U. S. NUCLEAR REGULATORY COMMISSION
REGION I

DOCKET/REPORT NOS.	50-387/94-14 50-388/94-15
LICENSEE:	Pennsylvania Power and Light Company Allentown, Pennsylvania
FACILITY:	Susquehanna Steam Electric Station
DATES:	October 3-13, 1994
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SCOPE: The licensee's program developed in response to NRC Generic Letter 89-10 was evaluated, including a review of design basis capability, motor-operated valve (MOV) sizing, switch settings, and test data. Five MOVs were selected for detailed review based on probabilistic risk assessment (PRA) classification, valve type, differential pressure conditions, and percentage of differential pressure testing relative to design-basis conditions. Programmatic topics, identified during the NRC team inspection (Report 91-80) conducted in September 1991 were reviewed for progress.

FINDINGS: One unresolved item involving pressure locking/thermal binding was identified. The executive summary provides additional details. Unresolved Item 91-80-02 was closed based on a demonstration that dc motor stroke times were within operability limits.

TABLE OF CONTENTS

EXECUTIVE SUMMARY

SUSQUEHANNA MOV INSPECTION 94-14/94-15

Management oversight was apparent through interviews with licensee managers, communications between site and corporate staff, an independent audit of the GL 89-10 program, and in the quality and current status of the program.

A review of five motor-operated valves for design basis capability, sizing, and switch settings indicated that the licensee was using an effective methodology. Appropriate factors were considered, such as for load sensitive behavior, stem lubricant degradation, torque switch repeatability, and diagnostic equipment inaccuracies. Data and results from actual dynamic testing corroborated these assumptions.

A technical basis for the 25% margin proposed as a screening criteria for future dynamic testing to detect MOV degradation (i.e., periodic verification) needs to be further justified. The exclusion of low priority valves and valves not deemed susceptible to aging requires further discussion.

Operability determinations were found to be comprehensive for MOVs susceptible to the pressure locking/thermal binding phenomenon. Eight valves in the core spray and low pressure coolant injection systems were modified to increase design margin. Pending the issuance of additional NRC generic communications, and the evaluation of an acceptable methodology to address this phenomenon, this issue was left unresolved (URI 50-387/94-14-01, 50-388/94-15-01).

DETAILS

1.0 INTRODUCTION

On June 28, 1989, the NRC issued Generic Letter (GL) 89-10, requesting licensees to establish a program to ensure that switch settings for safety-related motor-operated valves (MOVs) were selected, set, and maintained properly. Six supplements to the generic letter have been issued to clarify the NRC request. NRC inspections of licensee actions, implementing the provision of the generic letter and its supplements, have been conducted based on guidance provided in Temporary Instruction (TI) 2515/109, "Inspection Requirements for Generic Letter 89-10, Revision 1," which is divided into MOV Part 1, "Program Review," and Part 2, "Verification of Program Implementation."

The NRC conducted an initial team inspection (Part 1 program review) at Susquehanna in September of 1991, as documented in Inspection Report 91-80. The purpose of this current Part 2 inspection was to review the MOV program implementation at both units. Prior to this inspection, the licensee was requested to compile a table of the pertinent information obtained for all MOVs that had been dynamically tested as part of the GL 89-10 program. The inspectors reviewed this information at the beginning of the inspection to select a sample of MOV dynamic test results for detailed review. The results of this review, together with other MOV program topics, are discussed below.

2.0 MOV PROGRAM IMPLEMENTATION

2.1 Detailed Review of Selected MOVs

2.1.1 Design Basis Reviews

The inspectors selected the following MOVs for design basis review based on dynamic testing, safety significance, risk, and capability margin:

HV-151F007A	RHR Pump Minimum Flow Recirculation Valve
HV-151F022	RHR Head Spray Inboard Containment Isolation Valve
HV-151F028A	Suppression Chamber Test Shutoff Valve
HV-152F031B	Core Spray Pump Minimum Flow Valve
HV-255F001	HPCI Steam Supply to the HPCI Turbine

The inspectors reviewed the licensee's documentation for determination of design basis differential pressure. The licensee used the first safety relief valve (SRV) setpoint for reactor pressure where required by the design basis reviews. Elevation differences were calculated using shutoff pump head, and downstream pressure was assumed to be zero for pipe break scenarios. The licensee reviewed their design basis accident scenarios for each motor operated valve (MOV) and then utilized the scenario with largest differential pressure. The inspectors considered the design basis differential pressures, calculated for the above valves, to be appropriate. Test parameters and results for the valves, which were independently evaluated by the NRC, are summarized in the following table.

VALVE NUMBER	VALVE TYPE	TEST CONDITIONS (psid)		% DESIGN BASIS		DYNAMIC VALVE FACTOR [1]		STEM FRICTION COEFFICIENT		% LOAD[2] SENSITIVE BEHAVIOR
		Open	Close	Open	Close	Open	Close	Static	Dynamic	
HV-151F007A	6" Anchor Darling 300# Flex Wedge Gate	345	345	99	102	0.52	0.52	0.10	0.10	3.22
HV-151F022	6" Anchor Darling 900# Flex Wedge Gate	0.0	295	NSD	98	0.47	0.47	0.16	0.13	-14.50
HV-151F028A	18" Anchor Darling 300# Flex Wedge Gate	336	336	93	101	0.37	0.37	0.10	0.12	11.60
HV-152F031B	3" Anchor Darling 300# Flex Wedge Gate	371	371	96	100	0.53	0.53	0.06	0.09	10.80
HV-255F001	10" Anchor Darling 900# Flex Wedge Gate	1042	0.0	88	NSD	N/C	N/C	0.11	N/C	N/C

1. Valve factor was calculated using mean seat diameter from vendor supplied information.
2. A negative number indicates that the thrust observed at CST during the dynamic test was greater than the thrust observed at CST during the static test.
3. "N/C" = Not Calculated; "NSD" = Non Safety Direction.
4. Grease used for stem lubrication was Swepco Moly 101.

2.1.2 MOV Sizing and Switch Settings

The inspectors reviewed documentation for determination of thrust and torque requirements for the selected valves. The inspectors reviewed Procedure MDS-04, "Design Standard For Motor Operated Valve Engineering Requirements," Revision 7, which specified the use of the standard industry equations for calculating thrust for gate and globe valves. A valve factor (VF) of 0.50 was utilized for gate valves and 1.10 for globe valves to initially set up MOVs. A different valve factor was used if other plant data were available which constituted "best available data" (i.e., identical valves dynamically tested in similar systems with equivalent differential pressures and flows). The valves' mean seat diameter was used to calculate the valve disc seat area.

The minimum required thrust was calculated and then adjusted for torque switch repeatability. The licensee's calculations included a margin of 10% for load sensitive behavior (also known as "rate of loading") and stem lubrication degradation.

To determine the maximum thrust setpoint for a MOV, the licensee selected the lowest value of the Limitorque actuator's published thrust rating, the valve's weak link analysis, or the reduced motor output due to degraded voltage. The licensee adjusted the maximum thrust setpoint for torque switch repeatability. Diagnostic equipment inaccuracies were accounted for by adjusting the measured values. The licensee then compared maximum thrust (adjusted for torque switch repeatability and diagnostic equipment inaccuracies) to the valve's weak link analysis and actuator thrust ratings. If the maximum thrust had been exceeded, the licensee required an engineering evaluation. The licensee was a member of the Kalsi study and used the study only as required to extend actuator thrust ratings. This was considered by the inspectors to be a reasonable practice.

A required minimum and maximum torque were calculated. The minimum torque was based on the calculated minimum required thrust converted to torque, using a stem friction coefficient of 0.15 for Anchor Darling valves and 0.20 for all other valve manufacturers. The maximum torque was based on the smallest of either (a) the actuator's torque rating, (b) the actuator's published thrust rating converted to torque using a stem friction coefficient of 0.10, (c) the motor's torque output calculated at degraded voltage conditions, or (d) the springpack's torque rating. The thrust values, used to determine torque outputs, were adjusted for torque switch repeatability and diagnostic equipment inaccuracies.

The inspectors were concerned that the use of a stem friction coefficient of 0.15 for Anchor Darling valves would over-predict the thrust available for MOV operation during design basis conditions. Testing had shown dynamic stem friction coefficients from 0.07 to 0.20, which indicated that an assumed stem friction coefficient of 0.15 was not bounding. The licensee performed a study, EC-VALV-1007, "Evaluation of Motor Capability and Maximum Allowable Open Thrust for GL 89-10 MOV's Assuming A Stem/Stem Nut Coefficient of Friction of 0.20," Revision 2, dated March 23, 1994. This study indicated that three valves needed further evaluation for motor capability. Valves HV-1(2)51F008 (Shutdown Cooling Supply Outboard Containment Isolation Valve) indicated insufficient motor capability in the open direction; however, an opening stroke is in the non-safety (functional) direction. Valve HV-151F016A (RHR Pump Shutdown Cooling Isolation Valve) was originally assumed to have flow over the seat for conservatism. Valve HV-151F016A has flow under the seat aiding the globe valve to open; therefore, HV-151F016A has sufficient motor capability.

The licensee measured total thrust using VOTES diagnostic equipment. During the static test, the diagnostic equipment inaccuracies were noted and used to adjust the thrust recorded at control switch trip (CST). The inspectors noted that torque was not measured during their dynamic testing. Rather, a linear variable differential transformer (LVDT) was used to measure spring pack displacement during dynamic testing. The licensee used a spring pack tester

to develop or verify the spring pack curves for each MOV and derive a measured torque value. When a LVDT was not used, the thrust from CST was converted to torque using the appropriate stem friction coefficient. A 10% margin was required between the CST torque value and the spring pack torque capability and/or the motor torque capability at degraded voltage. The inspectors considered this practice to be satisfactory.

2.1.3 Motor Brakes

In response to NRC Information Notice 93-98, "Motor Brakes on Valve Actuator Motors," dated December 20, 1993, the licensee indicated that no motor brakes were installed on GL 89-10 MOVs at Susquehanna.

2.1.4 Design Basis Capability

The inspectors reviewed the licensee's dynamic test data for the valve packages requested. A total of 190 MOVs in the Generic Letter 89-10 program. All valves have been statically tested using VOTES diagnostic equipment; however, the licensee required three MOVs to be retested for resolution of either VOTES 10 CFR 21 data, or for other deficiencies. Dynamic differential pressure tests had been performed on 47 MOVs.

The licensee intends to statically retest three MOVs, HV-151F007A (RHR Pump Minimum Flow Valve), HV-151F009 (Shutdown Cooling Supply Inboard Containment Isolation Valve), and HV-151F023 (RHR Head Spray Outboard Containment Isolation Valve). HV-151F023 had a springpack the licensee wanted to replace. The installed springpack was operating properly; however, the lot number for that springpack had shown a history of springpack relaxation. The inspectors considered this to be a plant improvement. HV-151F009 had the torque switch set too high. The MOV was capable of performing its required safety function; however, after performing its safety function the MOV could possibly stall and damage the motor. HV-151F009 was only required to perform its automatic safety function once, and was not relied upon later in accident scenarios. The licensee reduced the original torque switch setting for HV-151F007A because they had not received weak link data for the MOV. After they lowered the torque switch, they performed a static test. Subsequent to this activity, the weak link data were recieved, but the licensee reset the torque switch to the previous setting without statically testing the MOV. The inspectors questioned whether the torque switch was set to the same thrust level as prior to resetting. Procedure MT-AD-531, "Motor-Operated Valve (MOV) Maintenance Program," mentions the adjustment or replacement of actuator torque switch assembly as potentially requiring a static retest. Surveillance and stroke tests were completed for the valve in question, however the inspectors considered the licensee's actions related to HV-151F007A to be a poor practice. The licensee intends to address each of these valves during the next outage.

The licensee's dynamic testing indicated closing gate valve factors up to 0.69 and closing globe valve factors up to 1.45. Based on this data, the licensee's general valve factor assumption for gate valves of 0.50 and 1.10 for globe valves was not always bounding. However, the licensee had differentially pressure tested several valves, used data from identical

valves, or recalculated the required thrust using the latest available information for valve factor. The test review and reconciliation process increased valve factors where necessary. The inspectors were concerned about those valves which could not be differentially pressure tested, or for valves where the test conditions did not supply meaningful data. The licensee indicated that they plan to use the best available data and document each case where this occurs.

The licensee performs an operability review prior to returning MOVs to service after design basis differential pressure testing. This review was documented in Procedure M-1503, "Technical Specification for Verifying Motor Operated Valves Ability to Function," Appendix C, Rev. 2, dated January 20, 1994. The licensee used the thrust measured at flow cut-off or hard seat contact, whichever was greater (adjusted for running loads), and then multiplied this value by the ratio of the design basis differential pressure to the test differential pressure. Running load was then added to determine the design basis thrust requirements. The design basis thrust requirement was compared to the calculated minimum required thrust, and the larger of the two was then compared to CST (adjusted for diagnostic equipment inaccuracies). If the dynamic test values were used, they were corrected for torque switch repeatability (static test results were also corrected for torque switch repeatability). The licensee required a margin equal to the torque switch repeatability and the diagnostic system inaccuracies. The inspectors noted that dynamic test analyses were not evaluated to ensure margin to account for MOV degradation, although such margin was considered later during the functionality review. The inspectors were concerned that a valve could be returned to service immediately if the operability review was acceptable, but the functionality review may later determine that there is inadequate margin until the next available maintenance period. The inspectors will consider this issue when closing the concerns with MOV periodic verification.

Load sensitive behavior, stem factor, and stem friction coefficient were calculated at a later date by PP&L engineering personnel using MDS-06, "Design Standard For Verification of Motor Operated Valve Functionality," Rev. 4, dated July 18, 1994, and then compiled into a package for each valve tested. The inspectors noted that the justification for a linear extrapolation to design basis differential pressure was written for the open direction only. Licensee personnel revised the justification to include extrapolations in the closed direction. The inspectors also noted that in the functionality assessment, calculation of valve factor was optional. The inspectors discussed with the licensee the need to apply best available data or data from identical valves if the valve factor was not calculated. The licensee's engineering personnel stated that they intend to calculate valve factors, where possible, and revise the thrust calculations as appropriate.

The licensee's method for assessing load sensitive behavior required removing the diagnostic system inaccuracies and torque switch repeatability prior to the assessment. The inspectors discussed with the licensee the potential of a bias during the testing, which was less than torque switch repeatability and diagnostic system inaccuracies, but could be attributed to load sensitive behavior. The licensee agreed and revised their procedure accordingly.

2.2 Periodic Verification

Generic Letter 89-10 discusses features to periodically verify that the MOVs will perform their design basis function when the effects of aging, including degradation due to wear, erosion, or corrosion are considered. This verification testing should be trended so that MOVs are retested before aging can adversely affect their capability to perform. Static testing alone has not been shown to provide this confidence.

The licensee's presently proposed program requires the dynamic test of all butterfly valves every 5 years or 3 refueling outages, which the NRC considers appropriate. Unless otherwise specified, the maximum time interval between static diagnostic periodic tests for gate and globe valves is 5 years.

Gate and globe valves would not be dynamically tested on a periodic basis if they meet any one of the following screening criteria: (1) ≥25% capacity margin with no control switch anomaly; (2) not potential aging candidates; (3) Priority 3 valves which do not have high risk reduction worth and of which failure won't cause the loss of a safety function. The document, EC-CALC-1022, "Generic Letter 89-10 Periodic Verification Method Evaluation," evaluated a methodology which relies on static testing to provide periodic verification and purports that, with a 25% margin, any disparity in the detection of aging between static and dynamic is taken into account. The evaluation stated that guide-to-guide rib interface deterioration may be detected only by dynamic tests. The licensee needs to provide a basis or validation to demonstrate that 25% margin will adequately bound divergence between periodic static and dynamic testing for age detection. Priority 3 MOVs also need to be further addressed to ensure they can perform their safety function.

2.3 Pressure Locking and Thermal Binding

The phenomenon of pressure locking is caused by valve bonnet pressure hydraulically locking the stem and disk, resulting in high thrust requirements to open the valve. Plant or system temperature conditions can also cause the valve disc to bind in its seat. Valve actuators generally are not sized to open the valves when high pressure fluid is trapped in the valve bonnets or when excessive binding forces are present.

The NRC inspectors reviewed the licensee's initial screening and evaluation of pressure locking and thermal binding, as documented in EC-VALV-0548, "Safety-Related Gate Valves INPO SOER 84-7 Screening Evaluation," and EC-VALV-0549, "Safety-Related Gate Valves INPO SOER 84-7 Detailed Evaluation," dated June 17, 1994. These design analyses contained the initial study that screened all safety-related valves for susceptibility to the phenomena and detailed evaluations for valve operability, when determined to be potentially susceptible. The analyses specifically addressed the valves identified in the NRC Special Study AEOD/S92-07, "Pressure Locking and Thermal Binding of Gate Valves," dated December 1992. The operability determinations were thorough and the criteria for screening were reasonable.

As a result of the licensee's evaluation, a total of eight low pressure coolant injection (LPCI) and core spray (CS) injection isolation valves were modified by drilling a small hole in the valve disc. The inspectors reviewed EDRs G30028 and G30027 (generated in response to events at another BWR) and noted that the reactor core isolation cooling (RCIC) and high pressure coolant injection (HPCI) inboard steam supply valves were not considered for modification. Rather, the licensee revised the use of procedures for warmup of these valves to prevent the conditions that could lead to pressure locking or thermal binding.

The actions taken to date by the licensee are considered proactive and appropriate. Because the evaluation of this generic phenomenon is ongoing, and additional corrective actions may be required in the future when an acceptable methodology is approved by the NRC, this item is unresolved. **(URI 50-387/94-14-01, 388/94-15-01).**

2.4 Quality Assurance

The inspectors reviewed independent assessment report, "PP&L Susquehanna Steam Electric Station - Units 1 & 2 NRC GL 89-10 MOV Program Assessment Report," dated March 21, 1994, which was performed by Vectra Technologies, Inc. The assessment was requested by PP&L to review the content, status, and implementation of the GL 89-10 MOV Program for compliance with regulatory requirements and current industry practice. Overall, the assessment was positive and found that the licensee's current program would preclude many of the discrepancies noted because they occurred at an earlier time in the program's development. The report was thorough, and identified weaknesses as well as strengths in the licensee's program. The inspectors discussed the report with the licensee and confirmed that appropriate actions have been (or will be) taken to address the findings from the assessment.

2.5 MOV Failures, Corrective Actions, and Trending

Recommended action "h" of the generic letter requests that licensees analyze and justify each MOV failure and corrective action. The documentation should include the results and history of each as-found deteriorated condition, malfunction, test, inspection, analysis, repair, or alteration. All documentation should be retained and reported in accordance with plant requirements. It is also suggested that the material be periodically examined (every 2 years or after each refueling outage after program implementation) as part of the monitoring and feedback effort to establish trends of MOV operability.

Overall, the licensee's program for identifying MOV failures, implementing corrective actions, and trending pertinent data, was good. The focal point for MOV failure trending at Susquehanna is the MOV engineer, as documented in Procedures MI-VL-003, "MOV Performance Evaluation and Trending," Revision 1, 2/11/93, and MT-AD-531, "MOV Maintenance Program," Revision 0, 1/17/94. The inspector reviewed the content of this database and determined that it contained all necessary parameters as indicated in Generic Letter 89-10. It also encompassed additional data which may aid the licensee in the future,

such as spring pack number and calibration data. The inspector found the parameters selected to be recorded in the database and should be sufficient to assist the licensee in trending MOV degradation and failures.

The trending database was well controlled. The licensee used a spreadsheet which has graphic capability. The inspector noted that this feature has not been used to any degree yet, but the capability does exist and, as the database grows, this should be useful. Although the database is cumbersome due to its spreadsheet layout and size, it can be adjusted to allow specific parameters to be more easily viewed. The licensee intends to acquire software which will allow overlay mapping of tests and enhance the licensee's trending capability.

The inspector reviewed the number and types of tests recorded in the database. The licensee does record most tests; however, some as-found test results were not recorded. The inspectors discussed these observations with the MOV maintenance program personnel and they indicated that they are in the process of determining what additional test data would better aid in their trending of MOV performance. The licensee's periodic review of trending data is discussed in Section 3.3.1 (Quarterly Trend Reports).

The inspector reviewed nonconformance reports and significant operating occurrence reports (SOORs) for selected valve failures over the past 24 months. The reports were thorough, however, it was not clear in the documentation for all NCRs and SOORs that "sister" (like) valves were analyzed for similar failure mechanisms. Discussions with engineering personnel provided sufficient information to indicate that, in each case, they were. Due to the familiarity of the personnel involved with the site, they sometimes did not state why one problem on a valve at one unit would not necessarily apply to the other unit, due to certain differences in design. The inspector noted that frequent communication between site and corporate engineering enabled an efficient exchange of information to aid in the determination of the possible extent of a problem and the best solution. Appropriate corrective actions were identified and implemented in a timely manner.

2.6 Schedule for Completion

The licensee had originally committed to complete its MOV test program by June 28, 1994.

In a letter, PLA-4124, dated April 29, 1994, the licensee requested a schedule extension for the completion of their GL 89-10 program implementation activities, primarily to complete planned testing. A followup letter, PLA-4163, dated July 11, 1994, provided additional information and revised the licensee's test schedule. The April 29 letter also presented the licensee's justification for the deferral of diagnostic MOV testing on the main steamline isolation valve leakage control system (MSIV-LCS) and elimination of "E" diesel generator emergency service water butterfly valves from the scope of the Generic Letter 89-10 Program.

The diagnostic testing on the MSIV-LCS was deferred because the entire system is scheduled for removal during the Unit 1 Fall 1996 and Unit 2 Fall 1995 outages. The NRC inspectors reviewed EC-083-1012, "Capability Evaluation for MSIV Leakage Control System MOVs" and determined that the valves' design reviews and weak link analyses were already done. Switch settings were determined by calculations of equivalent MOVs in the 89-10 program. When these facts are considered in conjunction with the licensee's inservice stroke testing, the licensee has reasonable justification for considering these valves currently capable. The licensee intends to statically test the MSIV leakage control system MOVs in accordance with the GL 89-10 program if the schedule for removal is delayed. This item will, therefore, be separately considered from GL 89-10 closure.

During this inspection, the licensee subsequently decided to retain the "E" diesel ESW valves in the GL 89-10 program using an alternate, but equivalent method, to assure continued design basis capability. Valves HV-01110E (HV-01112E) and HV-01120E (HV-01122E) are required to provide a safety function only when a surveillance test is being performed on the "E" emergency diesel generator, which is normally less than 70 hours per year. The NRC inspectors and NRR staff, therefore, considered this alternate testing approach appropriate.

As of this inspection, the licensee had dynamically tested 45 of the 190 MOVs in the GL 89-10 program (for both units), with eight MOVs in the high pressure coolant injection and reactor core isolation cooling systems planned for the upcoming refueling outages on both units in the next year. These eight MOVs are being reviewed for practicability of meaningful dynamic testing. The licensee will inform the NRC if there are any changes to the scope of dynamic testing results from this review. Three static tests will also be repeated to resolve questions regarding margin or diagnostic measurement uncertainties.

The NRC staff determined that the licensee's April and July 1994 letters were consistent with the guidance for extension requests provided in GL 89-10, Supplement 6. On October 11, 1994, a conference call was conducted with licensee representatives, members of the NRC Region I staff, and NRR staff. The NRC concluded that the licensee had adequately justified extending the completion date of its GL 89-10 program to December 31, 1995, for both units.

3.0 PROGRAMMATIC UPDATES

3.1 MOV Sizing and Switch Settings (IR 91-80, Section 2.4; IR 93-08 Section 3.0)

3.1.1 (CLOSED) Complete the Remaining Operator Sizing and Switch Setting Calculations

The September 1991 NRC team inspection (the Part 1 inspection) identified several programmatic or technical issues which needed to be resolved in the licensee's GL 89-10 program. Included in these items were: 1) completion of the remaining operator sizing and switch setting calculations, 2) review of each torque switch setting following design basis testing and adjustment where needed, and 3) completion of detailed evaluations of minimum voltage available to MOVs.

The licensee initiated Engineering Deficiency Report (EDR) G30034 to address all GL 89-10 MOV program issues. Included were: 1) the effect of elevated temperatures on ac motor starting torque, 2) increased valve factors, 3) degraded voltage, and 4) the Part 21 notification concerning VOTES inaccuracies. The inspectors reviewed the status of this EDR and found that all initial reviews and analyses have been completed. As a result of these analyses, over 200 action items were generated. Currently, 34 are still open. All are scheduled to be completed by November 1995, which is the date of the Unit 2 (R07) outage. The inspectors verified that all operator sizing and switch setting calculations have been completed. This item is therefore considered closed.

3.1.2 (CLOSED) Use of 0.15 Stem Friction Coefficient

The licensee had previously used a stem friction coefficient of 0.15 for MOV operator sizing calculations. This value was considered appropriate for well lubricated valve stems. As discussed in Section 3.2.1 of this report (Stem Lubrication Frequency), the licensee had not committed to the vendor-recommended 18-month valve stem lubrication frequency, and the licensee was asked, therefore, to document their justification for using the 0.15 stem friction coefficient.

PP&L used a 0.15 stem friction coefficient for all Anchor Darling valves for close capability only, a value of 0.20 for all other manufacturers and open motor capability calculations for Anchor Darling valves. The licensee used 0.20 for motor capability and max allowable open thrust calculations. This was also identified in Section 2.1.2 of this report. The inspectors reviewed the licensee's justification study, EC-VALV-0536, "MOV Stem-to-Stem Nut Coefficient of Friction," Revision 1, 10/3/94, which recommends using a design coefficient of friction of 0.15, unless otherwise specified by manufacturer or test data, and found it to be acceptable. Also, the licensee did perform a calculation for all 89-10 MOVs using a stem friction coefficient of 0.20 and found that their valves had sufficient margin. Considering the licensee's study and their commitment to the vendor-recommended stem lubrication frequency of 18 months, this item is closed.

3.1.3 (CLOSED) Review Each Torque Switch Setting Following Design Basis Testing and Make Adjustments If Required

The inspectors reviewed the test packages for the valves selected and verified that following design basis testing, the licensee reviewed each torque switch setting and made adjustments if required. This item is also captured in EDR G30034 as discussed above. This item is closed.

3.1.4 (CLOSED) Licensee Incorporation of Ambient Temperature Effects in Switch Setting Calculations

During a previous NRC MOV inspection, the licensee had indicated that they would review the Limitorque 10 CFR Part 21 study on ambient temperature effects on ac motors and incorporate their findings into their switch setting calculations. The inspectors reviewed PP&L study EC-VALV-0508 (formerly SEA-VE-010), "Assessment of Elevated Temperature Effects on AC MOVs," Revision 2, 7/20/94, which concluded that all MOV motors at SSES have an inherent torque reduction based on the Part 21 condition identified in the Limitorque study. The inspectors also reviewed PP&L Design Standard MDS-01, "Design Standard for Sizing of Limitorque Actuators Including Thrust Calculation, Actuator Sizing, Spring Pack Selection, Torque Switch Setting, and Limiting Valve Factor Determination," Revision 7, 1/26/94, and verified that temperature effects on ac motors are factored into actuator sizing and switch setting calculations, along with other factors as part of EDR G30034. The method for incorporating this information is comprehensive. The inspectors reviewed the design packages for the valves selected and verified that these calculations were implemented. The licensee confirmed that calculations for all valves in Units 1 and 2 have been completed. This item is closed.

3.2 MOV Maintenance (IR 91-80 Section 2.7, IR 93-08 Section 3.0)

3.2.1 (CLOSED) Frequency of Stem Lubrication

During previous NRC inspections, PP&L had not committed to routine stem lubrication. Recently, the licensee conducted an 18-month interval lubrication program to identify trends and to assess the adequacy of the interval using new and better grades of grease. Previous NRC inspections reviewed the analyses of several grease samples and observed good agreement between the consultant's analysis and PP&L's analysis. This study has been completed and the licensee is now routinely using a lubrication frequency of 18 months for all 89-10 valves. The inspectors reviewed the licensee's procedure for performing preventive maintenance and overhauls on SMB Limitorque actuators, MT-GM-050, "Limitorque Type SMB 000-4 Operator Maintenance," Revision 6, 3/16/94, and verified that Step 8.1.8 requires lubrication of the stem nut and threaded area. This item is closed with the understanding that the licensee plans to maintain the 18-month interval for stem lubrication in accordance with vendor recommendations.

3.2.2 (CLOSED) Procedure for Spring Pack Relaxation Measurement

The NRC MOV Part 1 inspection team noted that the method used for checking for spring pack relaxation did not, in fact, determine if the spring pack was relaxed. At that time, the licensee had acquired a spring pack tester and planned to revise the maintenance procedure to require the use of a spring pack tester for checking spring pack relaxation during overhauls. A subsequent inspection found that the licensee was not using the spring pack tester, but instead changed the procedure to make more careful spring pack measurements during overhauls. During this inspection, the inspectors verified that PP&L is currently using a spring pack tester during actuator overhauls. Maintenance Procedure MT-GM-075, "Spring Pack Testing," Revision 3, 7/5/94, has been written and is being used as part of preventive maintenance. The inspectors did note that although this procedure references the MT-GM-050 procedure and vice versa, the actual step where this procedure should be used does not clearly indicate that MT-GM-075 should be used. It merely states that the spring pack tester should be used. The inspectors discussed this with licensee personnel and are satisfied that the work packages will contain MT-GM-075 if the spring pack is to be tested. The testing to be performed with the spring pack tester is too involved for the maintenance technicians to proceed without a procedure. This item is closed.

3.2.3 (CLOSED) Justify Deviations from Vendor-recommended Maintenance Schedules

The inspectors verified that this has been done through the Preventive Maintenance Improvement Project. Package Number 130, "Limitorque Valve Motor Operators NRC GL 89-10 VOTES Tested," Revision 0, 9/28/93, Table D, documents vendor recommendations, industry recommendations, PP&L commitments, and additional PP&L recommendations. Documentation is brief and the table references other tables for justification for deviations from recommended intervals. Although this document was current at the time of this inspection, there is no plan to update it. Therefore, in the future, if PP&L maintenance practices change, there will not be a central document containing any justification. This is not a concern today since, although some justifications are sparse, the personnel involved are still in the company and can be reached. However, this will not always be the case and a centralized, updated justification system would maintain better control of the issue. The licensee agreed with this observation; however, no actions are planned to modify the situation. The licensee stated that, although any future deviations from vendor recommendations will not be documented in the PMIP package, it will be possible to trace the justification through the request to change the affected maintenance procedures. Because the licensee has in place justification for any deviations from vendor recommendations, and because any further changes will be traceable, this item is considered closed.

3.3 Trending (IR 91-80 Section 2.8, IR 93-08 Section 3.0)

3.3.1 (CLOSED) Quarterly Trend Reports

Previous NRC inspections have noted development in the area of trending MOV failures and performance. Currently, a trending program is in place for valves in the licensee's 89-10 program. This program is discussed in Section 2.5. As a followup to the earlier NRC inspections, the inspector reviewed the past two quarterly trend reports. Procedure MT-AD-531, "Motor Operated Valve (MOV) Maintenance Program," Revision 0, 1/17/94, was written to replace AD-QA-531, and provides instruction to the MOV engineer to perform a quarterly review of previously performed MOV maintenance and testing activities. This review is scheduled as a preventive maintenance activity task to ensure it is completed. This procedure fully explains the intent of the reviews which is to: 1) identify MOVs which exhibit degradation in performance, 2) identify MOVs for which increased attention is required, 3) adjust the assigned frequency of preventive maintenance tasks to match MOV performance and trending results, and 4) emphasize or identify needs for specific training or other procedural controls to improve overall MOV maintenance and testing performance. This procedure also delineates several possible actions for the MOV engineer to take, following completion of the quarterly trend review including changing PM frequency, updating the MOV Database, and changing maintenance procedures.

The inspectors discussed this process with licensee MOV personnel and learned that completed work packages are reviewed quarterly to compile the information. All MOV work packages are reviewed, including those for non 89-10 valves, which shows the licensee has an encompassing view of possible MOV problems. Although this is a good method and should capture most relevant data, the inspectors suggested that perhaps NCRs not generated as a direct result of a work order could also be reviewed. In addition, significant operational occurrence reports (SOORs) may provide helpful detail. The inspectors do realize that SOORs often lead to maintenance work package generation and, therefore, will in most cases be captured in that way.

The inspectors reviewed the quarterly trend reports for the past two quarters for each unit. The reports were completed in a timely fashion and did reference NCRs generated directly from testing. However, it was not clear in quarterly reports that a broader view is taken, rather than just for that quarter. For instance, no recommendations for increased preventive maintenance or changes to the program were included, nor was a statement explaining why no action was needed when other occurrences were noted. The licensee acknowledged the need for a more comprehensive report. The NRC considers this item closed.

3.3.2 (CLOSED) Complete Review of the Preventive Maintenance Improvement Program

At the time of the August 1993 NRC inspection of PP&L's MOV program, the licensee had not yet completed their Preventive Maintenance Improvement Program because it was put on hold while they were rethinking GL 89-10 requirements. This program requires the incorporation of all past history regarding MOVs (i.e. SSES failures; industry failures; vendor, industry, and SSES requirements, etc.) into a package for use by the MOV engineer. The inspectors reviewed the final package of the PMIP related to MOVs, Package 130, "Limitorque Valve Motor Operators NRC GL 89-10 Votes Tested," Revision 0, 9/28/93, and verified that it has been completed in accordance with the requirements of the program. This item is closed.

3.4 (CLOSED) Decreased Motor Speed Effects (Unresolved Item NO. 50-387, 50-388/91-80-02)

During the Phase I Motor Operated Valve (MOV) inspection in September 1991, the NRC team found that dc-powered MOVs stroke time changes, caused by decreases in motor speed, had not been reviewed by the licensee. (Unresolved Item No. 50-387,50-388/91-80-02)

Inherent to dc motors, a change in available terminal voltage alters the operating speed of the motor. Specifically, a reduction in voltage will decrease the motor speed and, thereby, increase the stroke time of the valve. The licensee was able to obtain dc motor speed at reduced voltages for their Peerless motor, and, rather than wait an indeterminate time for Reliance, the licensee assumed a linear relationship between motor speed and decreases in voltage.

The licensee has assumed that the relationship of voltage to torque/speed can be considered linear for Reliance and Peerless motors with insignificant error. This is based on IEEE Energy Conversion documentation, Commonwealth Edison Company dc motor testing, and Limitorque test data for Peerless motors.

The licensee's methodology for stroke time calculation was done in three parts. The first part was to evaluate the valve application to determine a load profile. The second part was to develop a load profile to calculate the available motor terminal voltage for each segment of the profile. The final part was to use the developed load profile and available voltage to determine the motor speed for each load segment and associated stroke time.

The inspector reviewed selected licensee calculations of dc motor stroke times. The licensee identified the high pressure coolant injection (HPCI) system pump minimum flow bypass valve (HV155F012) as having an increase in stroke time that did not meet the FSAR requirement to ensure that the HPCI system can be brought to design flow rate within 30 seconds from the receipt of the initiation signal. The stroke time given in the FSAR Section 7.3.1.1.A.1.3.7 and Table 6.3-8 is 10 seconds for the valve to travel from the fully closed to fully open position, or vice versa. The calculated degraded voltage stroke times for HV155F012 are 8.8 seconds to open, and 11.7 seconds to close.

The licensee provided traces of actual tests using steam inlet pressure equal to nominal reactor pressure, and 150 psig resulted in the HPCI system having enough reserve capability to inject the required 5000 GPM with the minimum flow bypass valve full open and passing 500 GPM in 27 seconds. The licensee's determination that the HPCI system was meeting the required injection rate, and is fully capable and operable, was satisfactory. Stroke times taken during static conditions for performance of SO-152-002, "Quarterly HPCI Flow Verification," gave the licensee confidence of the ability of HV155F012 to actually stroke within the requirements, but the most recent recorded stroke time did not substantiate this claim.

The licensee is working an engineering deficiency report (EDR 93-122) to address the stroke time. The motor and gearing ratios of HV155F012 are planned for modification under DCP 93-3078 during the next outage, which would bring the stroke times to 5.8 seconds to open and 7.3 seconds to close. This is a reasonable corrective action and, when implemented, should provide sufficient stroke time margin for the HPCI minimum flow bypass valve. This item is closed.

3.5 (CLOSED) Weak Link Analyses

The licensee had used M1509, "Specification for MOV Weak Link Analysis," to set criteria for the procurement of the weak link analysis for the GL 89-10 MOVs. The criteria for determining the requirements for maximum allowable thrust/torque, and accelerations was established in MDS-05, "MOV Weak Link Evaluation Criteria." The inspectors verified that the structural limit analysis for each MOV in the 89-10 program was obtained and incorporated into maximum thrust calculations. This item is also discussed in Section 2.1.2 of this report. The licensee has taken thorough action in this area; therefore, this item is closed.

3.6 (CLOSED) Use of 0.3 Valve Factor

During the Part 1 inspection the licensee had used a 0.3 valve factor for calculating minimum thrust requirements for gate valves. At that time, the NRC indicated that use of a valve factor of 0.3 had been shown to be non-conservative in recent NRC-sponsored testing. The licensee agreed to evaluate, during design basis testing, the use of 0.3 valve factor and incorporate its findings into the GL 89-10 program. Subsequently, during an NRC inspection in August 1993 (IR 93-08), the final determination of valve factor was incomplete, but the licensee recommended a 0.5 value be used for gate valves.

The licensee is using a 0.5 valve factor for initial calculation for determining thrust requirements. Since all tests performed at Susquehanna are not bounded by this value, the licensee is using the test validated valve factor and updating thrust calculations as part of the testing feedback process. Valve factor is also discussed in Sections 2.1.2 and 2.1.4 of this report. The licensee's current use of a 0.5 valve factor is reasonable,

considering the low number of gate valves at Susquehanna with valve factors outside this range, and the remedial action taken when they are encountered. The continuation of high valve factors in the future may require a review of this policy. This item is closed.

3.7 (OPEN) Load Sensitive Behavior

The licensee was planning to evaluate the rate of loading/load sensitive behavior effects through in-situ design basis testing and other efforts, and adjust torque switch settings as appropriate, as reported in the NRC GL 89-10 MOV inspection of September 1991 (IR 91-80). In August 1993 (IR 93-08), the NRC reported the licensee used an allowance of 5% included in the MOV sizing calculation to compensate for rate of loading. The licensee is using a 10% margin to account for load sensitive behavior and lubrication degradation. This item is also discussed in Section 2.1.2 of this report.

During review of the licensee's program, the NRC inspectors noted that the licensee had observed a wide range of values for load sensitive behavior (from -17.80 to 31.80%). A negative number indicates that the thrust observed at CST during the dynamic test was greater than the thrust observed at CST during the static test. The inspectors were concerned that the 10% margin for load sensitive behavior may not be sufficient to account for load sensitive behavior in all cases. Licensee personnel stated that evaluation of test data from Susquehanna and other sources did not clearly indicate an appropriate amount of margin to be set aside for load sensitive behavior. In some cases, actuator thrust at control switch trip (CST) decreased under dynamic conditions and, in other cases, actuator thrust at CST increased under dynamic conditions.

The inspectors noted that the licensee's MDS-06, "Design Standard for Verification of Motor Operated Valve Functionality," calculated load sensitive behavior for each valve that was differentially pressure tested. The inspectors were concerned about how load sensitive behavior would be accounted for in valves which could not be differentially pressure tested, or for valves where the test conditions did not supply meaningful data. The licensee was in the process of developing a position on load sensitive behavior for these particular valves, using a combination of one standard deviation data from identical valves, and mean-weighted averages to account for load sensitive behavior. The inspectors noted the licensee's progress and stated that, whatever method was used to account for load sensitive behavior in these valves, should bound the majority of the data. Therefore, the inspectors concluded that the licensee needs to confirm the appropriateness (or revise the continued use) of 10% for load sensitive behavior and degradation. This item will be required to be addressed for closure of the GL 89-10 program.

4.0 MANAGEMENT SUPPORT

The licensee has provided effective management support and oversight of the Generic Letter 89-10 program. The NRC inspectors reviewed self-assessments and past management meeting minutes, conducted interviews, and observed the 89-10 program implementation. The inspectors noted good communications between the site and corporate offices, and a thorough, independent audit of the 89-10 program (refer to Section 2.4).

5.0 MANAGEMENT MEETINGS

Licensee representatives were informed of the scope and purpose of this inspection at an entrance meeting conducted on October 3. Findings were periodically discussed with the licensee throughout the course of this inspection. The inspectors met with the principals listed below at the Allentown corporate offices to summarize preliminary findings on October 14, 1994. The licensee acknowledged the inspection findings and had no additional comments regarding the inspection results. Phone calls were held on October 28 and November 29 to discuss the licensee's approach to periodic verification testing. Further, the preliminary conclusions did not involve proprietary information, nor was any such information included as part of the written inspection report.

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