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April 26, 1990

U. S. Nuclear Regulatory Commission
Attention: Document Control Desk
Washington, D. C. 20555

Gentlemen:

Subject: Docket No. 50-206
Permanent Change For Limitation Of AFW Flow
San Onofre Nuclear Generating Station, Unit 1

In our February 2, 1990 letter, we stated that we have been working diligently to develop a permanent change to the Auxiliary Feedwater System (AFWS) which will satisfy the design and licensing bases with respect to limiting AFW flow rate. We also stated, in the February 2, 1990 letter, that in the interim a dedicated individual has been stationed at the AFW panel to ensure that the AFW flow would be limited to the design basis water hammer flow limit of 150 gpm per steam generator. After further evaluations, SCE has concluded that a permanent change to modify the AFWS flow venturis should be implemented during the Cycle 11 refueling outage scheduled to begin no later than June 30, 1990. The detailed description for the venturi modification and the results of its supporting safety analysis will be submitted by June 30, 1990 for NRC approval as a proposed change to the Technical Specifications.

SCE has extensively evaluated several modification options and concluded that the best design is to retain the passive, flow limiting venturis. However, to design a venturi to limit flow to 150 gpm under all circumstances, it is necessary to decrease the minimum flow requirements.

Safety analyses are being performed to support a reduction in the minimum AFW flow requirements for the redesigned flow venturis. The analyses are intended to demonstrate that the minimum AFW flows required for decay heat removal can be reduced, 1) from 125 gpm per train to 100 gpm per train in the case of two intact main feedwater lines and pressurized steam generators, and 2) from 250 gpm per train to 175 gpm per train with two intact main feedwater lines and depressurized steam generators.

The enclosure provides the results of the AFWS testing which was performed during startup from the Cycle 10 refueling outage. This information was requested by the NRC in a telephone conversation on February 23, 1989. The results of the testing shows that under certain conditions the maximum AFW flow could exceed the water hammer flow limit of 150 gpm per steam generator (450 gpm total), as was reported in LER 89-031.

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We plan to perform AFW flow testing, with the new venturis, during the Cycle 11 startup. We will continue to maintain the dedicated individual at the AFW panel, when the AFW system is required to be operable, and until the modification is completed.

If you have any questions or comments, or if you would like additional information, please let me know.

Sincerely,

cc: J. B. Martin, Regional Administrator, NRC Region V
C. Caldwell, NRC Senior Resident Inspector, San Onofre Units 1, 2, and 3

Enclosure

Auxiliary Feedwater System Testing

As part of TMI lessons learned, SCE committed to resolve all concerns related to Unit 1's capability to respond to certain transients and accidents, assuming an arbitrary single failure. The integration of a third auxiliary feedwater pump, G-10W, into the existing AFW system (in conjunction with modifications to the AFW system configuration and operation) was intended to ensure that the AFW system configuration will meet the requirements of design basis events including single failure of an active component.

The applicable RPS/AFW transient analyses evaluated for the AFW modifications (Reference 1) are:

1. Loss of normal feedwater to one Steam Generator (S/G), from 100% power; Reactor trip on high pressurizer water level (50%); total AFW flow of 185 gpm at 30 minutes.

2. Loss of normal feedwater to 3 S/G's; from 100% power; Reactor trip on steam/feedwater flow mismatch; total AFW flow of 165 gpm at 30 minutes.

3. Loss of normal feedwater to 3 S/G's; from 50% power; Reactor trip on high pressurizer water level (50%); total AFW flow of 185 gpm at 30 minutes.

4. Main feed line break (upstream of in-containment check valve); from 100% power; Reactor trip on steam/feedwater flow mismatch; total AFW flow of 125 gpm at 30 minutes.

5. Main feed line break (upstream of in-containment check valve); from 50% power; Reactor trip on high pressurizer water level (50%); total AFW flow of 125 gpm at 15 minutes.

6. Main feed line break (downstream of in-containment check valve); from 100% power; Reactor trip on steam/feedwater flow mismatch; total AFW flow of 250 gpm at 15 min.

7. Main feed line break (downstream of in-containment check valve); from 50% power; Reactor trip on high pressurizer pressure; total AFW flow of 250 gpm at 15 min.

PURPOSE

The purpose of the test was to verify that the train A pumps, G-10 (turbine driven) and G-10S, and the train B pump, G-10W, can satisfy the design basis for their respective flow requirements.

The AFW flow requirements (Reference 2) for decay heat removal are based on the pressure conditions for each given design basis event concurrent with or without a single active failure. These requirements are as follows:

1. The total minimum delivered flow to the three steam generators from AFW pump G-10 and G-10S (operating concurrently) or G-10W (operating alone) following a loss of feedwater event shall be 185 gpm (plus a margin as defined below) at a steam generator pressure of 1015 psig. (See Preoperational and Mode 1 Tests, pages 3, 6 and 7)

2. The total minimum delivered flow to the three steam generators from AFW pump G-10 following a station blackout shall be 165 GPM (plus margin) at a steam generator pressure of 1015 psig. (See Mode 1 Test, pages 6 and 7)

3. The total minimum delivered flow to the unaffected steam generators from AFW pump G-10W for a feedwater line break event (upstream of the in-containment check valves) shall be 125 GPM (plus margin) at a steam generator pressure of 1015 psig (operator action to equalize flow in each AFW line is credited in this situation). (See Preoperational Test, page 3)

4. The total minimum delivered flow to the unaffected steam generators from AFW pumps G-10 and G-10S operating concurrently for a feedwater line break event (upstream of the in-containment check valves) shall be 125 GPM (plus margin) at a steam generator pressure of 1015 psig (no operator action to equalize flow in each AFW line is credited in this situation). (See Mode 1 Test, pages 6 and 7)

5. The total minimum delivered flow to the unaffected steam generators from either AFW pump G-10W or G-10S for a feedwater line break event (downstream of the in-containment check valves) shall be 250 GPM (plus margin) at depressurized steam generator conditions. (See Preoperational Test, page 3)

6. The maximum flow from AFW pump G-10S shall be limited to 420 GPM (pump run-out limit) at depressurized steam generator conditions, considering the most limiting single active failure and using only passive mechanical means. Note: The 420 gpm limit was increased from 405 gpm in accordance with PFC 1-88-3364 due to a decrease in the minimum discharge pressure (from 545 to 500 psi). (See Preoperational Test, page 4)

The margin included in the flow requirements is specified to be not less than 7% and not greater than 10% on minimum delivered flow unless waived (Ref. 2) on a case by case basis.

RESULTS - PREOPERATIONAL TEST

An AFW preoperational test (Test Procedure S01-XXVI-9.3364.0.1) was conducted on January 27, 1989. Unit 1 was operating in Mode 5 during the test. The test verified that pump G-10W (train B) flow and pump G-10S (train A) flow under depressurized and simulated pressurized conditions satisfied the acceptance criteria as follows:

Flow Requirement 1:

The total flow from pump G-10W (operating alone) shall be at least 185 gpm when pressurized to 1015 (+30,-0) psig. After including other flow requirements (i.e. the pump's mini-flow, cooling water to the lube oil cooler, and a 7% margin), the minimum required flow was increased to 290 gpm. The flow recorded during the test was 355 gpm.

Flow Requirement 3:

The total flow from pump G-10W to two S/G's (operator equalized) when pressurized to 1015 (+30,-0) psig shall be at least 125 gpm when the third feedwater line or S/G is depressurized. After including the other flow requirements (i.e. the pump's mini-flow, cooling water to the lube oil cooler, the flow to the depressurized S/G, and a 7% margin), the minimum required flows were increased to 318 gpm for S/G's 1B and 1C and 311 gpm for S/G's 1A and 1B. The flow recorded for both tests was 355 gpm.

Flow Requirement 5:

The flow from either pump G-10W or G-10S to each S/G shall be at least 125 gpm (a total of at least 250 gpm to the two unaffected S/G's) at depressurized conditions. With the S/G's depressurized, the flow to each S/G from either pump G-10W or G-10S can not exceed 150 gpm (a total of 300 gpm to the two unaffected S/G's) due to water hammer concerns. The minimum flow to each S/G from either pump was required to be in the range of 128 gpm to 147 gpm, including +/-3 gpm for instrument inaccuracies. The recorded flows to each of the S/G's from pump G-10W were 137, 137, and 138 gpm. The flows recorded from pump G-10S to each S/G were 130 gpm.

Flow Requirement 6:

With the S/G's depressurized, the G-10S flow shall not exceed a total of 420 gpm. The recorded flow during the test was 419 gpm including the pump's mini-flow, pump bearing cooling water flow and 5 gpm for instrument inaccuracies.

During the flow testing the following was also demonstrated:

The new AFW flow control valves, FCV-3300A and FCV-2300C, for Train B pump, G-10W, will properly control flow to the S/G's.

Pump G-10W will start and discharge valve CV-3110 will open within the specified time requirements following receipt of a Train B AFWAS signal with the Train B AFW system in the "AUTO" mode.

The preoperational test also met the additional objectives outlined below:

1. Train A and B Loop Verification Test

   Demonstrated that a Train A or Train B, Auxiliary Feedwater Actuation Signal (AFWAS) was generated when a simulated steam generator low level input was received by any two channels.

2. Auto Initiation and AFWAS Logic Verification Test Train A - Pump G-10 and CV-2620.

   Demonstrated with pump G-10 in "AUTO", that upon receipt of a train A AFWAS signal, the system valves were properly positioned during the specified "warm up" period and that those positions were maintained after the "warm up" period was complete.

   Demonstrated that the G-10 "warm up in progress" and "warm up completed" indicating lights operated per design.

   Demonstrated that after G-10 has completed the "warm up" period, that Main Steam Inlet Valve, CV-2614, (and associated drain valves) and discharge valve CV-2620 operated per design in the "AUTO" mode and correctly responded to design logic and interlocks.

3. Auto Initiation and AFWAS Logic Verification Test Train A - Pump G-10S and MOV-1202

   Demonstrated with G-10S in the "AUTO" mode, that with a

train A AFWAS signal present, the pump motor breaker and control circuit operated per design and correctly responded to design logic and interlocks.

Demonstrated proper "AUTO" operation of the G-10S breaker and discharge valve, MOV-1202.

4. Auto Initiation and AFWAS Logic Verification Test Train B - Pump G-10W and CV-3110

Demonstrated with G-10W in the "AUTO" mode, that upon receipt of a train B AFWAS signal, the pump started and correctly responded to design logic and interlocks.

Demonstrated proper "AUTO" operation of G-10W discharge valve, CV-3110.

5. Annunciator Circuit Verification Tests

Verified that a simulated alarm level input to each alarm point (i.e., window) in the K04 AFW annunciator panel resulted in an alarm state for the respective window.

6. Auxiliary Feedwater Pump G-10W Discharge Flow Control Valve CV-3110 Back Up Nitrogen System Verification Test

Demonstrated that CV-3110 would close and remain closed for the required period with the minimum nitrogen back pressure.

Demonstrated that backup nitrogen system check valve ISA-1392 has an acceptable leak rate.

Demonstrated proper operation of the CV-3110 backup nitrogen pressure regulating control valve.

Demonstrated that the G-10W Discharge Valve ,CV-3110, can be stroked using instrument air without depleting the nitrogen backup.

7. Appendix R Emergency Lighting Verification

Demonstrated the EL-L2-33-21-R and EL-L2-33-22-R emergency lighting units operated upon a loss of AC for required minimum durations with correct charging circuitry operation.

Demonstrated that the emergency lighting units test switches and indicators functioned per design.

Verified that adequate illumination exists for access to

and egress from, and manual operation of, the Auxiliary Feedwater Control Valves.

8. Pump G-10W Forty Eight Hour Endurance Run

   Demonstrated that pump G-10W can run continuously for at least 48 hours without exceeding design limits with respect to bearing/bearing lube oil temperatures and vibration.

9. Pump G-10 Orifice Sizing/Speed Measurement Test

   Demonstrated that in the standby mode of operation, pump G-10 will reach 2000 +/- 200 RPM.

RESULTS - MODE 1 TEST

The AFW train A pump test (Test Procedure S01-XXVI-9.3364.0.3) was conducted on June 28, 1989. Unit 1 was operating in Mode 1 at 17% reactor power at the beginning of the test. The test was intended to verify that Train A flow (pumps G-10 and G-10S) requirements under pressurized conditions remained within the acceptance criteria. The acceptance criteria and results for the test are as follows:

Flow Requirement 1:

The total flow to all three S/G's with pumps G-10 and G-10S operating concurrently shall be at least 185 gpm at 1015 (+30, -0) psig system pressure. After including other flow requirements (i.e. the pump's mini-flow, 5 gpm for instrument inaccuracies, and a 7% margin), the minimum required flow was increased to 260 gpm. The test was conducted at approximately 800 psig steam generator pressure because 1015 psig is above the safety valve set point. The flow recorded during the test was 534 gpm.

Flow Requirement 2:

The total flow to all three S/G's with pump G-10 operating alone shall be at least 165 gpm at 1015 (+30,-0) psig system pressure. After including other flow requirements (i.e. the pump's mini-flow, 5 gpm for instrument inaccuracies, and a 7% margin), the minimum required flow was increased to 224 gpm. The flow recorded during the test was 364 gpm.

Flow Requirements 1, 2, 4:

Using pump head capacity curves (Reference 3) that have been verified at selected points, we can confirm the acceptability of other selected points. The minimum acceptable flow for pumps G-10 and G-10S (operating concurrently) and pump G-10 (operating alone) using this methodology were respectively 307 and 274 gpm at S/G pressures of 798 and 791 psig, respectively. The minimum required flows include allowances for the pump's mini-flow, 5 gpm for instrument inaccuracies, and a 7% margin. The flow rates recorded during the test were 578 gpm (526 gpm plus allowances) for G-10 and G-10S operating concurrently and 437 gpm (398 gpm plus allowances) for G-10 operating alone.

Flow Requirement 4:

The total flow to the unaffected S/G's at pressurized conditions of 1015 (+30, -0) psig with pumps G-10 and G-10S operating concurrently shall be 125 gpm. This was met by the verification of the Hydraulic Calculations (Ref. 3) with the data obtained from both the preoperational and mode 1 tests and by the combined performance of pumps G-10 and G-10S demonstrated in the mode 1 test.

REFERENCES

1. M39419 Rev. 2 - Event Specific Single Failure Response Evaluation, San Onofre Nuclear Generating Station, Unit 1, February 1989.

2. M86315 Rev. 7 - Design Criteria for Auxiliary Feedwater System Modifications, Southern California Edison, San Onofre Nuclear Generating Station, Unit 1, June 1989.

3. DC-2836 Rev. 3 - Hydraulic Calculations for AFW Lines/New Venturi Additions, Flour Engineers Inc.: Power Division, San Onofre Nuclear Generating Station, Unit 1, January 1989.

P&ID's of the Auxiliary Feedwater System