Preliminary 26

TEST RESULTS REPORT

PROCEDURE NO. 91HF-1AF01

PROCEDURE TITLE PRECORE EMERGENCY & AUXILIARY FEEDWATER SYSTEM TEST

REVISION AT THE COMMENCEMENT OF TESTING 0 DATE 4/30/83

REVISION AT COMPLETION OF TESTING 0 DATE 4/30/83

LATEST TEST CHANGE NOTICE NO. 49 DATE 6/28/83

DATES OF TEST PERFORMANCE 5/3/83 THROUGH 7/3/83



Review and Approval of Test Results

PREPARED BY: J. W. Moreland DATE 10/5/83

TECHNICAL REVIEW: [signature] DATE 10/5/83

GROUP SUPERVISOR REVIEW: R J Beuchler DATE 10/4/83

TEST WORKING GROUP MEETING NUMBER: _____ DATE _____

PLANT REVIEW BOARD MEETING NUMBER: _____ DATE _____

QUALITY ASSURANCE REIVEW: _____ DATE _____
(Required for Test Results Reports not reviewed by TWG)

STARTUP MANAGER APPROVAL: _____ DATE _____





54-528

## 1.0 TEST PURPOSE AND SCOPE

1.1 The Purpose of this test was to demonstrate the ability of the Auxiliary Feedwater System to perform the following:

1.1.1 Supply sufficent auxiliary feedwater to the steam generators for Reactor Startup, Normal Reactor Cooldown and Emergency conditions.

1.1.2 Respond correctly to automatic and manual system controls.

1.2 The Scope of this test consisted of the following:

1.2.1 Auxiliary Feedwater System controls from Main Control Room only. All aspects of operability of the system from Remote Shutdown Panels was performed under 91HF-1ZZ03, Remote Shutdown Hot Functional Test.

1.2.2 Those tests requiring integrated system operational verification under simulated plant conditions, i.e., Hot Standby, Mode 3.

NOTE

This procedure did not reverify all of the electrical/mechanical tests performed under Preoperational Test 91PE-1AF01, Auxiliary Feedwater System.

## 2.0 COMPLEMENTARY TESTS

91PE-1AF01 - Auxiliary Feedwater System

91PE-1FW02 - Precore Downcomer Feedwater System Water Hammer Test

90HF-1ZZ01 - Precore Hot Functional Testing Controlling Document

## 3.0 TEST DESCRIPTION

This test procedure was divided into the following three sections:

Procedure Section 8.1
Non Safety Auxiliary Feedwater Pump AFN-P01 Subsystem AF-02

This section included the following:

1. Exercise of Power Operated Valves
2. Verification of Pump Suction and SIAS Trip Logic
3. Depressurized Filling of Steam Generators
4. Seat Leakage Measurement of SG-FV-1113 & SG-FV-1123
5. Flow Performance Testing of AFN-P01 into Steam Generator at Mode 3 Plant Conditions
6. Verification of AFN-P01 System Override Feature During Receipt of a MSIS Signal.

Procedure Section 8.2 -
Safety Motor Driven Auxiliary Feed Pump AFB-P01 Subsystem AF-01

This section included the following:

1. Exercise of Power Operated Valves
2. Verify Capability of AFB-P01 to Operate with RMWT as Source of Suction
3. Depressurized Filling of Steam Generators
4. Seat Leakage Measurement of AF-HV-30 & AF-HV-31
5. Flow Performance Testing of AFB-P01 into Steam Generators at Mode 3 Plant Conditions
6. AFB-P01 on Demand Start Times and Flow Performance to AFAS-1 & AFAS-2 Signals
7. Verification of AFB-P01 System Override Features during Receipt of a AFAS-1 and AFAS-2 Signals.

Procedure Section 8.3 -
Safety Turbine Driven Auxiliary Feed Pump AFA-P01 Subsystem AF-03

This section included the following:

1. Exercise of Power Operated Valves

2. Performance of a Minimum of Five Repetitive Cold Starts of AFA-P01

3. Verify Capability of AFA-P01 to Operate with RMWT as Source of Suction

4. Seat Leakage Measurement of AF-HV-32 & AF-HV-33

5. Flow Performance Testing of AFA-P01 into Steam Generators at Mode 3 Plant Conditions

6. AFA-P01 on Demand Start Times and Flow Performance to AFAS-1 & AFAS-2 Signals

7. Verification of AFA-P01 System Override Features during Receipt of a AFAS-1 and AFAS-2 Signals

8. Verification of AFA-P01 Turbine Auxiliary Feed Pump over its Design Range of Inlet Steam Conditions

## 4.0 TEST EVENTS

Commenced testing on 5/3/83. Required administrative prerequisite functions were performed including personnel briefing and verification of initial conditions.

Commenced exercise of system power operated valves. Performed verification of AFN-P01 suction and SIAS trip logic. Also verified system override features for AFN-P01 with SIAS signal.

While attempting to change the source of suction for AFB-P01 from the CST to the RMWT, adequate suction flow was lost. The pump was manually tripped based upon high differential pressure on suction strainer. TER #001 was written. The strainer was inspected and found to be clean. Futher investigation revealed that the RMWT suction line N-431-HCDA-8" was not vented properly. A high point vent, CH-V069 had been added by Rev. 6 of 13-M-CHP-003 which was not included in the 410P-1AF01 Valve Line-up Checklist. A PCN was generated adding CH-V069 to the operating procedure, 410P-1AF02. After the suction line venting was completed successful operation of AFB-P01 pump operation was achieved with the RMWT as the suction source.

Upon performing full flow recirculation testing of AFB-P01, low flow indication was noted on test flow indicator AF-FI-15. TER #002 was written. Also, during this phase of the test it was noted that full flow test recirculation valve AF-V027 could not be closed with AFB-P01 in operation. TER #003 was written in this anomaly.

In preparation for the actual flow testing to steam generator, two of the economizer line isolation valves were inoperable, TER #004 was written. However, alternate valve line-up isolation for the flow path was achieved, thus allowing testing to continue, without any impact on the test results.

Performed seat leakage test on regulating valves AF-HV-30 and AF-HV-31. Both valves exceeded the manufacturer's leakage rate, thus TER #005 was generated. During seat leakage testing with AFB-P01, suspended pump operation in order to resolve maximum bearing operating temperature limits. For AFB-P01 bearing temperatures are bearing metal not drain oil temperatures, thus the allowable operational limit is higher. A PCN was prepared to correct the operating procedure 410P-1AF01. The "true" maximum bearing temperatures were not exceeded, nor even approached.

Upon filling steam generators with AFB-P01, lower than acceptance criteria flow rate limits were recorded, thus TER #006 & #007 were written.

Seat leakage testing of AFN-P01 regulating valves SG-FV-1113 & SG-FV-1123 were performed with TER #008 being generated due to the gross seat leakage from both valves.

During the required draining of steam generators for additional flow testing in order to expedite testing, the decision was reached to drain without a nitrogen blanket with concurrence of Chemistry and Shift Supervisor, however, TER #009 was written. Also, during the filling of the steam generators a significant overall test delay was encountered due to the lack of correlation between steam generator level instruments, TER #010 was written for this problem.

Testing of downcomer containment isolation valves under flow and shut off head conditions produced two TERs. TER #011 was generated due to AFN-P01 discharge pressure indicators, local & control room were not in agreement. TER #012 was written due to downcomer isolation valves SG-UV-135 and SG-UV-175 that would not fully close.

Exercise of power operated valves revealed AF-HV-32 position indicator to be inoperable, TER #013 written.

A common problem of leaking unions on steam traps was found during the warm-up of the steam supply to AFA-P01. TER #014 was written.

Operation of AFB-P01 was suspended due to vibration-related damage to system valves and a cracked socket weld on flow element AF-FI-15. The problem was previously uncovered during the preop testing phase and documented with SFR-AF-088 and NCR-SM-1955. Repairs were made and testing continued.

The first cold start attempt on AFA-P01 was performed on 6/4/83. The turbine promptly tripped on overspeed, thus TER #016 was generated. Considerable troubleshooting was performed in conjunction with vendor personnel in efforts to prevent overspeed trips on turbine starts with the "as designed" system. Finally, a design change was implemented to install a orificed 1" solenoid valve bypass around steam admission valves SG-UV-134 and SG-UV-138. The subsequent turbine starts were successful with the design change installed.

Full-flow AFAS-1 and AFAS-2 testing using AFP-P01 to Feed the Steam Generators was performed with the following problems. TER #017 was written due to erratic response of valve position indication for AF-HV-30. TER #018 was written concerning the pump hydraulic performance, i.e. flow verus head measurements.

During full flow recirculation testing of AFA-P01, low flow indication was noted on test flow indicator AF-FI-26 similar to that experienced with AFB-P01. TER #019 was prepared.

Full flow AFAS-1 & AFAS-2 response testing of AFA-P01 was performed with similar results as AFB-P01 with pump hydraulic performance, i.e. flow verus head measurements, TERs 022, 023, 027, & 028 were written on these problems. TER #021 was also written at this time due to a failure of SG-UV-138 to open on a simulated AFAS signal. This problem did not repeat itself and appears to have been a temporary test switch continuity failure.

Experienced excessive steam seat leakage through valves SG-UV-134 & SG-UV-138 that appeared to be due to the inability of the DC high speed motor operator to close the valve and hold it on its seat. Both valves were physically observed to "relax & back off" approximately 2% to 3% when electrically closed. A SFR was prepared by PSE for this problem.

Performed seat leakage test on regulating valves AF-HV-32 and AF-HV-33. One of the valves AF-HV-33 exceeded the manufacturer's leakage, thus TER #020 was written.

During the fourth cold start of AFA-P01 the local room air handling unit ACU-M-HAA-204 failed to start, thus TER #020 was written. During the cold start tests a inadvertent turbine roll occurred due to excessive seat leakage through SG-UV-134 & SG-UV-138 which kept the inlet steam header pressurized. Thus, when AF-HV-54 was opened for turbine prestart valve alignment, an unplanned turbine roll occurred. TER #026 was written.

During the final AFAS-1 & AFAS-2 full flow test runs, a vibration/pulsation abnormality was observed on AFA-P01 while operating at rated speed and minimum flow conditions. Any increase in flow through the pump caused the pulsation to cease. SFR AF-130 & AF-105 were written on this problem.

Successfully operation of AFA-P01 was achieved with low pressure, 135 psia steam. The hydraulic performance of the turbine driven pump operating at these conditions exceeded the acceptance criteria by a significant margin.

Testing was completed on 7/3/83 for 91HF-1AF01, Pre Core Emergency & Auxiliary Feedwater.

5.0 TEST RESULTS

Procedure Section 8.1 -
Non Safety Auxiliary Feedwater Pump AFN-P01 Subsystem AF-02

The planned testing for this auxiliary feed train was severly curtailed due to excessive gross seat leakage of valves SG-UV-1113 & SG-UV-1123. The hydraulic performance of AFN-P01 could not be verified nor could the manual or automatic operation of the feedwater downcomer control system.

The following TERs were written against this section of the procedure:

| TER NUMBER | DESCRIPTION / RESOLUTION | RETEST REQ'D |
|---|---|---|
| 008 | Description:<br>Excessive seat leakage was noted across the seats of control valves SG-UV-1113 & SG-UV-1123.<br><br>Resolution:<br>1. SFR 1SG-098 was issued with DCP 1SJ-AF-37 as the final disposition which modifies the system by adding a low flow bypass valve around the leaking control valves.<br><br>2. Work request #31066 was issued to disassemble and inspect both SG-UV-1113 and SG-UV-1123. | YES |

| TER NUMBER | DESCRIPTION / RESOLUTION | RETEST REQ'D |
|---|---|---|
| 009 | Description:<br>Steam Generator #1 was drained without nitrogen blanket.<br><br>Resolution:<br>Short term draining of steam generator is permissible without a nitrogen blanket. | NO |
| 010 | Description:<br>Steam generator level transmitters were inoperative.<br><br>Resolution:<br>Retest following completion of modifications of level instrument condensing pots. | YES |
| 011 | Description:<br>AFN-P01 pump discharge pressure indicators did not correlate, i.e.; AF-PI-19 and AF-PIT-19.<br><br>Resolution:<br>Retest requirements pending SFR disposition. | YES |
| 012 | Description:<br>Downcomer isolation valves SG-UV-135 and SG-UV-175 failed to close properly.<br><br>Resolution:<br>Retest after DCP 1SJ-AF-37 is implemented. | YES |

Procedure Section 8.2 -
Safety Motor Driven Feed Pump AFB-P01 Subsystem AF-01

The planned testing for this auxiliary feed train was conducted completely. The test performed did satisfy the control function and hydraulic performance requirements of the acceptance criteria. The following TERs were written against this section of the procedure:

| TER NUMBER | DESCRIPTION / RESOLUTION | RETEST REQ'D |
|---|---|---|
| 001 | Description:<br>Upon transferring source of suction from CST to RMWT on AFB-P01 adequate suction flow was lost.<br><br>Resolution:<br>Inlet strainer was inspected and found to be clean. Suction line from RMWT was vented and successful retest was performed. | COMPLETE |
| 002 | Description:<br>Full flow recirculation of AFB-P01 could not be achieved as read by AF-FI-15.<br><br>Resolution:<br>Engineering evaluation continuing by SFR 1-AF-119. | YES |
| 003 | Description:<br>Full flow recirculation path isolation valve AF-V027 could not be reclosed with flow.<br><br>Resolution:<br>Rework of valve actuator performed under WR #020376 and WR #010612. | YES |
| 004 | Description:<br>Economizer isolation valves SG-UV-137 and SG-UV-174 were inoperable.<br><br>Resolution:<br>These valves were used as double isolation in 91HF-1AF01 only, alternate isolation was achieved. These valves are to be tested under preop 91PE-1SG04. | YES |

| TER NUMBER | DESCRIPTION / RESOLUTION | RETEST REQ'D |
|---|---|---|
| 005 | Description:<br>AFB-P01 regulating valves AF-HV-30 & AF-HV-31 exceed their seat leakage criteria.<br><br>Resolution:<br>Leakage is suspected to be due inadequate valve seating force. Present actuators are being replaced under DCP 1SJ-AF30. | YES |
| 006 | Description:<br>Full flow injection to Steam Generator #1 resulted in lower than expected discharge head values.<br><br>Resolution:<br>SFR-1AF-116 was generated with interim disposition to retest. Retest was done with data indicating pump curve is being met or exceeded. Final retest pending final resolution of SFR-1AF-116. | YES |
| 007 | Description:<br>Full flow injection to Steam Generator #2 resulted in lower than expected discharge head values.<br><br>Resolution:<br>SFR-1AF-116 was generated with interim disposition to retest. Retest was done with data indicating pump curve is being met or exceeded. Final retest pending final resolution of SFR-1AF-116. | YES |
| 018 | Description:<br>The hydraulic performance of AFB-P01 was slightly below the acceptance criteria.<br><br>Resolution:<br>SFR-1AF-104 was generated with the resolution that the test value was in the acceptable loop accuracy range. | NO |

Procedure Section 8.3 -
Safety Turbine Driven Feed Pump AFA-P01 Subsystem AF-03

The planned testing for this auxiliary feed train was conducted completely, however test results were degraded to some degree due to the following:

1. Steam admission valves SG-UV-134 and SG-UV-138 could not be electrically closed tightly.

2. To eliminate turbine overspeed trips on cold fast start a significant hardware modification had to be implemented during the test.

3. Pump hydraulic performance results appeared to be marginal possibly due to instrument accuracy for flow measurements and/or pump speed measurements.

However, significant successful testing of this auxiliary train was completed. i.e. AFAS-1 and AFAS-2 response testing, low steam pressure turbine/pump performance, five repetitive, cold quick starts and other functional tests of system controls.

The following TERs were written against this section of the procedure:

| TER NUMBER | DESCRIPTION / RESOLUTION | RETEST REQ'D |
|---|---|---|
| 013 | Description:<br>Valve AF-HV-32 position indicator was inoperative.<br><br>Resolution:<br>DCP 1SJ-AF-030 replaces the actuator for AF-HV-32, restest after DCP is implemented. | YES |
| 014 | Description:<br>Steam trap AFN-M01 on AFA-P01 main steam inlet header was bypassed due to inlet union steam leaks.<br><br>Resolution:<br>For this test the trap was bypassed, however SFR-1AF-118 address the long term solution. | NO |

| TER NUMBER | DESCRIPTION / RESOLUTION | RETEST REQ'D |
|---|---|---|
| 015 | Description:<br>AFA-P01 governor failed to respond and lube oil pressure was high.<br><br>Resolution:<br>Governor was adjusted by Woodward Service Engineer and subsequently retested satisfactorily. Lube oil pressure was adjusted to correct reading by adjusting PSV-73. | COMPLETE |
| 016 | Description:<br>AFA-P01 tripped on overspeed during first cold fast start.<br><br>Resolution:<br>This auxiliary feed train was modified by DCP 1SM-AF-042, subsequent cold, fast starts were successful. | NO |
| 024 | Description:<br>During the fourth cold start of AFA-P01 the local air handling unit failed to start.<br><br>Resolution:<br>Investigation revealed that the power supply breaker had been inadvertently left open. Upon closing the breaker the air handling unit did start. | COMPLETE |
| 025 | Description:<br>The as written procedure called for the use of DART for valve timing which was unavailable at the time.<br><br>Resolution:<br>TCN was prepared to modify the procedure to use a stop watch for timing. Timing steps were repeated the required three times. | COMPLETE |

| TER NUMBER | DESCRIPTION / RESOLUTION | RETEST REQ'D |
|---|---|---|
| 026 | Description:<br>An inadvertent roll of AFA-P01 occurred due to excessive seat leakage through SG-UV-134 & SG-UV-138.<br><br>Resolution:<br>This test run, while successful was not used to document the final fifth cold start. Run number ten was used as the final fifth cold start. | NO |
| 019 | Description:<br>Full flow recirculation of AFA-P01 could not be achieved as read by AF-FI-26.<br><br>Resolution:<br>Engineering evaluation continuing by SFR-1AF-119. | YES |
| 020 | Description:<br>Seal leakage of AF-HV-33 exceeded the acceptance criteria of 2.5 cc/min. Actual measured was 5.0 cc/min.<br><br>Resolution:<br>SFR-1AF-120 was generated with the final disposition to use as is. | NO |
| 021 | Description:<br>Upon receipt of a simulated AFAS-2 signal valve SGA-UV-138 failed to open.<br><br>Resolution:<br>Repeated additional AFAS-2 tests were successful. Problem was isolated to continuity in temporary test switch, i.e., permanent hardware performed as designed. | NO |

| TER NUMBER | DESCRIPTION / RESOLUTION | RETEST REQ'D |
|---|---|---|
| 022 & 023 | Description: AFA-P01 failed to reach its full flow rate.<br><br>Resolution: Full flow recirculation valve AF-V018 was found to have vibrated partially open. Valve was closed and subsequent retest successful. | COMPLETE |
| 027 & 028 | Description: The average test flow of AFA-P01 to both AFAS-1 and AFAS-2 signals did not meet acceptance criteria.<br><br>Resolution: SFR-1AF-123 was generated. Final retest pending final disposition of the SFR. | NO |

## 6.0 CONCULSIONS

The planned testing for each of the three auxiliary feed trains was performed as previously discussed. On all three trains the rotating equipment, i.e., pumps and drivers performed satisfactorily. However, system accessories, i.e., control valves, flow meters, and pressure indicators, demonstrated less than uniform satisfactory results. Some of these problems such as unsatisfactory full flow recirculation test loop performance, were repeated on each of the three trains. Prior to this system reaching the Hot Functional Test Phase, more of these types of problems should have been discovered and resolved. That is, the preoperational test for this system should have been more system orientated instead of focusing on individual components.

This test did demonstrate that the auxiliary feed system has the ability to supply sufficient auxiliary feedwater to the steam generators for reactor cooldown and emergency conditions. The objectives of FSAR Chapter 14B.13 were satisfied. The technical problems that were encountered were not of a severe nature and have been appropriately documented in SFR's, NCR's and DCP's. Thus, final resolution of all the problems encountered is assured. Based upon review of the test results and resolutions of problems that have been completed or are in progress of completion, it is felt that this system will support the next phase of testing.

## 7.0 RECOMMENDATIONS

1. Upon completion of the various DCP's and work orders that are outstanding on the system, complete required retesting.

2. Based upon the results of the subject testing, it is recommended that approval of test results by the reviewing organization be granted contingent upon successful completion of retest.