U.S. NUCLEAR REGULATORY COMMISSION
REGION I

REPORT/DOCKET NOS.: 50-352/93-28
50-353/93-28

LICENSE NOS: NPF-39
NPF-83

LICENSEE: Philadelphia Electric Company
Post Office Box A
Sanatoga, Pennsylvania 19464

FACILITY NAME: Limerick Generating Station, Units 1 & 2

INSPECTION AT: Limerick, Pennsylvania

INSPECTION DATES: November 15-19, 1993

INSPECTORS: Mark R. Holbrook, Engineering Specialist, INEL
Beth E. Korona, Reactor Engineer Intern, NRC

Thomas J. Kenny, Senior Reactor Engineer
Systems Section, EB, DRS

12/16/93
Date

APPROVED BY: P. K. Eapen

Plackeel K. Eapen, Chief
Systems Section, EB, DRS

12/16/93
Date

EXECUTIVE SUMMARY

PECo has made substantial improvements in their GL 89-10 program and has updated most of the outstanding items from the team inspection of January 1992. The program is on schedule for completion, as required by GL 89-10 (Section 2).

The inspectors noted excellent housekeeping on their tour of selected areas of the facility (Section 3).

Through observation, the inspectors verified that testing was performed in accordance with established guidelines by qualified personnel using well written procedures (Section 4).

PECo has performed preliminary calculations and studies into pressure locking and thermal binding of motor-operated gate valves. See Section 5 for more details.

Dynamic testing reviews showed that testing is being performed well with a few minor problems identified by the inspectors. See Section 6 for details.

Overall PECo's GL 89-10 program has shown improvements.

DETAILS

1.0 INTRODUCTION

On January 13-17, 1992, a team inspection was conducted to evaluate the adequacy of Philadelphia Electric Company's (PECo's) actions, in response to NRC Generic letter (GL) 89-10, "Safety-Related Motor-Operated Valve Testing and Surveillance," and its supplements 1-5. NRC Combined Inspection Report No. 50-352/92-80 and 50-353/92-80, documented the findings of that inspection. The team concluded that PECo's implementation of the GL 89-10 program in some cases did not meet the intent of the letter and that the program did not have full management support. There was concern that the program would not be completed on time. The purpose of this inspection was to update the table that appears at the end of the above NRC inspection reports.

2.0 UPDATE OF TABLE 1

2.1 Scope and Administration of the Program

- PECo was to address the omission of a number of valves from the program scope.

  During the team inspection, the inspectors identified that three valves were omitted from the scope of PECo's program (HV-51-2F049, HV-51-2F040 and HV-55-126). PECo has conducted a valve by valve review of both units and issued Specification NE-145 that documents the scope of the program that now includes 405 valves for both units including the three valves listed above.

2.2 Design Basis Reviews

- PECo was to review and revise, as appropriate, emergency operating procedures to assure maximum differential pressure (dp) and flow are used in design basis reviews.

  The inspector reviewed PECo Report 2954 that was completed in May 1992 and documented the review and revision of EOP's. The report also updated the dp and flow calculations for all valves in the GL 89-10 program.

- PECo was to evaluate fluid and ambient temperatures as well as external effects on valve operability and include them in the design basis reviews.

  The inspector reviewed documents describing: AC and DC undervoltage studies, seismic issues and temperature studies involving voltages. There are still reviews in progress, by PECo, and this item has not yet been completed.

- PECo was to revise design basis reviews pertaining to reactor water cleanup system. PECo revised the design basis for the RWCU valves to use the reactor pressure vessel full power pressure in lieu of the lowest safety relief valve setpoint. However, PECo has not documented whether the main steam isolation valves would close during the accident scenario. PECo committed to verify the closure of the MSIVs by December 31, 1993.

2.3 Diagnostics Systems

- During the team inspection, PECo stated that the MOVs in the GL 89-10 program would be reviewed for operability as diagnostic equipment inaccuracies became available from actual tests or industry equipment validation tests.

  The inspector has confirmed this to be an ongoing process and notes that PECo discussed this in their response to Supplement 5.

2.4 MOV Switch Settings and Setpoint Control

- PECo was to revise guideline inadequacies for performing switch setting calculations.

  PECo has revised the guideline inadequacies and has issued documents to formulate calculations and methodology used in performing switch calculations. See Section 6.2 of this report for additional details.

- PECo was to complete MOV operator sizing and switch setting calculations by April 1, 1992.

  The inspector reviewed documents completed March 31, 1992, and found that they addressed operator sizing and switch settings for all the valves in the GL 89-10 program.

- PECo was to review torque switch settings and to include an operability determination for a primary containment isolation valve in the core spray system. This was unresolved item 50-352/92-80-01.

  All torque switch settings were reviewed by PECo using calculation LN-097. The inspector reviewed the document and confirmed that all valves were readdressed. The calculation showed that the valve (HV-52-1F015B suppression pool return) was operable at the time. The valve was later removed from the program as a result of calculation NEDC-31871 that showed that the valve is a normally closed valve and is not required to change position during an accident. The unresolved item is closed based on the inspectors review of calculation LM-097.

- PECo was to complete a review of Technical Specifications for bypassed status of thermal overloads.

  The document annotating the review of Technical Specifications was reviewed by the inspector, who found it complete. The valves required to be bypassed by TS have been identified in the GL 89-10 program.

2.5 Motor-Operated Valve Testing

- PECo failed to address design basis testing, and was to respond by Marc! 15, 1992.

  PECo is currently performing design basis testing. See Section 6.0 of this report for additional details.

- There appeared not to be a large effort on the part of PECo to implement the GL 89-10 program in a timely manner.

  PECo is currently on schedule to complete the GL 89-10 program as required by the letter.

2.6 Periodic Verification of MOV Capability

- PECo was to reevaluate the periodic testing of MOVs following a dynamic test program.

  PECo is still considering this item.

2.7 MOV Maintenance and Post Maintenance Testing

- PECo was to review observations made by inspectors regarding maintenance procedures with respect to spring pack relaxation, overfilling actuators with lubrication(overlubricating), and stem lubrication frequency and make appropriate changes to the maintenance procedures.

  The NRC MOV Phase I team noted that procedures only required measurement of belleville washer compression that would not detect all cases of spring pack relaxation. PECo has revised maintenance procedures M-C-700-254 (formerly M-500-021), "Limitorque Motor Operator Size SMB-00 and SMB-000 Slotting Spring Pack Torque Limiting Sleeves," and M-C-700-255 (formerly M-500-022), "Slotting Spring Pack Torque Limiting Sleeves Limitorque Motor Operator Size SMB-0 Through SMB-4," to correct this problem.

Previous procedures did not contain a caution to prevent overlubricating the limit switch gear case, clutch and worm gear housing, or main gearbox as established in Limitorque Maintenance Updates 88-2 and 90-1. The inspector verified that the applicable procedures have been revised and do currently contain a caution statement to prevent overlubrication.

The team also noted that Limerick's stem lubrication frequency did not comply with Limitorque recommendations. Limerick's current valve stem lubrication frequency of 2-6 years is much longer than the Limitorque recommended 18 month frequency. PECo's GL 89-10 MOV "Testing and Surveillance Program Plan" contains position papers that reference various procedures used in the plant. Position Paper #11 addresses the stem lubrication frequency and references Limerick Generating Station (LGS) Maintenance Section Guideline 42, "Motor-Operated Valve Preventive Maintenance Categorization." This guideline provides criteria such as plant operability importance, thrust margin, strokes/year, operator history, and accident environment to determine the preventive maintenance frequency for MOVs. The Preventative Maintenance (PM) program includes stem lubrication. If there is a problem when the valve is tested, the results are fed back into the rating criteria and the lubrication frequency is increased. Although no problems have been detected to date, the program is not old enough to provide results for the 6 year cycle. The inspector conducted a plant walkdown and found good overall stem lubrication.

- PECo agreed to document their justification for not overhauling operators prior to GL 89-10 testing and routinely overhaul motor operators.

  PECo overhauled and tested all safety-related MOVs prior to initial fuel load of Unit 2. Maintenance Guideline 46, "Maintenance Engineering Technical Position on Refurbishment and Preventive Maintenance Frequency of Safety-Related Motor-Operated Valves," has been issued to document their justification. Position Paper #12 was being revised to incorporate the above justification in their GL 89-10 program by December 31, 1993.

2.8 MOV Failures, Corrective Actions, and Trending

- PECo was to review current trending guidelines with regard to the lack of identification of trended parameters and the documentation of trended data and make the appropriate changes to satisfy the intent of the generic letter.

  PECo has developed the MOV Trending Database to trend the results of diagnostic testing. Maintenance Guideline 45, "MOV Performance Evaluation and Trending," has been issued and gives instruction on what parameters or failures to trend and how to document the trend data. This guideline was issued October 25, 1993, and all tests performed prior to that date have been input to the system and also sent to an offsite contractor for evaluation against this criteria. PECo expects to have the results of this

review by January 1, 1994. The electronic database is configured to be able to list the number of valves overtorqued, overthrusted, and underthrusted. The maintenance engineer responsible for the control of the tracking system created the trending program and performs his duties with regard to trending well.

2.9 MOV Training

♦ The team inspection had noted that there was no formal refresher training program for MOV maintenance.

PECo now provides yearly refresher training for all technicians and engineers involved with the GL 89-10 program. Each period of training is followed by formal testing both practical and written.

2.10 Industry Experience and Vendor Information

♦ The team inspection had noted that the Limitorque Maintenance Updates were not included in the Operating Experience Assessment Program.

Limitorque has been instructed by PECo to send all correspondence to the document control desk, where it receives a wider distribution. The inspector tracked several recent Limitorque Maintenance Updates through the PECo system including the plant information management system (PIMS) where the information is tracked via an Action Request (AR). This program assigns a responsible person and tracks the actions through completion.

2.11 Schedule

♦ The team had determined that a significant station and management effort would be required to complete the GL 89-10 program in a timely manner.

PECo's current schedule shows the static testing of all valves in the GL 89-10 program being completed on schedule. Unit 1 will be completed in June '94, and Unit 2 in March '95. This review of the GL 89-10 program shows considerable management attention has been devoted to the implementation of the program. The program appears to be on schedule in accordance with the GL 89-10.

3.0 PLANT WALKDOWN

The inspectors conducted a walkdown of selected areas of both units, with emphasis on MOVs. The inspectors found the housekeeping in these areas to be in excellent condition with no excess material in the area. The material condition of the MOV's inspected was clean with no identified concerns.

4.0 TESTING OBSERVATIONS

The inspectors witnessed the static testing of HV-050-1F046, "RCIC Lube Oil Cooling Water Supply Valve," a rising stem globe valve with flow under the seat in the open direction. The test was performed in accordance with M-500-030, Rev. 6, "Diagnostic Testing of Limitorque Motor-Operated Valves." The as found thrust measurement did not fall within the acceptable window as per the procedure (6,931-15,111 psi). The minimum required thrust of 4,892 psi was below the new procedure requirement; however, it was inside of the as-left value that had a minimum of 4,761 psi from the old procedure. The procedure had been changed based on new data for minimum thrust obtained through calculations since the last test.

Within the bounds of the procedure, the test engineer changed the torque switch setting from 1.0 to 2.0 and the test was rerun. The minimum thrust value still did not fall within the required range and testing was suspended until an engineering evaluation could be performed. The inspector reviewed the results of the evaluation that concluded to use the valve in its as left condition for the following reasons: The valve has an open and close function. The valve is flow assisted to open. The design basis open dp equals 1,333 psi and close dp equals 60 psi. Since the valve is flow assisted to open, and the opening thrust was adequate, the opening thrust was considered satisfactory. After evaluating the variables in the closing direction PECo accepted the valve as is. The new valves will be changed in the procedure based on actual testing. The valve was operable in the as found, as well as the as left condition. The inspector noted that the engineer and technicians closely followed a well written procedure to perform the testing in accordance with established guidelines.

5.0 DISCUSSION OF PRESSURE LOCKING AND THERMAL BINDING OF MOTOR-OPERATED GATE VALVES

The NRC requested all licensees to review the design basis for their safety-related MOVs. The licensees were expected to evaluate the potential for pressure locking and thermal binding of gate valves and then to take action to ensure that these phenomena do not affect the capability of MOVs to perform their safety-related functions. After reviewing PECo's preliminary evaluation, the inspectors noted that 14 valves were identified as having the potential for pressure locking or thermal binding. PECo stated that a study was in progress, the scope of the number of valves affected will be available by the end of 1993, and the operability questions will be answered by the end of January 1994.

6.0 VERIFICATION OF PROGRAM IMPLEMENTATION

6.1 MOV Design Basis Reviews

The inspectors reviewed the calculations determining the design basis differential pressure, design flow conditions, design temperature, and other design parameters for each of the following MOVs selected for review:

HV-13-107	RECW Isolation Valve
HV-51-1F007B	1B RHR Pump Minimum Flow Bypass Valve
HV-55-2F001	HPCI Steam Valve to Pump Turbine
HV-49-1F019	RCIC Loop Minimum Flow Valve
HV-51-1F068A	1A RHR Heat Exchanger Cooling Water Discharge Valve

During review of thrust calculation for HV-13-107, it was noted that the thrust calculation used a lower differential pressure than specified in the RECW design basis review document, LM-45. A hand written note at the bottom of the summary sheet indicated that approximately 99 psid was a more reasonable differential pressure for this valve. This change was based on an undocumented assumption that the postulated line break was not applicable to HV-13-107. PECo personnel conducted a review and determined that a line break was not within the design basis for this valve and verified that 99 psid was bounding for this valve. PECo personnel also stated that their design basis documentation would be revised, as necessary, to ensure that revisions to differential pressures include adequate formal documentation of the basis for any necessary changes.

In a letter from PECo to the NRC, dated July 20, 1993, it was identified that the design basis differential pressure for reactor water cleanup (RWCU) MOVs would be lowered from the lowest reactor pressure vessel (RPV) safety relief valve setpoint to RPV full power pressure. This change was based on a Boiling Water Reactor Owners Group position and information contained in an internal NRC memorandum from James E. Richardson, "Guidance for Inspections of Programs in Response to Generic Letter 89-10," dated April 30, 1993. However, PECo's letter did not identify that the main steam isolation valves (MSIVs) do not close during accident scenarios that involve closure of the RWCU MOVs, a provision necessary in order to apply the lower differential pressure. After further review by PECo personnel, it was determined that use of the higher differential pressure may be necessary due to an alternate RWCU break scenario that was not analyzed for MSIV closure. However, there may be a reduction in the differential pressure experienced by the system's MOVs due to backpressure caused by the location of the postulated line break. A capability assessment was performed (using the higher differential pressure) that resulted in the identification of HV-44-2F004 as potentially having an inadequate torque switch setting. The switch settings for the other three RWCU MOVs were determined to be adequate. PECo is performing an assessment to determine the appropriate differential pressure for the identified line break scenario (considering system backpressure) and has initiated a paraliel effort to determined when the MSIVs would be expected close, relative to the closure of HV-44-2F004.

6.2 MOV Sizing and Switch Setting

The inspectors reviewed specification NE-119, "Motor-Operated Valves Thrust/Torque Determination Methodology," Rev. 2, dated November 11, 1993, and PECo's documentation for determination of thrust and torque requirements for the selected valves.

PECo's gate valve thrust equation typically incorporated a valve factor of 0.30 for rising stem wedge gate valves and 1.10 for globe valves. A stem friction coefficient of 0.20 was used for determination of actuator output thrust capability. An engineering safety factor of 15% was set aside to address MOV load sensitive behavior (also known as "rate of loading") and other uncertainties. Minimum thrust requirements were adjusted to account for diagnostic equipment inaccuracy and torque switch repeatability.

At the time of this inspection, PECo had contracted Liberty Technology for MOV dynamic test data review, using PECo's data evaluation procedures. The determination of valve factor, load sensitive behavior, and stem friction coefficient were included in this review. PECo engineering will use the results of this review to help develop justifications for assumptions used in thrust calculations and to setup non-dynamically tested valves by the schedule completion date.

Limerick has not implemented the torque switch repeatability values provided by Limitorque in Maintenance Update 92-02. PECo is conducting a static test program in an effort to justify fewer conservative values for MOVs that have a torque switch dial setting of "1." This testing consists of a series of three diagnostic tests per valve. The inspectors were concerned if this number of tests would adequately account for torque switch repeatability under these conditions. As a result PECo agreed to contact Limitorque and get their concurrence that three tests are adequate for the quantification of torque switch repeatability, for a given actuator.

The inspectors noted that NE-119 incorrectly contained reference to application of Kalsi Engineering thrust rating study to Limitorque SB operators. PECo personnel indicated that this was an error and agreed to revise the document to remove these references.

PECo was completing an evaluation of the effects of Limitorque's potential 10 CFR 21 condition, "Reliance 3 Phase L. C. Actuator Motors (Starting Torque at Elevated Temperatures)," dated May 13, 1993, which dealt with the effect of elevated temperature on the output of AC motors. Preliminary results identified several valves with narrow margins, but after revising their methodology to use the 1.0 application factor allowed by Limitorque, no immediate operability concerns have been identified. PECo's evaluation of this issue is scheduled to be completed by the end of 1993.

6.3 Design-Basis Capability

The inspectors reviewed Maintenance Guideline 47, "Conduct of Motor-Operated Valve Differential Pressure Testing and Data Analysis," Rev. 2, dated November 9, 1993, static test results, and dynamic test packages for the selected MOVs under the following conditions:

VALVE	CLOSE D/P (psid)	% DESIGN BASIS	OPEN D/P (psid)	% DESIGN BASIS
HV-13-107	108	109%	108	N/A
HV-51-1F007B	358	99%	358	98%
HV-55-2F001	N/A	N/A	989	88%
HV-49-1F019	820	62%	820	62%
HV-51-1F068A	185	93%	N/A	N/A

The inspectors reviewed PECo's dynamic test data that used the industry standard equation, the valves' mean seat diameters, and the dynamic test conditions. This review indicated closing gate valve factors up to 0.88 and load sensitive behavior for globe valves as high as 16% (see Appendix A). Based on this data, PECo's valve factor assumption for gate valves is not always bounding. The inspectors were concerned with PECo's continued use of a 0.30 valve factor for initial setup of gate valves in the GL 89-10 program, and emphasized that all MOVs not dynamically tested will be expected to have been setup with a methodology that has been validated by PECo's dynamic test program by the scheduled program completion date. PECo personnel indicated that torque switches are set in the upper end of the allowable thrust window to provide a maximum amount of margin and to account for higher valve factors should best available data indicate that a higher valve factor was necessary. The inspectors did not identify any operability concerns associated with the valves selected for review.

To determine the operability of an MOV, PECo linerally extrapolates the thrust necessary to overcome differential pressure to design basis conditions. This was done by determining the apparent valve factor based on the dynamic test conditions and then using this valve factor to recalculate the minimum thrust requirements at design basis conditions. Until PECo develops a justification for their extrapolation method, the inspectors consider PECo's extrapolation to be the first stage of a two stage approach, where the valves are setup using the best available data, as discussed in GL 89-10. PECo will be expected to justify its method of extrapolation by the schedule commitment date for the completion of their GL 89-10 program.

Specification NE-169, "NED Evaluation of MOV Dynamic Test Results," Rev. 0, dated March 4, 1993, stated that extrapolations would be performed for testing conducted at 90% (and higher) of design basis conditions. The inspectors noted that this was inconsistent with Maintenance Guideline 47, which indicated that extrapolations would be conducted from 80%, up to design basis conditions. After discussions with PECo personnel, they decided that NE-169 would be revised to be consistent with Maintenance Guideline 47.

When determining the force used for the purpose of extrapolation to design basis conditions, Limerick uses the highest of the forces measured at flow isolation (VOTES mark C10), or hard seat contact (VOTES mark C11). However, the inspectors noted that there may be cases for gate valves where it is appropriate for the extrapolation technique to consider the forces in between these two points on the force trace, if the forces in this region are higher. Consideration of forces in this region provides an assessment of the force required to seat the valve and ensures that bypass flow is completely isolated. This anomaly was evaluated by PECo and determined to be caused by the disc transitioning onto the seat ring. The inspectors were concerned that PECo's method would overestimate the margin available for HV-51-1F007B to function during a design basis event. However, HV-51-1F007B was tested at 99% of design basis conditions and still had excess margin available after consideration of the higher forces between C10 and C11. After discussions with the inspectors, PECo personnel agreed to consider this issue as part of their extrapolation methodology.

Rev. 1 of Maintenance Guideline 47 was used at the time of the dynamic testing to evaluate the test data for the selected MOVs. The inspectors noted that this document did not specifically identify the margin available based on a comparison of thrust at torque switch trip to the extrapolated minimum required thrust. The guideline only contained a general statement that directed the technician to look at this margin, and the document did not provide a step completion block to record the results of this operability assessment. Further, the inspectors noted that the guideline contained several calculations used as a basis for the operability assessment, but that document did not have a review signature block. PECo personnel indicated that these issues had been identified and corrected in Rev. 2 of Maintenance Guideline 47. Rev. 2 is being used by PECo's contractor as guidance for conducting an independent review of all dynamic test data. The inspectors did not note any errors in the Rev. 1 calculations for the selected MOVs.

After discussions with PECo personnel, the inspectors determined that the GL 89-10 program and non-conformance report process may not identify cases where the MOV has been inoperable prior to the implementation of the program. Specifically, new minimum required thrust limits (based on dynamic testing) were not compared to the original as-found thrust at torque switch trip in those cases where the assumed valve factor was found to be nonconservative. The inspectors did not identify any MOV's that required reporting. However, PECo personnel agreed to review their procedures to ensure that the reportability requirements are met.

7.0 CONCLUSIONS

The inspectors noted substantial improvements in the GL 89-10 program since the January 1992 team inspection. Management attention to the program is at the highest level and this has contributed to the improvements. The inspectors also noted that the communications between the on and off site engineering departments has improved greatly, as demonstrated by the responses shown during the inspection.

APPENDIX A

LIMERICK GATE & GLOBE VALVE DATA

Diagnostics: VOTES/VOTES Torque Cartridge System

VALVE NUMBER	VALVE SIZE & MANUFACTURER	TEST CONDITIONS psid	DYNAMIC VALVE FACTOR[1]	STEM FRICTION COEFFICIENT [2]	LOAD SENSITIVE BEHAVIOR[3]
HV-13-107	4" Velan 150# Flex Wedge Gate	108 (Close) 108 (Open)	0.88 (Close) 0.80 (Open)	Not Determined	-8.7%
HV-51-1F007B	4" Velan 300# Flex Wedge Gate	358 (Close) 358 (Open)	0.51 (Close) 0.54 (Open)	0.16 (Static)	-2.5%
HV-55-2F001	12" Velan 900# Flex Wedge Gate	N/A (Close) 989 (Open)	N/A (Close) 0.2 (Open)	Not Determined	N/A
HV-49-1F019	2" Anchor Darling 600# Globe (Flow Under Seat)	820 (Close) 820 (Open)	0.97 (Close) N/A (Open)	0.16 (Static)	-17%
HV-51-1F068A	20" Anchor Darling 300# Globe (Flow Under Seat)	185 (Close) N/A (Open)	0.89 (Close) N/A (Open)	Not Determined	16%[4]

1. The dynamic valve factors listed were calculated by the licensee using a mean seat diameter.
2. Grease used at the time of testing was Mobilux EP-1.
3. 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.
4. Parameters were calculated by the inspectors.