Arizona Nuclear Power Project
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December 12, 1984
ANPP-31451-TDS/TRB

U. S. Nuclear Regulatory Commission
Region V
1450 Maria Lane - Suite 210
Walnut Creek, California 94596-5368

Attention: Mr. D. F. Kirsch, Acting Director
Division of Reactor Safety and Projects

Subject: Final Report - DERs 84-72 and 84-81
A 50.55(e) Reportable Condition Relating To HPSI System Valves.
File: 84-019-026; D.4.33.2

Reference: A) Telephone conversation between C. Sorenson and T. Bradish on September 25, 1984
B) ANPP-30952, dated October 25, 1984 (Interim Report)
C) ANPP-31151, dated November 15, 1984 (Time Extension)
D) ANPP-31260, dated November 30, 1984 (Time Extension)
E) Telephone conversation between D. Hollenbach and T. Bradish on October 9, 1984
F) ANPP-31071, dated November 6, 1984 (Interim Report)
G) ANPP-31257, dated November 29, 1984 (Time Extension)

Dear Sir:

Attached is our final written report of the Reportable Deficiency under 10CFR50.55(e) referenced above.

Very truly yours,

E. E. Van Brunt

E. E. Van Brunt, Jr.
APS Vice President
Nuclear Production
ANPP Project Director

EEVB/TRB/nj
Attachment

cc: See Page Two

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cc: Richard DeYoung, Director
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Washington, D. C. 20555

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FINAL REPORT - DERs 84-72 and 84-81
DEFICIENCY EVALUATION 50.55(e)
ARIZONA PUBLIC SERVICE COMPANY (APS)
PVNGS UNITS 1, 2, 3

DER 84-72 identified the condition of HPSI pump miniflow valve 1JSIBUV667 failing to close. The root cause of this valve failing to close is similar to the cause of the HPSI injection valves failing to open. Therefore, the complete evaluation and final report for the subject of DER 84-72 will be included in this DER.

I. Description of Deficiency

A. HPSI Injection Valves

1. During the performance of Unit 2 preoperational test procedure 91PE-2SI08, operational problems with the Train "B" HPSI injection valves were encountered. The tag numbers of the subject valves are 2JSIBUV616, 626, 636, and 646. NCR SM-4956 documented the following conditions that were observed while troubleshooting.

   a. With the HPSI pump running, while attempting to open or close any one of the four valves with the other three remaining in the closed position, hesitation was noted between 65 percent and 90 percent open position.

   b. When closing any one of the valves to the position where the flow actually stopped (other three valves closed) and the motor operator stopped, the "open" indicating light would remain on. Reducing the pressure on the valve by either stopping the HPSI pump or opening the other valves would allow further stroking of the troubled valve to the position where the "open" light would go off.

   c. Current traces revealed that one phase of the three phase motors was drawing significantly lower current than the other two.

2. NCR SE-4358 documented high currents in the motor operators of valves 1JSIAUV617 and 1JSIAUV627.

3. Modifications to the Unit 1 HPSI injection valves and motor operators were made as a result of the above conditions. The modifications included turning the valves around, installing 90 ft. lb. spring packs, change out of the pinion and spur gears and adjusting the limit and torque switches. For details see Section IV. Upon retest of procedure 91PE-1SI08, valve 1JSIBUV616 stalled while attempting to stroke closed. This condition was documented on NCR SM-5310.

The HPSI injection valves are two inch, Limitorque motor operated globe valves manufactured by Borg-Warner and supplied by Combustion Engineering (C-E). They are installed in "flow over the seat" configuration to minimize the possibility of reactor coolant leakage through the valve stem packing during normal plan operation conditions. They are required to open to allow the HPSI pump to deliver water to the reactor during a loss of coolant accident (LOCA).

B. HPSI Pump Miniflow Valves

1. While troubleshooting the HPSI injection valves discussed above, the HPSI pump miniflow valves were tested for comparison data (the miniflow valves are similar to the isolation valves). During this testing, miniflow valve 2JSIAUV666 torqued out while going closed at approximately 20 percent open position. This condition was documented on NCR SM-5108.

2. During the performance of Unit 1 preoperational test procedure 91PE-1SI08, HPSI pump miniflow valve 1JSIBUV667 torqued out wile stroking closed near the closed position. This condition was documented on NCR SM-4338.

3. During the performance of Unit 2 preoperational test procedure 91PE-2SI08, HPSI pump miniflow valve 2JSIBUV667 torqued out while stroking closed near the closed position. This condition was documented on NCR SM-5346.

4. As a result of the above conditions, the miniflow valve motor operators were modified. The modifications included installing 90 ft. lb. spring packs, change out of the pinion and spur gears and adjusting the limit and torque switches. For details, see Section IV. Upon retest per Unit 1 preoperational test procedure 91PE-1SI08, valve 1JSIAUV666 failed to stroke open. This condition was documented on NCR SM-5311.

The HPSI pump miniflow valves are two inch, Limitorque motor operated globe valves, manufactured by Borg-Warner and supplied by C-E. These valves are normally open to provide miniflow protection for the HPSI puumps. However, on a recirculation actuation signal (RAS), the miniflow valves are required to close to preclude flow of contaminated water to the refueling water tank (RWT).

Evaluation

A. HPSI Injection Valves

Troubleshooting the HPSI injection valves revealed several factors that contributed to the operational problems experienced. A list of identified factors and discussions follows.

1. Limitorque Operator Torque Output

The capacity of the spring packs provided in these operators (Limitorque Model SMC-09-7.5) is 68 ft. lbs. Testing revealed that torques in excess of 68 ft. lbs. were intermittently required to operate the valves. With the torque switch bypassed, greater torque output from the motor operator can be achieved. However, these valves require the torque switch to be "active" (not bypassed) near the full open and full closed positions to stop the motor in the open and closed positions.

The solution to this problem is to install a higher capacity (90 ft. lb.) spring pack.

2. Torque Switch Contact Chatter

Vibration causes the contacts of the torque switch which is installed on the operator assembly to chatter which in turn trips the motor.

The solution to this problem is to install higher tension contact springs.

3. Flow Over the Seat

The subject valves were installed with flow over the seat which caused two problems: a) Flow over the seat works against the operator in the opening direction which is the "safety" direction of these valves; b) Flow over the seat caused the false "open" indication discussed in Section I. The design of the subject valves is such that there is axial "play" of approximately 1/8 inch between the stem and the disc. When approaching the closed position, flow over the seat causes the disc to be pushed into the seat (stem still 1/8 inch away from full stop), thus stopping the flow. At

this point, the disc no longer rotates while the stem, which is engaged with the operator worm gear, continues to rotate. High friction between the disc and stem caused the required torque to exceed the capacity of the torque switch, thereby "tripping" the motor. The above condition occurred when attempting to operate only one valve with the other three closed as discussed in Section I. Reducing the pressure on the valve by opening the other valves or turning off the HPSI pump results in reduced stem-to-disc friction. The required torque is then reduced allowing further stroking of the valve to the point of full "indicated" closure.

The solution to all of these problems is to re-orient the valves such that the flow would be under the seat. This orientation assists the motor operator in opening the valves and causes the flow to push the disc against the stem so that when the disc reaches the closed position, the stem will also be in the closed position.

The above conditions are common to the below-listed Train A and B HPSI injection valves.

1, 2, 3JSIAUV617	1, 2, 3JSIBUV616
1, 2, 3JSIAUV627	1, 2, 3JSIBUV626
1, 2, 3JSIAUV637	1, 2, 3JSIBUV636
1, 2, 3JSIAUV647	1, 2, 3JSIBUV646

The root cause of the current imbalance problems discussed in Section I is attributed to the torquing out problems with the motor operators. Testing the operators after modifications to produce higher torque resulted in normal current traces.

B. HPSI Pump Miniflow Valves

As with the HPSI isolation valves, there are several factors that contribute to operational problems with the HPSI pump miniflow valves. A list of identified factors and discussions follows.

1. Limitorque Operator Torque Output

The capacity of the spring packs provided in these operators (Limitorque Model SMC-09-7.5) is 68 ft. lbs. Testing revealed that torques in excess of 68 ft. lbs. were intermittently required to operate the valves. With the torque switch bypassed, greater torque output from the motor operator can be achieved. However, these valves require the torque switch to be "active" (not bypassed) near the full open and full closed positions to stop the motor in the open and closed positions.

The solution to this problem is to install a higher capacity (90 ft. lb.) spring pack.

The condition discussed in Section II.A.1 for the HPSI isolation valves applies to the miniflow valves also.

2. Packing Friction

The disposition of NCR SM-4338 indicates that excess packing friction has contributed to valve torquing out problems. As described in that NCR, valve 1JSIBUV667 "torqued out" while closing. Upon repacking and lubrication, the valve operated satisfactorily. Since the motor operators produce sufficient but marginal torque, any excessive friction such as that resulting from packing will cause "torque out" of the motor operator. Thus packing friction compounds the condition but is not considered a significant problem with the miniflow valves.

3. Worm Shaft to Declutch Shaft Cap Interference

As discussed in section I, valve 1JSIAUV666 failed to stroke open after modifications were made to the motor operator. The root cause of this condition is attributed to interference between the worm shaft and the declutch shaft cap. This cap acts as a cover over the spring pack and worm shaft. Under operation, the 90 ft. lb. spring pack caused further axial movement of the worm shaft than the original 68 ft. lb. spring pack. Consequently, an interference problem existed.

The solution to this problem is to counter bore the cap to provide more clearance. This is done by machining the inside surface of the declutch shaft cap.

II. Analysis of Safety Implications

A. HPSI Injection Valves

As stated in Section I, these valves are required to open to allow the HPSI pumps to deliver water to the reactor during an accident.

Based on the above, this condition is evaluated as reportable under the requirements of 10CFR 50.55(e); since, if this condition were to remain uncorrected, it would represent a significant safety hazard.

This project also has evaluated this condition as reportable under 10CFR21.21(b)(3). This report addresses the reporting requirements of the regulation with the exception of subpart (vi), regarding the number and location of such components supplied to other facilities.

B. HPSI Pump Miniflow Valves

As stated in Section I, these valves are required to close on a RAS to preclude flow of potentially contaminated water to the RWT. However, downstream valves 1, 2, 3JSIAUV660 and 1, 2, 3JSIBUV659 also close on a RAS which would preclude flow of contaminated water to the RWT.

Based on the above, this condition is evaluated as not reportable under the rquirements of 10CFR50.55(e) and 10CFR Part 21; since, if this condition were to remain uncorrected, it would not represent a significant safety hazard.

III. Corrective Action

DCPs 1SM, 2SM, and 3CM-SI-150 and dispositions to the NCRs listed on page 1, reference documents, have been issued to perform the following modifications:

1. Turn the HPSI injection valves around for flow under the seat. Miniflow valves are already installed with flow under the seat. Reference DCPs 1SM, 2SM, and 3CM-SI-150.

2. Install higher capacity spring packs (90 ft. lbs.) on the HPSI injection and miniflow valves. Reference DCPs 1SM, 2SM, and 3CM-SI-150.

3. Change out of a pinion and spur gear in the motor operators to assure the higher torque rating of 90 ft. lbs. at 75 percent voltage. Reference DCPs 1SM, 2SM, and 3CM-SI-150.

4. Install stronger torque switch contact springs. Excessive vibration has only been documented for the injection valves. However, for consistency, this modification applies to the injection and miniflow valves. Reference NCRs SM-5310, SM-5311, and SE-4358 for Unit 1 and DCPs 2SM and 3CM-SI-150 for Units 2 and 3.

5. Adjust the limit switches as follows for both the injection and miniflow valves. Reference DCPs 1SM, 2SM, and 3CM-SI-150.

   a) Limit switch contacts controlling the red indicating light will be set to function at 10-15% open travel.

b) The bypass of the open torque switch will be set to open at 15-20% open travel.

c) The opening circuit travel limit switch will be set to open at 90-95% open travel position.

d) The green light limit switch is on the same rotor as the opening circuit travel switch, and will also be set to function at 90-95% open travel position.

e) The close torque switch bypass will be set to actuate at 90-95% open travel.

6. The torque switches must be individually adjusted for each motor operator to obtain the required torque output of 90 ft. lbs. (Reference 5).

7. Install a modified declutch shaft cap to provide additional clearance between the cap and the worm shaft. Interference between the cap and worm shaft has only been documented on valve 1JSIAUV666 on NCR SM-5311. However, this modification applies to the injection and miniflow valves. Reference NCRs SM-5310, SM-5311, and SE-4358 for Unit 1 and DCPs 2SM and 3CM-SI-150 for Units 2 and 3.

The above modifications will be completed prior to Mode 6 on Unit 1 and prior to operating license on Units 2 and 3. The referenced NCRs have been dispositioned as follows:

NCR SM-4956 has been dispositioned to rework valves 2JSIBUV616, 626, 636, and 646 per Mod V to DCP 2SM-SI-150.

NCR SM-5108 has been dispositioned to rework valve 2JSIAUV666 per Mod V to DCP 2SM-SI-150.

NCR SM-5310 has been dispositioned to rework all of the Unit 1 injection and miniflow valves in accordance with V-CE-31465 which describes the installation of the stronger torque switch contact springs and the modified declutch shaft caps.

NCR SM-5311 has been dispositioned the same as NCR SM-5310 above.

NCR SE-4358 has been dispositioned the same as NCR SM-5310 above.

NCR SM-5346 has been dispositioned to rework valve 2JSIBUV667 per Mod V of DCP 2SM-SI-150.

NCR SM-4338 has been dispositioned "use-as-is" since valve 1JSIBUV667 did not torque out after repacking and lubrication in accordance with the interim disposition of the NCR.

IV. References

1. Letter V-CE-31058, October 2, 1984

2. Letter V-CE-31167, October 17, 1984

3. Letter V-CE-31194, October 24, 1984

4. Letter V-CE-31242, October 26, 1984

5. Letter V-CE-21799, November 5, 1984

6. Letter V-CE-21803, November 8, 1984