10°. Operating limits of rotation are 17° and 183° on the display (which correspond to 7° and 173° actual).

16.13 Set the Autotech Corp. Reverse Single Preset Module, RSPM, value to +01700.

16.14 Set the Autotech Corp. Forward Single Preset Module, FSPM, value to +18300.

16.15 Set the Autotech Corp. Preset Number value to 100.

16.16 Set the Autotech Corp. Position Controller Scaling Factor to the value obtained in step 16.11.

16.17 Operate the rotation system for 4 complete cycles in order to verify that it is functioning properly.

17.0 MIXER PUMP STARTUP, VARIABLE SPEED DRIVE TEST, AND ALARM TEST

17.1 Fill the pit with water to a depth of approximately 27 feet and no greater than 30 feet.

17.2 Record the pit water temperature.

Water Temperature _____ °F

17.3 Verify that labels on the mixer pump conform with those shown on Figure 4.

PUMP COG ENGINEER _____

17.4 To make sure impeller rotation is correct, turn on the mixer pump, check the motor amperage and compare to its expected value ($\approx$ 53 amps at 100% speed).

17.5 Verify that the 3 (E)-STOP stations can shut down the 75 HP motor while it is operating at 100% speed. Allow approximately 2 minutes between motor starts to permit heat to dissipate from the motor windings.

- 17.6 To test for critical speeds, program the variable speed drive to run at 10% speed and let run for 1 minute. Record data on the MIXER PUMP TEST DATA SHEET. Repeat in 5% speed increments up to 100% of rated speed. Observe the pump for excess noise, changes in vibration, and increased unbalanced loads. If these occur to an excessive degree, the pump operating speed shall be immediately increased to 100% of rated speed. The Test Director and PUMP COG ENGINEER shall then confer before resuming test.
-

- 17.7 Program the variable speed drive to run the pump at 100%, 80%, 60%, 40%, and 25% speed, each for 10 minutes. Record parameters on the MIXER PUMP TEST DATA SHEET. Compare to values obtained in the August 1993 pump run-in. If vibration velocity readings in excess of 0.28 in/s were recorded in the previous step, pump operating speeds within 20% of the corresponding speed(s) shall be skipped and this shall be noted on the DATA SHEET.
-

Test mixer pump alarms.

WARNING:

Allow approximately 2 minutes between motor starts to permit heat to dissipate from the motor windings.

- 17.8 Verify that the 75 HP motor moisture interlock and alarm is operational. This can be done by temporarily jumpering between TBX-AN-2C terminals 5 and 6.
-

- 17.9 Reset Beta Products annunciator, ANN-001.
-

- 17.10 Verify that the 75 HP motor temperature interlock and alarm is operational. This can be done by setting the temperature digital indicator, DI-3, AL2 alarm point below the current readout value. Reset alarm point to its original value.
-

- 17.11 Reset Beta Products annunciator, ANN-001.
-

- 17.12 Verify that the 75 HP motor compression interlock and alarm is operational. This can be done by setting the strain digital indicator, DI-1, AL2 alarm point below the current readout value. Reset alarm point to its original value.
-

- 17.13 Reset Beta Products annunciator, ANN-001.
-

- 17.14 Verify that the 75 HP motor tension interlock and alarm is operational. This can be done by setting the strain digital indicator, DI-1, AL1 alarm point above the current readout value. Reset alarm point to its original value.
-

- 17.15 Reset Beta Products annunciator, ANN-001.
-

- 17.16 Verify that the 75 HP motor vibration interlock and alarm is operational. This can be done by connecting any TB-1A X2 terminal to K7 terminal B for 5 seconds and then remove.
-

- 17.17 Reset Beta Products annunciator, ANN-001.
-

Test the Tank Farm related alarms.

- 17.18 Verify that the Tank 107AN High Pressure 75 HP motor interlock and alarm is operational. In order to accomplish this apply 120 VAC from any TB-2A X1 terminal to K11 terminal A for 5 seconds and then remove.
-

- 17.19 Reset Beta Products annunciator, ANN-001.
-

17.20 Verify that the Tank Farm Area Radiation 75 HP interlock and alarm is operational. In order to accomplish this apply 120 VAC from any TB-2A X1 terminal to K12 terminal A for 5 seconds and then remove.

17.21 Reset Beta Products annunciator, ANN-001.

17.22 Verify that the Pit 07A Leak detection 75 HP interlock and alarm is operational. Place the leak detector probe assembly in a pan filled with at least 3 inches of water.

17.23 Reset Beta Products annunciator, ANN-001.

17.24 Shut off pump and associated equipment.

IV. SYSTEM INTEGRATED FUNCTIONAL TEST

18.0 PUMPING SYSTEM RUN-IN TEST

It is intended that this test simulate an addition of caustic to Tank 107-AN as closely as possible. QA/QC shall observe this portion of the test.

18.1 Before beginning integrated system run-in test, contact East Area Operations Department to inform them that the test is due to be run. They are encouraged to send personnel to witness the test. Personnel observing the test need to be briefed on the safety requirements discussed in Section 4.0. The Operations representatives who witness some part of the test shall print and sign their names in the following blanks. If no representatives attend this test, write none in each blank.

Operations:

- 18.2 Set the valves as shown in the following valve lineup. For more information see the isometric drawing of the caustic injection skid piping shown in Figure 3.

INITIAL VALVE LINEUP

V-100	CLOSED		PRV-105	N/A		V-110	CLOSED	
V-101	OPEN		V-106	CLOSED		V-112	CLOSED	
V-102	OPEN		V-107	CLOSED		V-113A	OPEN	
V-103	OPEN		V-108	OPEN		V-113B	OPEN	
V-104	OPEN		V-109	CLOSED		V-114	OPEN	

- 18.3 Line reference arrow up with the 7° mark on the mixer pump adaptor flange using jog switch, SW1. This is the first indexing angle for mixing.
- 18.4 Check the following to ensure caustic injection skid is in configuration it was left in after the sub-system tests. Enter NA if step already performed:
- 18.4.1 Attach one end of the caustic addition hose to Kamvalock fitting, V-114, and the other to the caustic addition riser atop the mixer pump.
- 18.4.2 Attach short hose (≈ 6 foot) to Kamvalock fitting, V-113B, at discharge of 150 gallon tank and the other end to Kamvalock fitting, V-113A, in the suction piping to the metering pump.
- 18.4.3 Run a hose from a water supply valve (faucet) into the 150 gallon tank.
- 18.4.4 Fill 150 gallon tank approximately half full with water.

18.5 Record the pit water temperature.

Water Temperature _____ °F

18.6 Start the mixer pump. Program the variable speed drive to run at 100% speed and run for 5-10 minutes. Record parameters on the SYSTEM INTEGRATED RUN-IN TEST DATA SHEET. Compare to values obtained in the August 1993 pump run-in.

18.7 Open V-100.

18.8 Start the metering pump, and ramp up to 100% speed.

18.9 Turn on water faucet. Ideal flowrate is approximately 15 gallons per minute (i.e. 1/10th of tank is filled in 1 minute's time). Adjust flowrate as necessary to keep the tank water level reasonably constant.

18.10 Rotate the mixer pump to the next indexing angle using jog switch SW1 and run for 5-10 minutes. Record parameters on the SYSTEM INTEGRATED RUN-IN TEST DATA SHEET. Repeat this step at 10° intervals between the 7° and 173° operating limits. Vary the speed of the metering pump and the mixer pump as desired and record settings.

WARNING:

Do not submerge upper column pipe of pump support column. Use shop submersible pump to evacuate water from pit if water level approaches bottom of upper column pipe.

18.11 Verify that the caustic addition pumping system (mixer pump and caustic injection operating in conjunction) has operated for a minimum of 2 continuous hours.

QA/QC _____

18.12 Verify that rotational overtravel in both directions will shut down the rotation system. Perform this by activating the limit switches by hand when the rotation system is in auto mode.

18.13 Turn water supply valve (faucet) off.

18.14 When the 150 gallon tank on the caustic injection skid is nearly empty, shut down the 75 HP motor. Verify that both the rotation system and caustic injection skid metering pump also shut down.

18.15 Close V-100.

18.16 Verify that the rotation system and caustic injection skid metering pump can not start with the 75 HP motor not operating.

18.17 Open V-109 and V-110 to allow residual liquid in piping lines to drain into 10 gallon tank.

18.18 Record the water level in 10 gallon tank after all residual liquid has drained from piping. Estimate fluid level in tank (ex. 3/4 full, 1/2 full, etc.)

10 gallon tank fluid level _____

18.19 Open V-107 and V-112 to drain water out of 10 gallon tank and skid pan.

18.20 Close V-107 and V-112.

18.21 Ensure that entire system is off.

V. POST-TEST MAINTENANCE

19.0 POST-TEST MAINTENANCE

Dismantle the pumping system with field installation in mind. Issuance of the official test report shall not be contingent on completion of the following tasks. Tasks to be performed include:

- Lower the pit water level with shop submersible pump in order to prevent unnecessary corrosion of the mixer pump.
- Disconnect power to pump control building.
- Detach electrical connections between the pump control building, caustic injection skid, and mixer pump.
- Detach hose connecting caustic injection skid to mixer pump.
- Remove mixer pump from the pump pit using the CRITICAL LIFT procedure.

Figure 1 - Pumping System Test Setup at 272-E

Figure 2. Mixer Pump Setup In Test Pit at 272-E
(Not to Scale)

General Note: All valves have prefix CHEMB-

Figure 3 - Caustic Addition Skid Piping Isometric

FIGURE 4
MIXER PUMP TURNTABLE ASSEMBLY
PLAN VIEW

FIGURE 5
PUMP CONTROL BUILDING
INSTRUMENTATION RACK LAYOUT

FIGURE 6--
PUMP CONTROL BUILDING
POWER RACK LAYOUT

APPENDIX

WHC-SD-WM-TC-062
Rev. 0 Page 55 of 61

DATE _____

[illegible]

Data Recorders: Print name, Sign name, Date

Test Director _____

WHC-SD-WM-TC-062
Rev. 0 Page 56 of 61

DATE _____

[illegible]

Test Director

WHC-SD-WM-TC-062
Rev. 0 Page 57 of 61

DATE _____

[illegible]

Test Director

SYSTEM INTEGRATED RUN-IN TEST DATA SHEET

DATE _____

REFERENCE SECTION 18.0

[illegible]

PD - Positive Displacement

Data Recorders: Print name, Sign name, Date

QA/QC Witness _____

Test Director

SYSTEM INTEGRATED RUN-IN TEST DATA SHEET

DATE _____

REFERENCE SECTION 18.0

[illegible]

PD - Positive Displacement

Data Recorders: Print name, Sign name, Date

.....

QA/QC Witness _____

Test Director _____

CLARIFICATION / TROUBLESHOOTING SHEET NUMBER _____

Procedure Step: _____

Make copies of this page as necessary.

Description of Problem:

Problem Resolution:

Date Resolved: _____

Test Director _____

Cognizant Engineer _____

EXCEPTION SHEET NUMBER _____

Procedure Step: _____

Make copies of this page as necessary.

Description of Problem:

Exception Resolution:

Test Director _____

Equipment Cognizant Engineer _____

Quality Assurance Engineer _____