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July 13, 1981

United States Nuclear Regulatory Commission
Region I
631 Park Avenue
King of Prussia, PA 19406

ATTENTION: Mr. Boyce H. Grier, Director

SUBJECT: BEAVER VALLEY POWER STATION - UNIT NO. 2
Docket No. 50-412
3" MOV Gate Valves in Safety Injection and Chemical and Volume Control System - Significant Deficiency 80-06

Gentlemen:

We reported to your office on October 29, 1980, a significant deficiency of problems with three-inch gate valves manufactured by the Westinghouse Electro-Mechanical Division. We provided you an interim report on this problem on November 20, 1980.

An investigation into this valve deficiency is still underway. Pursuant to the requirements of 10CFR50.55(e), enclosed is "Interim Report No. 2 on 3" MOV Gate Valves in Safety Injection and Chemical and Volume Control System at Beaver Valley Power Station - Unit No. 2". We plan to issue another report when valve modification details are complete.

DUQUESNE LIGHT COMPANY

By E. J. Woolever
E. J. Woolever
Vice President

wjs

Enclosure

cc: Mr. V. Stello (15)
Mr. K. Jabbour

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Interim Report
Westinghouse 3" ad 4" MOV Gate Valves

1.0 SUMMARY

The Westinghouse Electro-Mechanical Division Gate Valve problem surfaced when several valves failed to fully close during start-up testing at the Almarez Nuclear Station in Spain and during EPRI PORV Block Valve Tests at Duke Power's Marshall Station. These valves are classified as "active" valves (i.e., mechanical operation is required to accomplish a safety function).

Beaver Valley Power Station Unit No. 2 has several of these valves located in the Chemical Volume Control, and Safety Injection Systems. The valve types are Westinghouse Model Nos. 3GM88 and 4GM88. A complete list of the valve's function and location No. is provided in Attachment No. 1.

2.0 IMMEDIATE ACTION TAKEN

In November, 1980, nonconformance and disposition reports 1456 and 1457 were issued to identify and control all applicable 3" Westinghouse supplied motor-operated valves. Nonconformance and disposition report 5025 was issued in June, 1980, to identify and control all applicable 4" Westinghouse supplied motor-operated valves.

As discussed in this report, the valve deficiency exists only for those valves which do not meet their functional requirements. These valves are the charging line isolation valves location Nos. 8107 and 8146, the charging pump miniflow valve location No. 8106, and the PROV Block Valves Location Nos. 8000A, B, and C

As part of the DLC "Approach to Safety-Grade Cold Shutdown", PORV Block Valves Location Nos. 8000A, B, and C will be upgraded to safety-grade (active) and qualified to IEEF 323-74 and IEEE 344-75. In addition, the new valve design will address the funtional concerns summarized in this report.

Nonconformance and disposition reports 1456, 1457, and 5025 will be closed. A new nonconformance and disposition report will be written to identify and control only the valves which failed to meet their functional requirements. The following valves will be put on hold until modification is complete.

Valve Function	Valve Location Number	WEMD Model Reference
Charging Line Iso.	8107	3GM88
Charging Line Iso.	8146	3GM88

Charging Pump Miniflow	8106	3GM88
PORV Block Valves	8000A,B,&C	3GM88

3.0 DESCRIPTION OF DEFICIENCY

Typically, these motor-operated valves operated through 75 percent of their full disc travel leaving about 5 percent of the flow passage unsealed. Subsequent strain gage testing showed the stem thrust loads required to fully close the valve to be 50 percent larger than original design calculations predicted.

In these original design calculations, the stem thrust required to fully seat the wedge or disc against flow was calculated using what were considered valve industry standard equations which are part of the actuator manufacturer's sizing criteria. This calculated stem thrust was then used to size the Limitorque motor operator that powers the valve. Since the strain gage testing showed the actual required thrust load to be 50 percent higher than the calculated load which was used to size the operators, the operators do not have the capacity to fully close the valve particularly under their difficult 80 percent voltage requirement.

4.0 ANALYSIS OF SAFETY IMPLICATIONS

The safety implications are listed in the last column of Attachment No. 1 titled "Potential Safety Consequences". The key to interpreting this column is as follows:

Potential Consequences

1. (PORV Block Valves) Potential incomplete isolation of pressurizer PORV.

2. Potential cavitation of a centrifugal charging pump or safety injection pump due to operation beyond maximum runout flow.

3. Potential inability to perform post accident containment isolation.

4. Potential degradation of safety injection flow below values given in SAR.

5. Potential inability to isolate RCS pressure boundary (no valves applicable to this concern).

5.0 CORRECTIVE ACTION TO REMEDY DEFICIENCY

All valves listed in Attachment No. 1 do not meet the equipment specification for valve closure at the maximum differential pressure as flow approaches zero at 2750 psi. To eliminate the number of valves requiring modification, a final valve closure functional requirement is defined for

each valve. This functional requirement is based on system design requirements, single failure criteria, and the Westinghouse Reference Emergency Operating Instructions.

The emergency Operating Instructions, in certain applications, require stopping the high pressure safety injection pumps during the switchover to hot leg recirculation. The pumps are not restarted until all of the hot leg recirculation valve realignments have been accomplished. For this condition, valve closure differential pressure will be zero. The differential pressure of 500 psi is based on the worst case flow mismatch for parallel high pressure safety injection pump operation during the transfer to cold leg recirculation phase of ECCS.

For those valves identified on Attachment No. 1 for which a new functional requirement could not eliminate modifications, WNES has not yet completed the testing and redesign program to choose the best modification for each valve type.

To determine the source of the higher-than-expected valve closing loads, a series of analyses and tests were initiated. The testing programs as listed on Attachment No. 2 include: full flow testing, mechanical fixture testing, seat friction factor testing, and motor operator testing. Kinematic, force, flow, deflection, and stress analyses have been performed. Although this work is not totally complete, it indicates that higher-than-expected seat friction forces are the source of the majority of the excess load. Backseat friction reactions and stem-disc connection reactions also contribute.

Reducing the actual required closing loads is not possible so attention must focus on increasing the force capabilities of the valve actuators. Depending on the valve being considered, the force capability can be increased by some combination of gearing changes, motor size changes, and operator frame size changes. On the W-EMD Model No. 3GM88 valve, the modifications will include: change operator gear ratio to guarantee adequate thrust capability at 80 percent voltage, and rewire the operator for limit closing control.

6.0 ADDITIONAL REPORTS

A final report will be issued when valve modification details are complete.

ATTACHMENT NO. 1
MAXIMUM ΔP (PSID)
AS FLOW APPROACHES ZERO

VALVE FUNCTION	VALVE LOCATION NUMBER	WEMD MODEL REFERENCE	EQUIP. SPEC.	INTERIM FUNCT. REQMT.	FINAL FUNCT. REQMT.	ΔP (PSID) BELOW WHICH VALVE WILL CLOSE (AS SHIPPED)	VALVE CAPABILITY SATISFIES FUNCTION REQUIREMENT (AS SHIPPED)	POTENTIAL SAFETY CONSEQUENCES
Charging Line Iso.	8107	3GM88	2750	2700	2750	1500	No	2,4
Charging Line Iso.	8146	3GM88	2750	2700	2750	1500	No	2,4
Charging Pump Miniflow	8106	3GM88	2750	2700	2750	1500	No	2,4
Boron Injection Tank Iso.	8801A	3GM88	2750	1200	0	1500	Yes	2,3
Boron Injection Tank Iso.	8801B	3GM88	2750	1200	0	1500	Yes	2,3
Boron Injection Tank Iso.	8803A	3GM88	2750	1200	0	1500	Yes	2,3
Boron Injection Tank Iso.	8803B	3GM88	2750	1200	0	1500	Yes	2,3
Hot Leg Recirc. Iso.	8814	3GM88	2750	1200	0	1500	Yes	2,3
Hot Leg Recirc. Iso.	8816	3GM88	2750	1200	0	1500	Yes	2,3
Cold Leg Recirc. Iso.	8885	3GM88	2750	1200	0	1500	Yes	2,3
Charging Pump Discharge XO Iso.	8132A,B	4GM88	2750	500	500	750	Yes	2,4
Charging Pump Discharge XO Iso.	8133A,B	4GM88	2750	500	500	750	Yes	2,4
PORV Block Valve (1)	8000A,B,C	3GM88	2750	----	2500	1500	No	1

(1) These valves are presently "inactive" valves; however, these valves will be upgraded to "active".

ATTACHMENT NO. 2

SUMMARY OF TESTING ACTIVITIES--VALVE CLOSING PROBLEM

1. Water Flow Testing (at Pacific Pump Company)

Condition up to and including 600 gpm and 2800 psi

4 valves - 3GM88 + field modifications	complete
3 valves - 3GM99	complete
3 valves - 4GM88	complete

Field modifications for the 3GM99 and 4GM88 to be tested in early-May.

2. EPRI Steam Flow Tests (PORV Block, Steam Flow)

1 valve - 3GM88	complete
1 valve - 3GM99	complete

3. Site Testing (Full Flow Water Testing, Safety Injection System)

Almarez:	Approximately 10 valves - 3GM88	complete
CGE:	Approximately 10 valves - 3GM88	complete
STP:	3 valves - 3GM88	complete

4. EdF (Steam and Water Flow Testing)

2 valves - 3GM99	in process

5. Mechanical Fixture Testing (At WEMD)

Using hydraulic cylinder to duplicate flow loads so force transfer can be studied in depth.

1 valve - 3GM88	complete
1 valve - 3GM99	complete
1 valve - 4GM88	complete

6. Seat Friction Factor Tests (At Westinghouse R&D)

To determine stellite on Stellite friction factors under water and steam conditions. Test samples are nearing completion at EMD.