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SUBJECT: Forwards addl info requested in NRC 950615 ltr re safety insp rept 50-305/95-06 on 950522-26 re grouping of valves, plans for justification of assumptions for stem lubrication degradation & open stroke valve factors.

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October 24, 1995

U.S. Nuclear Regulatory Commission
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Ladies/Gentlemen:

Docket 50-305
Operating License DPR-43
Kewaunee Nuclear Power Plan
Reply to Inspection Report 95-006

References: 1) Letter from J.M. Jacobson (NRC) to M.M. Marchi (WPSC) dated June 15, 1995 (Inspection Report 95-006).

2) C10836, KNPP MOV Valve Factor and Load Sensitive Behavior Evaluation, Rev. Original (Attachment 2)

In Reference 1, the Nuclear Regulatory Commission (NRC) provided Wisconsin Public Service Corporation (WPSC) with the results of a routine safety inspection conducted May 22-26, 1995. This inspection primarily focused on completion of commitments to Generic Letter (GL) 89-10, "Safety-Related Motor-Operated Valve Testing and Surveillance."

As noted in the inspection report, additional information was requested related to the grouping of valves, plans for justification of assumptions for stem lubrication degradation and open stroke valve factors, and justification of the linear extrapolation methodology for some valves.

Attachment 1 to this letter provides our written summary of the actions taken with regard to valve grouping, stem lubrication degradation, open stroke valve factors, and linear extrapolation. Evaluation C10836 was generated to support KNPP's grouping methodology; the body of the evaluation report is included as Attachment 2.

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It is expected that this letter will close-out the KNPP GL 89-10 Program. If you have any questions or need additional information, please contact a member of my staff.

Sincerely,

Mark L. Marchi
Manager - Nuclear Business Group

JRR

Attach.

cc - US NRC Region III
US NRC Senior Resident Inspector

ATTACHMENT 1

Letter from M. L. Marchi (WPSC)

To

Document Control Desk (NRC)

Dated

October 24, 1995

Re: Inspection Report 95-006
(GL 89-10 Close-Out Inspection)

NRC Comment - Design Basis Capability (3.2)[1]

The thrust calculations utilized the standard industry equations and valve orifice diameter to calculate valve seat area. A VF of 0.5 for gate valves and 1.1 for globe valves was used for initial valve set-up unless actual test data from similar valves indicated other values were appropriate. A stem coefficient of friction of 0.15 was assumed unless test data indicated a different value was appropriate. The calculated minimum required thrust was increased by 15% for load sensitive behavior and 5% for actuator degradation (stem and gear lubricant degradation and spring pack relaxation) unless test data or an engineering evaluation supported another value. For all MOV tests, the torque and thrust was measured using a Torque Thrust Cell.

WPSC Clarification

For non-Dp testable MOVs, KNPP will assume a 10% load sensitive behavior percentage based on Attachment 2 rather than 15%.

NRC Concern - Maximum Unwedging Forces Not Compared to Actuator Capability (3.2.1)

The licensee did not compare operator capability at degraded voltage to maximum unwedging force for open safety function valves that could not be dynamically tested. A subsequent review of static tests of valves with open safety functions did not identify any operability concerns; however, the licensee will be expected to revise appropriate procedures to include this comparison in future tests to ensure that open safety function valves have the capability to open under design-basis conditions.

WPSC Response

KNPP General Maintenance Procedure (GMP) 236-02, "MOV Diagnostic Test Analysis and Acceptability Determination," will be revised to include acceptance criteria for static test unwedging force. Using the ITI MOVATS Torque/Thrust Cell (TTC), thrust and torque are simultaneously measured; therefore, the calculated actuator torque capability at degraded voltage

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1 Parenthetical numbers are to the applicable sections of Inspection Report 95-006.

using pullout efficiency can be compared to the unseating torque as indicated on static test traces. The acceptance criteria for non-Dp testable valves with a safety function to open will be that the actuator torque capability at degraded voltage must exceed the static test unwedging torque.

NRC Concern - Lack of Justification for Use of Close VF to Evaluate Open Stroke (3.2.2)

The inspectors noted that the licensce did not calculate an open VF. Kewaunee used dynamic test data from the valve closing stroke to calculate a close VF. This value was then extrapolated to design-basis conditions in the open direction, where appropriate. The inspectors were concerned that if the opening VF was larger than the closing VF, the comparison of actuator capability to minimum required thrust and torque would be in error. In response to this concern, licensee personnel randomly selected five valves and calculated the open VFs. Three MOVs exhibited a closing VF greater than the opening VF and two MOVs exhibited an opening valve factor greater than the closing VF. The inspectors considered this data insufficient to justify the use of a closing VF in the opening direction. Prior to program closeout, Kewaunee will be expected to review open dynamic test data and calculate opening VF, where appropriate, or provide further justification to support the stated position.

WPSC Response

The open valve factors have been calculated for cach dynamic test performed on gate valves. Open valve factors were not calculated for globe valves since the globe valves that were Dp tested are oriented with flow from under the seat, which tends to assist the actuator during opening; a true open valve factor cannot be calculated for globe valves with flow under the seat. See Attachment 2 for the open valve factor calculation results.

NRC Concern - Linear Extrapolation to Design-Basis Conditions (3.2.4)

The inspectors determined that the justification for linear extrapolation of MOV test data to design-basis conditions was not sufficient in some cases. A straight line extrapolation was used on all Dp tests, regardless of the actual Dp or Dp load. However, EPRI and industry testing suggested that straight line extrapolation was not always appropriate at low Dps, low Dp loads, or for valves required to operate under high velocity flow (e.g., blowdown conditions). Under low Dp loads, reasonably accurate extrapolations to design-basis conditions have not been achievable due to significant scatter in the testing data. EPRI has stated that extrapolation from 33% of the MEDP (Maximum Expected Differential Pressure) was acceptable; however, the staff has expressed reservations about this position since it did not require a minimum absolute pressure value to ensure that the data is beyond the scatter area. Under high velocity flow conditions, valve damage could occur, which could increase the VF beyond that calculated by the straight line extrapolation. The staff did not have a concern with extrapolation in the blowdown range; however, due to the large percentage of EPRI blowdown valves that were damaged during testing, there appear to be limitations on the applicability of this approach. These issues will be discussed in the EPRI Topical Report SER, due to be issued in December 1995.

Kewaunee used linear extrapolation of MOV test data for four MOVs tested at low Dp as well as for at least six MOVs required to close under blowdown conditions. For these valves, the inspectors reviewed the safety function(s), MEDPs, minimum thrust requirements and assumptions, as-left thrust at CST, and the valve capabilities. Based on this review, it did not appear that the operability of these valves would be affected; however, the licensee will be expected to provide further justification for this position prior to program closure. The failure to justify the stated position with in-plant test data or to address readily available industry information, which indicated that the stated position may not be appropriate, was considered to be a weakness.

WPSC Response

Two issues are described: (1) low Dp testing (i.e., less than 33% of the maximum expected design-basis Dp (DBDP)), and (2) blowdown isolation valves.

(1) Dynamic testing of two valves (SI-302A/B) was performed at 19% and 26% of DBDP as indicated in the Inspection Report (3.3 valve group 12). Attachment 2 justifies the use of this Dp test data for these valves based on the valve safety function and interpretation of EPRI test data from a similar valve.

The other two low Dp tests were performed on main steam valves (MS-100A/B). The Dp test was performed with 80% of the design-basis line pressure; however, the differential pressure decreased following valve closure and resulted in less than 20% of the DBDP.

The DBDP was conservatively calculated assuming a line break immediately downstream of the valves. However, the location of the analyzed break for which these valves are required to close is greater than 325 feet downstream of each valve resulting in a significant pressure drop. Extrapolation to the calculated condition assuming a line break immediately downstream of the valves is conservative compared to the analyzed design-basis line break location.

(2) The six "blowdown" valves discussed with the NRC inspectors were four steam generator blowdown treatment (BT) isolation valves and the aforementioned main steam valves.

The BT valves were tested at greater than 60% of their design-basis Dp, which considers a line break downstream of the valves. The dynamic test directs flow to a standpipe at maximum flow conditions with the given system configuration. In addition, the BT valves are globe valves, for which there exists limited industry blowdown test data. Attachment 2 compares EPRI blowdown test data for similar valves to Kewaunee's BT valves.

Blowdown conditions for the two main steam valves (MS-100A/B), which direct flow to the turbine-driven auxiliary feedwater pump, were discussed above. Given the intervening piping and associated check valves, significant backpressure would exist at the analyzed break location. Therefore, these valves are not relied upon to close under blowdown conditions.

NRC Concern - Grouping (3.3)

Kewaunee did not use grouping to eliminate any practicable Dp testing. This was considered to be a strength in the program as it resulted in dynamic testing of over 58% of the program valves. However, overall, the inspectors considered the justification for valve groups to be weak. The grouping methodology did not meet the guidelines of GL 89-10, Supplement 6 and had not satisfactorily established the design-basis capability of MOVs that had not been tested or that had not been tested near design-basis conditions.

Kewaunee relied on only two sources for industry Dp test information (EPRI and one other plant). The relatively small sample of valve test data available from these two sources resulted in various groups not having any Dp test data to support the design-basis VF assumptions. While the default VFs were not unreasonable, there was insufficient supporting documentation. The licensee will be expected to document and strengthen the justifications for valve groups prior to program closure.

Important grouping considerations were also not fully assessed. For example, when using EPRI data, Kewaunee incorrectly equated EPRI's Apparent Disk Coefficient of Friction to Kewaunee's definition of VF, bringing into question the application of EPRI test data. Further, even though industry test data indicated a relationship between valve manufacturer, valve type, valve size, and even ANSI pressure class rating, valve groups were developed according to valve manufacturer and type only.

Concerns identified with specific groups included the following:

- Valve group 1 contained 3, 6, and 12 inch Aloyco double disk gate valves and had very limited data from another site. Two of four valves were tested in this group and both tests were open-stroke, hydrostatic tests with zero flow. Further justification is needed to closeout these MOVs.

- Valve group 2, which had no in-plant data, contained 4, 6, and 8 inch Anchor-Darling flex wedge gate valves. EPRI valve Number 3 appeared to be a close match to the licensee's 6 inch valves, and indicated a VF greater than the 0.55 assumed.

- Valve group 6 consisted of two untested 3 inch Crane globe valves with an assumed VF of 1.1 and a load sensitive behavior of 15%; however, no data was available on site to verify these assumptions. Further, the valves had a small calculated margin.

- Valve group 8 contained 8, 10, and 12 inch Crane flex wedge gate valves. Only one of nine valves had been tested in this group. Further justification is needed to closeout these MOVs.

- Valve group 10 contained 2 inch Edwards globe valves. The licensee had tested all four valves in the group; however, data from two of the tests were suspect. The licensee assigned a VF of 0.9 and a load sensitive behavior of 5% to these valves which bounded the licensee's test data. However, these valves were steam generator blowdown valves and EPRI blowdown test data showed VFs as high as 1.48. The licensee needed to review the EPRI data and verify appropriate VF.

- Valve group 12 contained 3, 6, 8, and 12 inch Velan flex wedge gate valves. The licensee applied a VF of 0.55 and a load sensitive behavior value of 10% to the valve group. In-plant testing bounded the VF and load sensitive behavior; however, two of the four valve tests were conducted at only 19% and 26% of design-basis Dp. The inspectors noted that another test indicated a negative VF. Due to the test results, further justification for the assumed VF and load sensitive behavior applied to this valve group is needed.

- Valve group 13 contained 2 inch Velan globe valves. Two of the three valves had been dynamically tested and, although the load sensitive behavior value bounded the test data, the VF of 1.1 did not. Use of a 1.1 VF is not justified when only two dynamic tests were performed, one of which indicated a VF of 1.23.

- Valve group 15 contained 16 inch Powell flex wedge gate valves and had no data to support closeout. Further, EPRI data was not available for these valves. The licensee will be expected to justify VF assumptions for these valves prior to program closeout.

- Valve group 16 contained 3, 4, 8, 10, and 12 inch Powell solid wedge gate valves. The inspectors noted that the licensee applied two different VFs to this group. This indicated that the group definitions should be re-examined and split into other more appropriate groups. Further, two valves exhibited VFs significantly higher than the assumed VFs of 0.75 and 0.96. The licensee needed to reconcile the valve factor discrepancies.

WPSC Response

The KNPP "Valve Factor and Load Sensitive Behavior Evaluation," C10836, was strengthened to justify valve factor assumptions. The valve families were re-grouped based on valve type, size, pressure class, and manufacturer. Each valve sub-family was individually evaluated to justify appropriate valve factor assumptions based on in-plant dynamic test data, dynamic test data from other nuclear plants, and EPRI flow loop test results. Table 1 is a listing of the companies contacted during performance of the evaluation. The EPRI "apparent" valve factors were converted to the industry-defined valve factor.

Subsequent to the inspection, WPSC updated the NRC Region III staff on the status of the revised evaluation in late July, 1995. Several valve families are not represented by in-plant dynamic test data. During a later telephone conversation the NRC Region III inspectors requested that a maximum available valve factor be calculated for specific MOVs. Although Kewaunee feels that the valve factor assumptions are adequately justified in Attachment 2 based on industry data, in support of this request the maximum available valve factors were calculated for these MOVs based on the KNPP thrust requirement calculation methodology.

For valves with a safety function to close, the maximum available valve factor is the valve factor that equates the calculated minimum closing thrust requirement to the as-left thrust at torque switch trip. The closing thrust requirement includes the running (packing) load, piston effect, load sensitive behavior (10%), actuator degradation allowance (5%), torque switch repeatability (5%), and instrument inaccuracies.

For valves with a safety function to open, the maximum available valve factor is the valve factor that equates the calculated minimum opening torque requirement to the calculated actuator output torque, which includes consideration of the running (packing) load, pull out efficiency, degraded voltage and ambient temperature correction factor, actuator degradation allowance (5%), and stem coefficient of friction (0.15).

The running load allowance and stem coefficient of friction values bound the values determined from static test data. Table 2 is a list of KNPP's non-Dp testable MOVs and the calculated maximum available valve factors for the valve safety function direction.

NRC Comment - Periodic Verification of MOV Design Basis Capability (3.6)

Kewaunee's plans for periodic verification of MOV design basis capability were considered satisfactory for program closeout. Per the plan, each valve would be diagnostically tested every three refueling outages or five years from the time of the last diagnostic test. The approach would include a combination of static and dynamic testing. Valves to be dynamically tested included new valves, valves subject to recent maintenance, and a sample of valves based on risk and margin.

As of the inspection date, 20 MOVs would require Dp testing because of maintenance or new valve installation. Up to seven additional valves were determined to be candidates for Dp testing, based on safety significance and available margin; however, the specific number of valves to be tested had not been finalized.

With Kewaunee's Dp testable population of 39 MOVs, the number of valves to be Dp tested over 5 years or 3 refueling outages (up to 20 valves due to maintenance performed and up to 7 of the originally installed valves) was considered to be a reasonable number of tests to meet the intent of GL 89-10.

The dynamic test results would be monitored through the trending program to verify that the MOV's design-basis capability is maintained. When evaluating whether additional Dp testing would be required, Kewaunee is expected to evaluate valve performance degradation information promulgated by the industry, EPRI, and the NRC.

WPSC Clarification

In response to GL 89-10, Kewaunee performed dynamic testing on all MOVs where practicable.

With the impending release of GL 89-10, Supplement 7, Valve Mispositioning in Pressurized-Water Reactors, several Dp testable MOVs may be removed from the scope of the Kewaunee MOV Program. This will reduce the number of MOVs that would require re-Dp testing as a result of previous valve maintenance or new valve installations.

The number of valves to be Dp tested on a periodic basis shall be determined based upon a representative number of those Dp testable valves in the MOV program which automatically reposition or are required to be repositioned to mitigate the consequences of an accident. MOV performance shall be trended and the frequency of periodic dynamic testing may be adjusted based on the results.

TABLE 1 - List of Company Contacts

The following companies were contacted during the performance of calculation/evaluation C10836:

Utility/Organization	Locations Contacted
Commonwealth Edison	Corporate Office, Byron, Braidwood, Dresden, Quad Cities
Consumers Power	Big Rock Point
Crane Valves	Regional Office
Detroit Edison	Fermi
Duquesne Light	Beaver Valley
GPU Nuclear	Corporate Office
Illinois Power	Clinton
MPR Associates (EPRI)	
Nebraska Public Power	Cooper
New York Power Authority	Fitzpatrick
Niagara Mohawk	Nine Mile Point
Northeast Utilities	Millstone
Northern States Power	Prairie Island
Pacific Gas & Electric	Corporate Office, Diablo Canyon
PECO Energy	Corporate Office
Pennsylvania Power & Light	Corporate Office
Tennessee Valley Authority	Corporate Office, Salem
Virginia Power	Innsbrook Technical Center, North Anna
Wisconsin Electric	Point Beach

TABLE 2 - MAXIMUM AVAILABLE VALVE FACTORS

VALVE No.	VALVE TYPE	Safety Function / Valve Factor	
		OPEN	CLOSE
CVC-211	Aloyco DDG	NA	0.84
CVC-212	Aloyco DDG	NA	0.81
FW-12A	Wm. Powell FWG	NA	0.68
FW-12B	Wm. Powell FWG	NA	0.69
ICS-2A	Crane FWG	10.55	4.11
ICS-2B	Crane FWG	10.41	4.49
MS-2A	Crane Globe	NA	1.31
MS-2B	Crane Globe	NA	1.28
RHR-300A	Aloyco DDG	1.48	0.76
RHR-300B	Aloyco DDG	1.50	0.61
SI-300A	Crane FWG	26.58	NA
SI-300B	Crane FWG	26.80	NA
SI-350A	Crane FWG	7.79	NA
SI-350B	Crane FWG	8.92	NA
SI-351A	Crane FWG	8.53	NA
SI-351B	Crane FWG	8.25	NA
SW-502	Wm. Powell SWG	2.51	NA
SW-601A	Wm. Powell SWG	1.93	NA
SW-601B	Wm. Powell SWG	1.93	NA
SW-1400	Velan Globe	57.89	NA

NOTES:

1. DDG = Double Disc (Ball and Socket) Gate Valve
   FWG = Flexible Wedge Gate Valve
   SWG = Solid Wedge Gate Valve
   NA = Not Applicable

2. Valve factors are based on KNPP's required thrust calculation methodology.

ATTACHMENT 2

Letter From M. L. Marchi (WPSC)

To

Document Control Desk (NRC)

Dated

October 24, 1995

Re: Inspection Report 95-006
(GL 89-10 Close-Out Inspection)

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