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ENGINEERING DATA TRANSMITTAL

Page 1 of 1

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Reason	Disp.									Reason	Disp.
1	1	Cog. Eng. Allen K. Brewer <i>Allen K. Brewer</i> 11/7/94				Kim F. Armatis <i>Kim F. Armatis</i> 12/7/94 N1-27				1	1
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12/21/94

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12/22/94

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7. Abstract

This document provides the results of the run-in test of the replacement mixer pump for the Tank 241-SY-101. The test was conducted at the 400 Area MASF facility between August 12 and September 29, 1994. The report includes findings, analysis, recommendations, and corrective actions taken.

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TEST REPORT FOR RUN-IN ACCEPTANCE TESTING
OF HYDROGEN MITIGATION TEST PUMP-2

Prepared by Allen K. Brewer and
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Hanford Operations and Engineering Contractor

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WHC-SD-FF-EV-002
Rev. 0

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1.0 Introduction

This report will provide the findings of the demonstration test conducted on the DST 241-SY-101 HMT Pump-2 at the 400 Area MASF building which was performed from 25 July 1994 through 29 September 1994 per work package 4A-94-0063/W.

The DST 241-SY-101 HMT Pump-2 is a 150-HP submersible electric driven pump that has been modified for use (as needed) in the DST 241-SY-101 Mixed Waste Tank located in the 200W area. The pump has a motor driven rotation mechanism that allows the pump column to be rotated through 190°. The pump is instrumented in the following manner:

- Moisture detector in the motor casing
- Motor oil temperature sensors
- Pump vibration sensors
- Pump nozzle discharge pressure monitoring
- Column pressure (nitrogen) monitoring
- Pump nozzle discharge temperature monitoring
- Pump column strain imbalance monitoring
- Pump orientation

Additionally the pump is monitored for load (amps) and RPM. The Large Diameter Cleaning Vessel (LDCV) in which the pump was tested was monitored for water level and water temperature.

A 480-volt source is used to power a Variable Speed Drive that provides power to the pump at various frequencies and voltages, controlling the speed and power output of the pump. A second VSD is used to power the rotation drive motor.

Control of pump functions and monitoring of the pump parameters is accomplished at the Mini-DACS, system of three computers, software and PLC's. Startup and shutdown of either the pump motor or the rotation motor can be accomplished at the Mini-DACS. When the pump is in operation the Mini-DACS monitors the above mentioned instrumentation. If an out of limit parameter is read, an alarm is sounded at the Mini-DACS console. If the parameter is in the abort range the pump is automatically shutdown by the system. Actual data points taken from the test although available are not provided in this report, since this would result in an unnecessary large volume of information. (Mini-DACS recorded parameters every six seconds during the test.)

2.0 Before Installation

Prior to installing the pump in the LDCV the pump was laid horizontal on the floor of MASF. Two items were completed prior to the installation: 1) the pump was "Bump" tested to determine direction of rotation and 2) instrument loop checks were completed to verify accuracy and alarm and abort setpoints.

Bump Test

While the pump was on the floor of MASF electrical connections were made from the VSD to JBX-3 of the pump. Enclosures (1), (2) and (3) are provided for documentation of the connections at the VSD and JBX-3. The bump test was performed and the direction of rotation was recorded in the work package. The rotation was counterclockwise (as looking from the top of the pump) with the terminations as indicated. When the pump was reconnected to electrical power after the pump had been installed in the LDCV, two phases between the VSD and JBX-3 were switched to correct for rotation.

Instrumentation Checks

It became evident after the pump arrived that there were deficiencies by the manner in which the instrumentation wiring had been terminated in JBX-1 (Enclosure 4). Shields were exposed, touching ground and each other, providing a pathway for stray voltages and ground loops. Ground wires were bare and frayed, again providing a pathway for stray voltages and ground loops. All wiring in JBX-1 with the exception of the strain gage wiring was reterminated; ground wires were separated and insulated; heat shrinking was installed over the shields. The strain gage wiring was not repaired as this would have required pulling in new pairs of wires from the elements (the strain gages and wiring were functional; repairs would have been to improve appearance and ensure system reliability). The strain gages performed without event in their present condition.

The accelerometer WE307 was rewired, the volute pressure element PE304 was replaced due to deficient wiring methods at the sensor (Enclosures 5, 6 and 7), ground loops were the major concern. It was discovered during testing that the wires between the sensor and JBX-1 had been double spliced in their housing. These splices were cut out and a single splice was used to reterminate the sensor to the wires.

Elements PE503, PE506 and PE507 were rewired at the sensor terminals due to incorrect terminations. Excitation and sensor wires had been switched, the sensors could not function at all in this configuration.

At the completion of correcting the problems found in JBX-1 the instrumentation was terminated to the Instrument Cabinet at TB-1 and a second check for grounding problems was conducted. Additional grounding problems were found and then corrected.

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Individual instruments were loop checked from the sensor to the output reading on the Mini-DACS. Additionally, the four Barton pressure gages (PE110A, PE110B, PE111A, and PE111B) were individually calibrated and then loop checks were completed. The calibration sheets for the loop checks were copied from the work package and included as (Enclosure 8). Special notes for specific instruments are as follows:

PE304 - readings from the Mini-DACS were in PSIA (absolute), the source gage used was calibrated in terms of PSIG. To convert from gage pressure to absolute pressure, a constant barometric pressure of 14.44 (obtained from Battelle Meteorological Lab) was added to the source gage reading.

PE506 - this sensor gets its input from a pressure regulator which had a maximum setting of 12.0 psig, in order to verify the full scale of the loop the regulator was isolated to allow the pressure source to reach the upper range of the sensor and to verify alarm and abort setpoints.

PE507 - this sensor gets its input from a pressure regulator which had a maximum setting of 29.0 psig, in order to verify the full scale of the loop the regulator was isolated to allow the pressure source to reach the upper range of the sensor and to verify alarm and abort setpoints.

PE110B - as this sensor is a spare, no (-10) psig offset was factored into the system to account for the fact that the element would be under several feet of water.

PE111B - as this sensor is a spare, no (-10) psig offset was factored into the system to account for the fact that the element would be under several feet of water.

The strain gage amplifier's were setup per instructions provided by Marion Hufford of EG&G. There were no loop checks conducted for this instrumentation as no viable input signal could be generated.

3.0 Installation

No events occurred during installation of the pump in the LDCV. GST-32 Turbine oil (5.5 gal) was added to the barrier reservoir while the pump was being held in the vertical position. Shaft runout was measured as 0.0015". The final survey for plumb was completed before lower into the LDCV (see Enclosure 13) After the pump had been installed in the LDCV, power connections were made to the pump motor (two phases were interchanged to cause clockwise rotation) and rotation motor and instrumentation loops were reconnected in JBX-1. The resolver supplied with the instrument cabinet had to be replaced as it was too tall to fit above the gear box. The resolver was replaced with a shorter resolver supplied from the manufacturer. The nitrogen and hydraulic connections were made to the pump void system and stabilization system respectfully. The motor reservoir was filled with approximately 18.5 gallons of Royco 5320 oil (Note: An oil sample was taken from the source drum, see Enclosure 16. Note: Oil fill procedure had to be modified to successfully fill and drain the motor reservoir).

4.0 Testing

The testing of 101-SY Backup Pump was considered successful with the below noted discrepancies. Evaluation and analysis of Mixer Pump-2 Performance Test are provided in Enclosure 9. Oil analysis reports are provided in Enclosure 16 (Note: Results of oil analysis after the 72 hour run-in were not available at the time of issue of this report. The results will be added at a later date.) Actual data points taken from the test although available are not provided in this report, as this would have resulted in a large physical volume of information. (Mini-DACS recorded sensor inputs every six seconds when actual testing was ongoing.)

The pump could not be rotated the full 190 ° without mechanical binding occurring.

Recommend the problem be determined and corrected and the rotation drive be retested per the ATP. (See Corrective Action section of this report)

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The pump could not be run continuously at full speed for 72 hours. Pump aborts occurred due to HIGH PUMP MOTOR SPEED shutdowns that took place throughout the test (pump speed was lowered to 1100 RPM which resulted in fewer shutdowns). The problem was isolated to the communication link between the VSD and Mini-DACS or in the Mini-DACS system.

Recommend the problem be identified and corrected and a second run-in test at full speed under the control of the Mini-DACS be conducted. Satisfactory completion of the run-in test would be 12 hours of nonstop operation. (See Corrective Action section of this report)

Two legs of the nitrogen pressure system saw an increase in pressure when the pump was running. The increase was dependent upon the pump speed. It was determined that this pressure increase comes from an impressed stray voltage that is generated in the pump structure only when the pump is running. The elements for these two nitrogen legs were electrically insulated from the pump to insure reliable readings.

Recommend a permanent method for isolating these pressure elements from the pump structure be devised. (See Corrective Action section of this report)

Pump Test (Narrative)

On August 4 power was applied to all systems. No faults or alarm indications occurred. The system was ready for testing.

Rotation Drive

Testing began on the rotation drive mechanism on 9 August. The CW and CCW switches were manually tripped to 1) verify the proper indication on the Mini-DACS and 2) verify the rotation drive could not be operated with a limit switch activated. Several system errors resulted in failures in the first few attempts of this verification; after corrections were made to the wiring and software, the limit switches and rotation performed as designed. (Note: The design of the limit switch circuitry and programming is such that if either limit switch is tripped, the rotation drive motor cannot be operated from the Mini-DACS console, i.e if the CW limit switch is activated, Mini-DACS will not allow the motor to be driven in either direction and the same for the CCW limit switch. This should be considered a design flaw and should be corrected.)

After the limit switches were completed, the pump was rotated. The first attempt resulted in a sheared pin on the drive shaft of the rotation drive. Something was physically binding the rotation mechanism. In order to isolate the cause the rotation drive motor was disconnected from the drive gear and power was applied to the rotation drive motor. The motor operated fully in both directions without any incidence of high torque or high current. The fault in the drive gear was left as is for later determination of the problem.

Pump Test

The first portion of the pump run-in test required the pump to be started at 500 RPM, followed by 200 RPM speed increases when critical parameters had stabilized. This pattern would continue until full speed of 1180 RPM was reached. The pump would then be shut down, the motor reservoir oil changed from Royco 5320 to Royco 5220, and a second startup test would be run, starting at 500 RPM and continuing to full speed as before. At the completion of the second startup test, the 72 hour run-in would begin.

The pump was started at 2250 on 8/12/94. Initial speed setting was 500 RPM. Initial conditions were in the normal operating range (Enclosure 10) with the exception of nitrogen pressure leg on the pump column (ZIMPE142). Upon pump startup this pressure immediately increased by approximately 2 psi. No cause was identified at the time. The test continued, increasing speed by 200 RPM after critical parameters had stabilized. At 900 RPM the pump shut itself down on a HIGH PUMP MOTOR SPEED abort. The decision was made to restart at 900 RPM since no actual fault could be found. The pump was operated at 900 RPM until critical parameters had reached steady state. Final full speed was achieved but the pump shut itself down a second time after approximately one minute at 1180 RPM. The pump was restarted at full speed and run until the completion of this startup test. At the completion of the startup test, Test Operators shutdown the pump and proceeded to the oil change. Throughout the test the pump column nitrogen pressure increased with each pump speed increase.

Approximately 17.5 gallons of Royco 5320 oil were drained out to the motor reservoir and 17.5 gallons of Royco 5220 oil were added. A sample of the oil was taken for analysis. (See 4A-94-0063/W) (It was estimated that 1.5 gallons remained in the drain line and could not be removed.) The second startup test began at 0543 on 8/13/94. The test proceeded to completion without incident except the nitrogen pressure leg continued to follow speed increases.

At 0740 on 8/13/94 the 72 hour run-in test began with the pump running at full speed. During the initial seven hours of the run-in test several pump aborts occurred due to a HIGH PUMP MOTOR SPEED shutdown. The maximum run time during the period was one hour and 52 minutes and the shortest under two minutes. The Test Engineer ordered the speed decreased to 1100 RPM. This significantly improved the performance for the next 38 hours. Run times between aborts ranged from between nine and 12 hours. Early on 8/15/94 pump aborts due to a

HIGH PUMP MOTOR SPEED shutdown increased in frequency, with run times ranging from a few hours to only several minutes. No cause for the change in frequency or the aborts had been determined. It was discovered that by waiting 15 minutes after a shutdown before starting again the periodicity between aborts increased. At 1026 on 8/15/94 the pump shutdown on a HIGH PUMP MOTOR SPEED. The pump remained shutdown for a period of three hours to complete a software check on Mini-DACS. At 1339 on 8/15/94 the pump was restarted 1180 RPM, no problems were noted in the software. After several aborts, pump speed was reduced to 1100 RPM. The pump was operated at this speed for the next 13 hours and 40 minutes. The pump shutdown on HIGH PUMP MOTOR SPEED four more times before completing the test. At 1340 on 8/16/94 the Test Operator shutdown the pump as an accumulated time of 72 hours had been reached. It was noted throughout the 72 hour test that large dips in RPM, and MOTOR AMPS had occurred (Enclosure 11), in some cases these were followed shortly after by a pump abort but not every time.

After pump testing was completed, an attempt was made to determine what was the cause for the pump not to rotate. The pump was manually rotated 30° in the clockwise direction and then manually rotated 45° in the counterclockwise direction using a 2000 FT-LB torque wrench. When the 45° counterclockwise position was reached the pump would rotate no further. The actual results of this effort were recorded in the Test Log book on page 32 (Enclosure 12).

In an attempt to determine the cause of the aborts, the communication line between the 200 HP VSD and Mini-DACS was disconnected. Operating the pump from the VSD keypad, the pump was ramped to 1180 RPM. The pump ran for 12 hrs and 50 minutes without a shutdown. Although this isolated the cause to the VSD communication or the Mini-DACS, further investigation will be required to determine the exact reason. The pump was then secured.

5.0 CORRECTIVE ACTIONS

Rotational Repairs

Introduction

As discussed in Section 4.0, SY-101 Mixer Pump-2 was tested in the Maintenance and Storage Facility (MASF) per Work Package No. 4A-94-63/W. During the pump rotation portion of the test an exception occurred. The brass shear pin in the gear rotational drive shaft failed after only a few degrees of pump rotation. Torque measurements at this location equaled 1,000 ft-lbs. Full 190° rotation could not be completed due to mechanical interference. Pump rotation torque measurements were stopped when torque values reached 1,200 ft-lbs. The failure was documented in the Test Log and further pump rotational testing was deferred until the rest of the test program was completed. A new work package (4A-94-78/W) was prepared to trouble shoot and repair the pump rotation mechanism. A retest of pump rotation was specified after pump repairs.

Summary

The SY-101 Mixer Pump-2 rotational mechanism seized during initial pump rotation testing per Work Package 4A-94-63/W and sheared the brass shear pin. After completion of the rest of the test procedure, the pump was removed for trouble shooting and repair per Work Package 4A-94-78/W. Repairs included deburring galled surfaces, reshaping the 16-inch inner pipe column with hydraulic rams, opening the ID of the 18-inch pipe in the lower crush plate assembly by grinding, and recentering the lower crush plate assembly fixed seal ring. After all pump repairs were complete the pump was reinstalled in the LDCV for retest. The rotational torque measured at the pinion gear was between 75 and 325 ft-lbs over the required 190° rotation. The pump was then reconnected to the gear rotational drive and the pump rotation retest was successful.

Discussion

After completion of the remainder of the test program, trouble shooting and repair of the pump rotational mechanism was performed per Work Package 4A-94-78/W. Enclosure 14 shows a sketch of the pump rotational mechanism. The pump was removed from the test stand and placed in the horizontal position. Torque data were recorded at each stage of disassembly. These data show each of the three bolted flange joints added to the torque buildup. Disassembly showed physical evidence of mechanical interference and galling between the inner pump column (16-inch STD WT Pipe) and the inside surfaces of the pump lower crush plate assembly (18-inch SCH 80 Pipe). Disassembly also showed binding of the pump rotational bearing when it was bolted to the

modified pump flange. Inspection also showed that the lower crush plate assembly fixed seal ring was not concentric with the 18-inch pipe.

Dimensional analysis showed the inner pump column outside diameter was out of round by 0.5-inch in the lower crush plate assembly region where previous weld modifications had been made. Hydraulic rams were used to bring this 16-inch diameter pipe within the allowable tolerance of Pipe Specification A-53. Efforts to correct this out of round condition were successful. After repair the 16-inch pipe OD is within 0.070-inch of nominal. Additional dimensional data showed the ID of the 18-inch pipe was too small to allow rotation with the reshaped inner pipe. The ID of the 18-inch pipe was opened approximately 0.140-inch by grinding. However, the barrel assembly and 16-inch pipe column are not concentric when bolted together; therefore, the clearance is not uniform. The minimum clearance is 0.002 to 0.004-inches measured in the horizontal position.

The surface of the 16-inch pipe was coated with Nickel Neverseize during reassembly. Efforts to shim the pump rotational bearing were not productive and reassembly was completed without shimming. After reassembly, a new lower crush plate assembly fixed seal ring was welded in place. Full 360° rotation is now possible with measured torque values between 100 and 300 ft-lbs measured in the horizontal position. The pump was returned to the test stand and pump rotational testing per 4A-94-63/W is complete. The torque values over the required 190° rotation ranged between 75 and 325 ft-lbs. All of the torque and dimensional data recorded and summarized above are included in 4A-94-78/W. Additional trouble shooting and repair details are included in the Test Log.

Pump Aborts

As discussed in Section 4.0 of this report, the pump frequently shutdown on HIGH PUMP MOTOR SPEED aborts when the pump was running at or near full speed. Prior to removing the pump for repairs to the rotation drive, the problem was isolated to a communication problem between the VSD and the Mini-DACS. After the pump was reinstalled in the LDCV further testing was done to determine the cause for the aborts. With assistance from the Software Support personnel and an Eaton representative the problem was isolated to a communication error occurring in the ModPlus Genesis software (see Enclosure 15). Changes in the software were made and an eight hour run of the pump at full speed with control from the Mini-DACS was completed. Resolution of the problem is considered complete.

Nitrogen Pressure Elements

The nitrogen pressure elements were permanently isolated with an adaptor inserted at the pressure elements. The stray signals noted when the pump was running were eliminated. Resolution complete.

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Enclosures

- 1 Copy of work package page listing connections for bump test and direction of rotation during Bump Test. (2 pages)
- 2 Picture of VSD connections for Bump Test. (1 page)
- 3 Picture of JBX-3 connections for Bump Test. (1 page)
- 4 JBX-1: Note Upper wires on TB1 are BEFORE, lower wires on TB1 are AFTER. Wires on TB2 are BEFORE. (1 page)
- 5 Strain gage sensor wiring with double splice. (1 page)
- 6 Strain gage wiring noting shield and strands of ground wire. (1 page)
- 7 Strain gage wiring noting strands of grounding wire not cut off. (1 page)
- 8 Loop Calibration sheets. (18 pages)
- 9 Evaluation and analysis of Double-Shell Tank 241-SY-101 Mixer Pump-2 Performance Test. (33 pages)
- 10 Initial pump operating parameters from screen print. (3 pages)
- 11 Screen print showing data losses/dips during pump operation. (11 pages)
- 12 Copy of log sheet showing torque values at various stages of manual rotation. (1 page)
- 13 Pump plumb readings
- 14 Rotation drive thickness measurements and Flange & Barrel sketch.
- 15 Fax letter delineating ModPlus Genesis software corrective action.

101-SY BACKUP PUMP PERFORMANCE
DEMONSTRATION TEST
4A-94-00063/W
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- 6.4.4 Close the Instrument Cabinet circuit breakers CB-1 and CB-6. Energize the Mini-DACS and complete calibrations per Attachment 7. Operate Mini-DACS per Attachment 9.
See WCN-008 attached page for instructions to power up mini-DACS. *8/11/94*
See WCN-008 for Step 6.4.4.1 - 6.4.4.3 and signoffs. See WCN-009 for Ground Loop Confirmation *8/11/94*
- 6.4.5 Disconnect all instrumentation wiring from JBX-1 and disconnect the thermocouple wires. Set wires aside for later reconnect.

WCN008
Allison Brown
8/4/94

8/11/94 *RC*
CRAFT/Date

6.5 BUMP TEST

The pump will be bumped while in the horizontal position to determine direction of rotation with respect to the 200 HP VSD. Proper rotation is clockwise as viewed from the top of the pump. The bump test and instrumentation calibration may be completed in parallel up to the point of energizing the pump.

- 6.5.1 Meter motor leads and check for motor continuity. Megger motor leads to ground and record results. Install the 4/0 power cable and ground cable from the 200 HP VSD to JBX-3, record terminations at the VSD and at JBX-3. Barricade the area during the bump test.

MEGGER
545-77-08-012
10/6/94
Fluke
646-45-08-164
7/20/95

Motor Leads Continuity Check *ML* (Initial)

Megger to Ground T1 *∞* T2 *∞* T3 *∞*

VSD Termination Point Cable JBX-3 Termination Point

TC Red *Right*

TA Blue *Left*

TB *Yellow* *Center*
White

Swap 2 leads TC & TA to correct
the Pump Rotation to CW. CR Nash
See step 6.5.7 *8-2-94*

Nash *8-2-94*
CRAFT/Date

- 6.5.2 Rotate the pump shaft by hand both directions to verify it turns freely.

Nash *8-2-94*
CRAFT/Date

101-SY BACKUP PUMP PERFORMANCE
DEMONSTRATION TEST
4A-94-00063/W
Page 11 of 27

- 6.5.3 Clear the danger tag on MCC 4 bkr F1, and close the power supply to the VSD.

[Signature] 8/2/94
OPERATIONS/Date

Caution: Prior to energizing power to the pump, barricade the area to prevent personnel from entering cable and pump area.

- 6.5.4 Review VSD settings per the Manufacturers instructions.

Allen K. Brewer 8/2/94
COG ENG/Date

- 6.5.5 Review with the Operator motor speed setpoints, start, stop, and emergency stop procedures.

Allen K. Brewer 8/2/94
COG ENG/Date

- 6.5.6 Set the pump speed to a nominal slow speed (50 RPM's). Press the Start button on the VSD and push the Emergency Stop button to verify it shuts down the system.

Gail Dowe 8/2/94
OPERATIONS/Date

- 6.5.7 Bump test the mixing pump, set speed per the Cog Engineer's instructions. Keep pump speed the minimum required to observe pump rotation. Rotation clockwise/~~counterclockwise~~ (circle one)(looking from the top). Stop the pump after rotation has been determined.

OBSERVED Rotation CCW - Reverse Direction
Step 6.5.1 wiring will swap 2 leads
to correct Rotation - CR neash
8-2-94

[Signature] 8/2/94
OPERATIONS/Date

- 6.5.8 Open and danger tag MCC 4 bkr F1.

[Signature] 8/2/94
OPERATIONS/Date

- 6.5.9 Disconnect the motor from the VSD at JBX-3.

Lyn/Martin 8-5-94
CRAFT/Date

WCN008
Allen K. Brewer
8/14/94

PE304 Volute Pressure Sensor

Accuracy ± 1.2 psi

Disconnect the wires for PE304, at JBX-1 TB-1 and record the resistance readings between:

(+) Signal/ (-) signal	<u>1026.73 Ω</u>
(+) Excitation/ (+) Signal	<u>891.25</u>
(+) Excitation/ (-) Signal	<u>892.41</u>
(+) Excitation/ (-) Excitation	<u>1280.27</u>
(-) Excitation/ (-) Signal	<u>903.65</u>
(-) Excitation/ (+) Signal	<u>903.15</u>
Bridge/ Shield	<u>∞</u>
Bridge/ Ground	<u>∞</u>
Shield/ Ground	<u>128m Ω</u>

Terminate the wires at JBX-1.

See WCN-10 duplicate entry

Ground = Pump Ground

R. A. Brewer 8/19/94

CRAFT/Date

WCN008
Allen K. Brewer
8/4/94

PE304 Volute Pressure Sensor
Accuracy ± 1.0 psi

Connect a pressure source to the inlet of PE304 and record the output from the Mini-DACS (Tag: PIR12A01) for the following points:

INPUT	MODICON mv Record	DACS Dec Record	AS FOUND mv	AS LEFT mv
<u>PSIG</u>				
15.56 = 30.0 psia	4.09	838	4.09	4.09
45.56 = 60.0 psia	8.16	1668	8.16	8.16
75.56 90.0 psia	12.28	2510	12.28	12.28
105.56 120.0 psia	16.41	3350	16.41	16.41
135.56 150.0 psia	20.48	OVER RANGED	20.48	20.48
EXCITATION $V = 10.002$ max Reading $\nearrow$				
105.56 120.0 psia	16.40	3350	16.40	16.40
75.56 90.0 psia	12.30	2508	12.30	12.30
45.56 60.0 psia	8.13	1672	8.13	8.13
15.56 30.0 psia	4.06	832	4.06	4.06

CRAFT/Date

Barometric Pressure 14.44 psi per Battelle Met. LAB
Formula used $\frac{\text{DEC Reading}}{4095} \times 144.4388 - 9938$ CR Nash 8-8-94

CALIBRATION PROCEDURES

PE503 Pump Column Nitrogen Pressure

Accuracy ± 0.2 psi

Connect a pressure source to the inlet of PE503 and record the output from the Mini-DACS (Tag: ZIMPE142) for the following points:

	AS FOUND	INITIALS
0.0 psig	0.0	<i>ASX</i>
3.8 psig	3.9	
7.5 psig	7.6	
11.3 psig	11.4	
15.0 psig	15.0	
11.3 psig	11.4	
7.5 psig	7.5	
3.8 psig	3.8	
0.0 psig	0.0	
Hi Alarm	7.98	
Reset	7.92	
Lo Alarm	3.92	
Reset	3.97	<i>ASX</i>

ASX 8-3-94
CRAFT/Date

CALIBRATION PROCEDURES

PE506 Pump Shroud Nitrogen Pressure

Accuracy ± 0.3 psi

Connect a pressure source to the inlet of PE506 and record the output from the Mini-DACS (Tag: PN2P0506) for the following points:

	AS FOUND	INITIALS
0.0 psig	<u>0.07</u>	<u>AS</u>
3.8 psig	<u>3.89</u>	
7.5 psig	<u>7.59</u>	
11.3 psig	<u>11.40</u>	
15.0 psig-	<u>15.00</u>	
11.3 psig	<u>11.38</u>	
7.5 psig	<u>7.58</u>	
3.8 psig	<u>3.87</u>	
0.0 psig	<u>0.06</u>	
Hi Alarm	<u>14.84</u>	
Reset	<u>14.79</u>	
Lo Alarm	<u>6.90</u>	<u>✓</u>
Reset	<u>6.98</u>	<u>AS</u>

NOTE: Pressure Regulator relieves at 12.0 PSig. The Regulator was capped off to permit pressurizing the element to the High alarm limit and the 15 psig Range Value.

Bob Nash

~~AS~~ 8-3-94
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CALIBRATION PROCEDURES

PE507 Pump Dummy Legs Nitrogen Pressure Accuracy ± 0.3 psi

Connect a pressure source to the inlet of PE507 and record the output from the Mini-DACS (Tag: PN2P0507) for the following points:

	AS FOUND	INITIALS
0.0 psig	0.00	SEA
7.5 psig	7.49	
15.0 psig	14.98	
22.5 psig	22.43	
30.0 psig	29.87	
22.5 psig	22.40	
15.0 psig	14.93	
7.5 psig	7.44	
0.0 psig	0.00	
Hi Alarm	30.05	
Reset	29.95	
Lo Alarm	24.05	
Reset	24.17	SEA

Note: Pressure Regulator
relieves at 29.0 psig.

The Regulator was capped
off to permit pressurizing
the element to the High
Alarm limit and the
30 psig Range Value.

ADH 8-3-94
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WCN 005
Allen K. Brewer
8/3/94

CALIBRATION PROCEDURES

PE110A Pump Discharge Nozzle #2 Differential Pressure
Accuracy ± 1.0 psi

Connect a pressure source to the inlet of PE110A and record the output from the Mini-DACS (Tag: PITN0110) for the following points:

INPUT	PRESSURE TRANSMITTER	DACS TERMINAL	AS FOUND ma/psig	AS LEFT ma/psig
0.0 psig	4 ma	-10.0 psig	<u>4.07/-9.7</u>	<u>4.0/-10.0</u>
17.5 psig	8 ma	7.5 psig	<u>8.07/7.8</u>	<u>8.0/7.5</u>
35.0 psig	12 ma	25.0 psig	<u>13.08/25.4</u>	<u>12.0/25.0</u>
52.5 psig	16 ma	42.5 psig	<u>16.08/42.9</u>	<u>16.01/42.5</u>
70.0 psig	20 ma	60.0 psig	<u>20.09/60.0</u>	<u>20.02/60.0</u>
52.5 psig	16 ma	42.5 psig	<u>16.08/42.9</u>	<u>16.01/42.5</u>
35.0 psig	12 ma	25.0 psig	<u>12.08/25.4</u>	<u>12.01/25.0</u>
17.5 psig	8 ma	7.5 psig	<u>8.08/7.8</u>	<u>8.01/7.5</u>
0.0 psig	4 ma	-10.0 psig	<u>4.08/-9.7</u>	<u>4.0/-10.0</u>

R. J. Allen 8/4/94
CRAFT/Date

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8/3/94

CALIBRATION PROCEDURES

PE110B Pump Discharge Nozzle #2 Differential Pressure
Accuracy ± 1.0 psi

Connect a pressure/vacuum source to the inlet of PE110B and record the output from the Mini-DACS (Tag: SPARE1, value is calculated from Mod soft) for the following points:

INPUT	PRESSURE TRANSMITTER	DACS TERMINAL	AS FOUND ma/psig-DEC	AS LEFT ma/psig DEC
0.0 psig	4 ma	-10.0 psig	4.169 / 40	4.004 / 0.0
17.5 psig	8 ma	7.5 psig	8.162 / 1060	8.002 / 1025
35.0 psig	12 ma	25.0 psig	12.159 / 2088	11.997 / 2046
52.5 psig	16 ma	42.5 psig	16.16 / 3110	15.998 / 3070
70.0 psig	20 ma	60.0 psig	20.16 / 4138	20.001 / 4095
52.5 psig	16 ma	42.5 psig	16.157 / 3112	16.001 / 3070
35.0 psig	12 ma	25.0 psig	12.163 / 2090	12.000 / 2050
17.5 psig	8 ma	7.5 psig	8.164 / 1068	8.004 / 1024
0.0 psig	4 ma	-10.0 psig	4.169 / 40	4.005 / 0.0

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CRAFT/Date

* ((Modsoft DEC/4095)*Loop Range) = psig

Input	AS FOUND PSIG	AS Left PSIG
0.0	0.68	0.0
17.5	18.1	17.5
35.0	35.7	35.0
52.5	53.2	52.5
70.0	70.7	70.0
52.5	53.2	52.5
35.0	35.7	35.0
17.5	18.3	17.5
0.0	0.68	0.0

This Device is supposed to be SPARE1 on Modsoft DACS screen, however, SPARE2 responded. Sam Smith initiated software (EG+G) Swap
CR Nash
8-3-94

ATTACHMENT 7
4A-94-00063/W
WCN 005

WCN005
Allen K. Brewer
8/3/94

CALIBRATION PROCEDURES

PE111A Pump Discharge Nozzle # 1 Differential Pressure
Accuracy ± 1.0 psi

Connect a pressure source to the inlet of PE111A and record the output from the Mini-DACS (Tag: PITN0111) for the following points:

INPUT	PRESSURE TRANSMITTER	DACS TERMINAL	AS FOUND ma/psig	AS LEFT ma/psig
0.0 psig	4 ma	-10.0 psig	<u>4.04/-9.8</u>	<u>4.04/-9.8</u>
17.5 psig	8 ma	7.5 psig	<u>8.03/7.6</u>	<u>8.03/7.6</u>
35.0 psig	12 ma	25.0 psig	<u>12.02/25.1</u>	<u>12.02/25.1</u>
52.5 psig	16 ma	42.5 psig	<u>16.02/42.5</u>	<u>16.02/42.5</u>
70.0 psig	20 ma	60.0 psig	<u>20.03/60.0</u>	<u>20.03/60.0</u>
52.5 psig	16 ma	42.5 psig	<u>16.03/42.5</u>	<u>16.03/42.5</u>
35.0 psig	12 ma	25.0 psig	<u>12.02/25.1</u>	<u>12.02/25.1</u>
17.5 psig	8 ma	7.5 psig	<u>8.02/7.6</u>	<u>8.02/7.6</u>
0.0 psig	4 ma	-10.0 psig	<u>4.03/-9.8</u>	<u>4.03/-9.8</u>

RTO 8/4/94
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Allen K Brown
8/2/94

CALIBRATION PROCEDURES

PE111B Pump Discharge Nozzle # 1 Differential Pressure
Accuracy ± 1.0 psi

Connect a pressure source to the inlet of PE111B and record the output from the Mini-DACS (Tag: SPARE2, value is calculated from Mod soft) for the following points:

INPUT	PRESSURE TRANSMITTER	DACS TERMINAL	AS FOUND ma/psig DEC	AS LEFT ma/psig DEC
0.0 psig	4 ma	-10.0 psig	3.957/32768	3.957/32768
17.5 psig	8 ma	7.5 psig	7.954/1013	7.954/1013
35.0 psig	12 ma	25.0 psig	11.959/2040	11.959/2040
52.5 psig	16 ma	42.5 psig	15.956/3060	15.956/3060
70.0 psig	20 ma	60.0 psig	19.957/4087	19.957/4087
52.5 psig	16 ma	42.5 psig	15.956/3060	15.956/3060
35.0 psig	12 ma	25.0 psig	11.958/2040	11.958/2040
17.5 psig	8 ma	7.5 psig	7.957/1014	7.957/1014
0.0 psig	4 ma	-10.0 psig	3.960/32768	3.960/32768

RTP 8/4/94
CRAFT/Date

* ((Modsoft DEC/4095)*Loop Range) = psig

Input PSIG	AS FOUND PSIG	AS Left PSIG
0.0	Pegged low	Pegged Low
17.5	17.3	17.3
35.0	34.9	34.9
52.5	52.3	52.3
70.0	69.9	69.9
52.5	52.3	52.3
35.0	34.9	34.9
17.5	17.3	17.3
0.0	Pegged low	Pegged Low

CALIBRATION PROCEDURES

Temperature Calibrations

TE101A Pump Discharge Temperature Nozzle # 1
Accuracy $\pm 3^{\circ} \text{ F}$

Connect a Thermocouple Simulator to the thermocouple connector of TE101A and record the output from the Mini-DACS (Tag: TIPNP202) for the following points:

	AS FOUND	INITIALS
50° F	51.8	RJC
75° F	76.2	RJC
100° F	101.2	RJC
125° F	126.5	RJC
150° F	151.1	RJC
125° F	126.5	RJC
100° F	101.7	RJC
75° F	76.6	RJC
50° F	50.9	RJC
Hi Alarm	130	RJC
Reset	128	RJC
Abort	150	RJC
Reset	149	RJC

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CRAFT/Date

CALIBRATION PROCEDURES

TE101B Pump Discharge Temperature Nozzle # 1
Accuracy $\pm 3^{\circ} \text{F}$

Connect a Thermocouple Simulator to the thermocouple connector of TE101B and record the output from the Mini-DACS (Tag: SPARE3, value is calculated from ModSoft) for the following points:

	AS FOUND (DEC)	INITIALS
50° F.	88	RJC
75° F	203	RJC
100° F	318	RJC
125° F	429	RJC
150° F	542	RJC
125° F	428	RJC
100° F	316	RJC
75° F	204	RJC
50° F	89	RJC

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$$* ((\text{Modsoft DEC}/4095) * \text{Loop Range}) + 32 = ^{\circ} \text{F}$$

DEC	=	$^{\circ} \text{F}$	
88	=	51.34 $^{\circ} \text{F}$	} CR Nash 8/10/94
203	=	76.62 $^{\circ} \text{F}$	
318	=	101.89 $^{\circ} \text{F}$	
429	=	126.29 $^{\circ} \text{F}$	
542	=	151.12 $^{\circ} \text{F}$	
428	=	126.07 $^{\circ} \text{F}$	}
316	=	101.45 $^{\circ} \text{F}$	
204	=	76.84 $^{\circ} \text{F}$	
89	=	51.56 $^{\circ} \text{F}$	

CALIBRATION PROCEDURES

TE101C Pump Discharge Temperature Nozzle # 1
Accuracy $\pm 3^{\circ} F$

Connect a Thermocouple Simulator to the thermocouple connector of TE101C and record the output from the Mini-DACS (Tag: SPARE4, value is calculated from ModSoft) for the following points:

	AS FOUND(DEC)	INITIALS
50° F	91	CR
75° F	203	CR
100° F	318	CR
125° F	432	CR
150° F	544	CR
125° F	432	CR
100° F	319	CR
75° F	203	CR
50° F	90	CR

Per WCN-H CR Nash
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$$* ((\text{Modsoft DEC} / 4095) * \text{Loop Range}) + 32 = ^{\circ} F$$

$$\text{DEC} = ^{\circ} F$$

$$\begin{aligned} 91 &= 52^{\circ} F \\ 203 &= 76.62^{\circ} F \\ 318 &= 101.89^{\circ} F \\ 432 &= 126.95^{\circ} F \\ 544 &= 151.56^{\circ} F \\ 432 &= 126.95^{\circ} F \\ 319 &= 102.11^{\circ} F \\ 203 &= 76.62^{\circ} F \\ 90 &= 51.78 \end{aligned}$$

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WHL-SU-FF-EV-002

CALIBRATION PROCEDURES

TE102A Pump Discharge Temperature Nozzle # 2
Accuracy $\pm 3^{\circ}$ F

Connect a Thermocouple Simulator to the thermocouple connector of TE102A and record the output from the Mini-DACS (Tag: TIPN0101) for the following points:

	AS FOUND	INITIALS
50° F	52.0	RTC
75° F	76.2	RTC
100° F	101.2	RTC
125° F	126.3	RTC
150° F	151.3	RTC
125° F	126.7	RTC
100° F	101.2	RTC
75° F	76.4	RTC
50° F	51.6	RTC
Hi Alarm	179	RTC
Reset	128	RTC
Abort	150	RTC
Reset	149	RTC

RTC 8/10/94
CRAFT/Date

CALIBRATION PROCEDURES

TE102B Pump Discharge Temperature Nozzle # 2
Accuracy $\pm 3^{\circ} F$

Connect a Thermocouple Simulator to the thermocouple connector of TE102B and record the output from the Mini-DACS (Tag: SPARE~~5~~, value is calculated from Modsoft) for the following points:

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	AS FOUND (DEC)	INITIALS
50° F	89	RDC
75° F	203	RDC
100° F	317	RDC
125° F	429	RDC
150° F	541	RDC
125° F	429	RDC
100° F	317	RDC
75° F	205	RDC
50° F	87	RDC

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CRAFT/Date

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$$* ((\text{Modsoft DEC}/4095) * \text{Loop Range}) + 32 = ^{\circ}F$$

$$\text{DEC} = ^{\circ}F$$

$$\begin{aligned} 89 &= 51.54^{\circ}F \\ 203 &= 76.62^{\circ}F \\ 317 &= 101.67^{\circ}F \\ 429 &= 126.29^{\circ}F \\ 541 &= 150.90^{\circ}F \\ 429 &= 126.29^{\circ}F \\ 317 &= 101.67^{\circ}F \\ 205 &= 77.05^{\circ}F \\ 87 &= 51.12^{\circ}F \end{aligned}$$

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8-10-94

CALIBRATION PROCEDURES

TE102C Pump Discharge Temperature Nozzle # 2
Accuracy $\pm 3^{\circ} \text{ F}$

Connect a Thermocouple Simulator to the thermocouple connector of TE102C and record the output from the Mini-DACS (Tag: SPARE6, value is calculated from Modsoft) for the following points:

	AS FOUND (DEC)	INITIALS
50° F	85	ROT
75° F	203	ROT
100° F	315	ROT
125° F	426	ROT
150° F	543	ROT
125° F	429	ROT
100° F	317	ROT
75° F	202	ROT
50° F	87	ROT

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ROT am 8/10/94
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$$* ((\text{Modsoft} + \text{DEC}/4095) * \text{Loop Range}) + 32 = ^{\circ} \text{ F}$$

DEC	=	°F
85	=	50.68
203	=	76.62
315	=	101.23
426	=	125.63
543	=	149.34
429	=	126.29
317	=	101.67
202	=	76.396
87	=	51.12

CR
Mash
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4A-94-63/W
WCN-010

TE302A Pump Motor Oil Temperature Accuracy $\pm 3^{\circ} F$

Lift the leads from terminals TB1-11, TB1-12 and TB1-13 in JBX-1, connect a decade box to the wires. The TB1-11 lead connects to the isolated terminal on the decade box and the TB1-12 & 13 leads connect to the shorted terminals. Record the output from the Mini-DACS (Tag: TIR12A01) for the following points: (For the alarm settings take four readings and average.)

	AS FOUND ($^{\circ}F/DEC$)	INITIALS
100.63 $\Omega/32.16^{\circ}F$	32.1 / 33	RSC
115.94 $\Omega/100.37^{\circ}F$	100.3 / 841	RSC
137.39 $\Omega/200.04^{\circ}F$	200.0 / 1988	RSC
158.60 $\Omega/300^{\circ}F$	300.0 / 3142	RSC
137.39 $\Omega/200.04^{\circ}F$	200.0 / 1988	RSC
115.94 $\Omega/100.37^{\circ}F$	100.4 / 841	RSC
100.63 $\Omega/32.16^{\circ}F$	32.2 / 33	RSC
140.17 Ω Hi Alarm	220 / 2139	RSC
140.16 Ω Reset	219 / 2138	RSC
142.28 Ω Abort	230 / 2253	RSC
142.27 Ω Reset	229 / 2252	RSC

RSC 8/11/94
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4A-94-63/W
WCN-010

TE302B Pump Motor Oil Temperature Accuracy $\pm 3^{\circ} \text{ F}$

Lift the leads from terminals TB1-14, TB1-15 and TB1-16 in JBX-1, connect a decade box to the wires. The TB1-14 lead connects to the isolated terminal on the decade box and the TB1-15 & 16 leads connect to the shorted terminals. Record the output from the Mini-DACS (Tag: TIR12A02) for the following points: (For the alarm settings take four readings and average.)

	AS FOUND ($^{\circ}\text{F}/\text{DEC}$)	INITIALS
100.96 Ω /32.16 $^{\circ}\text{F}$	<u>32.0 / 50</u>	<u>RSC</u>
115.95 Ω /100.37 $^{\circ}\text{F}$	<u>100.2 / 841</u>	<u>RSC</u>
137.38 Ω /200.04 $^{\circ}\text{F}$	<u>199.1 / 1988</u>	<u>RSC</u>
158.59 Ω /300 $^{\circ}\text{F}$	<u>299.4 / 3142</u>	<u>RSC</u>
137.38 Ω /200.04 $^{\circ}\text{F}$	<u>200.0 / 1988</u>	<u>RSC</u>
115.95 Ω /100.37 $^{\circ}\text{F}$	<u>100.4 / 841</u>	<u>RSC</u>
100.96 Ω /32.16 $^{\circ}\text{F}$	<u>32.2 / 50</u>	<u>RSC</u>
140.17 Ω Hi Alarm	<u>220 / 2139</u>	<u>RSC</u>
140.16 Ω Reset	<u>220 / 2138</u>	<u>RSC</u>
142.28 Abort	<u>230 / 2253</u>	<u>RSC</u>
142.27 Reset	<u>230 / 2252</u>	<u>RSC</u>

8/11/94 RSC
CRAFT/Date

ATTACHMENT 7
4A-94-0063/W
WCN-010

4A-94-63/W
WCN-010

TE303A Backup Pump Motor Oil Temperature Accuracy $\pm 3^{\circ} F$

Lift the leads from terminals TB1-19, TB1-20 and TB1-21 in JBX-1, connect a decade box to the wires. The TB1-19 lead connects to the isolated terminal on the decade box and the TB1-20 & 21 leads connect to the shorted terminals. Record the output from the Mini-DACS (Tag: SPARE7, value is calculated from ModSoft) for the following points:

	AS FOUND ($^{\circ}F/DEC$)	INITIALS
100.96 $\Omega/32.1^{\circ}F$	<u>32.1 / 43</u>	<u>RJC</u>
115.93 $\Omega/100.38^{\circ} F$	<u>100.4 / 832</u>	<u>RJC</u>
137.41 $\Omega/200^{\circ} F$	<u>200.0 / 1981</u>	<u>RJC</u>
158.63 $\Omega/300.04^{\circ} F$	<u>300.0 / 3136</u>	<u>RJC</u>
137.41 $\Omega/200^{\circ} F$	<u>200.0 / 1981</u>	<u>RJC</u>
115.93 $\Omega/100.38^{\circ} F$	<u>100.4 / 832</u>	<u>RJC</u>
100.96 $\Omega/32.1^{\circ} F$	<u>32.0 / 43</u>	<u>RJC</u>

RJC 8/11/94
CRAFT/Date

WCN 005 C.R. Tech 8-9-94

$$* ((\text{modsoft DEC}/4095) * \text{Loop Range}) + 32^{\circ}F = \text{Actual Temp}$$

4A-94-63/W
WCN-010

TE303B Backup Pump Motor Oil Temperature Accuracy $\pm 3^{\circ} F$

Lift the leads from terminals TB1-22, TB1-23 and TB1-24 in JBX-1, connect a decade box to the wires. The TB1-22 lead connects to the isolated terminal on the decade box and the TB1-23 & 24 leads connect to the shorted terminals. Record the output from the Mini-DACS (Tag: SPARE8, value is calculated from Modsoft) for the following points:

	AS FOUND ($^{\circ}F/DEC$)	INITIALS
100.99 $\Omega/32.1^{\circ}F$	<u>32.0 / 51</u>	<u>RTL</u>
115.98 $\Omega/100.38^{\circ} F$	<u>100.4 / 843</u>	<u>RTL</u>
137.46 $\Omega/200^{\circ} F$	<u>200.0 / 1993</u>	<u>RTL</u>
158.68 $\Omega/300.04^{\circ} F$	<u>300.0 / 3149</u>	<u>RTL</u>
137.46 $\Omega/200^{\circ} F$	<u>200.1 / 1994</u>	<u>RTL</u>
115.98 $\Omega/100.38^{\circ} F$	<u>100.5 / 844</u>	<u>RTL</u>
100.99 $\Omega/32.1^{\circ} F$	<u>32.3 / 53</u>	<u>RTL</u>

WCN-005 C R Nash 8/9/94

RTL 8/11/94
CRAFT/Date

$$* \left(\left(\text{MODSOFT DEC} / 4095 \right) * \text{Loop Range} \right) + 32^{\circ}F = \text{Actual Temp.}$$

WCN 008
Allen K. B. Brewer
8/4/94

Replace strain gage calibration procedures with the following sheets.

Strain Gages

Complete for all six Ectron units.

A 2:1 divider has been installed on the output conditioner board. With gain set switch set to 1000 overall gain will be 500 at rear output BNC. Expected gage outputs are less than ± 2 mV, equal to $145.5 \mu\text{in/in}$, the alarm limit. Abort limit is $194 \mu\text{in/in}$ or ± 2.7 mV. Gage offsets may approach 20 mV, requiring careful selection of balance resistors R5 and R5B. See selection guide at end of procedures.

Guard has been connected to minus excitation on the voltage plug-in board. Guard (pin 13 to minus excitation of bridge (junction of R2, R3).

For the following setup, disconnect one end of the balance resistor R5A and R5B from their solder terminals. Set FINE and COURSE balance pots to about mid-range.

- 1) Connect signal cable plug to J1 on rear of Ectron, making sure none of the unterminated leads short. Set Ectron gain switch to 1000. Apply power to Ectron.
- 2) Ectron amp-input, amp-out, and excitation can be made by plugging hand calibrator in to front of Ectron. Five volt supply for the calibrator is not necessary. Connect DMM to blue calibrator cable.
- 3) Temporarily short green and white leads of input cable to shield (guard). Adjust RTO pot for best zero voltage at rear J2. Use hand calibrator set to amp out. Remove short.
- 4) Set a precision DC voltage source to +0.010 volts, and connect high side to green lead, and low side to white and shield leads of input cable. Adjust VERNIER GAIN pot as close as possible to +10.000 volts at rear J2 of Ectron. Use hand calibrator set to amp out. Disconnect voltage source.

ATTACHMENT 7

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- 5) Reconnect short between white, green, and shield leads.
- 6) Set calibrator to EXC V and rough adjust Ectron Excitation pot to 10 V.
- 7) Warm up Ectron's 2 hours and repeat steps 2, 3, and 4.
- 8) After zero and gain have stabilized, disconnect AC power to Channel # 1 Ectron by removing power plug from rear of amplifier.
- 9) Connect WE401 strain gage to Ectron input cable observing correct excitation and signal polarities.
- 10) Restore AC power to Ectron, measure gage offset using hand calibrator set to AMP-IN. Record this value for later use.
- 11) Again remove AC power from Ectron and also remove signal input plug from J1.
- 12) Slide amplifier from crate, remove left side panel, and solder appropriate balance resistors 5A and 5B to their terminals located on voltage plug-in card.
- 13) Install Ectron amplifier into crate, connect signal input plug to J1, and reconnect power plug.
- 14) Using hand calibrator set EXC V, adjust Ectron EXCITATION pot to 10 V plus estimated IxR loss to gage. This may be 0.1 V or more.
- 15) Set calibrator to AMP-IN and note amplifier input (millivolts).
- 16) Adjust COARSE balance pot over its entire range. Readjust COURSE pot for best zero at amplifier input.

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17) Adjust FINE balance pot over entire range. Ideally the FINE balance pot's zero should be near the center of its range. If not readjust COURSE balance pot to better center FINE balance pot's zero output.

18) Adjust FINE balance pot for best zero at Ectron J2 putput (use hand calibrator set to amp-out).

19) Repeat steps 9 through 18 for all strain gages.

	Initials		Initials	
WE401	<u><i>[Signature]</i></u>	WE402	<u><i>[Signature]</i></u>	<u><i>[Signature]</i></u> 8-11-94 CRAFT/Date
WE403	<u><i>[Signature]</i></u>	WE404	<u><i>[Signature]</i></u>	

Balance Resistor Selection Guide

R5A, R5B Max delta V mV for a 350 equal arm bridge

35.7 K	± 24.5 mV
41.2 K	± 21.4 mV
49.9 K	± 17.5 mV
75 K	± 11.6 mV
100 K	± 8.7 mV
150 K	± 5.8 mV
200 K	± 4.3 mV
301 K	± 2.9 mV

CALIBRATION PROCEDURES

2) Adjust COARSE balance pot to about zero at ECTRON rear BNC output.
Adjust FINE balance pot for best zero at Ectron rear BNC output

	Initials		Initials
WE401	_____	WE402	_____
WE403	_____	WE404	_____

CRAFT/Date

Accelerometer

WE307 Tap on pump motor casing and verify a signal is received at the Mini-DACS console (Tag: XIR12AN1). Record the max reading

* Reading See Below

Initials

[Signature]
8-8-94

Moisture Element

ME305 Lift one wire of the moisture element circuit at JBX-1. Short the terminals TB1-33 and TB1-34 in JBX-1 and verify an alarm is received at the Mini-DACS console (Tag: MIP00001).

Alarm Received (Initial)

XX CR Nash 8-10-94

* Response was noted on Modsoft; however, value was not large enough to provide a Genesis indication.

XX NOTED Green DOT change to Red

SCB 8-8-94
XX 8-8-94

**Westinghouse
Hanford Company**

From: Thermal Hydraulic Analysis 7E870-LEE-94-067
Phone: 376-5377 H0-33
Date: September 6, 1994
Subject: EVALUATION AND ANALYSIS OF DOUBLE-SHELL TANK 241-SY-101 MIXER
PUMP-2 PERFORMANCE TESTING AT MASF

To: J. W. Lentsch S7-15
T. R. Benegas N1-27

cc: K. F. Armatis N1-27 R. E. Merriman L4-90
S. A. Brisbin N1-21 C. P. Shaw L5-07
K. G. Carothers R1-51 N. D. Tamppari R1-51
J. G. Fadeff H0-33 J. R. Vincent N2-33
C. E. Hanson H5-09 LEE File/LB
J. J. Irwin H0-33

Reference: WHC 1994, Armatis, K. F., Roblyer, S. P. and Fadeff, J. G.,
*Test Plan for Run-in Acceptance Testing of Hydrogen
Mitigation Test Pump-2*, WHC-SD-WM-TP-220, Rev. 0,
Westinghouse Hanford Company, Richland, Washington.

SUMMARY

The purpose of this letter is to document the performance of the replacement mixer pump, pump number 2, for the Double-Shell Tank (DST) 241-SY-101 mitigation program. Pump number 2 was tested at the Maintenance Assembly and Storage Facility (MASF) from August 12 through 18, 1994 in the water-filled Large Diameter Cleaning Vessel (LDCV). A series of tests were performed where the pump was operated at speeds from 500 rpm to 1180 rpm. A number of long-duration run-in tests were performed at 1100 and 1180 rpm. All tests were performed in accordance with an approved test plan, (Armatis, et al 1994). Pump performance test data were recorded by a mini-DACS, stored on magnetic media, and transferred to the TWRS Thermal Hydraulics group for analysis.

Included are evaluations of the pump performance relative to centrifugal pump affinity laws and pump motor oil temperature transient responses experienced during testing. An additional investigation was performed to determine the calorimetric heat loss from the pump during various pump test periods. This latter investigation provides an estimate of the pump power factor.

CONCLUSIONS

The following conclusions were drawn from the data evaluation:

- Power factor evaluations were developed using calorimetric data derived from the water heat-up rate in the LDCV. Results ranged from 0.85 to 0.89 at 1180 rpm

J. W. Lentsch
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September 6, 1994

- Pump efficiency evaluations indicated a range from 66 percent at 1180 rpm to a minimum of 22 percent at 500 rpm
- Motor oil transients following an oil change resulted in an apparent reduction in the oil temperature heat-up rate; however, a definitive evaluation could not be performed since testing with the initial oil employed was not carried out to an equilibrium, maximum temperature condition
- The performance of Pump number 2 nearly duplicated that of the current mixer pump
- The pressure sensor at the pump volute location displayed significant noise
- Sufficient data have been obtained to refine the transient analysis model of motor oil heat-up
- Pump motor oil transient temperature heat-up decreased by about 26% following motor oil change-out prior to Performance Test 2.

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TWRS Thermal Hydraulics

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TWRS Thermal Hydraulics

skw

Attachment

CONCURRENCE:

T. B. McCall, Manager
TWRS Thermal Hydraulics

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SY-101 MIXER PUMP-2 PERFORMANCE ANALYSES

CONCLUSIONS

The following conclusions were drawn from the data evaluation:

- Power factor evaluations were developed using calorimetric data derived from the water heat-up rate in the LDCV. Results ranged from 0.85 to 0.89 at 1180 rpm
- Pump efficiency evaluations indicated a range of 66 percent at 1180 rpm to a minimum of 22 percent at 500 rpm
- Motor oil transients following an oil change resulted in an apparent reduction in the oil temperature heat-up rate; however, a definitive evaluation could not be performed since testing with the initial oil employed was not carried out to an equilibrium, maximum temperature condition
- The performance of Pump number 2 nearly duplicated that of the current mixer pump
- The pressure sensor at the pump volute location displayed significant noise
- Sufficient data have been obtained to refine the transient analysis model of motor oil heat-up
- Pump motor oil transient temperature heat-up decreased by about 26% following motor oil change-out prior to Performance Test 2.

PUMP-2 DATA ANALYSES

The pump-2 test summary is shown in Table 1. Performance test 1 consisted of short-duration test runs for a maximum period of 20 minutes at each of five discrete pump speeds of 500, 700, 900, 1100 and 1180 rpm. Performance test 2 was a repeat of test 1 following replacement of the pump oil. Run-in test 1 was a nominal 72 hour duration test with the pump operating at speeds of 1100 and 1180 rpm. Run-in test 2 was a nominal 12 hour duration test with the pump operating at a speed of 1180 rpm.

The time-history data for the SY-101 mixer pump-2 run-in test at the MASF was analyzed for each pump run. The data from the performance tests is utilized to develop the characteristic pump curve for pump-2 and to assess pump heat-up trends. The data from the run-in tests is utilized to develop long term characteristics for pump-2, to assess pump heat-up trends and to determine a power factor for the pump.

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The pump speed histogram for the pump-2 tests at MASF is depicted in Figures 1a and 1b. Performance test 1 and 2 and run-in tests 1 and 2 are noted on the figures. Run-in test 1 had numerous start and stop cycles as well as an elapsed pump operation time of 71 hours, 22 minutes at 1100 or 1180 rpm.

Table 1. Pump Performance Test Summary.

Test Name	Test Period	Remarks
Performance Test 1	8/12/94 - 8/13/94	Pump Speeds at 500, 700, 900, 1100 and 1180 rpm, initial startup
Performance Test 2	8/13/94	Pump Speeds at 500, 700, 900, 1100 and 1180 rpm, pump oil changed prior to start of test
Run-In Test 1	8/13/94 - 8/16/94	Pump Speeds at 1100 and 1180 rpm, 71.37 hour duration
Run-In Test 2	8/18/94	Pump Speed at 1180 rpm, 12.83 hour duration.

PUMP PARAMETERS

Various pump parameters were monitored to observe and analyze pump operation. These parameters consisted of the following:

- pump operating current
- pump operating voltage
- pump volute pressure
- pressure at the pump discharge nozzle exit
- pump motor oil temperature
- temperature of water flowing through the pump discharge pipes.

The pump performance data was recorded on a mini-DACS (similar to the DST 241-SY-101 DACS) located at the MASF. The data was recorded every 6 seconds during the pump tests and downloaded to magnetic media (DOS formatted floppy disks) as ASCII text files. These files were then imported into a spread sheet computer program (Quattro Pro for Windows Vers. 5.0) for data reduction and analysis. The data, both measured and calculated values, were then imported into a scientific graphing program (Grapher for Windows Vers. 1.3) for display and curve fitting.

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MIXER PUMP PERFORMANCE SUMMARY

The results given in Figure 2 display values of various pump parameters from the experimental data. Figure 2 contains the important pump performance parameters determined during pump-2 testing (the pump volute pressure, calculated motor input power and calculated pump flow rate as a function of pump speed). It is clear from the small scatter of the data at each speed that the pump performance was highly repeatable. Figure 3 contains plots of the same pump parameters as determined for pump-1, currently installed in DST 241-SY-101. Figure 3 was developed from the pump-1 run-in tests conducted at the MASF during September 1992 as has been previously reported.

Comparison of Figures 2 and 3 shows that pump-2 behaves in a similar fashion to pump-1. Pump performance is discussed in more detail in the following sections.

PUMP OIL TEMPERATURE TREND

Figures 4 through 9 contain the pump temperature histograms for the entire test sequence. Pump motor oil temperature and the temperature of the water flowing through the pump downcomer pipes are plotted as a function of time. The pump speed is also plotted to relate the effect of pump temperature with respect to the pump test operations.

The pump motor oil temperature increases to an equilibrium value following the start of the pump and the continued operation of the pump. The period of time to reach a quasi-steady state equilibrium value was approximately 2.5 hours for the 1180 rpm pump operation. The maximum pump motor oil temperature achieved during the test sequence was 220 °F. This temperature was reached at the near the end of the 12 hr 50 min test program on August 18, as shown in Figure 9.

A number of pump oil startup transients are exhibited in the test data. The run-in test 2 data contains the most useful data as shown in Figure 9. This latter test was started after a 36-hour idle period (no pump operations), thus the oil temperature approached the ambient temperature prior to startup. Run-in test 2 was also run to completion without interruptions in the pump operation.

The water temperature shows a small increase in temperature during the total pump sequence increasing from 75 °F, at the start of performance test 1 (Figure 4), to 118 °F at the completion of the last Run-in test (Figure 9). It should be noted that there is a 5 °F difference between the water temperature and the oil temperature prior to the start of the test sequence as shown in Figure 4. The temperatures should be nearly the same, the difference may be due to a calibration shift between the temperature sensors.

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PUMP CURRENT AND PUMP VOLTAGE

The pump current displays relatively constant behavior for the tests performed during the pump-2 test sequence as shown in Figures 10 through 15. No general trend from the phased-speed tests can be discerned.

The pump operating voltage, given in the same figures, also displays nearly constant behavior for the entire pump-2 test sequence. Minimal overall change in voltage was noted at each discrete rpm for all tests. This is indicative since changes in current were minimal.

PUMP INPUT POWER

Figures 16 and 17 contain the plot of pump motor input power, in units of horsepower, versus pump speed for all of the performance tests. These data were curve fitted using a polynomial regression technique and the equation of the curve determined. This curve fit is also shown in Figures 16 and 17. The curve fit determined that the pump input power increases as a power of approximately 2 as the pump speed increases. This trend includes electrical losses imposed by use of a variable-speed drive, and is the reason for a deviation from a pump affinity law that states that pump power increases as the cube power of the pump speed.

Figures 16 and 17 depict the pump input power requirement which for a three-phase motor is defined as the following:

$$\text{Input Power} = \frac{\sqrt{3}VA \times (pf)}{746} \quad [hp] \quad (1)$$

where,

V = voltage, Volts

A = current, Amps

pf = power factor = 0.85 to 0.95.

The figures show a set of three curves for each performance test having a power factor at 0.85, 0.89 or 0.95. The power factors of 0.85 and 0.89 were determined from a calorimetric data analysis described in the following section. The 0.95 power factor was the vendor-recommended power factor for pump-1 that is currently installed in DST 241-SY-101 and is included here for comparison purposes.

POWER FACTOR DETERMINATION BY CALORIMETRY

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The electrical power factor is defined as the ratio of the actual power converted by the motor to the apparent power, or (VA). Actual power is dissipated through losses at the motor and centrifugal pump as well as jet turbulence - all of which appear as heat addition to the 2270 ft³ of water contained in the LDCV. Motor loss components have been estimated by the supplier, Reliance Electric, and consist of; I²R losses of 20% and 45% at the rotor and stator, respectively, 5% frictional and windage, 18% core/iron losses, and 12% due to stray load losses. Pump losses consist of shaft seal friction, bearing friction, and fluid losses in the impeller passage and volute housing. Figure 5a describes the water heat-up rate and the oil reservoir heat-up rate which defines the actual power produced by the motor.

Examples of the power factor values of 0.89, 0.85, and 0.855 are derived from the water temperature heat-up rates displayed in Figures 5a, 7b, and 9, respectively. Additional evaluation is required for these cases due to the small amount of heat loss from the LDCV to the surrounding concrete enclosure. Note that power factor derivations have been limited to 1180 rpm operation.

PUMP HYDRAULIC POWER

The pump flow power, or hydraulic horsepower, is defined as the rate of energy supplied by the pump to the pumped fluid and is ultimately dissipated in the tank enclosure via jet mixing. Pump flow power is calculated from the product of pump volute pressure differential (volute pressure minus the static head) and flow rate with conversion to units of horsepower. The flow rate was calculated from the water-test data as described in a later section (see Pump Flow Rate). The pump flow power was calculated at each data time step as recorded by the mini-DACS. These calculated values are then used to calculate the net overall efficiency of the pump/motor combination.

PUMP EFFICIENCY

The net efficiency of the pump is the ratio of the hydraulic horsepower to the actual power (electrical equivalent) at the motor. The pump efficiency at each data point for the performance tests 1 and 2 was calculated by the use of a spread sheet computer program. Figures 18 and 19 show the results of these calculations for performance test 1 and 2 respectively. The figures depict the pump efficiency as a function of pump speed as well as a correlation for assumed pump power factor. Note that the losses incurred by the variable-speed drive (VSD) are not considered in this definition of efficiency since the apparent power was determined as input (VA product) to the motor as measured at the variable-speed drive.

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PUMP VOLUTE PRESSURE

Figure 20a and 21a contain plots of pump volute pressure versus pump speed for the completed pump-2 performance tests. This data was curve fitted using a polynomial regression technique and the equation of the curve determined. This curve fit is also shown in Figures 20a and 21a. The curve fit determined that the pump discharge pressure increases as a power of approximately two as the pump speed increases. This agrees with a pump affinity law that states that pump head increases as the square of the pump speed.

Figures 20b and 21b are also presented, these figures depict the volute pressure readings as a function of time as recorded during the performance tests 1 and 2. The data shows a large fluctuation of the pressure readings at a given pump speed. Variations in the pressure reading of up to ± 3 psia are displayed.

PUMP NOZZLE PRESSURE

Figures 22 through 25 display the pump nozzle pressure as a function of pump speed for all of the completed tests. Data for both pump nozzles is presented as well as data for performance tests 1 and 2. The data were curve fitted to a power law which shows that the nozzle pressure is approximately proportional to the square of the pump speed. As before, this is in agreement with the pump affinity law which states that pump head is proportional to the square of the pump speed. This behavior is expected since the pressure head is only measured at a different location for this case.

PUMP FLOW RATE

Figures 26 and 27 display the pump volumetric flow rate in units of gallons per minute (gpm) versus pump speed. Since the pump flow rate was not directly measured, the pump flow rate was determined from the pressure drop across the downcomer flow nozzles. Each nozzle is a flow measurement device which has been calibrated by the pump supplier and verified with flow testing on pump number 1 flow nozzles. The flow rate is calculated from the measured pressure at the flow nozzle from the following:

$$Q_{act} = K A_2 \sqrt{\frac{2g_c}{\rho} (P_1 - P_2)}$$

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where,

Q_{act} = Volumetric Flow rate, cu ft/sec

K = Flow discharge coefficient, 0.992

A_2 = Flow discharge area, sq. ft. (with diameter specified at 2.6 inches)

g_c = Conversion constant, 32.174 Lbm-ft/Lbf-sec²

ρ = Fluid density, Lbm/cu ft

P_1 = Upstream pressure, Lbf/sq in

P_2 = Downstream pressure, Lbf/sq in.

The pump nozzle data as recorded during performance tests 1 and 2 were utilized to calculate the total pump flow rate at the pump operating speeds. The calculated pump flow rate versus pump speed are depicted in Figures 26 and 27 for performance test 1 and 2 respectively. A linear regression analysis of the calculated pump flow rate were then performed by the use of the Grapher computer program. The results of the linear regression are shown on Figures 26 and 27. The pump flow rate linear relationship with respect to pump speed agrees with the pump affinity laws which state that the volumetric flow rate is proportional to pump speed.

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Figures

- 1a. Pump 2 Run-In Test At MASF - Pump Speed Histogram (August 12 - 16, 1994)
- 1b. Pump 2 Run-In Test At MASF - Pump Speed Histogram (August 16 - 18, 1994)
2. Pump 2 Run-In Test At MASF - Pump Performance Summary (August 13, 1994)
3. Pump 1 Run-In Test At MASF - Pump Performance Summary (September 23 - 24, 1992)
4. Pump 2 Run-In Test At MASF - Pump Speed and Temperature Histogram (August 12, 1994)
- 5a. Pump 2 Run-In Test At MASF - Pump Speed and Temperature Histogram (August 13, 1994)
- 5b. Pump 2 Run-In Test At MASF - Pump Speed and Temperature Histogram (August 13, 1994)
- 6a. Pump 2 Run-In Test At MASF - Pump Speed and Temperature Histogram (August 14, 1994)
- 6b. Pump 2 Run-In Test At MASF - Pump Speed and Temperature Histogram (August 14, 1994)
- 7a. Pump 2 Run-In Test At MASF - Pump Speed and Temperature Histogram (August 15, 1994)
- 7b. Pump 2 Run-In Test At MASF - Pump Speed and Temperature Histogram (August 15, 1994)
- 8a. Pump 2 Run-In Test At MASF - Pump Speed and Temperature Histogram (August 16, 1994)
- 8b. Pump 2 Run-In Test At MASF - Pump Speed and Temperature Histogram (August 16, 1994)
9. Pump 2 Run-In Test At MASF - Pump Speed and Temperature Histogram (August 18, 1994)
10. Pump 2 Run-In Test At MASF - Pump Speed, Current and Voltage Histogram (August 12, 1994)
- 11a. Pump 2 Run-In Test At MASF - Pump Speed, Current and Voltage Histogram (August 13, 1994)
- 11b. Pump 2 Run-In Test At MASF - Pump Speed, Current and Voltage Histogram (August 13, 1994)

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- 12a. Pump 2 Run-In Test At MASF - Pump Speed, Current and Voltage Histogram (August 14, 1994)
- 12b. Pump 2 Run-In Test At MASF - Pump Speed, Current and Voltage Histogram (August 14, 1994)
- 13a. Pump 2 Run-In Test At MASF - Pump Speed, Current and Voltage Histogram (August 15, 1994)
- 13b. Pump 2 Run-In Test At MASF - Pump Speed, Current and Voltage Histogram (August 15, 1994)
- 14a. Pump 2 Run-In Test At MASF - Pump Speed, Current and Voltage Histogram (August 16, 1994)
- 14b. Pump 2 Run-In Test At MASF - Pump Speed, Current and Voltage Histogram (August 16, 1994) {VA8_16b.wp5}
- 15. Pump 2 Run-In Test At MASF - Pump Speed, Current and Voltage Histogram (August 18, 1994)
- 16. Pump 2 Run-In Test At MASF - Pump Power vs. Pump Speed at Various Power Factors (August 12, 1994)
- 17. Pump 2 Run-In Test At MASF - Pump Power vs. Pump Speed at Various Power Factors (August 13, 1994)
- 18. Pump 2 Run-In Test At MASF - Pump Efficiency vs. Pump Speed at Various Power Factors (August 12, 1994)
- 19. Pump 2 Run-In Test At MASF - Pump Efficiency vs. Pump Speed at Various Power Factors (August 13, 1994)
- 20a. Pump 2 Run-In Test At MASF - Pump Volute Pressure vs. Pump Speed (August 12, 1994)
- 20b. Pump 2 Run-In Test At MASF - Pump Volute Pressure Histogram (August 12, 1994)
- 21a. Pump 2 Run-In Test At MASF - Pump Volute Pressure vs. Pump Speed (August 13, 1994)
- 21b. Pump 2 Run-In Test At MASF - Pump Volute Pressure Histogram (August 13, 1994)
- 22. Pump 2 Run-In Test At MASF - Pump Nozzle 1 Pressure vs. Pump Speed (August 12, 1994)

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23. Pump 2 Run-In Test At MASF - Pump Nozzle 1 Pressure vs. Pump Speed (August 13, 1994)
24. Pump 2 Run-In Test At MASF - Pump Nozzle 2 Pressure vs. Pump Speed (August 12, 1994)
25. Pump 2 Run-In Test At MASF - Pump Nozzle 2 Pressure vs. Pump Speed (August 13, 1994)
26. Pump 2 Run-In Test At MASF - Pump Flow Rate vs. Pump Speed (August 12, 1994)
27. Pump 2 Run-In Test At MASF - Pump Flow Rate vs. Pump Speed (August 13, 1994)

Figure 2. Pump 2 Run-In Test At MASF - Pump Performance Summary (August 13, 1994)

Figure 3. Pump 1 Run-In Test At MASF - Pump Performance Summary (September 23 - 24, 1992)

Figure 4. Pump 2 Run-In Test At MASF
Pump Speed and Temperature Histogram (August 12, 1994)

Figure 5a. Pump 2 Run-In Test At MASF
Pump Speed and Temperature Histogram (August 13, 1994)

Figure 5b. Pump 2 Run-In Test At MASF
Pump Speed and Temperature Histogram (August 13, 1994)

Figure 6a. Pump 2 Run-In Test At MASF
Pump Speed and Temperature Histogram (August 14, 1994)

Figure 6b. Pump 2 Run-In Test At MASF
Pump Speed and Temperature Histogram (August 14, 1994)

Figure 7a. Pump 2 Run-In Test At MASF
Pump Speed and Temperature Histogram (August 15, 1994)

Figure 7b. Pump 2 Run-In Test At MASF
Pump Speed and Temperature Histogram (August 15, 1994)

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Figure 8a. Pump 2 Run-In Test At MASF
Pump Speed and Temperature Histogram (August 16, 1994)

Figure 8b. Pump 2 Run-In Test At MASF
Pump Speed and Temperature Histogram (August 16, 1994)

Figure 9. Pump 2 Run-In Test At MASF
Pump Speed and Temperature Histogram (August 18, 1994)

Figure 10. Pump 2 Run-In Test At MASF
Pump Speed, Current and Voltage Histogram (August 12, 1994)

Figure 11a. Pump 2 Run-In Test At MASF
Pump Speed, Current and Voltage Histogram (August 13, 1994)

Figure 11b. Pump 2 Run-In Test At MASF
Pump Speed, Current and Voltage Histogram (August 13, 1994)

Figure 12a. Pump 2 Run-In Test At MASF
Pump Speed, Current and Voltage Histogram (August 14, 1994)

Figure 12b. Pump 2 Run-In Test At MASF
Pump Speed, Current and Voltage Histogram (August 14, 1994)

Figure 13a. Pump 2 Run-In Test At MASF
Pump Speed, Current and Voltage Histogram (August 15, 1994)

Figure 13b. Pump 2 Run-In Test At MASF
Pump Speed, Current and Voltage Histogram (August 15, 1994)

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Figure 14a. Pump 2 Run-In Test At MASF
Pump Speed, Current and Voltage Histogram (August 16, 1994)

Figure 14b. Pump 2 Run-In Test At MASF
Pump Speed, Current and Voltage Histogram (August 16, 1994)

Figure 15. Pump 2 Run-In Test At MASF
Pump Speed, Current and Voltage Histogram (August 18, 1994)

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Figure 16. Pump 2 Run-In Test At MASF
Pump Power vs. Pump Speed at Various Power Factors (August 12, 1994)

Figure 17. Pump 2 Run-In Test At MASF
Pump Power vs. Pump Speed at Various Power Factors (August 13, 1994)

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Figure 18. Pump 2 Run-In Test At MASF
Pump Efficiency vs. Pump Speed at Various Power Factors (August 12, 1994)

Figure 19. Pump 2 Run-In Test At MASF
Pump Efficiency vs. Pump Speed at Various Power Factors (August 13, 1994)

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Figure 20a. Pump 2 Run-In Test At MASF
Pump Volute Pressure vs. Pump Speed (August 12, 1994)

Figure 20b. Pump 2 Run-In Test At MASF
Pump Volute Pressure Histogram (August 12, 1994)

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Figure 21a. Pump 2 Run-In Test At MASF
Pump Volute Pressure vs. Pump Speed (August 13, 1994)

Figure 21b. Pump 2 Run-In Test At MASF
Pump Volute Pressure Histogram (August 13, 1994)

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Figure 22. Pump 2 Run-In Test At MASF
Pump Nozzle 1 Pressure vs. Pump Speed (August 12, 1994)

Figure 23. Pump 2 Run-In Test At MASF
Pump Nozzle 1 Pressure vs. Pump Speed (August 13, 1994)

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Figure 24. Pump 2 Run-In Test At MASF
Pump Nozzle 2 Pressure vs. Pump Speed (August 12, 1994)

Figure 25. Pump 2 Run-In Test At MASF
Pump Nozzle 2 Pressure vs. Pump Speed (August 13, 1994)

ATTACHMENT
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Figure 26. Pump 2 Run-In Test At MASF
Pump Flow Rate vs. Pump Speed (August 12, 1994)

Figure 27. Pump 2 Run-In Test At MASF
Pump Flow Rate vs. Pump Speed (August 13, 1994)

Main Menu MIXER PUMP [PUMP] MASFTST V1.02 22:38:03 28/12/94

ALARM ANNUNCIATOR ? Y
 DISPLAY UPDATE PERIOD 1.00 sec
 LOG(Y) or TEND(N) ? N
 CAN PERIODS: 0.50 0.00 0.00 0.00
 SYSTEM PARAMETERS
 ALARM PRINT ? Y
 SCAN I/O ? Y
 EVENTS PRINT ? N
 DISABLE TABBING TO PICKS ? N
 GLOBAL ALARM SQUELCH Y
 DSP0 AMK0 LOG0 PRNG
 ALARMS TO DISK ? Y
 EVENTS TO DISK ? Y
 ATTEM NIO COM

PRIOR To Pump RUN 8/12/94 22:38

HISTORY REPLAY

Aug 13/1994
15:26:58

??date??

1200.0
70.00
70.00

0.00
0.00
0.00

14:10:47 ??date?? 14:33:17 15:10:47 ??date??

VR232050 OUT 99.794 RPM
SPARE1 OUT 37.299 PSIG
SPARE2 OUT 37.094 PSIG

HISTORY FILE : 48DEPUMP

REL. TIME	X	Y 1	Y 2	Y 3	Y 4	Y 5	LOGARITHM	N
MIN 0:10	0.0	0.00	0.00	0.00	0.00	0.00	X GRIDS	4
MAX 1:10	0.0	1200.00	70.00	70.00	460.00	225.00	Y GRIDS	4

CFM-MF

1" restart
test
pump
speed
spike
5

Main Menu
PUMP OPERATIONS
(2 MINUTE TREND)

[PUMPOPS]

MASTEST
U1.02

03:44:43 08/14/94

VOLUME PSIA (30-150) NOZZLE PSIG (-10-60) NOZZLE TEMP (50-155°F)

PIR12AQ1

PIIN0110 PIIN0111

TIIN0101 TIIN0202

OIL TEMP (50-240°F) PUMP SPEED (0-1200 RPM) MOTOR AMPS (0-225 A)

HISTORY REPLAY

Aug 14/1994
22:45:19

Aug 14/94
80.00
190.00
15.00
460.00
225.00

0.00
0.00
0.00
0.00
0.00

22:00:02 Aug 14/94 22:26:08

XIR12AN1	OUT	4.376	G'S
ZIMPE112	OUT	96.000	DEG
ZIMPE142	OUT	9.194	PSIG
VR232020	OUT	425.999	VAC
VR232040	OUT	122.101	AMPS

HISTORY FILE : 48EMPUMP

REL. TIME	X	Y 1	Y 2	Y 3	Y 4	Y 5	LOGARITHM	N
MIN 0:00	0.0	0.00	0.00	0.00	0.00	0.00	X GRIDS	4
MAX 1:00	0.0	80.00	190.00	15.00	460.00	225.00	Y GRIDS	4

ALARM DIC Z7MPE1A2 GEN-MF

HISTORY REPLAY

Aug 14/1994
22:47:53

Aug 14/94
80.00
190.00
15.00
460.00
225.00

0.00
0.00
0.00
0.00
0.00

22:00:02 Aug 14/94 22:14:38
XIR12AN1 OUT 4.435 G'S
ZIMPE112 OUT 96.000 DEG
ZIMPE142 OUT 9.040 PSIG
VR232020 OUT 425.999 VAC
VR232040 OUT 121.600 AMPS

HISTORY FILE: 48EMPUMP

REL. TIME	X	Y 1	Y 2	Y 3	Y 4	Y 5	LOGARITHM	N
MIN 0:00	0.0	0.00	0.00	0.00	0.00	0.00	X GRIDS	4
MAX 1:00	0.0	80.00	190.00	15.00	460.00	225.00	Y GRIDS	4

ALARM DIG 77MPE142 CFM-NE

- T R E N D -

Aug 15/9
08:36:22

1 Minute

1200.00
1000.00
700.00
700.00
15.00

0.00
0.00
0.00
0.00
0.00

VAR	OUT	RPM
VR232050	OUT	1299.80
PIR12A01	OUT	65.31
PITN0110	OUT	36.32
PITN0111	OUT	35.95
PN2P0506	OUT	10.85

AG NAME	PIR12A01	VAR	out	TREND MENU	TREND PEN #: 1
SF1:	ADD POINT	SF2:	REMOVE POINT	SF3:	ASSIGN PEN
SF5:	ORIGINAL	SF6:	ZOOM	SF7:	UNZOOM
SF9:	TREND	SF10:	LOAD SNAPSHOT	ALT T:	SAVE SNAPSHOT
					PG KEYS: GROUP

CEN-NF

Aug 15/9
09:56:29

- T R E N D -

1 Minute

1181.00
70.00
70.00

1178.00
0.00
0.00

VR232050	OUT	1179.40	RPM
SPARE2	OUT	42.31	PSIG
SPARE1	OUT	43.38	PSIG

AG NAME	VAR	out	TREND MENU	TREND PEN #: 1
SF1: ADD POINT	:SF2: REMOVE POINT	:SF3: TREND LIST	:SF4: ASSIGN PEN	
SF5: ORIGINAL	:SF6: ZOOM	:SF7: UNZOOM	:SF8: 1,6, > 30 min	
SF9: TREND	:SF10: LOAD SNAPSHOT	:ALT T: SAVE SNAPSHOT	:PG KEYS: GROUP	

C74-MF

Aug 15/9
09:57:43

- T R E N D -

1 Minute

1181.00
70.00
70.00

1178.00
0.00
0.00

VR232050	OUT	1179.40	RPM
SPARE2	OUT	42.40	PSIG
SPARE1	OUT	42.56	PSIG

AG NAME	VAR out	TREND MENU	TREND PEN #: 1
SF1: ADD POINT	SF2: REMOVE POINT	SF3: TREND LIST	SF4: ASSIGN PEN
SF5: ORIGINAL	SF6: ZOOM	SF7: UNZOOM	SF8: 1, 6, > 30 min
SF9: TREND	SF10: LOAD SNAPSHOT	ALI T: SAVE SNAPSHOT	:PG KEYS: GROUP

CFM-NF

TREND

Aug 15/9
10:26:56

1 Minute

1181.00
70.00
70.00

1178.00
0.00
0.00

VR232050 OUT 0.00 RPM
SPARE2 OUT 0.00 PSIG
SPARE1 OUT 0.00 PSIG

HISTORY FILE: 48FASIRN

REL. TIME	X	Y 1	Y 2	Y 3	Y 4	Y 5	LOGARITHM	N
MIN 0:00	0.0	-760.00	-760.00	-760.00	-760.00	0.00	X GRIDS	4
MAX 1:00	0.0	760.00	760.00	760.00	760.00	0.00	Y GRIDS	4

ALARM DIC CRO+ CFM-MF

HISTORY REPLAY

Aug 15/1994
11:10:08

??date??

80.00
190.00
15.00
460.00
225.00

0.00
0.00
0.00
0.00
0.00

04:44:56 ??date??

XIR12AN1 OUT 0.039
ZIMPE112 OUT 96.000
ZIMPE142 OUT 6.736
UR232020 OUT 0.000
UR232040 OUT 0.000

05:44:50

G'S
DEG
PSIG
VAC
AMPS

05:44:56

HISTORY FILE : 48F4PUMP

REL. TIME	X	Y 1	Y 2	Y 3	Y 4	Y 5	LOGARITHM	N
MIN 0:45	0.0	0.00	0.00	0.00	0.00	0.00	X GRIDS	4
MAX 1:45	0.0	80.00	190.00	15.00	460.00	225.00	Y GRIDS	4

NETWORK: [STATION7] Now Offline

ALARM DTC 0001

CFR-NE

- T R E N D -

Aug 15/9
15:15:06

1 Minute

1200.00
70.00
70.00

900.00
0.00
0.00

UR232050	OUT	1179.40	RPM
SPARE2	OUT	42.74	PSIG
SPARE1	OUT	42.63	PSIG

TAG TIR12A01	CHAR	PUMP MOTOR OIL TEMP A	SCAN 1.00	sec
out a	203.9	DEG F	HRG 4095.00	LRG 0.00 HLM 4095.0 LLM 0.000
2034.0			HRG 4095.00	LRG 0.00
		IALM N	INIT N	
		0.00 RPM	DIG 77MDE142	CEN-RE

44

11:46 - Pump restarted on command of Bob N., Kim A., Test Eng. J.R.V. and LE Bob G for 2 hrs.

11:48 Was instructed to turn off feed? Bleed system by Bob Nash and LE Bob G.

13:40 ~~I~~ ~~to~~ Shut down pump as instructed by test ENG and Bob G. at Elapsed time 1:54:47 This was done because 72 hour accum. time was reached.

14:30 Measured breakaway Torque values for Mixer Pump-2 rotation. Used a calibrated torque wrench 0-2000 ft-lb range from Equipment Pool. Started at 0° (shipping position and went 30° clockwise and 45° counter clockwise. See results below

MAX TORQUE (FT-LBS)

Position (°)	Initial Rotation	Return Rotation
0-15	① 225	④ 150
15-30	② 400*	③ 200
0-345	⑤ 500	⑩ 800
345-330	⑥ 1000	⑨ 1000
330-315	⑦ 1200	⑧ 1200**
315-300	Stopped	

* Brake hydraulic hose tie wrap.
** Removed flange bolts.

KAISER ENGINEERS HANFORD		SURVEY DATA REPORT		- 9 4 4 - 3 2 9	
Project/W.O. No.		Title		File No.	
		FAB 101-SY SPARE PUMP		2 W S Y - 0 0 7	
KEH Job No.		Prepared By		Date	
CR±347		N.P. Fastabend		08/15/94	
				Reviewer	
				SAW - 1 1	
DESCRIPTION OF WORK		ACCEPTABILITY (Within Plan Tolerance)		DISTRIBUTION	
		Yes ☐		Survey File OR	
		No ☐		Field Project File --	
Check plumbness of pump while suspended		NA ☐		M.A. Butterworth 1	
in highbay at MASF Bldg.		TBD by		R. Kolowith 1	
		Requestor ☒			

SURVEY RESULTS AND COMMENTS

(STRONG BACK ATTACHMENTS ORIENTED NORTH AT TIME OF SURVEY)

Westinghouse Hanford Company		NDE ULTRASONIC MEASUREMENT PROCEDURE AND TEST REPORT <small>NONDESTRUCTIVE EXAMINATION 306 BLDG., 300 AREA - TEL. 376-5401</small>				94-2																			
Requester (client)		Company	MSIN	Bldg.	Area	PART INFORMATION																			
J.R. VINCENT		WHC	N2-33	4710	400	Material <u>C/S</u>																			
Project/System/Work Package/Traveler No.						Wall Thickness <u>0.937" NOMINAL</u> ☐ NA																			
ULTRASONIC THICKNESS MEASUREMENT ON 241-SY-101 SPARE PUMP						Diameter <u>18"</u> ☐ NA																			
CRUSH RING BARREL. WORK PACKAGE #4A-94-0078/W WORK ORDER						Schedule <u>80</u> ☐ NA																			
#B-5005.						Size ☒ NA																			
Acceptance Std.		Section	Para.	Date	☐ NA	Dwg. No.	☒ NA NCR ☒ NA																		
INFORMATION ONLY, ACCEPTANCE BY CLIENT																									
WHC PROCEDURE NO.				RESULTS NOTE: READINGS TAKEN GOING CLOCKWISE. LOOKING FROM THE HEAD END. THICKNESS READINGS TAKEN IN AREAS GROUND IN THE UNIT. 8 LOCATIONS.																					
NDT-UT-8000, Revision No. <u>3</u>																									
Appendix <u>A</u> Revision No. <u>2</u>																									
Special Technique No. ☒ NA																									
COVERAGE ☒ 100% of Area Requested ☐ Other _____																									
INSTRUMENTATION Mfg. <u>NORTEC</u> Model <u>124-D</u> Standards Lab No. <u>584-31-50-024</u> Expiration Date <u>11/30/94</u>				<table style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th style="text-align: left;">LOCATION NUMBER</th> <th style="text-align: left;">THICKNESS MEASUREMENT</th> </tr> </thead> <tbody> <tr><td>#1</td><td>.932"</td></tr> <tr><td>#2</td><td>.922"</td></tr> <tr><td>#3</td><td>.914"</td></tr> <tr><td>#4</td><td>.921"</td></tr> <tr><td>#5</td><td>.925"</td></tr> <tr><td>#6</td><td>.922"</td></tr> <tr><td>#7</td><td>.925"</td></tr> <tr><td>#8</td><td>.919"</td></tr> </tbody> </table>				LOCATION NUMBER	THICKNESS MEASUREMENT	#1	.932"	#2	.922"	#3	.914"	#4	.921"	#5	.925"	#6	.922"	#7	.925"	#8	.919"
LOCATION NUMBER	THICKNESS MEASUREMENT																								
#1	.932"																								
#2	.922"																								
#3	.914"																								
#4	.921"																								
#5	.925"																								
#6	.922"																								
#7	.925"																								
#8	.919"																								
CALIBRATION STANDARD(S) Standards Lab No. <u>584-99-30-134</u> Expiration Date <u>04/02/96</u> Standards Lab No. <u>N/A</u> Expiration Date <u>N/A</u>																									
TRANSDUCER Diameter <u>1/2"</u> Frequency <u>5 MHZ.</u> "E"-STD Mfg. <u>NORTEC</u> Serial No. <u>80767</u> Stand Off <u>N/A</u>																									
Couplant <u>ULTRAGEL II</u> Batch No. <u>BATCH #8336</u>																									
Technician <u>Janie Niederer</u>		UT Level <u>I</u>		Interpreted by <u>W.C. MILLIRON</u>		UT Level <u>II</u>																			
Date of examination <u>09/20/94</u>				Date of examination <u>09/20/94</u>		Reviewed by <u>Charles N. Jackson Jr</u>																			
						Date <u>9/22/94</u>

Westinghouse Hanford Company		NDE ULTRASONIC MEASUREMENT PROCEDURE AND TEST REPORT NONDESTRUCTIVE EXAMINATION 306 BLDG., 300 AREA - TEL: 376-5401				94-2	
Requester (client)		Company	MSIN	Bldg.	Area	PART INFORMATION	
J.R. VINCENT		WHC	N2-33	4710	400	Material <u>C/S</u>	
Project/System/Work Package/Traveler No.						Wall Thickness	<u>0.375" NOMINAL</u> ☐ NA
ULTRASONIC THICKNESS MEASUREMENT ON 241-SY-101 SPARE PUMP						Diameter	<u>12"</u> ☐ NA
STOCK UNDER ROTATION BARREL IN AREA OF LOWER SEAL. WORK						Schedule	<u>STANDARD</u> ☐ NA
PACKAGE #4A-94-0078/W, WORK ORDER #B-5005.						Size	☒ NA
Acceptance Std.		Section	Para.	Date	☐ NA	Dwg. No.	☒ NA NCR ☒ NA
INFORMATION ONLY, ACCEPTANCE BY CLIENT							
WHC PROCEDURE NO. NDT-UT-9000, Revision No. <u>3</u> Appendix <u>A</u> Revision No. <u>2</u> Special Technique No. ☒ NA				RESULTS SEE ATTACHED DATA PAGES FOR THICKNESS MEASUREMENTS. NOTES: 1) ALL THICKNESSES MEASUREMENTS ARE IN INCHES. 2) THICKNESS MEASUREMENTS WERE TAKEN IN THE CENTER OF THE 1" X 1" GRID SPACINGS. 3) MINIMUM THICKNESS READING NOTED: .351" AT THE D-38 LOCATION. MAXIMUM THICKNESS READING NOTED: .383" AT M-46 LOCATION.			
COVERAGE ☒ 100% of Area Requested ☐ Other _____							
INSTRUMENTATION Mfg. <u>NORTEC</u> Model <u>124-D</u> Standards Lab No. <u>584-31-50-024</u> Expiration Date <u>11/30/94</u>							
CALIBRATION STANDARD(S) Standards Lab No. <u>584-99-30-091</u> Expiration Date <u>11/09/96</u> Standards Lab No. <u>N/A</u> Expiration Date <u>N/A</u>							
TRANSDUCER Diameter <u>1/2"</u> Frequency <u>5 MHZ.</u> "E"-STD Mfg. <u>NORTEC</u> Serial No. <u>80767</u> Stand Off <u>N/A</u>							
Couplant <u>ULTRAGEL II</u> Batch No. <u>BATCH #8336</u>							
Technician		UT Level	Interpreted by		UT Level	Reviewed by
JANIE NIEDERER		I	W.C. MILLIRON		II
Date of examination		Date of examination		Date			
09/20/94		09/20/94		9-23-94			

Page 2 of 4

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q
1	.365	.365	.365	.366	.367	.369	.371	.370	.369	.372	.371	.370	.371	.370	.370	.369	.373
2	.365	.365	.357	.363	.363	.369	.371	.372	.370	.372	.372	.370	.372	.369	.369	.370	.373
3	.366	.365	.363	.366	.365	.369	.371	.371	.370	.373	.371	.370	.370	.366	.367	.369	.371
4	.367	.367	.363	.364	.366	.370	.371	.372	.371	.369	.371	.372	.370	.367	.369	.373	.374
5	.371	.368	.367	.366	.363	.371	.373	.373	.368	.373	.371	.370	.371	.368	.370	.374	.367
6	.370	.369	.365	.370	.369	.373	.373	.372	.371	.374	.371	.372	.369	.370	.370	.373	.375
7	.373	.368	.366	.369	.370	.375	.376	.373	.373	.373	.373	.374	.372	.372	.370	.374	.375
8	.370	.368	.369	.368	.371	.376	.374	.374	.374	.373	.374	.373	.372	.372	.374	.374	.374
9	.374	.372	.371	.370	.371	.376	.376	.375	.370	.374	.373	.374	.373	.372	.376	.373	.375
10	.376	.374	.373	.369	.370	.377	.376	.376	.372	.380	.377	.375	.373	.373	.375	.376	.375
11	.377	.372	.371	.372	.375	.380	.374	.372	.371	.380	.374	.374	.371	.371	.373	.375	.374
12	.373	.372	.374	.369	.375	.377	.374	.372	.370	.381	.373	.373	.370	.369	.372	.372	.372
13	.372	.371	.372	.373	.376	.377	.372	.370	.371	.381	.375	.376	.370	.369	.371	.372	.372
14	.372	.372	.374	.375	.377	.377	.376	.371	.373	.382	.376	.375	.371	.367	.370	.371	.373
15	.376	.375	.378	.376	.377	.379	.376	.374	.375	.380	.378	.376	.371	.369	.372	.370	.371
16	.374	.377	.378	.377	.380	.381	.375	.376	.375	.381	.376	.376	.373	.371	.373	.373	.372
17	.379	.378	.379	.379	.382	.377	.374	.375	.375	.381	.378	.377	.374	.372	.374	.372	.374

101-SY PUMP PIPE U.T. READINGS

SEPTEMBER 20, 1994

PK9 # 4A-94-0078/w

94-2

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	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q
18	.381	.377	.379	.381	.378	.373	.374	.374	.374	.376	.376	.376	.374	.370	.372	.371	.373
19	.380	.375	.377	.375	.376	.375	.374	.374	.375	.373	.375	.375	.373	.375	.374	.372	.376
20	.377	.372	.375	.382	.377	.372	.375	.373	.374	.372	.373	.374	.372	.374	.373	.373	.375
21	.374	.367	.371	.372	.373	.369	.368	.368	.371	.370	.370	.368	.368	.367	.372	.369	.373
22	.369	.369	.369	.369	.369	.368	.366	.365	.369	.368	.369	.368	.366	.366	.369	.369	.371
23	.368	.368	.368	.366	.370	.368	.365	.365	.368	.367	.369	.369	.367	.367	.370	.369	.370
24	.368	.364	.368	.367	.367	.365	.365	.367	.368	.366	.367	.366	.368	.368	.370	.369	.370
25	.368	.366	.368	.367	.362	.363	.363	.365	.362	.364	.364	.365	.366	.367	.367	.368	.369
26	.368	.368	.366	.363	.362	.362	.362	.365	.363	.362	.365	.366	.366	.367	.369	.369	.372
27	.364	.365	.365	.360	.364	.361	.361	.365	.365	.363	.364	.367	.365	.366	.369	.371	.372
28	.365	.367	.366	.364	.365	.364	.362	.366	.365	.363	.364	.368	.365	.368	.370	.371	.372
29	.366	.369	.368	.366	.365	.365	.364	.367	.367	.365	.367	.368	.367	.371	.371	.372	.371
30	.367	.369	.367	.366	.368	.365	.366	.367	.369	.367	.368	.371	.367	.372	.373	.371	.372
31	.368	.368	.366	.365	.367	.365	.364	.367	.369	.368	.370	.371	.368	.374	.375	.373	.374
32	.366	.368	.365	.363	.366	.367	.365	.367	.371	.371	.371	.375	.371	.376	.375	.374	.376
33	.363	.364	.361	.362	.365	.364	.363	.367	.372	.369	.370	.374	.373	.376	.376	.378	.379
34	.361	.364	.361	.361	.364	.361	.360	.365	.372	.368	.371	.372	.372	.374	.374	.377	.378

101-SY PUMP PIPE U.T. READINGS

SEPTEMBER 20, 1994

PKg. # 4A-94-0078/w

94-2

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q
35	.361	.364	.359	.360	.363	.361	.357	.363	.367	.366	.367	.368	.369	.372	.373	.373	.376
36	.362	.363	.360	.356	.357	.352	.353	.361	.364	.365	.367	.368	.369	.371	.372	.373	.374
37	.362	.359	.359	.356	.358	.356	.357	.362	.364	.369	.370	.368	.369	.369	.371	.374	.375
38	.360	.359	.354	.351	.355	.359	.359	.363	.365	.370	.370	.367	.368	.371	.373	.375	.375
39	.357	.358	.354	.352	.352	.354	.356	.360	.360	.366	.368	.366	.369	.372	.373	.375	.375
40	.361	.362	.359	.358	.360	.360	.363	.366	.368	.375	.374	.374	.375	.375	.377	.377	.377
41	.360	.361	.360	.360	.358	.358	.362	.366	.371	.374	.375	.371	.376	.378	.378	.380	.379
42	.362	.360	.360	.361	.360	.358	.361	.364	.369	.373	.374	.373	.375	.376	.376	.378	.378
43	.361	.359	.357	.359	.360	.359	.363	.365	.370	.374	.376	.375	.377	.377	.377	.379	.377
44	.363	.360	.359	.362	.367	.366	.369	.367	.370	.372	.373	.373	.377	.375	.377	.378	.378
45	.364	.362	.362	.366	.368	.369	.372	.371	.373	.376	.375	.374	.378	.377	.377	.378	.379
46	.366	.364	.364	.366	.369	.371	.373	.373	.374	.377	.377	.377	.380	.378	.378	.379	.379
47	.364	.362	.363	.367	.368	.368	.372	.371	.374	.376	.377	.381	.383	.379	.378	.378	.377
48	.361	.359	.361	.367	.367	.368	.372	.372	.374	.376	.380	.378	.381	.379	.377	.381	.380
49	.363	.361	.360	.364	.367	.368	.371	.373	.373	.376	.376	.375	.378	.377	.376	.377	.377
50	.364	.361	.362	.366	.365	.368	.372	.372	.374	.376	.377	.375	.377	.375	.376	.376	.377
51	.365	.363	.365	.365	.368	.370	.372	.371	.373	.371	.375	.372	.374	.374	.374	.374	.377

101-SY PUMP PIPE U.T. READINGS

SEPTEMBER 20, 1994

PK9. # 4A-94-0078/w

94-2

PUMP FLANGE & BARREL ASSEMBLY SKETCH

0003

FFTF/FMEF PROG.

NDE

3509 376 1503

11/03/94 15:35

From: Ken Eldridge To: Sam Smith

Date: 9/29/94 Time: 17:35:46

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Problem with overspeed abort at MASF with ModPlus/AF5000+

09/29/94Page 2

To: Sam Smith
From: Ken Eldridge
Date: September 29, 1994
Subject: Problem with overspeed abort at MASF with ModPlus/AF5000+

The problem with the overspeed false abort at the MASF facility was identified to be related to the ModPlus Genesis driver corruption of the AF5000+ Genesis driver. The corruption of CPU task time sharing caused the AF5000+ serial communications to fail just enough to miss characters without reporting a receive fault. Most retries with problems did report a comm. receive fault error, but the few that sneaked by caused miss readings in parameters from the VFD's which would in turn cause false abort conditions on the motor speed. This abort was caused from a high miss read on speed or a low miss read on maximum speed. The AF5000+ VFD communication strings vary in length based on the value for the parameter and there is no checksum or character count embedded in the string to help recognize a problem with communications on invalid data received. The AF5000+ driver depends totally on the receive routine to report all errors.

The ModPlus driver was modified further to solve the problem with *wait()* function calls around the send routine as well as the receive routine. This causes the driver scan time to be 1 second instead of 0.5 seconds. If this proves to be a final solution this ModPlus driver should also be integrated into the DACS-1 system with a 1 second scan time in the MOTOR strategy for task 3. The AF5000+ scan times can remain at 0.5 seconds each. The TEST strategy can function with the ModPlus driver version 3.37 from Iconics, but it should be discussed with Bob and Jeff before a final decision is made. The scan time will need to be moved to 1 second in the TEST strategy also if the new ModPlus version 3.38 is used with the *wait()* functions.

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