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TWRS	R. S. Nicholson	N/A
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for release)		**10. System/Bldg./Facility:** 241-AN-107
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16. KEY

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(See Approval Designator for required signatures)

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1	1	Cog. Mgr. DG Baide	D Baide	5/15/97	S5-05
1	1	GA Leshikar	GA Leshikar	5/12/97	S2-24
1	1	Prog. Mgr. KG Carothers	KG Carothers	5/12/97	B2-11
		QA			
		Safety			
		Env.			

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3		DW Vandyke			S5-07
3		RE Parazin			S4-43
3		JT Ross			S5-03
3		RA Dodd			S5-07
3		LT Pedersen			N1-46

18.	19.	20.	21. DOE APPROVAL (if required) Ctrl. No.
GA Leshikar 5/12/97 Signature of EDT Originator Date	KG Carothers 5/12/97 Authorized Representative for Receiving Organization Date	Robert Nicholson 5/15/97 Design Authority/ Cognizant Manager Date	[ ] Approved [ ] Approved w/comments [ ] Disapproved w/comments

BD-7400-172-2 (05/96) GEF097

Acceptance Test Report: Field Test of Mixer Pump for 241-AN-107 Caustic Addition Project

GA Leshikar
SGN Eurisys Inc., Richland, WA 99352
U.S. Department of Energy Contract DE-AC06-87RL10930

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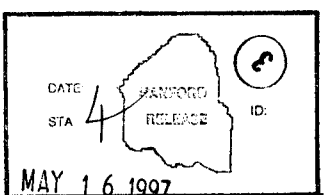
Abstract: The field acceptance test of a 75 HP mixer pump (Hazleton serial # N-20801) installed in Tank 241-AN-107 was conducted from October 1995 thru February 1996. The objectives defined in the acceptance test were successfully met, with two exceptions recorded. The acceptance test encompassed field verification of mixer pump turntable rotation set-up and operation, verification that the pump instrumentation functions within established limits, facilitation of baseline data collection from the mixer pump mounted ultrasonic instrumentation, verification of mixer pump water flush system operation and validation of a procedure for it's operation, and several brief test runs ("bump") of the mixer pump.



Release Approval 5/16/97 Date

Release Stamp

Approved for Public Release

TABLE OF CONTENTS

1.0 INTRODUCTION

The field acceptance test of a 75 HP mixer pump installation at Tank 241-AN-107 was conducted from October 1995 thru February 1996. The test was performed under JCS work package number 2E-94-00198. A copy of the work-completed test procedure is included as Appendix A of this document. The mixer pump itself was acceptance tested previously at the 272-E shop per document WHC-SD-WM-TRP-149.

2.0 SYSTEM DESCRIPTION

The 75 HP Hazleton rotating submersible mixer pump (serial no. N-20801) is a key component of a caustic addition and entrainment system that has been installed at Double-Shell Tank (DST) 241-AN-107 for the purpose of increasing the hydroxide concentration of the waste. The desired result is to bring the waste into compliance with Tank Farm operating specifications for corrosion control.

The caustic addition system consists of three major components: a mixer pump, a caustic injection skid, and a pump control building. The focus of the ATP was the mixer pump installed on a stand above the central pump pit 42" riser. The mixer pump produces 960 gpm and 115 feet total dynamic head at 1800 rpm and is 50' long from mounting flange to bottom of discharge nozzles. Pump suction is taken approximately 68" above the tank floor and discharge is through two opposed 1.5" diameter nozzles approximately 10" above the tank floor. Discharge nozzles for caustic addition are located adjacent to the mixer pump discharge nozzles. The pump is capable of rotating thru 180° to obtain 360° coverage. The outside of the pump column has piping to transport caustic and flush water along with four echo ranging ultrasonic transducers and a densitometer to measure mixing effectiveness.

A portable mixer pump control building contains all the necessary electrical, control, and instrumentation hardware to operate the mixer pump. The control building, 241-AN-274, is located outside AN Tank Farm.

3.0 TEST DESCRIPTION

The acceptance test encompassed field verification of mixer pump turntable rotation set-up and operation, verification that the pump instrumentation functions within limits, facilitation of baseline data collection from the mixer pump mounted ultrasonic instrumentation, verification of mixer pump water flush system operation and validation of procedural steps for it's operation, and a brief test run ("bump") of the mixer pump to verify that it operates.

4.0 TEST RESULTS

The objectives defined in WHC-SD-WM-ATP-155 were successfully met, with two exceptions recorded. A copy of the work-completed test procedure is included as Appendix A of this document. The exceptions are presented in Appendix B.

Listed below is each objective taken from WHC-SD-WM-ATP-155 followed by test results showing how the objective was achieved.

1.3.1 To verify that the mixer pump operates. This will be confirmed by briefly running the pump.

Result: On December 5, 1995 the mixer pump operated inside Tank AN-107 for approximately 45 seconds at 400 rpm (approx. 22% of full speed). On February 15, 1996 the mixer pump was operated five or six times at 400 rpm for durations between 30 seconds and one minute in order to allow troubleshooting of exceptions. Motor power was recorded as 1.3 kW and motor current draw was 22 amps. These values are nearly identical to the results obtained during shop testing (see Section 5 for comparison). Noticable, albeit very gentle, agitation of the waste surface could be discerned viewing the in-tank camera.

Water flushes of the pump inlet screen and discharge nozzles were performed each day before the mixer pump was operated.

1.3.2 To verify that the pump strain, vibration, motor temperature, and motor cavity moisture instrumentation functions within limits.

Result: Pump strain, motor temperature, and motor cavity moisture instrumentation functioned and gave reasonable output within the limits given in Appendix A of the ATP. See the MIXER PUMP "BUMP" TEST DATA SHEET for recorded values.

Pump vibration instrumentation functioned but gave wildly scattered readings that quickly exceeded the limits given in Appendix A of the ATP. See Test Exception Sheet #1 for detailed description of the problem and the resolution action.

The vibration monitor, strain transmitter, and temperature monitor were calibrated before testing (see Appendix D).

1.3.3 To perform actions, such as rotating the mixer pump, that allow Iowa State/Ames Laboratory engineers to initial test the pump column mounted echo ranging ultrasonic transducers. Also to verify those tests are complete before tank mixing is commenced.

Result: Actions to support baseline data gathering from the ultrasonic transducers were performed per Section 6.2 of the ATP and such data was obtained. Results pertaining to the content or accuracy of that data were beyond the defined scope of the ATP.

1.3.4 To set the mixer pump turntable rotation arrow to the reference angle and visually verify versus the position controller readout in the pump control building. Also, to verify that mixer pump rotation in "auto mode" stops on the border of the defined non-indexing region, whose purpose is to prevent direct jet impingement on the tank thermocouple tree at full pump speed.

Result: Section 6.1 of the ATP was completed without exception. The pump turntable was rotated so the reference arrow pointed at the 90° mark on the pump adaptor flange. Then the reference angle on the position controller in 241-AN-274 was set to 90.00 degrees. The pump was rotated until position controller readout was 0 degrees. Personnel observing from above the central pump pit verified that the reference arrow pointed at the 0° mark. This procedure was repeated for the 180° mark. Shop calibration of the position controller scale factor proved to be accurate.

Mixer pump rotation in the "auto mode" was observed to stop as expected at the 7° and 173° marks and, after a short time delay, reverse rotation.

1.3.5 To verify that there are no interferences in the pump pit between the cable swing arm, junction boxes, cables, and jumpers while the mixer pump turntable is rotating.

Result: Visual verification (with the cover blocks off) that there were no pump pit interferences throughout the 180° range of mixer pump turntable rotation was accomplished. The power cable needed to be re-adjusted on the swing arm to avoid interference with the water flush line jumper head.

1.3.6 To test the mixer pump water flush system using raw water from AN tank farm. Also, to validate the procedure for operating the flush system in the waste tank environment.

Result: The mixer pump water flush system was used successfully per Section 6.4 of the ATP. Section 6.4 was performed four separate times. Some major items that were verified include:

- The flush system solenoid valves (normally open type) closed successfully when energized to prevent water flow into tank.
- AN farm service water pressure ranged between 100 psig and 135 psig outside the central pump pit.
- System pressure was reduced to approximately 0 when the service water supply valve was closed and all in-line flush system valves open. When the isolation valve to the vacuum breaker was subsequently opened, system pressure remained at 0 psig. Total flush system depressurization allowed the safe detachment of the temporary above-ground piping apparatus (see ATP Figure 7).

- Flow rate thru the pump inlet screen branch of the flush system was approximately 4.8 gpm. See Section 6.0 for discussion.

- Flow rate thru each discharge nozzle branch of the flush system was approximately 3.2 gpm. See Section 6 for discussion.

5.0 DISCUSSION - MIXER PUMP FIELD DATA VS. SHOP TEST DATA

A direct comparison of some field data with shop data is possible. WHC-SD-WM-TRP-222 (Reference 3) was the only shop test to utilize the variable frequency drive (VFD).

MIXER PUMP SHOP DATA[1] VS. FIELD DATA[2] FOR OPERATION AT 400 RPM

5N-HAZLETON TYPE "SSB/MIXING" PUMP, SERIAL NO. N-20801

Test	Motor Speed (rpm)	Motor Power (kW)	Motor Current (amps)	Pump Vibration (in/s)	Motor Temp. (°F)	Strain / Unbalance Load (lb)	Motor Moisture (yes/no)
WHC-SD-WM-TRP-222 (shop test)	360	1.6	22.3	over scale	n/a[3]	-4	NO
WHC-SD-WM-ATR-155 (field test)	400	1.3	22.3	over scale	106.4	-35	NO

1. Shop test fluid was water, specific gravity = 1.0.
2. Tank 241-AN-107 estimated specific gravity = 1.4.
3. Motor temperature is dependent on the environment temperature, length of time the mixer pump has operated and on the horsepower delivered.

Motor power and motor current data between shop and field are essentially identical. This is encouraging but is not a conclusive indicator of proper pump performance because of the low speed at which the pump was operated. For a motor speed of 400 rpm, the pump characteristic curve (see Figure 1) predicts a flow of approximately 180 gpm and total head of 7 ft. Using the formula to calculate brake horsepower:

$$bhp = \frac{QxTDHxsp.gr.}{3960xpumpefficiency} = 2.0 = 1.5kW$$

where: Q = flowrate = 180 gpm
TDH = total dynamic head = 7 ft
sp. gr. = specific gravity = 1.4
pump efficiency = 22% from characteristic curve

The predicted power of 1.5 kW compares favorably with the measured value of 1.3 kW.

Pump vibration data was faulty for both the field test and the shop test (when VFD operating). Attempts to resolve the vibration problem were unsuccessful. See Test Exception #1, Reference 3, and Reference 4 for more information.

Pump strain (unbalanced load) shop and field data compare very favorably. The difference in the values is due to wandering of the strain base value, which was expected considering the lifting stresses the pump column experienced while moving the pump out of the shop and installing it in Tank AN-107. Strain readings have varied less than 20 lb from the unstrained initial value in both shop tests and the ATP.

During shop testing, the mixer pump motor winding RTD consistently indicated a temperature higher than ambient when the pump was at rest. A difference of approximately 7 to 8°F was recorded. The motor winding RTD (Rosemount, Series 78S) was determined to be the source of inaccuracy during troubleshooting. This is documented in Reference 3. Reference 3 recommended that the shop test temperature data be used with the waste tank temperature data to obtain an "adjusted" temperature line. For this reason, AN-107 thermocouple tree temperatures were recorded in the ATP. Per the manufacturer the RTD exhibits a linear resistance vs. temperature relationship. Figure 2 is an extrapolation from two temperature readings located relatively close to each other on the low end of the graph. It illustrates the potential difference between the RTD temperature readout in 241-AN-274 and what the actual temperature of the motor windings could be. The recommendation of this observer is that 10°F be subtracted from all motor winding temperature readings since a difference of that magnitude was actually measured. This is a conservative interpretation. This will allow longer duration mixer pump operation at full speed than would result otherwise, without risking exceedance of the manufacturer's 240°F temperature limit.

6.0 DISCUSSION - WATER FLUSH SYSTEM

6.1 WATER FLUSH SYSTEM FIELD DATA

Section 6.4 of the ATP was performed four times for various reasons:

Test Run #1 - 11/17/95, discovered that solenoid valves not working, later found out the wiring to the solenoid switches in 241-AN-274 was not completed. Results from Test Run #1 are therefore for flow through all 3 branches simultaneously.

Test Run #2 - 11/30/95, water flush procedure validated for first time, solenoid valves operating properly.

Test Run #3 - 12/5/95, each branch flushed immediately prior to the mixer pump "bump".

Test Run #4 - 2/15/96, each branch flushed immediately prior to initial mixer pump "bump". It is believed that this run gave the best data for flow rates.

WATER FLUSH SYSTEM FIELD DATA

Test Run # (see above)	Branch[1]	System Pressure (psi)	Initial Gallon Reading[2]	Final Gallon Reading[2]	Total Gallons Used	Elapsed Time (minutes)	Estimated GPM
1	all	95	511079	511106	27	4:00	7
2	1	100	115.8	122.3	6.5	1:00	6.5
2	2	101	122.3	124.7	2.4	1:00	2.4
2	3	101	124.7	128.6	3.9	1:00	3.9
3	1	106	128.6	135.8	7.2	1:00	7.2
3	1	106	135.8	180.1	44.3	13:33	3.3
3	2	108	180.1	183.4	3.3	3:00	1.1
3	3	106	183.4	193.8	10.4	3:00	3.5
3	2	108	193.8	201.8	8.0	5:00	1.6
4	1	135	201.8	206	4.2	5:00	1.0
4	2	133	206	210	4.0	5:00	0.8
4	3	132	210	226	16.0	5:00	3.2
4	1	130	226	250.1	24.1	5:00	4.8
4	2	131	250.1	266.2	16.1	5:00	3.2

1. Branch #1 - pump inlet screen, WST-SOV-140G and WST-SOV-141 energized.
Branch #2 - pump discharge nozzle, WST-SOV-140G and WST-SOV-142 energized.
Branch #3 - pump discharge nozzle, WST-SOV-141G and WST-SOV-142 energized.
2. Test #1 flow total readings taken from AN farm service water meter
Tests #2 - #4 flow total readings taken from in-line flowmeter (see Figure 7 of ATP).

During Test #4, toggling the applicable solenoid valve switch on/off seemed to increase the flow rates. Speculation: Debris in the raw water gets trapped in the solenoid valve. Better raw water filtration is recommended to prevent sluggish flow.

The first flush of each test run generally resulted in the highest flow rates because a significant portion of the flush line is initially vacant of fluid. For 70' of 1" diameter hose plus about 15' of empty 2" pipe, a quick volume calculation gives:

$70'(12\ in/ft)\pi(1"^2)/4 = 660\ in^3\ (gal/231\ in^3) = 2.9$ gallons

$15'(12\ in/ft)\pi(2"^2)/4 = 754\ in^3\ (gal/231\ in^3) = 2.5$ gallons

So it takes approximately 5.4 gallons of fluid just to fill the piping with water.

6.2 COMPARISON OF WATER FLUSH LINE ACTUAL FLOW RATE TO PREDICTED FLOW RATE

A pipe flow analysis of the mixer pump water flush system was performed using the computer program HYDROFLO by Engineering Software Inc., copyright 1988-90. The user creates a detailed hydraulic system including data for fluid viscosity, specific gravity, pipe roughness, loss coefficients for fittings, pipe length and pipe diameter. Some fittings were modeled as equivalent lengths of pipe and these numbers were obtained from Cameron Hydraulic Data, pg. 3-121. The flush system inlet pressure was assumed to be 100 psig and the outlet pressure was calculated to be approximately 20 psig (because the discharge is under approximately 30 feet of fluid of specific gravity 1.4). See Figures 3 and 4 for the detailed results from HYDROFLO.

Branch	Predicted Flow Rate using HYDROFLO (gpm)	Flow Rate obtained during testing (gpm)
1	7	4.8
2	5	3.2
3	5	3.2

The analysis predicts higher flow rates thru the flush system piping than what were obtained in the field.

7.0 RECOMMENDATIONS

1. Install better filtration on the AN-107 raw water supply to ensure that the water flush system solenoid valves will operate without plugging.

2. Eliminate vibration indication as relevant monitoring data since it has been proven faulty. Impact to Caustic Addition Project is the possible loss of forewarning to excessive pump vibration which could lead to premature bearing wear and equipment failure. Note that vibration indication can not prevent equipment failure. There is no impact to tank safety.

3. Subtract 10°F from all motor winding temperature readings based on the earlier discussion of the systematicly high temperature readings given by the RTD. This will allow longer duration mixer pump operation at full speed without exceeding the manufacturer's 240°F temperature limit. The motor winding temperature digital indicator (which is tied into a VFD shut-off interlock) should be reprogrammed from 240°F to 250°F.

8.0 REFERENCES

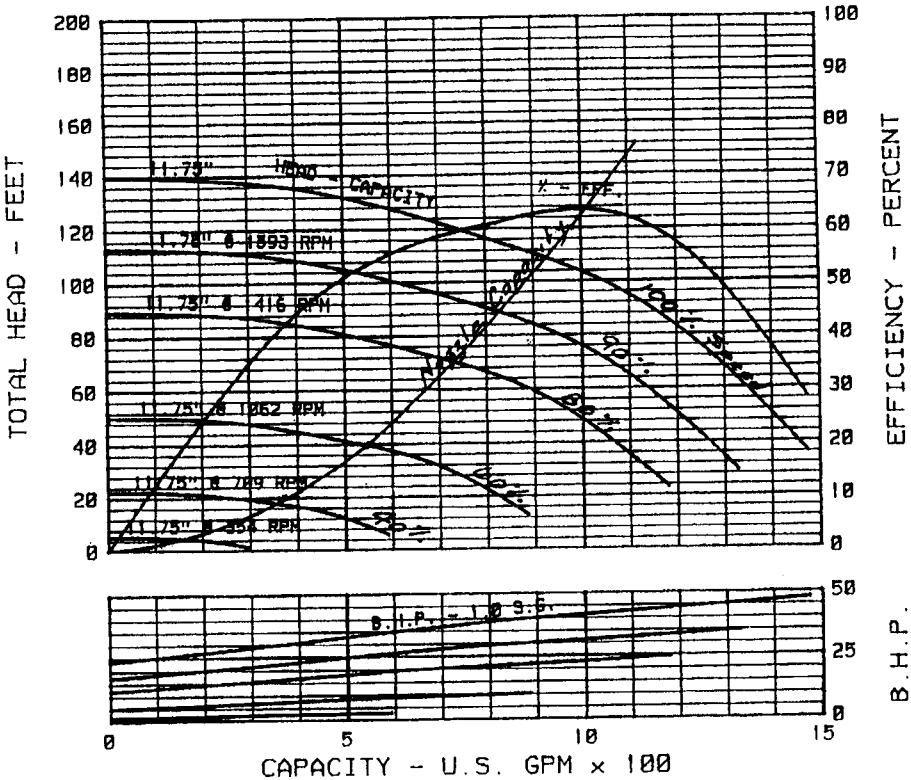
1. WHC-SD-WM-TRP-149 *Test Report for Hazleton Rotating Submersible Mixer Pump SN N-20801*, 2-07-94.

2. WHC-SD-WM-ATP-155 *241-AN-107 Caustic Addition Project - 75 HP Mixer Pump Field Acceptance Test*, 10-25-95.

3. WHC-SD-WM-TRP-222 *Test Report - Pumping System for Caustic Addition Project*, 6-26-95.

4. WHC-SD-WM-ATP-144 *Acceptance Test Procedure for 241-AN-274 Mixer Pump Water Flush System*, 7-14-95.

CHARACTERISTIC CURVE
5N TYPE SSB PUMP @ 1770 RPM



22084 Figure 1 - Mixer Pump Characteristic Curve 2/13/95

HAZLETON PUMPS

Actual Fluid Temperature vs. RTD Temperature (mixer pump at rest) during shop & field tests		
Actual Temperature, °F	RTD Temperature, °F	
71	79	shop test - actual temp. is pit water temp.
96	106.3	field test - actual temp. is Tank AN-107 waste temp.

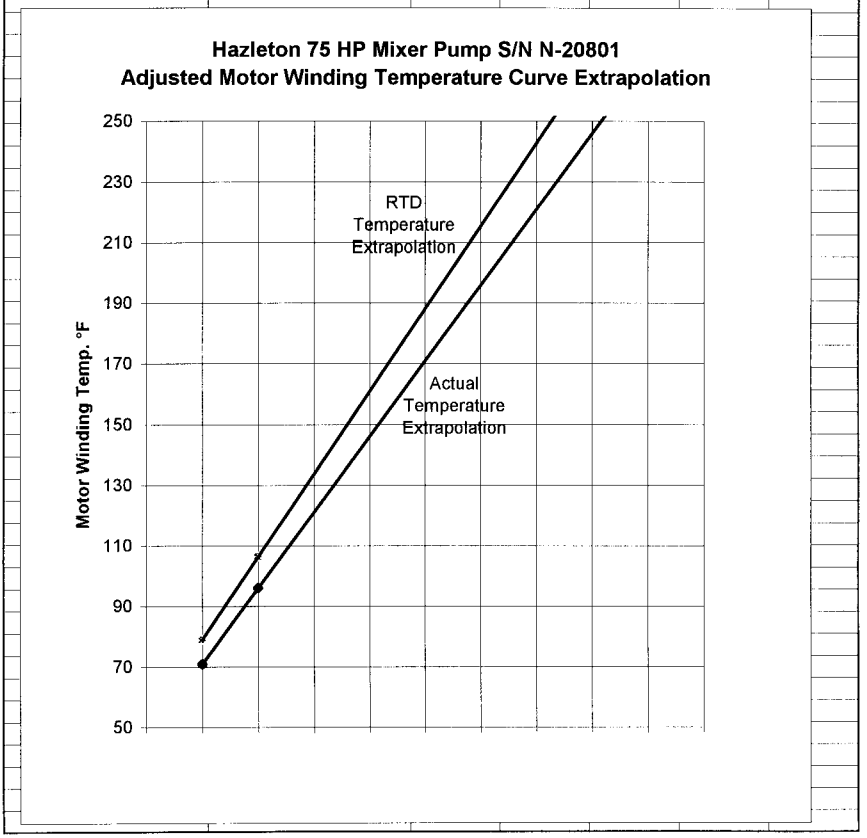


Figure 2 - Motor Winding Temperature Extrapolation

DETAILED REPORT - INDIVIDUAL ELEMENTS
(System: SCREEN3.FLO) @ flow = 7.11 gpm

El#	Description			Fric	Dia (inches)	Vel (ft/s)	HL (feet)
1	Inlet AN Raw Water Supply			1.00	1.00	2.90	0.13
	Elev = 0.00 feet	Press = 114.70 psia					
2	Pipe Water hose	l=	70.00	8.50e-004	1.00	2.90	4.50
3	Fitt turbine flowmeter			5.00	1.00	2.90	0.65
4	Pipe 1" to 2" diffuser	l=	1.00	1.50e-004	1.00	2.90	0.05
5	Pipe Ball valve	l=	1.20	1.50e-004	2.00	0.73	0.00
6	Pipe 90 deg med rad elb	l=	3.50	1.50e-004	2.00	0.73	0.01
7	Pipe	l=	4.00	1.50e-004	2.00	0.73	0.01
8	Pipe 90 deg med rad elb	l=	3.50	1.50e-004	2.00	0.73	0.01
9	Pipe 90 deg short rad e	l=	5.00	1.50e-004	2.00	0.73	0.01
10	Pipe Stainless stl flex	l=	9.00	1.50e-004	2.00	0.73	0.01
11	Pipe 90 deg short rad e	l=	5.00	1.50e-004	2.00	0.73	0.01
12	Pipe 2" to 1.5" Reducer	l=	1.00	1.50e-004	1.50	1.29	0.01
13	Pipe Pump top to manifo	l=	15.00	1.50e-004	1.61	1.12	0.07
14	Pipe std tee side outle	l=	10.00	8.50e-004	1.50	1.29	0.08
15	Pipe trans to 1.2" pipe	l=	0.50	1.50e-004	0.50	11.61	0.76
16	Pipe	l=	1.00	8.50e-004	0.50	11.61	2.51
17	Fitt solenoid valve			2.97	0.21	65.82	199.94
18	Pipe 90 deg elbow	l=	1.50	8.50e-004	0.50	11.61	3.77
19	Pipe trans to 1.5" pipe	l=	1.50	1.50e-004	0.50	11.61	2.28
20	Pipe	l=	20.00	1.50e-004	1.61	1.12	0.09
21	Pipe (12), 45 deg elbow	l=	24.00	1.50e-004	1.50	1.29	0.15
22	Pipe Dual Check Valves	l=	22.00	1.50e-004	1.50	1.29	0.14
23	Pipe 1.5" to 3/4" Reduc	l=	0.80	1.50e-004	0.75	5.16	0.16
24	Exit Inlet Screen Water Flush			1.00	0.50	11.61	2.09
	Elev = -23.00 feet	Press = 30.50 psia					

Figure 3 - Predicted Flow Rate Thru Water Flush System to Inlet Screen - HYDROFLO output

DETAILED REPORT - INDIVIDUAL ELEMENTS
(System: NOZZLE3.FLO) @ flow = 5.15 gpm

El#	Description			Fric	Dia (inches)	Vel (ft/s)	HL (feet)
1	Inlet	AN Raw Water Supply		1.00	1.00	2.11	0.07
		Elev = 0.00 feet	Press = 114.70 psia				
2	Pipe	Water hose	l= 70.00	1.50e-004	1.00	2.11	1.80
3	Fitt	turbine flowmeter		5.00	1.00	2.11	0.34
4	Pipe	1" to 2" diffuser	l= 1.00	1.50e-004	1.00	2.11	0.03
5	Pipe	Ball valve	l= 1.20	1.50e-004	2.00	0.53	0.00
6	Pipe	90 deg med rad elb	l= 3.50	1.50e-004	2.00	0.53	0.00
7	Pipe		l= 4.00	1.50e-004	2.00	0.53	0.00
8	Pipe	90 deg med rad elb	l= 3.50	1.50e-004	2.00	0.53	0.00
9	Pipe	90 deg short rad e	l= 5.00	1.50e-004	2.00	0.53	0.00
10	Pipe	Stainless stl flex	l= 9.00	1.50e-004	2.00	0.53	0.01
11	Pipe	90 deg short rad e	l= 5.00	1.50e-004	2.00	0.53	0.00
12	Pipe	2" to 1.5" Reducer	l= 1.00	1.50e-004	1.50	0.94	0.00
13	Pipe	Pump top to manifo	l= 15.00	1.50e-004	1.61	0.81	0.04
14	Pipe	std tee side outle	l= 10.00	1.50e-004	1.50	0.94	0.04
15	Pipe	trans to 1/2" pipe	l= 0.50	1.50e-004	0.50	8.42	0.41
16	Pipe		l= 1.00	1.50e-004	0.50	8.42	0.82
17	Fitt	solenoid valve		2.97	0.21	47.74	105.18
18	Pipe	Dual Check Valves	l= 14.00	1.50e-004	0.50	8.42	11.51
19	Pipe	(8), 45 deg elbows	l= 8.00	1.50e-004	0.43	11.39	14.24
20	Pipe	(3) 90 deg elbows	l= 1.50	1.50e-004	0.43	11.39	2.67
21	Pipe	sst tubing	l= 40.00	1.50e-004	0.43	11.39	71.18
22	Exit	Discharge Nozzle Water Flush		1.00	0.50	8.42	1.10
		Elev = -23.00 feet	Press = 34.10 psia				

Figure 4 - Predicted Flow Rate Thru Water Flush System to Mixer Pump Discharge Nozzle - HYDROFLO output

APPENDIX A

HNF
~~WHC~~-SD-WM-ATP-155
(signed off copy from JCS work package 2E-94-00198)

DISTRIBUTION SHEET

To	From	Page 1 of 1
Distribution	Mitigation Systems Integration	Date 10/24/95
Project Title/Work Order		EDT No. 609738
241-AN-107 Caustic Addition Project - 75 HP Mixer Pump Field Acceptance Test Procedure		ECN No.

Name	MSIN	Text With All Attach.	Text Only	Attach./ Appendix Only	EDT/ECN Only
KG Carothers	R1-51	X			
DB Cole	R3-27	X			
RA Dodd	S5-07	X			
RL Hand	H5-61	X			
GN Hanson	S5-05	X			
MD Harding	S5-07	X			
WW Jenkins	S2-24	X			
DC Larsen	R1-51	X			
GA Leshikar	S2-24	X			
RS Nicholson	S5-05	X			
GP Paintner	S2-02	X			
RE Parazin	R1-51	X			
LT Pedersen	N1-46	X			
GE Rensink	S2-24	X			
DW Vandyke	S5-03	X			
JJ Verderber	S1-57	X			
SU Zaman	R3-08	X			

Record Copy

740 Rev. 9

OCT 25 1995 **ENGINEERING DATA TRANSM**

HNF WHC-SD-WM-ATR-155 Rev.0 Page A-3

T 609738

2. To: (Receiving Organization) Process Engineering K.G. Carothers	3. From: (Origina Mitigation Systems Integration
5. Proj./Prog./Dept./Div.: Tank Waste Remediation Systems	6. Cog. Engr.: R.S. Nicholson
8. Originator Remarks: ETN-94-0010	9. Equip./Component No.: Hazleton S/N N-20801 10. System/Bldg./Facility: 241-AN-107
11. Receiver Remarks:	12. Major Assm. Dwg. No.: H-2-85573, H-2-85264 H-2-72010 13. Permit/Permit Application No.: N/A 14. Required Response Date: October 24, 1995

o.:

7. Purchase Order No.: N/A

15. DATA TRANSMITTED

(A) Item No.	(B) Document/Drawing No.	(C) Sheet No.	(D) Rev. No.	(E) Title or Description of Data Transmitted	(F) Approval Designator	(G) Reason for Transmittal	(H) Originator Disposition	(I) Receiver Disposition
1	WHC-SD-WM-ATP-155		0	241-AN-107 CAUSTIC ADDITION PROJECT - 75 HP MIXER PUMP FIELD ACCEPTANCE TEST PROCEDURE	SQ	1		

16. KEY

Approval Designator (F)	Reason for Transmittal (G)	Disposition (H) & (I)
E, S, Q, D or N/A (see WHC-CM-3-5, Sec.12.7)	1. Approval 4. Review 2. Release 5. Post-Review 3. Information 6. Dist. (Receipt Acknow. Required)	1. Approved 4. Reviewed no/comment 2. Approved w/comment 5. Reviewed w/comment 3. Disapproved w/comment 6. Receipt acknowledged

17. SIGNATURE/DISTRIBUTION (See Approval Designator for required signatures)

(G) Reason	(H) Disp.	(J) Name	(K) Signature	(L) Date	(M) MSIN	(J) Name	(K) Signature	(L) Date	(M) MSIN	(G) Reason	(H) Disp.
1	/	Cog.Eng. R.S. Nicholson		10/23/95	S5-05	M.D. Harding			S5-07	3	
1	/	Cog. Mgr. G.N. Hanson		10/23/95	S5-05	G.P. Paintner			S4-43	3	
1	/	QA J.J. Verderber		10/25/95	S1-57	R.E. Parazin			R1-51	3	
1	/	Safety S. Wiegman		10/24/95	R3-08	G.E. Rensink			S2-24	3	
		Env.				R.L. Hand			H5-61	3	
1	/	K.G. Carothers		10/23/95	S1-51	D. Larsen			R1-51	3	
1	/	G.A. Leshikar		10/23/95	S2-24						

18. G.A. Leshikar Signature of EDT Originator 10/23/95 Date	19. K.G. Carothers Authorized Representative for Receiving Organization 10/23/95 Date	20. G.N. Hanson Cognizant Manager 10/23/95 Date	21. DOE APPROVAL (if required) Ctrl. No. [] Approved [] Approved w/comments [] Disapproved w/comments

30-7400-172-2 (04/94) GEF097

BD-7400-172-1

RELEASE AUTHORIZATION

Document Number:	WHC-SD-WM-ATP-155, REV 0
Document Title:	241-AN-107 Caustic Addition Project - 75 HP Mixer Pump Field Acceptance Test Procedure
Release Date:	10/25/95

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

APPROVED FOR PUBLIC RELEASE

WHC Information Release Administration Specialist:

Kara Broz 10/25/95

Kara Broz

2. Title

241-AN-107 CAUSTIC ADDITION PROJECT - 75 HP MIXER PUMP FIELD ACCEPTANCE TEST PROCEDURE

5. Key Words

Hazleton, Mixer Pump, S/N N-20801, Caustic Addition, Tank 241-AN-107, ETN-94-0010, Barrett-Haentjens

6. Author

Name: G.A. Leshikar

Signature

Organization/Charge Code 74750/E49967

7. Abstract

The purpose of this Acceptance Test Procedure is to briefly test run the 241-AN-107 mixer pump to ensure the mechanical, electrical and instrumentation field installations perform per design. In addition, baseline data will be collected for the mixer pump ultrasonic instrumentation before mixing is commenced.

8. RELEASE STAMP

OFFICIAL RELEASE BY WHC (3)
DATE OCT 25 1995
Sta 4

TABLE OF CONTENTS

1.0 INTRODUCTION

1.1 SYSTEM DESCRIPTION

A caustic addition and entrainment system has been 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 for corrosion control.

The system consists of three major components: a mixer pump, a caustic injection skid, and a pump control building. The focus of this ATP is the mixer pump installed in the central pump pit 42" riser. It will be used as a platform to inject and entrain caustic with the tank waste. The mixer pump is a 50' long, 75 horsepower Hazleton rotating submersible mixer pump (S/N N-20801) with a best efficiency point of 960 gpm @ 115 feet total dynamic head. Pump suction is taken approximately seven feet above the tank floor and discharge is through two opposed 1.5" diameter nozzles approximately one foot above the tank floor.

The portable mixer pump control building contains all the necessary electrical, control, and instrumentation hardware to operate the 75 HP mixer pump. The control building, 241-AN-274, is located outside AN tank farm.

1.2 SCOPE

This test procedure provides instructions for acceptance testing of the 75 HP mixer pump installation at 241-AN Tank Farm. The mixer pump itself was acceptance tested previously per document WHC-SD-WM-TRP-149. The purpose of this test is to briefly test run ("bump") the mixer pump to verify that it operates, to verify that the pump instrumentation functions, to perform those tests that require an open pump pit (cover blocks off), and to facilitate the collection of baseline data by the mixer pump mounted ultrasonic instrumentation.

Testing specific to the pump control building is not required since it was recently acceptance tested per WHC-SD-WM-ATP-135. The caustic injection skid field installation will be tested at a later date per WHC-SD-WM-OTP-190.

Ultrasonic transducer initialization testing (density monitor and echo rangers) will be performed by engineers from Iowa State University / Ames Laboratory. It is not within the scope of this procedure to give detailed instructions or record data for those tests; only to perform actions that facilitate those tests and verify with Iowa State that they are complete.

1.3 OBJECTIVES

The objectives of this test are:

1.3.1 To verify that the mixer pump operates. This will be confirmed by briefly running the pump.

1.3.2 To verify that the pump strain, vibration, motor temperature, and motor cavity moisture instrumentation functions.

1.3.3 To perform actions, such as rotating the mixer pump, that allow Iowa State's engineers to initial test the pump column mounted ultrasonic transducers. Also to verify those tests are complete before tank mixing is commenced.

1.3.4 To set the mixer pump turntable rotation arrow to the reference angle and visually verify versus the position controller readout in the pump control building. Also, to verify that mixer pump rotation in "auto mode" stops on the border of the defined non-indexing region, whose purpose is to prevent direct jet impingement on the tank thermocouple tree at full pump speed.

1.3.5 To verify that there are no interferences in the pump pit between the cable swing arm, junction boxes, cables, and jumpers while the mixer pump turntable is rotating.

1.3.6 To test the mixer pump water flush system using raw water from AN tank farm. Also, to validate the procedure for operating the flush system in the waste tank environment.

1.4 ACCEPTANCE CRITERIA

The "acceptance criteria" for this test are primarily verifications. If the OBJECTIVES delineated in the above section can be successfully verified, the test is a success.

1.5 BACKGROUND

The 75 HP Hazleton pump was purchased in 1987 as a mixer pump for the AY/AZ tank farm and was stored at 2101-M laydown yard before shop modifications to the pump were undertaken beginning in July 1993. 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*.

Integrated functional and operational tests of the caustic addition system were performed at the 272E Rotating Equipment Shop in November 1994 (see

WHC-SD-WM-TRP-222, *Test Report - Pumping System for Caus.*
Project and WHC-SD-WM-OTR-167, *Test Report - Caustic Addition System*
Operability Test Procedure).

1.6 REFERENCES

1.6.1 Drawings

(Obtain ECN printout and ECN's from Document Control for complete drawing information)

- H-2-71912, Sh. 1 (structural - central pump pit)
- H-2-71998, Sh. 1 (piping plan - central pump pit)
- H-2-72010, Sh. 1 (equipment arrangement - central pump pit)
- H-2-72030, Sh. 1 (std. farm details, raw water attachment)
- H-2-72039, Sh. 1 (piping plan - Tank 107)
- H-2-85261, Sh. 1, (mixer pump stand)
- 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, Sh. 1, 2, & 3 (caustic injection skid)
- H-2-85351, Sh. 1 thru 6 (caustic injection skid electrical)
- H-2-85433, Sh. 1 (caustic delivery system general arrangement)
- H-2-85446, Sh. 1 & 2 (caustic injection skid base frame assembly)
- H-2-85573, Sh. 1-33 (electrical, control and instrumentation building)
- H-14-020301, Sh. 1 (AN farm service water P&ID)

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.

1.6.2 CVI

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

1.6.3 WHC Controlled Documentation

WHC-SD-WM-ATP-135 *Acceptance Test Procedure for the 241-AN-274 Caustic Pump Control Building*, 6-29-95.

WHC-SD-WM-ATR-135 *Test Report - 241-AN-274 Caustic Pump Control Building*, 9-28-95.

WHC-SD-WM-ATP-144 *Acceptance Test Procedure for 241-AN-274 Mixer Pump Water Flush System*, 7-14-95.

WHC-SD-WM-ATR-144 *Acceptance Test Report for 241-AN-107 Mixer Pump Water Flush System.* (pending release)

WHC-SD-WM-OTR-167 *Test Report - Caustic Addition System Operability Test Procedure.*

WHC-SD-WM-TRP-222 *Test Report - Pumping System for Caustic Addition Project*, 6-26-95.

WHC-SD-WM-TC-062 *Test Procedure - Pumping System for Caustic Addition Project*, 8-24-94.

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-HIE-003 *Safety Basis for the 241-AN-107 Mixer Pump Installation and Caustic Addition*, 9-30-94.

WHC-SD-WM-DA-148 *Structural Evaluation of Mixer Pump Installed in Tank 241-AN-107 for Caustic Addition Project*, 5-18-95.

WHC-SD-WM-ANAL-018 *Structural Evaluation of Tank 241-AN-107 Internal Components for Caustic Addition Mixing Operations*, 9-30-94.

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

TO-040-540 Raw Water Surveillance and Usage

2.0 RESPONSIBILITIES

2.1 Test Exceptions/Changes: Any variances from the procedure requiring more than minor red-lines, or problems encountered during testing shall be recorded on a Test Exception Sheet. The procedure step shall be referenced, the problem described, solution or course of action recorded, and sign-offs obtained from the Test Director, AN Farm Cognizant Engineer, and QA/QC representative; Equipment Cognizant Engineer and Safety sign-offs shall be required per AN Farm Cognizant Engineer's direction.

The following personnel will be required for the performance of this procedure:

2.2 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. As used in this document, "Test Director" shall be understood to include Test Director designees. The Test Director shall:

- Schedule and conduct a pre-ATP meeting with the participants prior to testing.
- Notify the persons performing and witnessing the test prior to the start of testing and whenever a change is made to the testing schedule.
- Ensure the required tools and personnel are present prior to performing test activities.
- Provide direction to test operators during performance of the test.
- Witness testing and sign/date where indicated in the ATP after completion of each test step.
- Consult with cognizant engineers to determine course of action for unexpected technical problems.
- If the test procedure is suspended, determine the location in the procedure where the test will be restarted.
- Sign/date the Test Execution Sheet when execution of the ATP has been completed.

2.3 Cognizant Facility Engineer:

- Approve red-lines to the test procedure as required. Any of the cognizant engineers may red-line items that are minor in nature such as typos, etc.
- Provide technical information during performance of test.
- Determine appropriate Approval Designators.
- Sign/Date the Test Execution Sheet when execution of the ATP has been completed.

2.4 Cognizant Pump Engineer:

- Approve mechanical equipment-related red-lines to the test procedure as required.
- Provide technical expertise during performance of test and work to resolve mechanical equipment-related test exceptions.
- Release the test report, ATR, upon completion of test.

2.5 Cognizant Electrical Engineer:

- Approve electrical equipment-related red-lines to the test procedure as required.
- Provide technical expertise during performance of test and work to resolve electrical equipment-related test exceptions.

2.6 Quality: QA/QC shall witness testing where designated, approve Test Exception resolutions, and sign/date the Test Execution Sheet when execution of the ATP has been completed and all exceptions resolved.

2.7 Safety: The responsibilities of the Safety Organization are to approve the ATP prior to field performance and approve Test Exception resolutions as necessary.

2.8 Operations: Personnel shall be provided to support testing activities.

2.9 Maintenance: Personnel shall be provided to support testing activities, including an electrician and pipe fitter.

2.10 Surveillance Systems Engineer: Responsibilities are to operate the video camera inside AN-107 as requested.

2.11 Industrial Hygiene: Measure AN farm primary stack NH_3 concentration.

3.0 SAFETY

3.1 Standard WHC safety requirements and safe practices followed by tank farm operations and field personnel shall be utilized during this test and shall be in effect at all times during this test.

3.2 The Test Director has the authority to remove non-essential spectator personnel during performance of this test, if in his determination, their presence adds to the potential for injury.

3.3 For portions of this test that are performed with the cover blocks off the AN-107 central pump pit, the radiation and contamination control requirements given in mixer pump installation work plan WTYP-94-009 shall be in effect.

3.4 If unexpected tank farm equipment alarms or abnormal indications are received during testing, then the test shall be immediately suspended and the equipment powered down as directed by the Test Director and Cognizant Engineers. When the reason for the unexpected condition is understood and resolved, testing activities may be resumed after permission to do so is received from the East Tank Farms Transition Project Shift Manager.

4.0 TEST SET-UP

See Figures 1 thru 7 for illustrations of the site plan, mixer pump installation, pump turntable and flange, discharge nozzle water flush system, and 241-AN-274 power and instrumentation racks.

4.1 TOOLS, EQUIPMENT, AND SUPPLIES

4.1.1 Water Flush System Hookup

- Required equipment is specified in detail on Figure 7. Equipment includes water hose, nipples, bushings, tees, couplings, valves, pressure gauge, and flowmeter.

4.1.2 Other Equipment

- Two-way Radios
- Timer, watch, or stopwatch
- Digital voltmeter (480 VAC range possible)
- Clamp-on ammeter (100 A range possible)

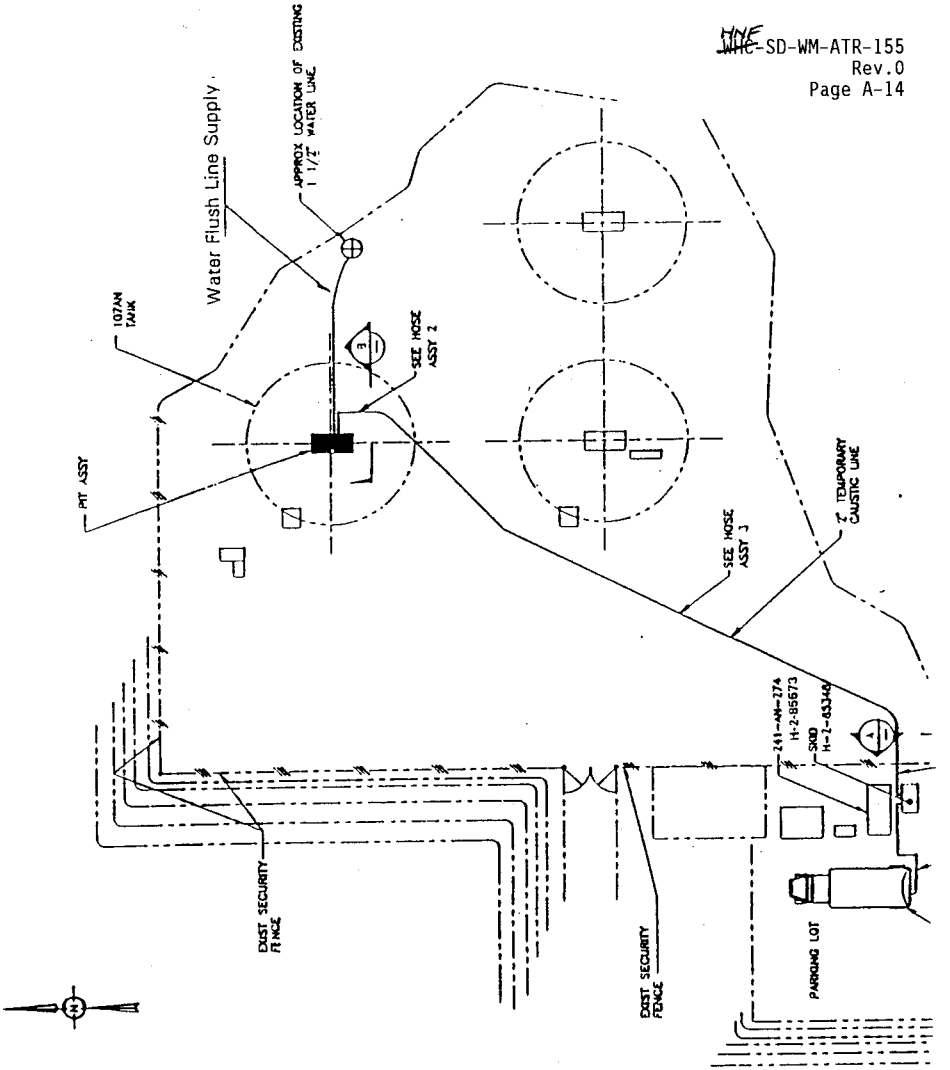

Water Flush Line Supply
APPROX LOCATION OF EXISTING 1 1/2" WATER LINE
107AN TANK
SEE HOSE ASSY 2
PIT ASSY
SEE HOSE ASSY 3
2" TEMPORARY CAUSTIC LINE
241-AN-274
H-2-95673
SHT 1
H-2-83348
EXIST SECURITY FENCE
EXIST SECURITY FENCE
PARKING LOT
N

Figure 1

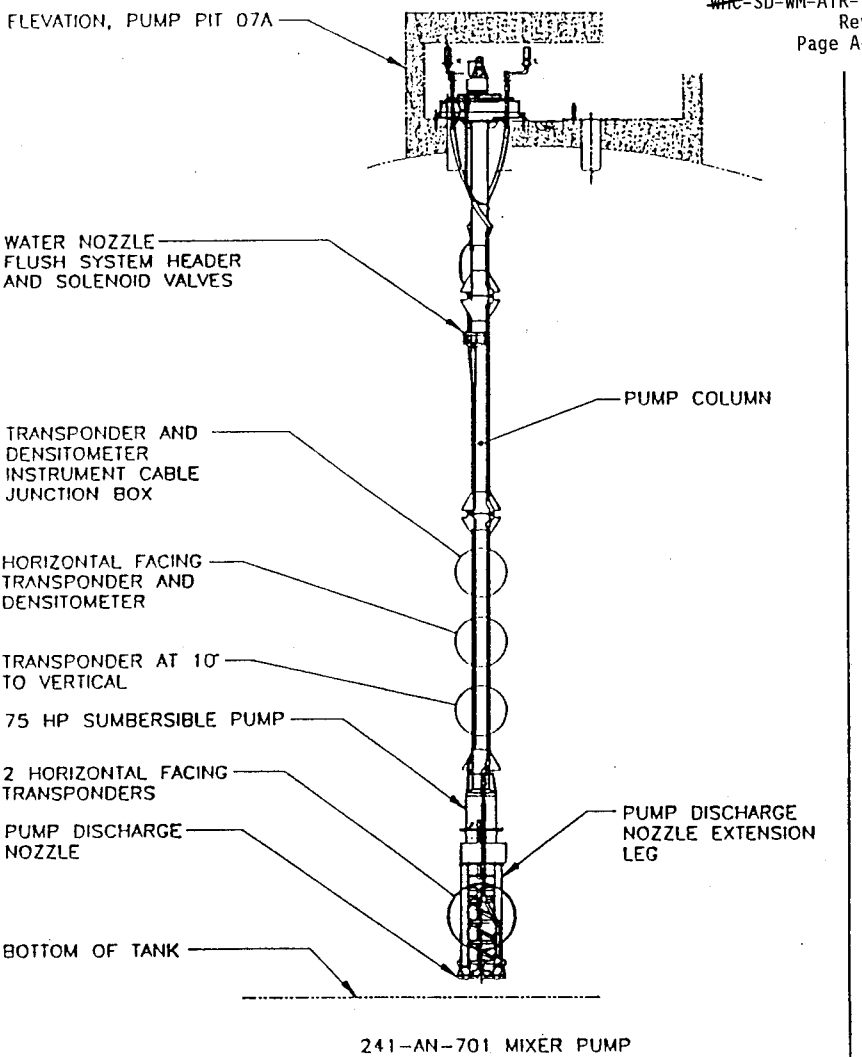
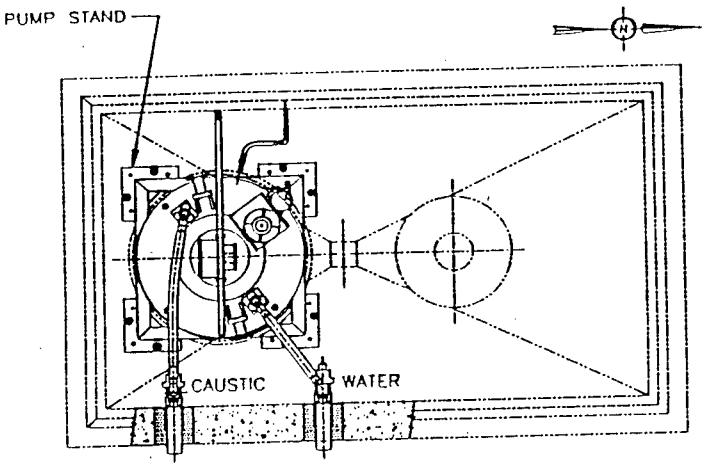

ELEVATION, PUMP PIT 07A
WATER NOZZLE FLUSH SYSTEM HEADER AND SOLENOID VALVES
PUMP COLUMN
TRANSPONDER AND DENSITOMETER INSTRUMENT CABLE JUNCTION BOX
HORIZONTAL FACING TRANSPONDER AND DENSITOMETER
TRANSPONDER AT 10° TO VERTICAL
75 HP SUMBERSIBLE PUMP
2 HORIZONTAL FACING TRANSPONDERS
PUMP DISCHARGE NOZZLE
PUMP DISCHARGE NOZZLE EXTENSION LEG
BOTTOM OF TANK
241-AN-701 MIXER PUMP

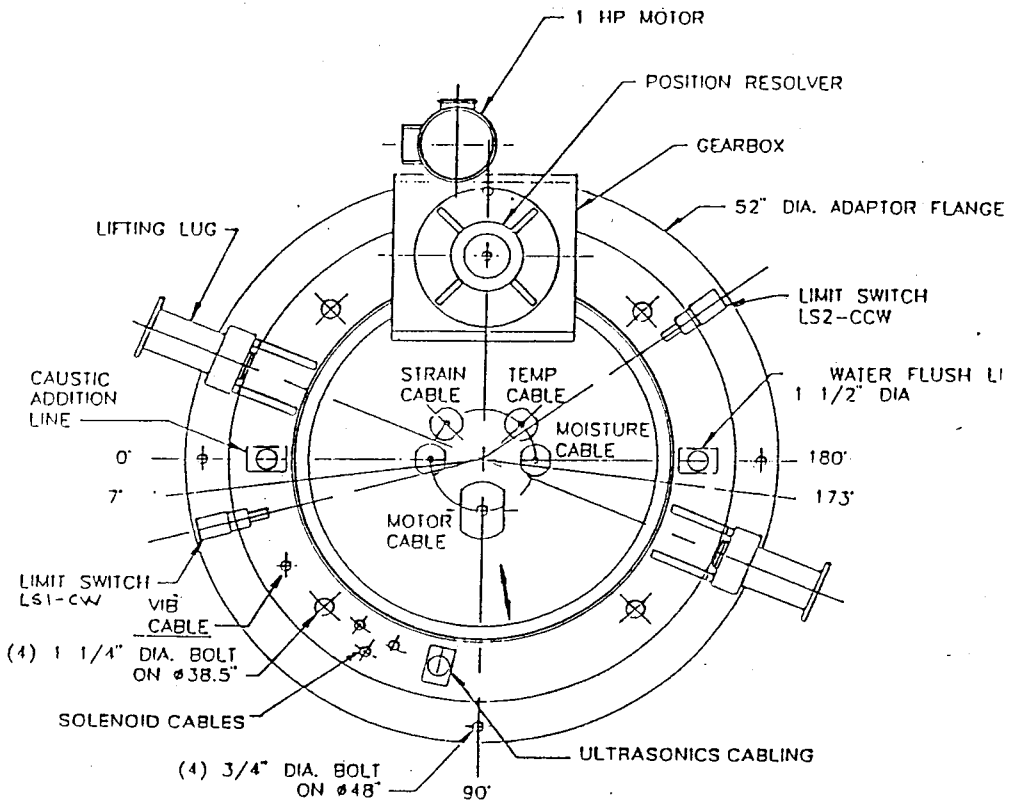
Figure 2

241-AN-107 MIXER PUMP
AND PUMP PIT 07A



PLAN–PUMP PIT 07A

Figure 3



MIXER PUMP TURNTABLE ASSEMBLY
PLAN VIEW

Figure 4

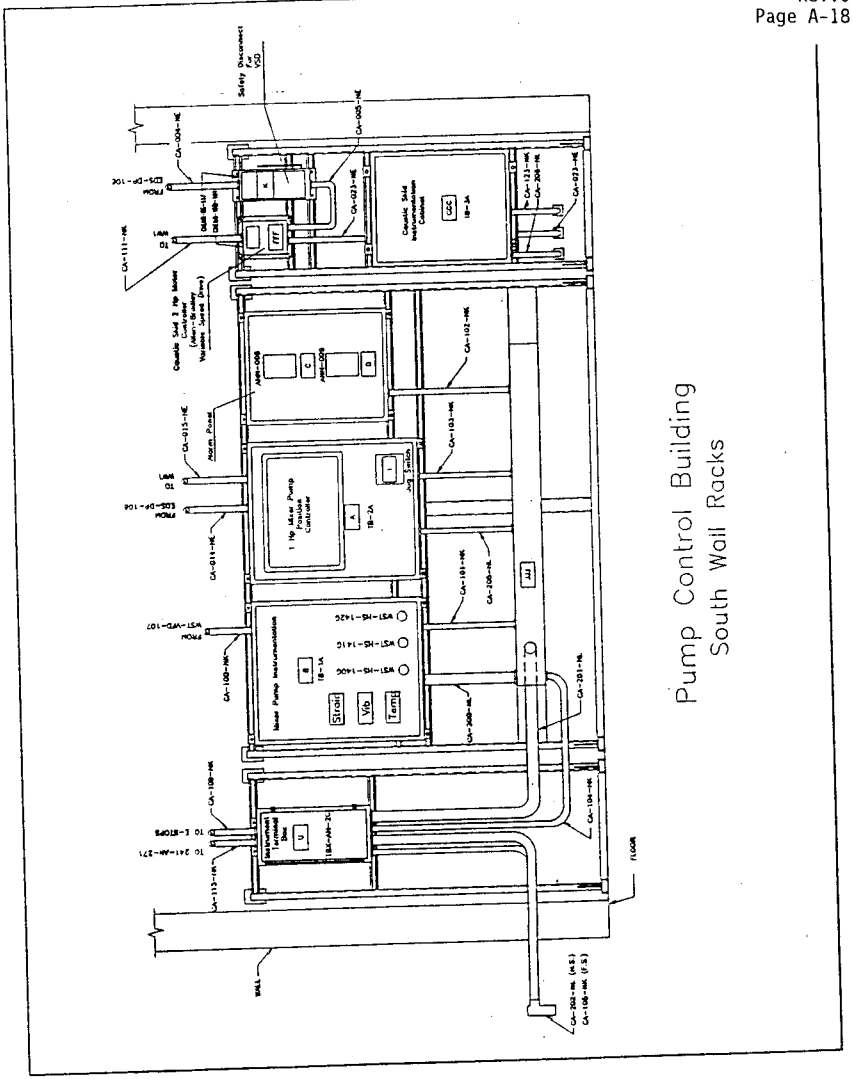

Pump Control Building
South Wall Racks
Safety Disconnect
Caustic Seal Instrumentation Cabinet
Alarm Panel
Strain
Vib.
Temp.
FLOOR
WALL

Figure 5

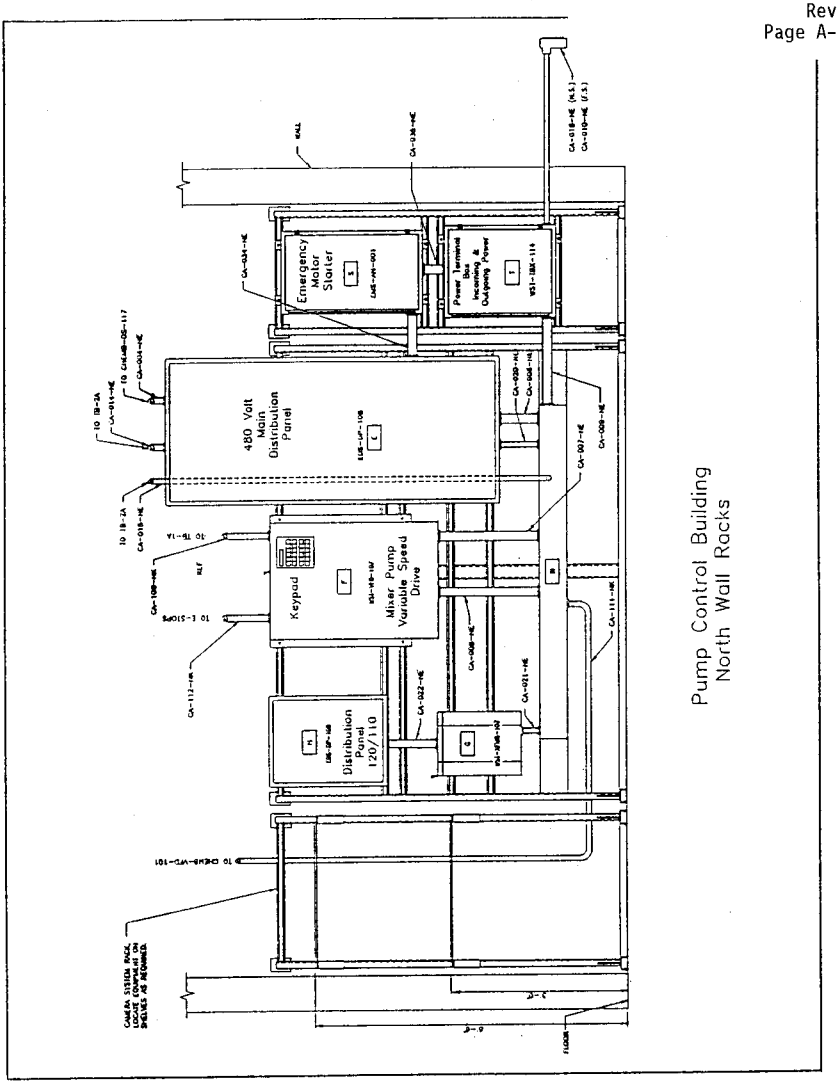

Emergency Motor Starter
480 Volt Main Distribution Panel
Keypad
Mixer Pump Variable Speed Drive
Distribution Panel 120/110
Pump Control Building
North Wall Racks

Figure 6

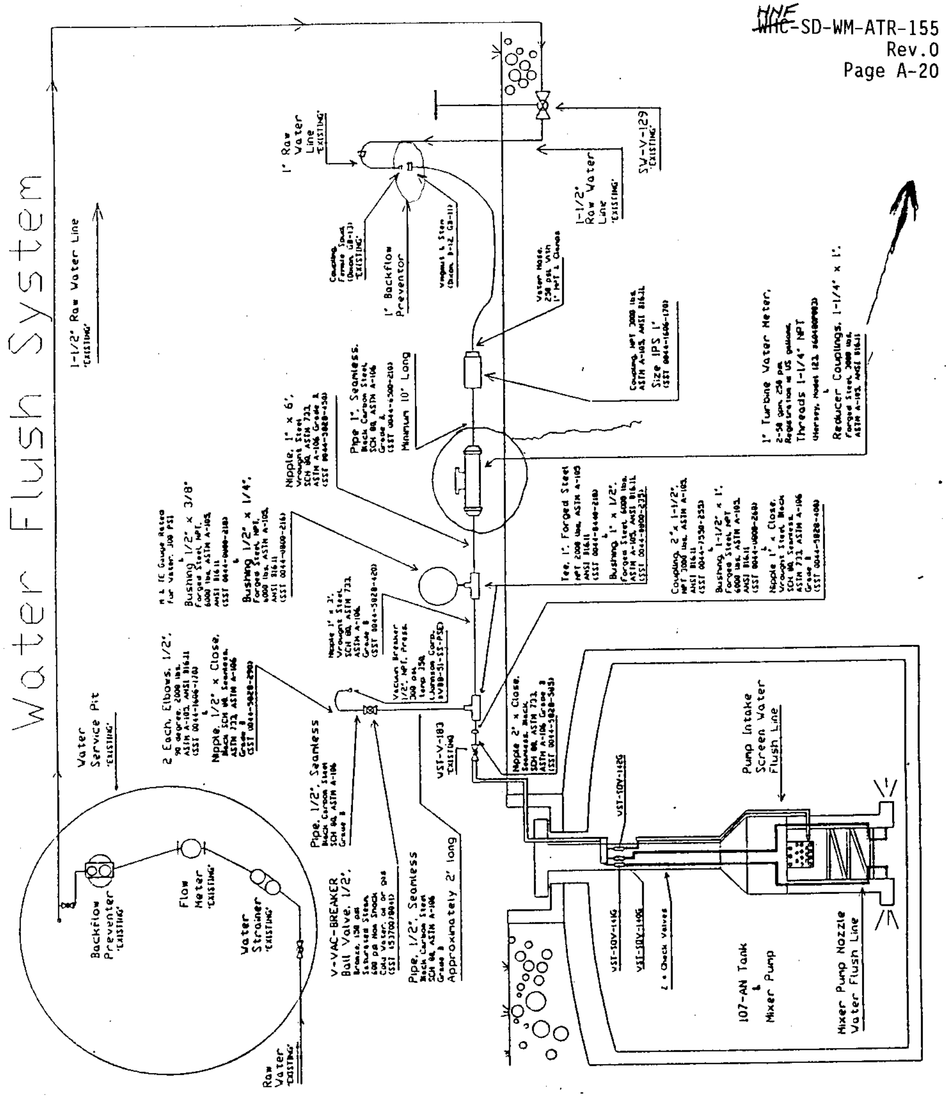

Water Flush System
Water Service Pit 'EXISTING'
1-1/2" Raw Water Line 'EXISTING'
1" Raw Water Line 'EXISTING'
1" Backflow Preventor
1-1/2" Raw Water Line 'EXISTING'
SV-V-129 'EXISTING'
Backflow Preventer 'EXISTING'
Flow Meter 'EXISTING'
Water Strainer 'EXISTING'
Raw Water 'EXISTING'
VST-V-183 'EXISTING'
Pump Intake Screen Water Flush Line
107-AN Tank & Mixer Pump
Mixer Pump Nozzle Water Flush Line
2 x Check Valves
VST-SOV-141G
VST-SOV-140G
VST-SOV-142G

Figure 7

4.2 TEST INSTRUMENTATION

4.2.1 Test instruments shall have a valid calibration stamp attached that indicates a calibration traceable to the National Institute of Standards and Technology.

4.2.2 Test Director shall verify that the following instruments have been calibrated. Complete the following table. Note the scale of each test instrument.

TEST INSTRUMENT	MAKE/MODEL	SERIAL #	CAL. DUE
Voltmeter (scale)	*		
Ammeter (scale)			
Pressure gauge (scale)			

Test Director *See attached sheets of calibration information 11-27-95

4.3 MIXER PUMP INSTRUMENTATION

4.3.1 Test Director shall verify that the following instruments have been calibrated. Complete the following table.

INSTRUMENT	MAKE/MODEL	SERIAL #	CAL. DUE
VM1-Vibration Monitor	Scientific-Atlanta M25-41-2-15-85	348	*
ST1-Strain Transmitter	Acromag 161T-M-iSG-U1C	XI0156	
TT1-Temperature Monitor	Rosemount 444RL2U1A2NA	27762	

Test Director 11-27-95 * See attached sheets

4.3.2 The load cell mounted on the mixer pump support column was zeroed at the 272-E shop (see WHC-SD-WM-TRP-222) with the mixer pump lifted vertically out of the pump pit. The base value achieved during shop testing was approximately -5 lb (compression). It is expected the base value will have changed slightly due to the lifting stresses the pump column has experienced while moving the pump out of the shop and into the tank.

4.4 SPECIAL REQUIREMENTS

4.4.1 The cover blocks must be off the AN-107 central pump pit to allow visual verification of the mixer pump turntable rotation angle.

4.4.2 Raw water usage shall be per Procedure TO-040-540.

4.4.3 Interface piping (hose, fittings, gauge, etc.) must be installed between AN farm raw water supply, SW-V-129, and mixer pump water flush system inlet valve, WST-V-183, per Figure 7.

4.4.4 Interface with WHC's engineering contact to Iowa State (Contact: Rich Hand, WHC Retrieval Engineering or designee) and with Iowa State's engineering representatives will be required during ultrasonic transducer testing.

5.0 PRE-TEST CHECKS

The Test Director shall initial and date the space provided after performance of each step, unless otherwise noted.

DV 10-27-95
5.1 A pre-job ATP meeting has been conducted with the test participants.

DV 10-27-95
5.2 **VERIFY** that all safety requirements, radiation and contamination control requirements, instrument calibrations, tools, and other prerequisites of this procedure have been met.

DV 10-27-95
5.3 Visually **VERIFY** that there is no damage to any external electrical cables in the central pump pit.

DV 10-27-95
5.4 **VERIFY** that labels on the mixer pump turntable and flange, and within the pump pit conform with those shown on H-2-85573, Sheets 6 and 16 (ECN 621953).

DV 10-27-95 COG ENGINEER [signature] 12595

5.5 **OBTAIN VERBAL CONFIRMATION** that Iowa State engineers have ultrasonic transducer equipment installed in 241-AN-271. (Contact: Rich Hand, WHC Retrieval Eng.)

DV 10-27-95
5.6 **ENSURE** the WST-VFD-107 EMERGENCY STOP push-pull operator on the mixer pump 75 HP VSD cabinet is pushed **IN**.

DV 10-27-95
5.7 The following subsection is the procedure for powering up the mixer pump and the 241-AN-274 building electrical equipment.

5.7.1 **ENSURE** the WST-VFD-107 EMERGENCY STOP push-pull operator on the west exterior wall of the 241-AN-274 building is pulled **OUT**.

DV 10-27-95

5.7.2 **ENSURE** the WST-VFD-107 EMERGENCY STOP push-pull operator on the safety switch rack by pump pit 241-AN-07A is pulled **OUT**.

DV 10-27-95

5.7.3 **ENSURE** switch WST-DS-116, 75 HP MOTOR DISCONNECT SWITCH, located on the safety switch rack by pump pit 241-AN-07A is **CLOSED**.

DV 10-27-95

5.7.4 **ENSURE** switch WST-DS-115, located on the safety switch rack by pump pit 241-AN-07A is **CLOSED**.

DV 10-27-95

5.7.5 **ENSURE** disconnect switch EDS-DS-114, located on the south exterior wall of the 241-AN-271 instrument building is **CLOSED**.

DV 10-27-95 5.7.6 ENSURE the following breakers in panelboard EDS-DP-108 are CLOSED.

- Main Breaker
- CKT #1: WST-VFD-107 Variable Frequency Drive 75 HP Motor
- CKT #2: WST-M-107 Rotation 1 HP Motor
- CKT #8: WST-XFMR-107 15 KVA Transformer

DV 10-27-95 5.7.7 ENSURE the following breakers in panelboard EDS-DP-109 are CLOSED.

- Main Breaker
- CKT #1: TB-1A Mixer Pump Instrumentation Cabinet
- CKT #2: TB-2A 1 HP Position Controller Cabinet
- CKT #4: ANN-008 and ANN-009 Annunciator Panels
- CKT #6: Camera Equipment, Building 241-AN-274
- CKT #7: Building 241-AN-274 Indoor Receptacles
- CKT #8: Camera Equipment - Field
- CKT #9: Building 241-AN-274 GFI Outdoor Receptacle
- CKT #10: Camera Equipment Rack GFI Receptacle
- CKT #11: Building 241-AN-274 Lights
- CKT #12: Building 241-AN-274 Heater/Air Conditioner

NOTE: S.T.O.P. stands for SoftTouch Operator Panel. S.T.O.P. is the Eaton Corp. Variable Frequency Drive operater interface. See CVI 22570 for more information.

DV 10-27-95 5.7.8 PULL OUT the WST-VFD-107 EMERGENCY STOP push-pull operator on the mixer pump 75 HP VSD cabinet.

DV 10-27-95 5.7.9 PRESS AND RELEASE the WST-VFD-107 S.T.O.P. OFF button.

DV 10-27-95 5.7.10 PRESS AND RELEASE the WST-VFD-107 S.T.O.P. SPEED SET pushbutton.

DV 10-27-95 5.7.11 PRESS AND RELEASE the WST-VFD-107 S.T.O.P. 10S pushbutton.

DV 10-27-95 5.7.12 PRESS AND HOLD the WST-VFD-107 S.T.O.P. DOWN ARROW until the S.T.O.P. screen indicates "S.T. 0000.00".

DV 10-27-95 5.7.13 PRESS AND RELEASE the WST-VFD-107 S.T.O.P. SPEED pushbutton and verify that the S.T.O.P. screen indicates "S.P. 0000.00".

6.0 FIELD ACCEPTANCE TESTS

The Test Director shall initial and date each test step as it is completed, unless otherwise noted.

6.1 MIXER PUMP ORIENTATION SET-UP TEST

NOTE: The cover blocks must be off the AN-107 central pump pit to allow visual verification of the mixer pump turntable rotation angle.

NOTE: Two-way radios will be required for communication between the AN-107 central pump pit and the pump control building.

DV 10-27-95 6.1.1 Visually CHECK to see that there are no obvious interferences (electrical cables or jumpers) in the pump pit that would prevent the mixer pump turntable from rotating.

DV 10-27-95 6.1.1A Jumper out mixer pump vibration interlock. Civilation alarm is activated, calibration not yet performed. HNF 10/26/95

DV 10-27-95 6.1.2 Prepare to VIEW AND RECORD the mixer pump rotation with the in-tank video camera.

DV 10-27-95 6.1.3 ENSURE electrical systems are powered up in accordance with the procedure of Section 5.7.

DV 10-27-95 6.1.3.A PUSH IN WST-VFD-107 EMERGENCY STOP ON VSD CABINET. HNF 10/26/95

NOTE: The following step starts the mixer pump with an operating speed of 0. The pump is being "started up", but the drive shaft is not rotating so no fluid is being pumped. The VFD has electrical contacts that must be closed in order to enable mixer pump turntable rotation.

10-27-95 DV 6.1.3.B. VERIFY VFD ~~E~~ POSITION CONTROLLER, & HP rot motor are off. HNF 10/26/95

10-27-95 DV 6.1.3.C. ENSURE VSD IS OFF.

10-27-95 DV 6.1.4 PRESS AND RELEASE the WST-VFD-107 S.T.O.P. HAND pushbutton and verify that the S.T.O.P. screen value stays at "S.P. 0000.00".

10-27-95 DV 6.1.5 VERIFY the VFD S.T.O.P. RUN LED is illuminated.

Note: During shop testing of the mixer pump, the vibration alarm limit could be exceeded when accelerating or decelerating the large mass of the pump with the 1 Hp turntable motor. This is a normal occurance and no cause for concern. If the limit programmed into the vibration digital indicator is exceeded, an interlock will turn off the turntable motor (and the pump) and alarm located on ANN-008 will annunciate. If limits are exceeded, record on TEST EXCEPTION sheet for information purposes, and clear alarms and interlocks.

10-27-95 DV 6.1.6 ROTATE the mixer pump turntable ccw, via jog switch SW1, up to limit switch LS2-CCW arm. During rotation, communicate to ensure there are no electrical cable and/or jumper interferences, and view the in-tank video camera to observe for flexhose/riser interferences. Immediately stop rotation if a problem is seen.

DV 10-27-95 6.1.7 **REPEAT** the previous step except rotate turntable cw, via jog switch SW1, up to limit switch LS1-CW arm.

NOTE: The following step orients the reference arrow on the pump turntable with a known point on the mixer pump adaptor flange. The arrow (black with yellow background) is on the same plane as the discharge nozzles within the tank.

DV 10-27-95 6.1.8 **SET** the reference arrow on pump turntable, via jog switch SW1, to the 90° mark on the pump adaptor flange.

COG ENGINEER Witnessed by Dave Van Dyke (not Cog Eng.). 11/27/95

NOTE: The following step sets the reference angle on the position controller located in 241-AN-274 to 90.00 degress.

DV 10-27-95 6.1.9 **PRESS AND RELEASE** the M1890 position controller preset pushbutton. Ensure that display reads 90.00.

NOTE: The next 2 steps set the limits of turntable rotation during automatic operation. Operating limits of rotation are 7° and 173° (which correspond to 7.00 and 173.00 on the display).

DV 10-27-95 6.1.10 **VERIFY** that the Autotech Corp. Reverse Single Preset Module, RSPM, value is +007.00. G.P. 10-27-95

DV 10-27-95 6.1.11 **VERIFY** that the Autotech Corp. Forward Single Preset Module, FSPM, value is +173.00. G.P. 10-27-95

DV 10-27-95 6.1.12 **VERIFY** the Autotech Corp. Position Controller Scaling Factor whole part is 43 and fractional is .875. G.P. 10-27-95

DV 10-27-95 6.1.13 **VERIFY** the position controller option number is 241.

DV 10-27-95 6.1.14 **VERIFY** that the Autotech Corp. Position Controller Decimal Point position is 2 places from the right.

DV 10-27-95 6.1.15 **PRESS AND RELEASE** the Position Controller Select function pushbutton until the LED next to POSITION ACTUAL is illuminated.

DV 10-27-95 6.1.16 Using jog switch SW1, **ROTATE** the pump turntable until the position controller angular readout is 0.00 ± 0.20 and stop.

DV 10-27-95 6.1.17 **VERIFY** that the turntable arrow points very close to the 0° mark. Visual verification is acceptable. If the arrow does not point at the designated mark, note this on a TEST EXCEPTION sheet.

COG ENGINEER

Note: Perform the next step only if the turntable arrow does NOT point at the 0° mark. If step not performed, fill in N/A.

N/A 6.1.18 **CALIBRATE** the position controller angle measurement vs. the angle marks on the adaptor flange. Do this by trial and error, using jog switch SW1 to rotate the turntable from 0° to 90° or 180°. Adjust position controller scale factor as required. Repeat until the readout consistently matches the angles indicated on the flange. Record the new position controller scale factor below.

Position controller scale factor N/A

DV 10-27-95 6.1.19 Using jog switch SW1, **ROTATE** the pump turntable until the position controller angular readout is 180.00 ± 0.20 and stop.

DV 10-27-95 6.1.20 **VERIFY** that the turntable arrow points very close to the 180° mark. Visual verification is acceptable. If the arrow does not point at the designated mark, note this on a TEST EXCEPTION sheet.

COG ENGINEER [signature]

Note: Perform the next step only if the turntable arrow does NOT point at the 180° mark. If step not performed, fill in N/A.

NA 10-27-95 6.1.21 **CALIBRATE** the position controller angle measurement vs. the angle marks on the adaptor flange. Do this by trial and error, using jog switch SW1 to rotate the turntable from 180° to 90° or 0°. Adjust position controller scale factor as required. Repeat until the readout consistently matches the angles indicated on the flange. Record the new position controller scale factor below.

Position controller scale factor N/A

DV 10-27-95 6.1.22 Using jog switch SW1, **ROTATE** the pump turntable until the position controller angular readout is approximately 90.00.

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.

Note: The following steps verify the proper operation of the TB-2A position controller automatic rotation system. Four complete cycles (reversals of the reversing motor) are required.

DV 10-27-95 6.1.23 PRESS AND RELEASE TB-2A WST-M-107 START SW2 pushbutton.

DV 10-27-95 6.1.24 VERIFY that the pump turntable is actually rotating (direction is not important).

DV 10-27-95 6.1.25 VERIFY that the position controller angular readout stops at 7.00 ± 1.00 or 173.00 ± 1.00, whichever is applicable.

DV 10-27-95 6.1.26 Visually VERIFY that the pump turntable stops very near the 7° mark or 173° mark, whichever is applicable. If not, stop test and note on a TEST EXCEPTION sheet (position controller may need to be recalibrated).

DV 10-27-95 6.1.27 VERIFY that after a few seconds delay, the turntable commences rotating in the opposite direction.

DV 10-27-95 6.1.28 REPEAT the previous 3 steps until the automatic rotation system has traveled thru 4 complete cycles.

DV 10-27-95 6.1.29 PRESS AND RELEASE TB-2A WST-M-107 STOP SW3 pushbutton and VERIFY that the pump turntable stops rotating.

Note: The following steps test the function of the rotational overtravel limit switches, LS1-CW and LS2-CCW.

DV 10-27-95 6.1.30 PRESS AND RELEASE TB-2A WST-M-107 START SW2 pushbutton.

DV 10-27-95 6.1.31 While the automatic rotation system is operating, MANUALLY ACTIVATE the LS1-CW arm and VERIFY that rotation stops.

Note: The previous action should also stop mixer pump operation.

DV 10-27-95 6.1.32 VERIFY that VFD S.T.O.P. RUN LED is off.

DV 10-27-95 6.1.33 PRESS AND RELEASE the VFD S.T.O.P. OFF pushbutton.

DV 10-27-95 6.1.34 PRESS AND RELEASE the VFD S.T.O.P. HAND pushbutton and verify that the S.T.O.P. screen value indicates "S.P. 0000.00".

DV 10-27-95 6.1.35 VERIFY the VFD S.T.O.P. RUN LED is illuminated.

DV 10-27-95 6.1.36 PRESS AND RELEASE TB-2A WST-M-107 START SW2 pushbutton.

DV 10-27-95 6.1.37 While the automatic rotation system is operating, MANUALLY ACTIVATE the LS2-CCW arm and VERIFY that rotation stops.

Note: The previous action should also stop mixer pump operation.

DV 10-27-95 6.1.38 VERIFY that VFD S.T.O.P. RUN LED is off.

6.2 ULTRASONIC TRANSDUCER PRE-MIXING BASELINE TESTS

NOTE: ISU - Iowa State University

DV 10-27-95 6.2.1 CONDUCT a brief pre-job meeting with cognizant ultrasonic transducer equipment personnel (WHC contact to ISU and/or ISU engineers) to verify specifics of WHC support.

DV 10-27-95 6.2.2 ENSURE electrical systems are powered up in accordance with the procedure of Section 5.7.

DV 10-27-95 6.2.3 PRESS AND RELEASE the VFD S.T.O.P. HAND pushbutton and verify that the S.T.O.P. screen value indicates "S.P. 0000.00".

DV 10-27-95 6.2.4 As necessary, ROTATE the pump via jog switch SW1 to allow ISU to acquire data. Do not rotate pump out of the 7° to 173° range identified on the position controller display.

DV 10-27-95 6.2.5 PRESS AND RELEASE the VFD S.T.O.P. OFF pushbutton after test data is obtained.

6.3 FIELD INSTRUMENTATION ALARM TESTS

The Pit 07A Leak Detector and Tank 107-AN High Pressure interlock and alarms are tested herein.

NOTE: Access to the AN-107 central pump pit is required to allow testing of the Pit 07A Leak Detector.

DV 10-27-95 6.3.1 ENSURE electrical systems are powered up in accordance with the procedure of Section 5.7.

DV 10-27-95 6.3.2 PRESS AND RELEASE the VFD S.T.O.P. HAND pushbutton and verify that the S.T.O.P. screen indicates "S.P. 0000.00".

DV 10-27-95 6.3.3 VERIFY the VFD S.T.O.P. RUN LED is illuminated.

DV 10-27-95 6.3.4 "SHORT OUT" the Pit 07A Leak Detector probes.

NOTE: To "short out" the leak detector, place in a bucket of water for example. Mixer pump operation should cease.

DV 10-27-95 6.3.5 VERIFY that VFD S.T.O.P. RUN LED is off.

DV 10-27-95 6.3.6 VERIFY that ANN-008 alarm LED is flashing and audible horn is operating.

DV 10-27-95 6.3.7 ACKNOWLEDGE and RESET Beta Products annunciator, ANN-008.

NOTE: The AN-107 High Pressure alarm and interlock will be tested by temporarily lifting a lead in 241-AN-274 building.

12-4 DV 6.3.8 PRESS AND RELEASE the VFD S.T.O.P. OFF pushbutton.

12-4 DV 6.3.9 PRESS AND RELEASE the VFD S.T.O.P. HAND pushbutton and verify that the S.T.O.P. screen indicates "S.P. 0000.00".

12-4 DV 6.3.10 VERIFY the VFD S.T.O.P. RUN LED is illuminated.

12-4 DV 6.3.11 "LIFT" ANN-107-2 inside TBX-AN-2C terminal TB4-1 from the Tank 107-AN High Pressure alarm.

12-4 DV 6.3.12 VERIFY that VFD S.T.O.P. RUN LED is off.

12-4 DV 6.3.13 VERIFY that ANN-008 alarm LED is flashing and audible horn is operating.

12-4 DV 6.3.14 "RE-ATTACH" ANN-107-2 inside TBX-AN-2C terminal TB4-1 to the Tank 107-AN High Pressure alarm.

12-4 DV 6.3.15 ACKNOWLEDGE and RESET Beta Products annunciator, ANN-008.

Witnessed PAW QC 12-4-95

6.4 MIXER PUMP WATER FLUSH SYSTEM TEST

12-30-95 DV 6.4.1 VERIFY that interface piping (hose, fittings, pressure gauge, flowmeter, etc.) listed in Section 4.1, **TOOLS, EQUIPMENT, AND SUPPLIES**, is installed between AN farm raw water supply, SW-V-129, and water flush piping inlet valve, WST-V-183.

DV 12-30-95 6.4.2 VERIFY the following valve configuration. See Figure 7 for sketch.

Note: Switches WST-HS-140G, WST-HS-141G, and WST-HS-142G operate respectively valves WST-SOV-140G, WST-SOV-141G, and WST-SOV-142G.

INITIAL VALVE LINEUP

SW-V-129	CLOSED	DV	WST-V-183	OPEN	DV
WST-SOV-140G	ENERGIZED (CLOSED)	DV	WST-SOV-141G	ENERGIZED (CLOSED)	DV
WST-SOV-142G	ENERGIZED (CLOSED)	DV	V-VAC-BREAKER	CLOSED	DV

DV 11-30-95 6.4.3 **RECORD** the following:

Reading on flow totalizer, FQI-AN-1, for AN farm service water (located in the ~~242-A Evaporator~~ 5-11079 AN service water bldg.). YHF 11/17/95

FQI-AN-1 total ~~511020~~ 511079 gallons (DV 11-17-95)

Reading on the flowmeter/totalizer located in the water flush system piping (see Figure 7). DV-12-5-95

Total 0 gallons 11-30-95 DV 115.8 DV 12-5-95 128.6 gal

Note: Flush the mixer pump inlet screen first.

DV 11-30-95 6.4.4 **DE-ENERGIZE** (OPEN) WST-SOV-142G.

DV 11-30-95 6.4.5 **OPEN** SW-V-129.

DV 11-30-95 6.4.6 **START** stopwatch.

DV 11-30-95 6.4.7 After about 1 minute, **RECORD** system pressure from calibrated pressure gauge. 11-30-95 108

Water pressure while flushing inlet screen 95 LB 122.3 12-5-95 DV 106 PSI

DV-11-30-95 6.4.8 After approximately 4 minutes have elapsed, **ENERGIZE** (CLOSE) WST-SOV-142G.

DV-11-30-95 6.4.9 **STOP** stopwatch. **RECORD** time elapsed below.

DV-11-30-95 Time Elapsed - Inlet Screen Flush ~~3:45~~ (DV 11-17-95) 4:00 11-30-95 1:00

6.4.10 **RECORD** the following:

1st run 12-5-95 1:00 DV 2nd run 12-5-95 13:33 DV

Reading on flow totalizer, FQI-AN-1, for AN farm service water (located in the ~~242-A Evaporator~~ 5-11106 AN service water bldg). YHF 11/17/95

FQI-AN-1 total ~~511057~~ (DV 11-17-95) gallons

Reading on the flowmeter/totalizer located in the water flush system piping (see Figure 7).

witnessed data obtained on 11-30-95 PHD QC

witnessed data obtained 12-5-95 again WD 12-5-95

DV - 11-30-95 Total 8 18 gallons 1st run 12-5-95 135.750 DV 2nd run 12-5-95 180.05 gal 11/30/95 122.3 gallons

✓ 6.4.11 RECORD pressure shown on the calibrated pressure gauge.

Service Water Pressure to Flush System 98 psig 11/30/95 108 PSIG

DV - 11-30-95 Note: Flush one pump discharge nozzle.

✓ 6.4.12 DE-ENERGIZE (OPEN) WST-SOV-141G.

DV - 11-30-95 ✓ 6.4.13 START stopwatch. 12-5-95 Start of 2nd run DV 193.8 gallon

DV ✓ 11-30-95 6.4.14 RECORD pressure shown on calibrated pressure gauge.

Water pressure while flushing 98 psig 11/30/95 101 psig 12-5-95 108 psig DV

DV - 11-30-95 ✓ 6.4.15 After 30 seconds have elapsed, ENERGIZE (CLOSE) WST-SOV-141G.

DV - 11-30-95 ✓ 6.4.16 STOP stopwatch. RECORD time elapsed below. 11/30/95 1:00

Time Elapsed - Nozzle Flush 35 SEC

DV - 11-30-95 ✓ 6.4.17 RECORD the following: 1st run 12-5-95 3:00 2nd run 12-5-95 5:00 DV

Reading on flow totalizer, FQI-AN-1, for AN farm service water (located in ~~242-A Evaporator~~ AN service water bldg.). DOE 11/17/95

FQI-AN-1 total 5111 49 gallons

Reading on the flowmeter/totalizer located in the water flush system piping (see Figure 7).

Total 59 gallons 11/30/95 124.7 gallons

DV - 11-30-95 ✓ Note: Flush the other pump discharge nozzle. 1st run 12-5-95 183.4 gal 2nd run 12-5-95 201.8 gal DV

DV - 11-30-95 ✓ 6.4.18 DE-ENERGIZE (OPEN) WST-SOV-140G.

DV - 11-30-95 ✓ 6.4.19 START stopwatch.

DV - 11-30-95 6.4.20 RECORD pressure shown on calibrated pressure gauge.

DV - 11-30-95 ✓ Water pressure while flushing 98 psig 11/30/95 101 psig 12-5-95 106 psig DV

DV - 11-30-95 ✓ 6.4.21 After 30 seconds have elapsed, ENERGIZE (CLOSE) WST-SOV-140G.

DV - 11-30-95 ✓ 6.4.22 STOP stopwatch. RECORD time elapsed below. 11/30/95 1:00 12-5-95 3:00 DV

Time Elapsed - Nozzle Flush 30 SEC

Witness' Data Obtained 11-30-95 DV PAW

DV-11-30-95

6.4.23 RECORD the following:

Reading on flow totalizer, FQI-AN-1, for AN farm service water (located in ~~242-A Evaporator~~ AN service water bldg. dat 11/17/95

FQI-AN-1 total 5711559 gallons

Reading on the flowmeter/totalizer located in the water flush system piping (see Figure 7). 12-5-95

Total 59 gallons 193.8 gal 11/30/95 12846 gallons

Note: The following steps prepare for hose detachment.

DV-11-30-95 6.4.24 CLOSE AN farm water supply valve, SW-V-129.

DV-11-30-95 6.4.25 DE-ENERGIZE WST-SOV-140G, WST-SOV-141G and WST-SOV-142G. VERIFY the following valve configuration.

VALVE LINEUP AT BEGINNING OF HOSE DETACHMENT PROCEDURE

SW-V-129	CLOSED	DV	WST-V-183	OPEN	DV
WST-SOV-140G	DE-ENERGIZED (OPEN)	DV	WST-SOV-141G	DE-ENERGIZED (OPEN)	DV
WST-SOV-142G	DE-ENERGIZED (OPEN)	DV	V-VAC-BREAKER	CLOSED	DV

DV 11-30-95 6.4.26 RECORD pressure shown on the calibrated pressure gauge.

Flush System Pressure 0 psig 8 psig 11/30/95 12-5-95 0 psig

Note: The following step breaks the vacuum on the upper portion of the water flush system. Opening valve V-VAC-BREAKER, located at the piping's highest elevation, will allow air to rush in thru the vacuum breaker and relieve backpressure in the flush system, with the result that water in the above-ground piping will drain into the tank.

DV-11-30-95 6.4.27 OPEN valve V-VAC-BREAKER.

DV 11-30-95 6.4.28 After sufficient time for the water to drain, CLOSE valves V-VAC-BREAKER and WST-V-183.

DV-11-30-95 6.4.29 VERIFY that the pressure shown on the calibrated pressure gauge is approximately 0 psig. 4 psig 11-30-95 12-5-95 0 psig

DV-11-30-95 6.4.30 DETACH and set aside interface piping installed between raw water supply, SW-V-129, and water flush inlet piping.

Witnessed Data Obtained 11-30-95 QA/QC

6.5 MIXER PUMP "BUMP" TEST

The purpose of this test is to verify that the mixer pump operates. This will be confirmed by a brief test run of the pump.

DV 12-5-95 6.5.1 **OBTAIN VERBAL CONFIRMATION** that Iowa State engineers have ultrasonic transducer equipment set-up in 241-AN-271 and have acquired their baseline data. (Contact: Rich Hand, WHC Retrieval Eng.)

DV-12-5-95 6.5.2 **RECORD** waste temperatures from selector switch WST-SS-107A, Positions 2 thru 19 (located in 241-AN-271):

Position 2	95 °F	Position 11	96 °F
Position 3	98 °F	Position 12	96 °F
Position 4	98 °F	Position 13	96 °F
Position 5	96 °F	Position 14	96 °F
Position 6	96 °F	Position 15	96 °F
Position 7	96 °F	Position 16	96 °F
Position 8	96 °F	Position 17	96 °F
Position 9	96 °F	Position 18	93.5 °F
Position 10	96 °F	Position 19	93 °F

DV 12-5-95 6.5.3 **RECORD** baseline values for the following:

Tank AN-107 primary tank pressure -2.0
Read red pen on chart recorder. (WST-PR-107)

AN farm primary stack flowrate .15
(DPI-28)

AN farm primary stack NH_3 concentration 50 ppm
(requires an Industrial Hygenist) 0% LEL

DV-12-5-95 6.5.4 **ENSURE** electrical systems are powered up in accordance with the procedure of Section 5.7.

DV-12-5-95 6.5.5 Prepare to **VIEW AND RECORD** the mixer pump operation with the in-tank video camera.

DV 12-5-95 6.5.6 **PRESS AND RELEASE** the VFD S.T.O.P. HAND pushbutton and verify that the S.T.O.P. screen indicates "S.P. 0000.00".

DV-12-5-95 6.5.7 **ROTATE** the turntable via jog switch SW1 to approximately 90.00 as indicated on the TB-2A position controller display.

DV-12-5-95 6.5.8 On the MIXER PUMP "BUMP" TEST DATA SHEET, **RECORD** baseline values for mixer pump strain, vibration, and motor temperature as shown on TB-1A. **RECORD** motor moisture

indication as indicated on ANN-008. (Record 0 for motor speed, power, and current)

Note: The water flush system solenoid valves close when energized. The valves should always be shut during mixer pump operation as they provide an extra barrier against waste backflow. See Figure 7.

DV-12-5-95 6.5.9 **ENERGIZE** (CLOSE) solenoid valves WST-SOV-140G, WST-SOV-141G, and WST-SOV-142G.

NOTE: The following steps prepare the VFD for mixer pump start with an operating speed of 400 rpm.

DV-12-5-95 6.5.10 **PRESS AND RELEASE** the VFD S.T.O.P. OFF pushbutton.

DV 12-5-95 6.5.11 **PRESS AND RELEASE** the VFD S.T.O.P. SPEED SET pushbutton.

DV 12-5-95 6.5.12 **PRESS AND RELEASE** the VFD S.T.O.P. 10S pushbutton.

DV-12-5-95 6.5.13 **PRESS AND HOLD** the VFD S.T.O.P. UP ARROW pushbutton until the screen indicates "S.T. 0400.00".

DV-12-5-95 6.5.14 **PRESS AND RELEASE** the VFD S.T.O.P. SPEED pushbutton and verify that the VFD S.T.O.P. indicates "S.P. 0000.00".

DV-12-5-95 6.5.15 **VERIFY** that all VFD S.T.O.P. LED's are off.

NOTE: This test is a "bump" and therefore of short duration (approximately 30 seconds). **READ AND PREPARE FOR THE NEXT 9 STEPS BEFORE CONTINUING THE PROCEDURE.**

NOTE: Operating limits have been programmed into the mixer pump strain, vibration, and motor temperature digital indicators. The values are given in Appendix A. If limits are exceeded, interlocks will shut off the pump and alarms located in ANN-008 will annunciate. If limits are exceeded, record on a TEST EXCEPTION sheet.

DV-12-5-95 6.5.16 **START** stopwatch.

DV-12-5-95 6.5.17 **PRESS AND RELEASE** the VFD S.T.O.P. HAND pushbutton and verify that the S.T.O.P. screen value increases from "S.P. 0000.00" to "S.P. 0400.00".

DV-12-5-95 6.5.18 **VERIFY** the VFD S.T.O.P. RUN LED is illuminated.

DV-12-5-95 6.5.19 **PRESS AND RELEASE** the VFD S.T.O.P. M AMPS pushbutton. Record this value on the MIXER PUMP "BUMP" TEST DATA SHEET

DV-12-5-95 6.5.20 **PRESS AND RELEASE** the VFD S.T.O.P. KILOWATTS pushbutton. Record this value on the MIXER PUMP "BUMP" TEST DATA SHEET

DV-12-95 6.5.21 Record the values of mixer pump strain, vibration, and motor temperature on the MIXER PUMP "BUMP" TEST DATA SHEET.

DV-12-5-95 6.5.22 PRESS AND RELEASE the VFD S.T.O.P. OFF pushbutton.

DV-12-5-95 6.5.23 VERIFY the VFD S.T.O.P. indicates "S.P. 0000.00".

DV-12-5-95 6.5.24 STOP stopwatch. RECORD time elapsed below.

Duration of mixer pump operation 47 sec.

DV-12-5-95 6.5.25 PUSH IN the WST-VFD-107 EMERGENCY STOP push-pull operator on the mixer pump 75 HP VSD cabinet.

DV-12-5-95 6.5.26 DE-ENERGIZE solenoid valves WST-SOV-140G, WST-SOV-141G, and WST-SOV-142G.

DV-12-5-95 6.5.27 On the MIXER PUMP "BUMP" TEST DATA SHEET, RECORD the values of mixer pump strain, vibration, and motor temperature shown on TB-1A. RECORD motor moisture indication as indicated on ANN-008. (Record 0 for motor speed, power, and current)

DV-12/5/95 6.5.28 RECORD values for the following:

Tank AN-107 primary tank pressure. -2.0 Read red pen on chart recorder. (WST-PR-107)

Tank AN-107 peak primary tank pressure during pump bump Read red pen on chart recorder. (WST-PR-107) -2.0

AN farm primary stack NH_3 concentration 50 ppm (requires an Industrial Hygenist)

DV-12-5-95 6.5.29 OPEN all breakers in EDS-DP-108 panelboard, except for:

- Main Breaker
- CKT #8: WST-XFMR-107 15 KVA Transformer

DV-12-5-95 6.5.30 OPEN all breakers in EDS-DP-109 panelboard, except for:

- Main Breaker
- CKT #6: Camera Equipment, Building 241-AN-274
- CKT #8: Camera Equipment - Field

DV-12-5-95 CKT#11 And CKT#12 open Also 12/5/95 6.5.31 ENSURE building 241-AN-274 is returned to a safe and stable state before ending test.

MIXER PUMP "BUMP" TEST DATA SHEET DATE 12-5-95

5N-HAZLETON TYPE "SSB/MIXING" PUMP, SERIAL NO. N-20801

Time / Recorder Initials	Motor Speed (rpm)	Motor Power (kW)	Motor Current (amps)	Pump Vibration (in/s)	Motor Temp. (°F)	Strain / Unbalance Load (lb)	Motor Moisture (yes/no)
11:20/GAL	0	0	0	0.27	106.2	-34	NO
11:22/GAL CLK	399.9	1.3	22.3	OVER LIMIT *	106.4	-35	NO
11:23/GAL CLK	0	0	0	0.27	106.3	-34	NO

1. Tank 241-AN-107 estimated specific gravity = 1.4.

Data Recorders: Print name, Sign name, Date

GA Leshikar GA Leshikar 12-5-95

CL Kearney CL Kearney 12-5-95

Pump Cognizant Engineer GA Leshikar 12-5-95

Test Director 12-5-95

QC Paul M Weiss 12-5-95

* See exception #1
PAW
12-5-95

APPENDIX A - MIXER PUMP OPERATING CRITERIA

MIXER PUMP OPERATING CRITERIA

Below is the expected operating range and limiting values for instrumentation when the mixer pump operates in Tank AN-107:

Parameter	Expected Operating Range	Limits / Comments
Pump Motor Current M AMPS	0-89 amps	89 amps [1]
Pump Vibration TB-1A DI-2	< 0.28 in/sec	0.65 in/sec [2]
Motor Power KILOWATTS	0-53.9 kW (72 HP)	55.9 kW [3] (75 HP)
Pump Motor Temperature TB-1A DI-3	50-200°F	240°F [4]
Pump Support Column Unbalanced Load TB-1A DI-1	< 100 lb	± 2000 lb
Moisture (motor) ANN-008	None	Any moisture reading is cause for concern

1. Full load amperage of 89 amps does not include 1.15 motor service factor.
2. Velocity value of 0.28 in/s corresponds to displacement of 3 mil. Limit value of 0.65 in/s is dictated by start/stop acceleration/deceleration of the large cantilevered pump mass by the 1HP turntable rotation motor.
3. The pump was designed for fluid with specific gravity of 1.4. If waste sp gr > 1.4, then operation at 100% speed (1800 rpm) could result in motor horsepower exceeding limit.
4. The heat load from the mixer pump to the waste will be a maximum of 3183 BTU/min. (equivalent to 75 HP).

APPENDIX B - TEST EXCEPTION SHEET

(Copy as Needed)

EXCEPTION SHEET NUMBER _____

Procedure Step: _____ Make copies of this page as necessary.

Description of Problem:

SEE APPENDIX B
of WHC-SD-WM-ATR-155

Exception Resolution:

Test Director _____

AN Tank Farm Cognizant Engineer _____

QA/QC _____

Note: Safety and Equipment Cognizant Engineer signatures may not be required per AN Tank Farm Cognizant Engineer's direction, N/A space if not applicable.

Equipment Cognizant Engineer _____

Safety _____

APPENDIX C - TEST EXECUTION/APPROVAL SHEET

TEST EXECUTION/APPROVAL SHEET

WHC-SD-WM-ATP-155

Signature below indicates concurrence with the following:

- The objectives delineated in Section 1.3 of this procedure have been achieved.
- All recorded test exceptions have been resolved, the resolutions approved, and any necessary retesting completed.

Approved by:

Test Director _____ 12-18-95

AN Tank Farm Cognizant Engineer _____ 12/18/95

AN Tank Farm Cognizant Manager _____ 12/21/95

Quality Assurance _____ 4/17/96
J. VERDERBER

APPENDIX B

Test Exceptions

EXCEPTION SHEET NUMBER 1

Procedure Step: 6.5.21 Make copies of this page as necessary.

Description of Problem:

Pump vibration indication exceeds limit (0.65 in/s) when the mixer pump is operated. Also, the at-rest vibration indication is approximately 0.27 in/s instead of the anticipated 0.0 in/s.

Note: To facilitate troubleshooting, the lead from the vibration monitor to mixer pump interlock was lifted to prevent automatic mixer pump shutdown due to vibration overscale.

Exception Resolution:

All attempts to obtain "good" data from the vibration instrumentation failed. The resolution is to reject and not use the faulty mixer pump vibration data. The impact to the Caustic Addition Project is the possible loss of forewarning to excessive pump vibration which could lead to premature bearing wear and equipment failure. Note that vibration indication can not prevent mixer pump failure. There is no impact to tank safety.

Suspected Causes: The at-rest (mixer pump not operating) indication of 0.27 in/s is suspected to be caused by a ground loop circuit, which can be difficult to find. Accelerometers are relatively sensitive so they may be especially prone to ground loop circuits. Electromagnetic interference from the mixer pump variable frequency drive (VFD) is suspected to play a role during pump operation. After the variable frequency drive starts the pump,

EXCEPTION SHEET NUMBER 1

Procedure Step: 6.5.21 Make copies of this page as necessary.

the vibration reading bounces around between 0.0 and 0.5 in/s before it shoots off-scale.

History: Falsely high vibration readings during VFD operation were first noted during shop testing (see WHC-SD-WM-TRP-222), where it was proven that actual pump vibration levels were the same whether run with VFD or 'across-the-line' (no VFD). After extensive troubleshooting and discussions with technical experts, it was theorized that VFD-induced electromagnetic interference due to the power cable's close proximity to the vibration cable was source of the falsely high vibration readings. To attempt to solve the problem, the existing vibration cable was cut off where it exited the mixer pump rotational turntable and left in the pump column. A new vibration cable was attached to the accelerometer (see WHC-SD-WM-ATR-144) and run entirely outside the column. Unfortunately, both time and funding constraints prevented a mixer pump run-in retest. The vibration equipment was tested for continuity and response (hit pump with hammer and verified that needle on vibration analyzer moved), however that did not conclusively proven that the problem was solved.

Test Director [signature]

AN Tank Farm Cognizant Engineer [signature]

QA/QC E.N. WEGENER E.N. Wegener 3-4-96

Note: Safety and Equipment Cognizant Engineer signatures may not be required per AN Tank Farm Cognizant Engineer's direction, N/A space if not applicable.

Equipment Cognizant Engineer [signature] 3/4/96

Safety N/A

EXCEPTION SHEET NUMBER 2

Procedure Step: 6.5.21 Make copies of this page as necessary.

Description of Problem:

Operation of the mixer pump variable speed controller causes interference to the in-tank video camera image. Analysis of the camera system power supply and S-VHS signal was performed at the camera master control location. The camera power supply showed large amplitude spikes (noise) on both the neutral and ground leads, and also being radiated from the motor controller. However, temporarily changing the camera power to an independent supply produced no noticable improvement. Isolation and separation of the AC supply and camera cables at the master control location also produced no noticable improvement. On the S-VHS waveform the sync pulses are clean (interference free) and the noise is in the signal components only, this indicates the interference is added prior to processing which takes place at the local control console. It now seems likely that the problem is caused by noise from the power supply to the camera system lights being inductively transferred to the video cable between the local control console and the camera.

Exception Resolution:

The image distortion is not severe. The image is acceptable for monitoring deflection of the thermocouple tree during the mixer pump OTP. This exception can be closed out for purposes of acceptance of the 75 hp mixer pump field ATP. Resolution of this problem will take place during performance of the mixer pump OTP.

Test Director _____

AN Tank Farm Cognizant Engineer _____

75 HP MIXER PUMP FIELD ACCEPTANCE

EXCEPTION SHEET NUMBER 2

Procedure Step: 6.5.21 Make copies of this page as necessary.

QA/QC E.N. WEGENER E.N. Wegener 3-4-96

Note: Safety and Equipment Cognizant Engineer signatures may not be required per AN Tank Farm Cognizant Engineer's direction, N/A space if not applicable.

Equipment Cognizant Engineer R.D. Gadwin

Safety N/A

5.0 PRE-TEST CHECKS

The Test Director shall initial and date the space provided after performance of each step, unless otherwise noted.

LR 2-15-96 5.1 A pre-job ATP meeting has been conducted with the test participants.

LR 2-15-96 5.2 **VERIFY** that all safety requirements, radiation and contamination control requirements, instrument calibrations, tools, and other prerequisites of this procedure have been met.

N/A KHC 2/15/96 5.3 Visually **VERIFY** that there is no damage to any external electrical cables in the central pump pit.

N/A KHC 2/15/96 5.4 **VERIFY** that labels on the mixer pump turntable and flange, and within the pump pit conform with those shown on H-2-85573, Sheets 6 and 16 (ECN 621953).

COG ENGINEER _____

N/A KHC 2/15/96 5.5 **OBTAIN VERBAL CONFIRMATION** that Iowa State engineers have ultrasonic transducer equipment installed in 241-AN-271. (Contact: Rich Hand, WHC Retrieval Eng.)

LR 2-15-96 5.6 **ENSURE** the WST-VFD-107 EMERGENCY STOP push-pull operator on the mixer pump 75 HP VSD cabinet is pushed **IN**.

5.7 The following subsection is the procedure for powering up the mixer pump and the 241-AN-274 building electrical equipment.

LR 2-15-96 5.7.1 **ENSURE** the WST-VFD-107 EMERGENCY STOP push-pull operator on the west exterior wall of the 241-AN-274 building is pulled **OUT**.

LR 2-15-96 5.7.2 **ENSURE** the WST-VFD-107 EMERGENCY STOP push-pull operator on the safety switch rack by pump pit 241-AN-07A is pulled **OUT**.

LR 2-15-96 5.7.3 **ENSURE** switch WST-DS-116, 75 HP MOTOR DISCONNECT SWITCH, located on the safety switch rack by pump pit 241-AN-07A is **CLOSED**.

LR 2-15-96 5.7.4 **ENSURE** switch WST-DS-115, located on the safety switch rack by pump pit 241-AN-07A is **CLOSED**.

LR 2-15-96 5.7.5 **ENSURE** disconnect switch EDS-DS-114, located on the south exterior wall of the 241-AN-271 instrument building is **CLOSED**.

J.R 2-15-96 5.7.6 **ENSURE** the following breakers in panelboard EDS-DP-108 are **CLOSED**.

- Main Breaker
- CKT #1: WST-VFD-107 Variable Frequency Drive 75 HP Motor
- CKT #2: WST-M-107 Rotation 1 HP Motor
- CKT #8: WST-XFMR-107 15 KVA Transformer

J.R 2-15-96 5.7.7 **ENSURE** the following breakers in panelboard EDS-DP-109 are **CLOSED**.

- Main Breaker
- CKT #1: TB-1A Mixer Pump Instrumentation Cabinet
- CKT #2: TB-2A 1 HP Position Controller Cabinet
- CKT #4: ANN-008 and ANN-009 Annunciator Panels
- CKT #6: Camera Equipment, Building 241-AN-274
- CKT #7: Building 241-AN-274 Indoor Receptacles
- CKT #8: Camera Equipment - Field
- CKT #9: Building 241-AN-274 GFI Outdoor Receptacle
- CKT #10: Camera Equipment Rack GFI Receptacle
- CKT #11: Building 241-AN-274 Lights
- CKT #12: Building 241-AN-274 Heater/Air Conditioner

NOTE: S.T.O.P. stands for SoftTouch Operator Panel. S.T.O.P. is the Eaton Corp. Variable Frequency Drive operater interface. See CVI 22570 for more information.

J.R 2-15-96 5.7.8 **PULL OUT** the WST-VFD-107 EMERGENCY STOP push-pull operator on the mixer pump 75 HP VSD cabinet.

J.R 2-15-96 5.7.9 **PRESS AND RELEASE** the WST-VFD-107 S.T.O.P. OFF button.

J.R 2-15-96 5.7.10 **PRESS AND RELEASE** the WST-VFD-107 S.T.O.P. SPEED SET pushbutton.

J.R 2-15-96 5.7.11 **PRESS AND RELEASE** the WST-VFD-107 S.T.O.P. 10S pushbutton.

J.R 2-15-96 5.7.12 **PRESS AND HOLD** the WST-VFD-107 S.T.O.P. DOWN ARROW until the S.T.O.P. screen indicates "S.T. 0000.00".

J.R 2-15-96 5.7.13 **PRESS AND RELEASE** the WST-VFD-107 S.T.O.P. SPEED pushbutton and verify that the S.T.O.P. screen indicates "S.P. 0000.00".

_____ 6.3.6 **VERIFY** that ANN-008 alarm LED is flashing and audible horn is operating.

_____ 6.3.7 **ACKNOWLEDGE and RESET** Beta Products annunciator, ANN-008.

NOTE: The AN-107 High Pressure alarm and interlock will be tested by temporarily lifting a lead in 241-AN-274 building.

_____ 6.3.8 **PRESS AND RELEASE** the VFD S.T.O.P. OFF pushbutton.

_____ 6.3.9 **PRESS AND RELEASE** the VFD S.T.O.P. HAND pushbutton and verify that the S.T.O.P. screen indicates "S.P. 0000.00".

N/A KJC 2/15/96

_____ 6.3.10 **VERIFY** the VFD S.T.O.P. RUN LED is illuminated.

_____ 6.3.11 **"LIFT"** ANN-107-2 inside TBX-AN-2C terminal TB4-1 from the Tank 107-AN High Pressure alarm.

_____ 6.3.12 **VERIFY** that VFD S.T.O.P. RUN LED is off.

_____ 6.3.13 **VERIFY** that ANN-008 alarm LED is flashing and audible horn is operating.

_____ 6.3.14 **"RE-ATTACH"** ANN-107-2 inside TBX-AN-2C terminal TB4-1 to the Tank 107-AN High Pressure alarm.

_____ 6.3.15 **ACKNOWLEDGE and RESET** Beta Products annunciator, ANN-008.

6.4 MIXER PUMP WATER FLUSH SYSTEM TEST

J.R 2-15-96 6.4.1 **VERIFY** that interface piping (hose, fittings, pressure gauge, flowmeter, etc.) listed in Section 4.1, **TOOLS, EQUIPMENT, AND SUPPLIES**, is installed between AN farm raw water supply, SW-V-129, and water flush piping inlet valve, WST-V-183.

J.R 2-15-96 6.4.2 **VERIFY** the following valve configuration. See Figure 7 for sketch.

Note: Switches WST-HS-140G, WST-HS-141G, and WST-HS-142G operate respectively valves WST-SOV-140G, WST-SOV-141G, and WST-SOV-142G.

INITIAL VALVE LINEUP

SW-V-129	CLOSED	✓	WST-V-183	OPEN	✓
WST-SOV-140G	ENERGIZED (CLOSED)	✓	WST-SOV-141G	ENERGIZED (CLOSED)	✓
WST-SOV-142G	ENERGIZED (CLOSED)	✓	V-VAC-BREAKER	CLOSED	✓

J.R 2-15-96

6.4.3 **RECORD** the following:

Reading on flow totalizer, FQI-AN-1, for AN farm service water ~~(located in the 242-A Evaporator)~~. KJC 2/15/96

FQI-AN-1 total 513997 gallons

Reading on the flowmeter/totalizer located in the water flush system piping (see Figure 7).

Total 201.0 (1st) gallons 226 (2nd)

Note: Flush the mixer pump inlet screen first.

J.R 2-15-96 6.4.4 **DE-ENERGIZE** (OPEN) WST-SOV-142G.

J.R 2-15-96 6.4.5 **OPEN** SW-V-129.

J.R 2-15-96 6.4.6 **START** stopwatch.

J.R 2-15-96 6.4.7 After about 1 minute, **RECORD** system pressure from calibrated pressure gauge.

Water pressure while flushing inlet screen 135 (1st) 130 (2nd)

J.R 2-15-96 6.4.8 After approximately 4 minutes have elapsed, **ENERGIZE** (CLOSE) WST-SOV-142G.

J.R 2-15-96 6.4.9 **STOP** stopwatch. **RECORD** time elapsed below. 1st: 2 no

Time Elapsed - Inlet Screen Flush 5

J.R 2-15-96 6.4.10 **RECORD** the following:

Reading on flow totalizer, FQI-AN-1, for AN farm service water ~~(located in the 242-A Evaporator)~~. KJC 2/15/96

FQI-AN-1 total N/A gallons

Reading on the flowmeter/totalizer located in the water flush system piping (see Figure 7).

Total 306 (1ST) gallons 250.1 (2ND)

1.R 2-15-96 6.4.11 **RECORD** pressure shown on the calibrated pressure gauge.

Service Water Pressure to Flush System 135.5 (1ST; 2ND) psig

Note: Flush one pump discharge nozzle.

1.R 2-15-96 6.4.12 **DE-ENERGIZE** (OPEN) WST-SOV-141G.

1.R 2-15-96 6.4.13 **START** stopwatch.

1.R 2-15-96 6.4.14 **RECORD** pressure shown on calibrated pressure gauge.

Water pressure while flushing 133.5 (1ST) 131 (2ND) psig

1.R 2-15-96 6.4.15 After 30 seconds have elapsed, **ENERGIZE** (CLOSE) WST-SOV-141G.

1.R 2-15-96 6.4.16 **STOP** stopwatch. **RECORD** time elapsed below.

Time Elapsed - Nozzle Flush 5 (1ST; 2ND)

1.R 2-15-96 6.4.17 **RECORD** the following:

Reading on flow totalizer, FQI-AN-1, for AN farm service water ~~(located in 242-A Evaporator)~~. KJC 2/15/96

FQI-AN-1 total N/A gallons

Reading on the flowmeter/totalizer located in the water flush system piping (see Figure 7).

Total 210 (1ST) 266.2 (2ND) gallons

Note: Flush the other pump discharge nozzle.

1.R 2-15-96 6.4.18 **DE-ENERGIZE** (OPEN) WST-SOV-140G.

1.R 2-15-96 6.4.19 **START** stopwatch.

1.R 2-15-96 6.4.20 **RECORD** pressure shown on calibrated pressure gauge.

Water pressure while flushing 132 (1ST; 2ND) psig

1.R 2-15-96 6.4.21 After 30 seconds have elapsed, **ENERGIZE** (CLOSE) WST-SOV-140G.

1.R 2-15-96 6.4.22 **STOP** stopwatch. **RECORD** time elapsed below.

Time Elapsed - Nozzle Flush 5 (1ST 2ND)

75 HP MIXER PUMP FIELD ACCEPTANCE

2-15-96

6.4.23 **RECORD** the following:

Reading on flow totalizer, FQI-AN-1, for AN farm service water ~~(located in 242-A Evaporator)~~. KJC 2/15/96

FQI-AN-1 total 514072 gallons

Reading on the flowmeter/totalizer located in the water flush system piping (see Figure 7).

Total 226.2 gallons

Note: The following steps prepare for hose detachment.

2-15-96 6.4.24 **CLOSE** AN farm water supply valve, SW-V-129.

2-15-96 6.4.25 **DE-ENERGIZE** WST-SOV-140G, WST-SOV-141G and WST-SOV-142G. **VERIFY** the following valve configuration.

VALVE LINEUP AT BEGINNING OF HOSE DETACHMENT PROCEDURE

SW-V-129	CLOSED	✓	WST-V-183	OPEN	✓
WST-SOV-140G	DE-ENERGIZED (OPEN)	✓	WST-SOV-141G	DE-ENERGIZED (OPEN)	✓
WST-SOV-142G	DE-ENERGIZED (OPEN)	✓	V-VAC-BREAKER	CLOSED	✓

2-15-96 6.4.26 **RECORD** pressure shown on the calibrated pressure gauge.

Flush System Pressure 0 psig

Note: The following step breaks the vacuum on the upper portion of the water flush system. Opening valve V-VAC-BREAKER, located at the piping's highest elevation, will allow air to rush in thru the vacuum breaker and relieve backpressure in the flush system, with the result that water in the above-ground piping will drain into the tank.

2-15-96 6.4.27 **OPEN** valve V-VAC-BREAKER.

2-15-96 6.4.28 After sufficient time for the water to drain, **CLOSE** valves V-VAC-BREAKER and WST-V-183.

2-15-96 6.4.29 **VERIFY** that the pressure shown on the calibrated pressure gauge is approximately 0 psig.

2-15-96 6.4.30 **DETACH** and set aside interface piping installed between raw water supply, SW-V-129, and water flush inlet piping.

6.5 MIXER PUMP "BUMP" TEST

The purpose of this test is to verify that the mixer pump operates. This will be confirmed by a brief test run of the pump.

N/A KMC 2/15/96 6.5.1 **OBTAIN VERBAL CONFIRMATION** that Iowa State engineers have ultrasonic transducer equipment set-up in 241-AN-271 and have acquired their baseline data. (Contact: Rich Hand, WHC Retrieval Eng.)

N/A KMC 2/15/96 6.5.2 **RECORD** waste temperatures from selector switch WST-SS-107A, Positions 2 thru 19 (located in 241-AN-271):

Position 2	_____°F	Position 11	_____°F
Position 3	_____°F	Position 12	_____°F
Position 4	_____°F	Position 13	_____°F
Position 5	_____°F	Position 14	_____°F
Position 6	_____°F	Position 15	_____°F
Position 7	_____°F	Position 16	_____°F
Position 8	_____°F	Position 17	_____°F
Position 9	_____°F	Position 18	_____°F
Position 10	_____°F	Position 19	_____°F

LCR 2-15-96 6.5.3 **RECORD** baseline values for the following:

Tank AN-107 primary tank pressure ~ 2.1 "
Read red pen on chart recorder. (WST-PR-107)

AN farm primary stack flowrate N/A KMC 2/15/96
(DPI-28)

107-AN ~~farm~~ primary ventilation ~~stack~~ NH_3 flammable gas (LFL) and organic concentration 3%
(requires an Industrial Hygenist) Take measurements from the vent port in the 107-AN ventilation pit and record results on J-5. Immediately notify CFC if LFL exceeds 10 percent. NOTE: LFL will be monitored continuously and results recorded every 5 minutes on J-5 during the pump bump and for 30 minutes afterwards.
KMC 2/15/96

LCR 2-15-96 6.5.4 **ENSURE** electrical systems are powered up in accordance with the procedure of Section 5.7.

LCR 2-15-96 6.5.5 Prepare to **VIEW AND RECORD** the mixer pump operation with the in-tank video camera.

LCR 2-15-96 6.5.6 **PRESS AND RELEASE** the VFD S.T.O.P. HAND pushbutton and verify that the S.T.O.P. screen indicates "S.P. 0000.00".

LCR 2-15-96 6.5.7 **ROTATE** the turntable via jog switch SW1 to approximately 90.00 as indicated on the TB-2A position controller display.

LCR 2-15-96 6.5.8 On the MIXER PUMP "BUMP" TEST DATA SHEET, **RECORD** baseline values for mixer pump strain, vibration, and motor temperature as shown on TB-1A. **RECORD** motor moisture

indication as indicated on ANN-008. (Record 0 for motor speed, power, and current)

Note: The water flush system solenoid valves close when energized. The valves should always be shut during mixer pump operation as they provide an extra barrier against waste backflow. See Figure 7.

IR 2-15-96 6.5.9 **ENERGIZE** (CLOSE) solenoid valves WST-SOV-140G, WST-SOV-141G, and WST-SOV-142G.

NOTE: The following steps prepare the VFD for mixer pump start with an operating speed of 400 rpm.

IR 2-15-96 6.5.10 **PRESS AND RELEASE** the VFD S.T.O.P. OFF pushbutton.

IR 2-15-96 6.5.11 **PRESS AND RELEASE** the VFD S.T.O.P. SPEED SET pushbutton.

IR 2-15-96 6.5.12 **PRESS AND RELEASE** the VFD S.T.O.P. 10S pushbutton.

IR 2-15-96 6.5.13 **PRESS AND HOLD** the VFD S.T.O.P. UP ARROW pushbutton until the screen indicates "S.T. 0400.00".

IR 2-15-96 6.5.14 **PRESS AND RELEASE** the VFD S.T.O.P. SPEED pushbutton and verify that the VFD S.T.O.P. indicates "S.P. 0000.00".

IR 2-15-96 6.5.15 **VERIFY** that all VFD S.T.O.P. LED's are off.

NOTE: This test is a "bump" and therefore of short duration (approximately 30 seconds). **READ AND PREPARE FOR THE NEXT 9 STEPS BEFORE CONTINUING THE PROCEDURE.**

NOTE: Operating limits have been programmed into the mixer pump strain, vibration, and motor temperature digital indicators. The values are given in Appendix A. If limits are exceeded, interlocks will shut off the pump and alarms located in ANN-008 will annunciate. If limits are exceeded, record on a TEST EXCEPTION sheet.

IR 2-15-96 6.5.16 **START** stopwatch.

IR 2-15-96 6.5.17 **PRESS AND RELEASE** the VFD S.T.O.P. HAND pushbutton and verify that the S.T.O.P. screen value increases from "S.P. 0000.00" to "S.P. 0400.00".

IR 2-15-96 6.5.18 **VERIFY** the VFD S.T.O.P. RUN LED is illuminated.

IR 2-15-96 6.5.19 **PRESS AND RELEASE** the VFD S.T.O.P. M AMPS pushbutton. Record this value on the MIXER PUMP "BUMP" TEST DATA SHEET

IR 2-15-96 6.5.20 **PRESS AND RELEASE** the VFD S.T.O.P. KILOWATTS pushbutton. Record this value on the MIXER PUMP "BUMP" TEST DATA SHEET

LR 2-15-96 6.5.21 Record the values of mixer pump strain, vibration, and motor temperature on the MIXER PUMP "BUMP" TEST DATA SHEET.

LR 2-15-96 6.5.22 **PRESS AND RELEASE** the VFD S.T.O.P. OFF pushbutton.

LR 2-15-96 6.5.23 **VERIFY** the VFD S.T.O.P. indicates "S.P. 0000.00".

~~2-15-96~~ LR 6.5.24 **STOP** stopwatch. **RECORD** time elapsed below.

Duration of mixer pump operation 1 min x several Times

LR 2-15-96 6.5.25 **PUSH IN** the WST-VFD-107 EMERGENCY STOP push-pull operator on the mixer pump 75 HP VSD cabinet.

LR 2-15-96 6.5.26 **DE-ENERGIZE** solenoid valves WST-SOV-140G, WST-SOV-141G, and WST-SOV-142G.

LR 2-15-96 6.5.27 On the MIXER PUMP "BUMP" TEST DATA SHEET, **RECORD** the values of mixer pump strain, vibration, and motor temperature shown on TB-1A. **RECORD** motor moisture indication as indicated on ANN-008. (Record 0 for motor speed, power, and current)

LR 2-15-96 6.5.28 **RECORD** values for the following:

Tank AN-107 primary tank pressure. ~2.1"
Read red pen on chart recorder. (WST-PR-107)

Tank AN-107 peak primary tank pressure during pump bump
Read red pen on chart recorder. (WST-PR-107) ~2.1"

KJC 2/15/96 107- AN ~~farm~~ primary ventilation ~~stack~~ NH_3 flammable gas (LFL) and organic concentration
(requires an Industrial Hygenist) Record results on J-5.

N/A KJC 2/15/96 6.5.29 **OPEN** all breakers in EDS-DP-108 panelboard, except for:

- Main Breaker
- CKT #8: WST-XFMR-107 15 KVA Transformer

N/A KJC 2/15/96 6.5.30 **OPEN** all breakers in EDS-DP-109 panelboard, except for:

- Main Breaker
- CKT #6: Camera Equipment, Building 241-AN-274
- CKT #8: Camera Equipment - Field
- CKT #1 • CKT #11 • CKT #12 KJC 2/15/96

LR 2-15-96 6.5.31 **ENSURE** building 241-AN-274 is returned to a safe and stable state before ending test.

75 HP MIXER PUMP FIELD ACCEPTANCE

MIXER PUMP "BUMP" TEST DATA SHEET

DATE 2-15-96

5N-HAZLETON TYPE "SSB/MIXING" PUMP, SERIAL NO. N-20801

Time / Recorder Initials	Motor Speed (rpm)	Motor Power (kW)	Motor Current (amps)	Pump Vibration (in/s)	Motor Temp. (°F)	Strain / Unbalance Load (lb)	Motor Moisture (yes/no)
1455 TJR	0	0	0	.26	107.7	-35	No
1545 TJR	400	1.3 RZ-TJR	22.1	OVERSCALE	106.0	-22	No
16:20 MAL	400	1.3	22.6	overscale	107.6	-23	NO

1. Tank 241-AN-107 estimated specific gravity = 1.4.

Data Recorders: Print name, Sign name, Date

James L. Ross JLR 2-15-96 K.J. Carlson 2/15/96

G.A. Leshikar 2-15-96

Pump Cognizant Engineer G.A. Leshikar

Test Director James L. Ross

APPENDIX C

Test Log

Test Log		Recorder: GA Leshikar
Date	Step #	Comments
10/26/95	6.1.6	Problem: Circuit breaker instantaneously shuts down the 1 HP rotation motor when Jog Switch SW1 is activated. Resolution: Circuit breaker is dial type, 3 amp rating, instantaneous trip. Motor amperage approximately 2 amps. Note that instantaneous type breaker is not optimal for motor start-up current. Dial was turned down too low so motor instantly tripped out. Per NEC 430-52, Part A, Exception (pg. 70-406), it is permissible to dial circuit breaker up to 1100% of full load amps. Attempted at 700%, breaker still tripped. Attempted at 900%, no breaker trip. Will keep at new setting.
10/27/95	6.1.6	Problem: 1 HP rotation motor makes loud "clacking" noise when energized. Resolution: Rotation motor is vertically mounted, Totally Enclosed Fan Cooled (TEFC) type, with fan on top which is covered by a cylindrical sheet metal guard. After watching personnel balance themselves while "clambering" over obstacles in the crowded pit, my suspicion is that someone applied a bit too much hand pressure to the sheet metal fan guard on top the motor and slightly "dented" in the guard. The fan blades then were contacting metal which accounted for the loud "clacking" noise. Fixing the problem was a simple matter of the electrician partially removing the fan guard and "denting" it back to it original configuration.
10/27/95		The bar (gear locking device) used by Hazleton to lock the pump turntable in place during transit has been taped to a piece of unistrut on the pit wall.
10/27/95	6.2	The Iowa State / Ames Laboratory engineer took ultrasonic transducer data. Apparently it was disappointing. He will take the data back to Ames for detailed analysis and return later to obtain new baseline data.
10/30/95		All mixer pump instruments calibrated except for vibration monitor. Vibration monitor is giving "out-of-range" signal. Need to troubleshoot.

Test Log		Recorder: GA Leshikar
Date	Step #	Comments
11/17/95	6.2	The Iowa State / Ames Laboratory engineer, Lance, returned with new equipment to take more ultrasonic transducer data today. The new data turned out to be inconsistent. Sometimes the returns showed that the signals penetrated the waste a good distance and other times the returns showed nothing. Lance thinks that he has a faulty amplifier. He plans to return again to take more data, hopefully before the mixing test commence.
11/17/95	6.4.3	Engineer, GA Leshikar, insists that AN farm raw water meter / flow totalizer, FQI-AN-1, outputs a signal to the 242-A Evaporator for indication. This is supported by drawings H-2-71944, H-2-71968, and H-14-021801. PIC - DW Vandyke, tank farm maintenance crew (i.e. people who have been in the water service pit), and Evaporator shift manager insist that AN farm raw water meter is local indication only. ?
11/17/95	6.4	Problem: Solenoid valves are not closing properly. Description: When the mixer pump's water flush system is pressurized and all 3 solenoid valves are closed, there should be no water flow into AN-107. Readings taken from both the AN farm raw water flow totalizer and the temporary in-line flow totalizer indicated that there was flush water flow into the tank even though all 3 solenoid valves were energized (closed). Flowrate was approximately 8 gpm, no matter whether the solenoid switches were on or off.
11/20/95	6.4	Solenoid valve troubleshooting: It was quickly discovered that the switches for the solenoids, mounted on the electrical cabinet door, were not wired. Therefore the solenoid valves could not be energized which explains why flush water flowrate was unchanging no matter if the switches were on or off.

Test Log		Recorder: GA Leshikar
Date	Step #	Comments
11/21/95		Reason for vibration monitor "out-of-range" signal was determined (with pump at rest). Wiring was corrected, however, the vibration monitor shows an "at-rest" reading of 0.27 in/s. Reason: As discovered in the shop tests of the mixer pump, the Hazleton-supplied mixer pump instrumentation was consistently wired strangely in that one conductor and the shield were used to transmit sensor signals. When the vibration cable was replaced in July '95, the electrician connected the cable leads to the accelerometer according to normally accepted practice, which is to use two conductors to transmit sensor signals and attach the shield for grounding purposes. Because this wiring is also grounded at the instrument cabinet, a current loop was apparently created which affected the sensors output. The solution was to remove the instrument cabinet ground. None of this was necessary with the other mixer pump instrumentation since it still uses the one conductor and shield configuration.
11/30/95	6.4	Water flush system test performed again. System worked as advertised. Solenoid valves operated properly.
12/5/95	6.5	Mixer pump bump performed. Test Exceptions were written for vibration indicator overscale and for video monitor "snow" (images from the in-tank camera) when the VFD operated the mixer pump. Camera video was recorded on a VCR tape.
1/10/96	6.2	Professor Martin from Iowa State / Ames Laboratory was able to fix the ultrasonic test equipment. He then obtained baseline data at 10° increments thru the defined 167° mixing range.
2/15/96=	6.5	Troubleshooting performed on vibration indicator overscale and video monitor "snow" exceptions. Neither problem was solved. Some recourse may be possible for the "snow" problem but no recourse for the faulty vibration indication problem.

APPENDIX D

Calibration Data

Add = A
Modify = M
Delete = D

1. Action: A

CBRS INPUT FORM

HNF WHC-SD-WM-ATR-155 Rev.0 Page D-2

3. Facility	4. Loop No.	5. Seq.	6. Component Identification
ET	AN	2	VM1

8. System No.	9. Safety Class	10. Application Code
241AN	3	E

11. Function Description: Mixer Pump Vibration Monitor

12. Engineering Dwg. No.	13. Sheet	14. Co-ord	15. Assoc. Loop	16. Oper Mode	17. Craft Code
H-2-85573	27	B03	None	AA	18

Recall

19. Status	20. Type
A	1

21. Verification Interval: 12

22. Next Due Date: 1095

18. Instructions: All input signals to be at a frequency of 61.4 Hz., See CVI 22528, for more information.

23. Reason: Instrument needs to be calibrated prior to performance of Mixer Pump ATP.

24. Cognizant Engineer	Date	25. Cognizant Engineer Manager	Date
	/ /		/ /
26. Environmental Assurance	Date	27. VCA	Date
	/ /		/ /
28. Quality Assurance	Date	29. Industrial Health, Safety and Fire Protection	Date
	/ /		/ /
30. Manufacturer: Scientic-Atlanta		31. Other	Date / /

32. Model	33. Serial No.	34. Comp Type	35. Function Code
M25-41-2-15-85	348	01	01

36. Bldg. No.	37. Room No.	38. Location	39. Procedure*
AN-274	N/A	Inst Rack	N/A

40. Input Low	41. Input High	42. Input Units	43. Tol (%)
0.00	70.70	mV rms	1.0

44. Maintenance Proc.	45. Output Low	46. Output High	47. Output Units	48. Tol (%)
None	4.00	20.00	mA	4.0

49. OSD No.	50. Condition

51. No. Cal Pts.	52. Ck. Pt. No.1	53. Ck. Pt. No.2	54. Ck. Pt. No.3	55. Ck. Pt. No.4	56. Ck. Pt. No.5	57. Ck. Pt. No.6
5	0	25	50	75	100	N/A

58. Low Alarm	59. High Alarm	60. Low Interlock	61. High Interlock	62. Alm/Interlock Tol.
N/A	0.65	N/A	0.65	4.0

63. Alarm Units	64. Interlock Units	65. DS Key
in/sec	in/sec	

66. Master Equipment List No.: N/A

*Does changing this procedure number cause a change to the data sheet?

Vibration Indicator VM1
Calibration Data Record Sheet

Alarm/Interlock Setpoint

AS FOUND	EXPECTED OUTPUT	MODIFIED (Y/N)	AS LEFT
6.5V	6.5V±.1V DC	N	6.5V

Instrument Span

PERCENT	INPUT ±1% (mV rms)	EXPECTED OUTPUT (mA)	TOL -	TOL +	AS FOUND	IN/OUT (Y/N)	AS LEFT
0	0.000	4.00	3.36	4.64	3.93	Y	3.93
25	17.675	8.00	7.36	8.64	7.89	Y	7.89
50	35.350	12.00	11.36	12.64	11.87	Y	11.87
75	53.025	16.00	15.36	16.64	16.05	Y	16.05
100	70.700	20.00	19.36	20.64	19.87	Y	19.87

Standards	Exp. Date	Tolerance
817-45-08-062	9-22-96	—
817-45-08-046	5-8-96	—

Donald E Parker — Instrument Technician — 11-1-95 — Date

N/A — Instrument Technician — N/A — Date

N/A — Quality Control Signature — N/A — Date

Robert Nelson — Cognizant Engineer Signature — 4/11/96 — Date

CBRS INPUT FORM

Add = A
Modify = M
Delete = D

1. Action	3. Facility	4. Loop No.	5. Seq.	6. Component Identification
A	ET	AN	2	ST1

8. System No.	9. Safety Class	10. Application Code
241AN	3	E

11. Function Description: Mixer Pump Strain Transmitter

12. Engineering Dwg. No.	13. Sheet	14. Co-ord	15. Assoc. Loop	16. Oper Mode	17. Craft Code
H-2-85573	27	B04	None	AA	18

Recall

19. Status	20. Type
A	1

21. Verification Interval: 12

22. Next Due Date: 1095

18. Instructions: None

23. Reason: Instrument needs to be calibrated prior to performance of Mixer Pump ATP.

24. Cognizant Engineer	Date	25. Cognizant Engineer Manager	Date
	/ /		/ /
26. Environmental Assurance	Date	27. VCA	Date
	/ /		/ /
28. Quality Assurance	Date	29. Industrial Health, Safety and Fire Protection	Date
	/ /		/ /
30. Manufacturer: Acromag		31. Other	Date / /

32. Model	33. Serial No.	34. Comp Type	35. Function Code
161T-M-iSG-U1C	XI0156	01	01

36. Bldg. No.	37. Room No.	38. Location	39. Procedure*
AN-274	N/A	Instr Rack	N/A

40. Input Low	41. Input High	42. Input Units	43. Tol (%)
-10.00	+10.00	mV DC	1.0

44. Maintenance Proc.	45. Output Low	46. Output High	47. Output Units	48. Tol (%)
None	4	20	mA	2.0

49. OSD No.	50. Condition

51. No. Cal Pts.	52. Ck. Pt. No.1	53. Ck. Pt. No.2	54. Ck. Pt. No.3	55. Ck. Pt. No.4	56. Ck. Pt. No.5	57. Ck. Pt. No.6
5	0	25	50	75	100	

58. Low Alarm	59. High Alarm	60. Low Interlock	61. High Interlock	62. Alm/Interlock Tol.

63. Alarm Units	64. Interlock Units	65. DS Key

66. Master Equipment List No.: Does Not Exist

*Does changing this procedure number cause a change to the data sheet?

Strain Transmitter ST1
Calibration Data Record Sheet

Excitation Voltage

AS FOUND	EXPECTED OUTPUT	MODIFIED(Y/N)	AS LEFT
5.0 V	5.0V ±.1V DC	N	5.0

Instrument Span

PERCENT	INPUT ±1% (mV DC)	EXPECTED OUTPUT (mA)	TOL -	TOL +	AS FOUND (mA)	IN/OUT (Y/N)	AS LEFT (mA)
0	-10.00	4.00	3.68	4.32	4.02	IN	4.02
25	-5.00	8.00	7.68	8.32	8.03	"	8.03
50	0	12.00	11.68	12.32	12.03	"	12.03
75	5.00	16.00	15.68	16.32	16.05	"	16.05
100	10.00	20.00	19.68	20.32	20.04	"	20.04

Standards	Exp. Date	Tolerance
817-45-08-046	5-3-96	—
817-23-01-007	7-12-96	—

Donald E Paulsen
Instrument Technician

DEP
~~11-1-95~~ 10-26-95
Date

N/A
Instrument Technician

N/A
Date

N/A
Quality Control Signature

N/A
Date

Cognizant Engineer Signature

4/12/96
Date

Add = A
Modify = M
Delete = D

1. Action	CBRS INPUT FORM
A	

3. Facility	4. Loop No.	5. Seq.	6. Component Identification
ET	AN	2	TT1

8. System No.	9. Safety Class	10. Application Code
241AN	3	E

11. Function Description: Mixer Pump Motor Temperature Transmitter

12. Engineering Dwg. No.	13. Sheet	14. Co-ord	15. Assoc. Loop	16. Oper Mode	17. Craft Code
H-2-85573	27	C04	None	AA	18

Recall

19. Status	20. Type
A	2

18. Instructions: See PSCP-6-118 and CVI #22528.

21. Verification Interval: 12

22. Next Due Date: 1095

23. Reason: Instrument needs to be calibrated prior to performance of Mixer Pump ATP.

24. Cognizant Engineer	Date	25. Cognizant Engineer Manager	Date
	/ /		/ /
26. Environmental Assurance	Date	27. VCA	Date
	/ /		/ /
28. Quality Assurance	Date	29. Industrial Health, Safety and Fire Protection	Date
	/ /		/ /
30. Manufacturer: Rosemount		31. Other	Date / /

32. Model	33. Serial No.	34. Comp Type	35. Function Code
444RL2U1A2NA	277622	01	01

36. Bldg. No.	37. Room No.	38. Location	39. Procedure*
AN-274	N/A	Instr Rack	

	40. Input Low	41. Input High	42. Input Units	43. Tol (%)
	100.00	175.84	OHMS	1.00
44. Maintenance Proc.	45. Output Low	46. Output High	47. Output Units	48. Tol (%)
	4.00	20.00	mA	3.00

49. OSD No.	50. Condition

51. No. Cal Pts.	52. Ck. Pt. No.1	53. Ck. Pt. No.2	54. Ck. Pt. No.3	55. Ck. Pt. No.4	56. Ck. Pt. No.5	57. Ck. Pt. No.6
5	0	25	50	75	100	

58. Low Alarm	59. High Alarm	60. Low Interlock	61. High Interlock	62. Alm/Interlock Tol.

63. Alarm Units	64. Interlock Units	65. DS Key

66. Master Equipment List No.: Does Not Exist

*Does changing this procedure number cause a change to the data sheet?

Temperature Transmitter TT1
Calibration Data Record Sheet

Instrument Span

PERCENT	INPUT ±1% (OHMS)	EXPECTED OUTPUT (mA)	TOL -	TOL +	AS FOUND (mA)	IN/OUT (Y/N)	AS LEFT (mA)
0	100.00	4.00	3.52	4.48	3.97	IN	3.97
25	118.96	8.00	7.52	8.48	7.89	"	7.89
50	137.92	12.00	11.52	12.48	11.87	"	11.87
75	156.88	16.00	15.52	16.48	15.91	"	15.91
100	175.84	20.00	19.52	20.48	20.03	"	20.03

Standards	Exp. Date	Tolerance
817-63-02-003	5-9-96	—
817-45-03-046	5-8-96	—

Donald E. Parker — Instrument Technician — Date 10-26-95

N/A — Instrument Technician — Date N/A

N/A — Quality Control Signature — Date N/A

Cognizant Engineer Signature — Date 4/12/96

Vibration Indicator DI-2
Calibration Data Record Sheet

Alarm Setpoint

As Found	Expected	Modified	As Left
.65	.65	No	.65

Instrument Span

PERCENT	INPUT ±1% (mA)	EXPECTED OUTPUT (in/s)	TOL -	TOL +	AS FOUND (in/s)	IN/OUT (Y/N)	AS LEFT (in/s)
0	4.00	0	-.04	.04	0	Y	0
25	8.00	.250	.21	.29	.25	Y	.25
50	12.00	.500	.46	.54	.50	Y	.50
75	16.00	.750	.71	.79	.750	Y	.750
100	20.00	1.00	.96	1.04	1.00	Y	1.00

Standards	Exp. Date	Tolerance
417-23-01-007	7-12-96	—

Instrument Technician — Date: 11-4-95

Instrument Technician: N/A — Date:

Quality Control Signature: N/A — Date: N/A

Cognizant Engineer Signature — Date: 4/12/96

Strain Indicator DI-1
Calibration Data Record Sheet

Low Alarm/Interlock Setpoint

AS FOUND (lbs)	EXPECTED (lbs)	MODIFIED(Y/N)	AS LEFT (lbs)
-103	-100	NO	-100

High Alarm/Interlock Setpoint

AS FOUND (lbs)	EXPECTED (lbs)	MODIFIED(Y/N)	AS LEFT (lbs)
100	100	N	100

Instrument Span

PERCENT	INPUT ±1% (mA DC)	EXPECTED OUTPUT (lbs)	TOL -	TOL +	AS FOUND (lbs)	IN/OUT (Y/N)	AS LEFT (lbs)
0	4.00	-2000	-2160	-1840	-1999	Y	-1999
25	8.00	-1000	-1160	-840	-1003	Y	-1003
50	12.00	0000	-160	160	-5	Y	-5
75	16.00	1000	840	1160	996	Y	996
100	20.00	2000	1840	2160	1996	Y	1996

Standards	Exp. Date	Tolerance
817-23-01-007	7-12-96	—

Donald E Rathbun — Instrument Technician — 11-1-96 Date

N/A — Instrument Technician — 11-1-96 Date

N/A — Quality Control Signature — N/A Date

Cognizant Engineer Signature — 4/12/96 Date

Temperature Indicator DI-3
Calibration Data Record Sheet

Alarm/Interlock Setpoint

AS FOUND (°F)	EXPECTED (°F)	MODIFIED (Y/N)	AS LEFT (°F)
200.1	200.00	NO	200°

Instrument Span

PERCENT	INPUT ±1% (mA)	EXPECTED OUTPUT (°F)	TOL -	TOL +	AS FOUND (°F)	IN/OUT (Y/N)	AS LEFT (°F)
0	4.00	32			31.8	Y	31.8
25	8.00	122			121.8	Y	121.8
50	12.00	212			212.0	Y	212.0
75	16.00	302			302.0	Y	302.0
100	20.00	392			392.2	Y	392.2

Standards	Exp. Date	Tolerance
817-23-01-007	7-12-96	

Instrument Technician — Date: 11-1-95

N/A
Instrument Technician — Date: N/A

N/A
Quality Control Signature — Date: N/A

Cognizant Engineer Signature — Date: 4/12/96