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Licensee: Boston Edison Company
800 Boylston Street
Boston, Massachusetts 02199

Facility Name: Pilgrim Nuclear Generating Station

Inspection At: Plymouth, Massachusetts

Inspection Conducted: March 9-13, 1992

Inspection Team Members: M. Buckley, Reactor Engineer
M. Holbrook, INEL
L. Kay, Reactor Engineer
L. Scholl, Resident Inspector, Limerick

Inspector: J.M. Trapp 5-4-92
James M. Trapp, Team Leader, Engineering Branch, Division of Reactor Safety — Date

Approved by: P. K. Eapen 5/5/92
Dr. P. K. Eapen, Chief, Systems Section, Engineering Branch, DRS — Date

Inspection Summary: See Executive Summary

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EXECUTIVE SUMMARY

The Nuclear Regulatory Commission (NRC) conducted a team inspection at the Pilgrim Nuclear Power Station (PNPS) on March 9-13, 1992 to assess the programs developed by the licensee in response to NRC Generic Letter 89-10, "Safety-Related Motor-Operated Valve Testing and Surveillance." This team inspection was accomplished in accordance with NRC Temporary Instruction (TI) 2515/109, "Inspection Requirements for Generic Letter 89-10, Safety-Related Motor-Operated Valve Testing and Surveillance." The generic letter and its Supplements (1, 2, 3 and 4) discuss the many factors and efforts required by licensees to develop adequate programs that will ensure design-basis operability of safety-related motor-operated valves.

The following are the teams most significant findings:

- The method used to set the motor-operated valve torque switches using diagnostic testing equipment was inadequate. The Motor-Operated Valve Analysis and Test System (MOVATS) published diagnostic test equipment inaccuracy was not included when setting motor operated valve torque switches. This oversight has resulted in torque switches being set marginaliy above the minimum required torque switch setting for a number of safety-related valves. Two valves, one in the core spray system (valve #1400-04A) and one valve in the reactor core isolation cooling system (valve #1301-53) were determined to be inoperable due to an inadequate torque switch setting. Calculations and diagnostic equipment tests performed following the inspection, however, indicated that these valves would have performed their intended safety function prior to torque switch adjustment.

- The torque switch settings on several safety-related motor-operated valves were not set in accordance with the plant design documents. Three valves in the residual heat removal system (valve #1001-26A, 1001-36A, and 1001-43C) were determined to have inadequate torque switch settings. Torque switch settings were increased following this inspection. Diagnostic equipment testing and calculations indicated that these valves would have been capable of performing their intended safety function prior to torque switch adjustment.

- Corrective actions taken in response to an internal audit of the Generic Letter 89-10 Program regarding the torque switch settings of safety-related valves were inadequate. These conditions were documented as Plant Conditions Adverse to Quality (PCAQ) in April 1991. The Plant Conditions Adverse to Quality had not been dispositioned at the start of this inspection. These Plant Conditions Adverse to Quality were dispositioned during this inspection and as a result, five safety-related valves were identified as having inadequate torque switch settings. The failure to take timely corrective action to resolve this issue is a violation of NRC requirements.

- The Generic Letter Supplement 3 response for the reactor water cleanup system isolation valve 1202-5 was inadequate. The value provided for the required thrust for the valve did not appropriately interpolate the data provided in NRC Information Notice 90-40. The valve operator appears to be marginally sized for an appropriate value for the required thrust. The supplement 3 response to the NRC needs to be amended to incorporate these findings.

- Plans for conducting design-basis differential pressure testing have not been clearly established. Discrepancies exist between the Generic Letter 89-10 response to the NRC and a draft Nuclear Organizational Procedure, "Motor Operated Valve Program," regarding the scope of design basis differential pressure testing.

- The current work instructions for performing design basis reviews and switch setting calculations lack adequate detail.

- A considerable effort remains to implement the Generic Letter 89-10 program in a timely manner. A strong commitment by management will be required to complete this program in a timely manner.

The team assessed the overall response to Generic Letter 89-10 as being weak. The licensee acknowledged the above and other findings documented in this report, and agreed to take actions summarized in Table 1 to resolve each of the findings.

1.0 Introduction

On June 28, 1989, the NRC staff issued Generic Letter (GL) 89-10, "Safety-Related Motor-Operated Valve Testing and Surveillance," which requested that licensees and construction permit holders establish a program to ensure that switch settings for motor-operated valves (MOVs) in safety-related systems were selected, set and maintained properly. The staff held public workshops to discuss the generic letter and to answer questions regarding its implementation. On June 13, 1990, the staff issued Supplement 1 to Generic Letter 89-10 to provide the results of the public workshops. In Supplement 2 (issued on August 3, 1990) to Generic Letter 89-10, the staff stated that inspections of programs developed in response to the generic letter would not begin until January 1, 1991. In response to concerns raised by the results of NRC-sponsored motor-operated valve tests, the staff issued Supplement 3 to Generic Letter 89-10 on October 25, 1990, which requested that boiling water reactor licensees evaluate the capability of motor-operated valves used for containment isolation in the steam lines to the high pressure coolant injection system and reactor core isolation cooling system turbines, in the supply line to the reactor water cleanup system, and in the lines to the isolation condenser as applicable. Supplement 4 to the generic letter was issued on February 12, 1992, to address the inadvertent mis-positioning of valves at boiling water reactors. The generic letter also recommended that each licensee with an operating license complete all design-basis reviews, analyses, verifications, tests and inspections that have been instituted within 5 years or three refueling outages, whichever is later, of the date of the generic letter (June 28, 1989).

The NRC inspection team used Temporary Instruction (TI) 2515/109 (dated January 14, 1991), "Inspection Requirements for Generic Letter 89-10, Safety-Related Motor-Operated Valve Testing and Surveillance," to perform this inspection. The inspection focused on Part 1 of the temporary instruction (TI), which involves a review of the program being established by the licensee in response to Generic Letter 89-10.

2.0 Generic Letter 89-10 Program for Pilgrim Nuclear Power Station

Boston Edison Company (BECo) provided their response to Generic Letter 89-10 for the Pilgrim Nuclear Power Station in a letter to the Nuclear Regulatory Commission (NRC), dated January 15, 1990. The letter stated that Pilgrim Nuclear Power Station would develop a program in response to the Generic Letter recommendations. Boston Edison Company stated that testing would begin in refueling outage 9 and take three outages to complete. The NRC staff responded to the Boston Edison Company in a letter on June 7, 1990. The licensee provided a response, to Generic Letter 89-10,

Supplement 3, on December 17, 1990, which was subsequently amended on February 26, 1991. The NRC staff replied to the Supplement 3 response on February 18, 1992. The team reviewed the licensee's response to the generic letter and the program details with licensee personnel. The inspection results related to each aspect of Generic Letter 89-10 are described below.

2.1 Scope and Administration of the Program

The program administration was reviewed to assure that the licensee has an adequate program plan and has delineated responsibilities to complete the Generic Letter 89-10 program commitments.

The program description, which was requested to be available for NRC review on January 1, 1991, was available. Program responsibilities are divided between the Pilgrim Plant Department and Nuclear Engineering Department. Responsibilities for each Generic Letter 89-10 recommendation were clearly delineated in a draft Nuclear Organization Procedure, "Motor Operated Valve Program." The schedule for completing the Generic Letter 89-10 program is provided in the licensee's January 15, 1990 response to the NRC and is periodically updated in the Pilgrim Long Term Plan. Guidance for the Generic Letter 89-10 Program are clearly delineated in the "NRC Generic Letter 89-10 Program Plan" and draft Nuclear Organization Procedure "Motor Operated Valve Program."

The NRC Generic Letter 89-10 Program Plan states that all safety-related motor operated valves are included in the scope of the Generic Letter 89-10 program. The valves included in the Generic Letter 89-10 program scope are included on drawings MOV-1 through 6. Ninety-three valves are included in the Generic Letter 89-10 program. Plant drawings, emergency operating procedures, and the updated final safety analysis report were reviewed to verify that appropriate valves were included in the Generic Letter 89-10 program scope.

The MOV Program Plan divides the motor-operated valves in the program into three categories based on the function of the valve. Priority 1 valves have an active function to open or close during the mitigation of an accident or transient. Forty-nine valves were designated as priority 1 valves. Priority 2 valves are valves which have the potential to be mispositioned and do not have an interlock to prevent mispositioning of the valve. Priority 3 valves do not have the potential to be mispositioned or have an interlock to prevent mispositioning of the valve. The current program has designated 15 valves as priority 2 and 29 valves as priority 3. The licensee staff stated that priority 1 valves would be fully incorporated into the Generic Letter 89-10 program including design basis differential pressure testing where practicable. Priority

2 and 3 valves would have design basis calculations and switch setting calculations completed, and torque switches would be set based on these calculations. The priority 2 and 3 valves would not be included in the population of valves to be differential pressure tested. The licensee's plans with regard to priority 2 and 3 valves is consistent with the recommendations of generic Letter 89-10 and its supplements.

The priority of several valves were determined to be inappropriate. The valves identified were the high pressure coolant injection system valves 2301-10, 2301-6 and 2301-14 and reactor core isolation cooling system valves 1301-53 and 1301-60. The licensee stated that the prioritization of all valves included in the Generic Letter 89-10 program would be reviewed and revised where appropriate. Following revision of valve priorities, the Generic Letter 89-10 program scope will satisfy the intent of the generic letter.

2.2 Design-Basis Reviews

Item "a" of the generic letter recommended that licensees review and document the design-basis for the operation of each motor-operated valve in the program, including differential pressure, flow, line pressure, temperature, valve orientation, minimum voltage, and others.

The methodology planned for conducting design basis reviews is documented in the Generic Letter 89-10 program description "NRC Generic Letter 89-10 Program Plan (Safety-Related Motor-Operated Valve Testing and Surveillance)," and the Nuclear Engineering Department Work Instruction NEDWI-429, "Documentation of Mechanical Design Basis Reviews for Determination of Maximum Differential and Line Pressures; GL 89-10 Motor Operated Valves." The methodology used to conduct design basis reviews was reviewed to determine if it satisfied the intent of the generic letter. The licensee had not completed any design basis reviews at the time of this inspection. The current schedule indicates that design basis reviews will be completed by the end of 1992.

Nuclear Engineering Department Work Instruction NEDWI-429 directed a review of the Final Safety Analysis Report (FSAR), Technical Specifications, normal operating procedures, surveillance procedures, and emergency operating procedures to determine worst case design basis conditions for the valves. Design basis reviews will use the methodologies described in the BWR Owners Group (BWROG) guidelines where applicable. Worst case conditions were considered for both opening and closing of valves during normal and abnormal design basis events. The instructions provided for determining the worst case design basis conditions were detailed and satisfy the intent of the generic letter.

Guidance for determining line pressure, differential pressure, flow rate, temperature, and fluid phase were provided in the Work Instruction NEDWI-429. Detailed guidance was provided for certain assumptions such as neglecting the pressure drop due to line losses and using a minimum differential pressure of 50 psid for rising stem gate and globe valves. However, the guidance regarding reactor vessel pressure, tank levels, sump levels, and pipe elevation were not adequate. A review of Supplement 3 differential pressures calculations indicated that conservative assumptions were used to determine worst case differential pressure. The licensee cognizant engineer stated that the appropriate work instruction would be revised.

The work instruction guidance for determining the differential pressure across valves during blowdown conditions includes a fluid deceleration term. The inclusion of the fluid deceleration term is consistent with the Boiling Water Reactors Owners' Group guidelines. However, the Supplement 3 valve differential pressure calculations, for blowdown conditions, did not include the fluid deceleration term. The licensee's cognizant engineer stated that sample calculations would be performed to evaluate the significance of this term. Based on the results of these calculations the work instruction would be revised.

All but 15 safety related motor-operated valves have their thermal overload control function bypassed. The thermal overloads relays provide control room annunciation only. Thermal overload devices are sized to provide motor protection and avoid inadvertent motor tripping. Calculation PS-101, "Replacement of H16A Overload Relay Heaters - 480 V MCC's" sizes the thermal overload devices for motor-operated valves. A review of this calculation indicated that the thermal overloads were appropriately sized.

The licensee plans to perform calculations of the minimum motor terminal voltage available for both alternating current (AC) and direct current (DC) motor-operated valves. Procedure NEDWI-428, "GL 89-10 MOV Calculation Methodology to Determine Minimum Terminal Voltages for AC Powered Valves" provides the methodology for determining AC MOV capabilities under degraded grid conditions. The methodology appropriately includes considerations for locked rotor conditions, effects of elevated temperature, and resistances. Calculations for minimum motor terminal voltage were not completed or reviewed during the inspection. The licensee had not developed procedures for minimum motor terminal voltage for DC motor-operated valves.

2.3 Diagnostics Systems

Thirty-four motor operated valves were statically tested using the Motor Operated Valve Analysis and Test System (MOVATS) diagnostic equipment in 1987. This testing was conducted to establish proper torque switch settings. Seventeen of the valves previously tested with MOVATS equipment were retested using Valve Operator Testing and Evaluation System (VOTES) diagnostic equipment in 1991. A VOTES equipment inaccuracies of $\pm$ 10% has been incorporated in the test program. Site specific VOTES testing procedures were under revision and were not reviewed during this inspection.

The licensee stated that the motor-operated valve diagnostic systems vendor equipment validation results, as reported by the Motor-Operated Valve User's Group (MUG), or the results of a comparable test program, will be reviewed and inaccuracies from such reports would be incorporated into the Pilgrim Motor-Operated Valve Program acceptance criteria, as appropriate. The licensee had not incorporated MOVATS equipment inaccuracies as provided in MOVATS Engineering Report 5.0 when setting torque switches. The licensee stated that the motor-operated valves in the generic letter program would be reviewed for operability, as diagnostic equipment inaccuracies became available from actual tests or industry equipment validation tests.

The current diagnostic equipment configuration does not provide a measurement of actuator output torque. This makes it difficult to ensure that torque limitations are not exceeded. A lack of torque measurement capability also makes it difficult to validate assumptions concerning stem friction coefficient and to detect "rate of loading" effects. Licensee personnel stated that efforts were being made to add this capability to their diagnostic equipment.

2.4 MOV Switch Settings and Setpoint Control

Item "b" of Generic Letter 89-10 recommended that licensees review and revise as necessary, the methods used for selecting and setting all motor-operated valve switch settings.

Work Instruction NEDWI-430, "Performance of Thrust and Torque Calculations and Evaluation of MOV Capability - GL 89-10 Motor Operated Valves," provides the methodology for performing motor-operated valve sizing and switch setting calculations. At the time of this inspection, only the Supplement 3 valve sizing and switch setting calculations were complete. The current schedule indicates that the sizing and switch setting calculation will be completed by the end of 1992.

The standard industry thrust equation was used for determining the required minimum thrust for gate and globe valves. The worst case differential pressures, used to determine the minimum thrust, is derived from design-basis calculations. The licensee cognizant engineer stated that a valve factors of 0.50 for gate valves, 0.20 for parallel disk gate valves, and 1.10 for globe valves would be used. Based on current industry information, these valve factors appear to be appropriate for the gate and globe valves. However, NRC Information Notice 90-72 recommended valve factors for parallel disk gate valves in the range of 0.30 to 0.40. The licensee cognizant engineer stated that this information would be reviewed and incorporated into NEDWI-430 where appropriate. Guidance for the selection of valve factors was not adequately documented in NEDWI-430. The licensee's cognizant engineer stated that the work instruction would be revised to include guidance for valve factor selection.

The generic letter program did not adequately identify a feedback process where an evaluation of differential pressure test results would be used to determine available thrust margins. Differential pressure test results should be used to validate assumptions (i.e., valve factor and stem friction coefficient) used in the thrust equations to ensure that design basis thrust requirements used for MOV baseline setup remain valid. The cognizant engineer stated that they intended to feedback the results of testing into the program and would document the methodology to perform this process.

The seating surface diameter is used to determine the disk area term used in the minimum required thrust equation. It was not apparent whether the valve orifice diameter or mean seat diameter was used to calculate the disk area for the Supplement 3 valve calculations. The valve diameter used in calculation need to be consistent so that apparent valve factors derived from design basis test results may be applied to motor-operated valves which cannot be tested. The cognizant engineer stated that the work instruction would be revised to include valve diameter assumptions.

The motor-operated valve sizing calculations used for the Supplement 3 valve calculations used 0.15 for the stem friction coefficient. This stem friction coefficient assumption is inconsistent with the guidance provided in NEDWI-430. NEDWI-430 adjusts upward the minimum required thrust to account for lubricant degradation based on an assumed worst case stem friction coefficient of 0.20. This method results in a conservative minimum required thrust limit. The licensee has not justified the use of a 0.15 stem friction coefficient. An assumption of 0.15 as the stem friction coefficient may be non-

conservative unless specific maintenance practices and lubrication frequencies are implemented. The licensee stated that diagnostic test results would be used to justify the stem friction coefficient.

Work Instruction NEDWI-430 specifies that the upper limit of the target thrust window be based on a comparison between actuator thrust/torque rating and valve allowable thrust. The comparison is inadequate because the limitations imposed by actuator spring pack and output capability at degraded voltage were not included. The cognizant engineer stated that NEDWI-430 would be revised to include these limitations. The weak link analyses were not complete and were not reviewed during this inspection.

Work Instruction NEDWI-430 does not provide guidance for load sensitive motor-operated valve behavior known as "rate-of-loading." Load sensitive motor-operated valve behavior can reduce the thrust delivered by the operator under high differential pressure and flow conditions. The cognizant engineer stated that guidance for the "rate-of-loading" effect would be incorporated into the generic letter program as information regarding this effect becomes available.

Work Instruction NEDWI-430 provides guidance for the adjustment of the target thrust window for diagnostic equipment inaccuracies. However, the Work Instruction does not specify the specific inaccuracy value to be used or account for torque switch repeatability. The licensee stated that a $\pm$10% margin was used to account for VOTES equipment inaccuracies. The licensee stated that they had requested specific guidance from their diagnostic vendor for the appropriate value to use for torque switch repeatability. The cognizant engineer stated that the Work Instruction would be revised to account for diagnostic equipment uncertainties and torque switch repeatability.

The Supplement 3 operator sizing calculations use the run efficiency in place of the pull-out efficiency in the Limitorque actuator output capability equation. The run efficiency was used when evaluating output capability in the closing direction. EPRI TR-100449, Project 3433-6, "EPRI MOV Performance Prediction Program," dated February 1992 was referenced as justification for use of run efficiency in lieu of pullout efficiency. However, EPRI TR-100449 identified restrictions for using runout efficiency related to valve stroke time and

thermal heating effects. In addition, the use of run efficiency was not consistent with Work Instruction NEDWI-430. The licensee stated that the justification for using run efficiency in lieu of pullout efficiency would be reviewed and a revision to the work instruction would be made if appropriate.

Generic Letter 89-10 motor operated valves torque switches are bypassed in the open direction. Torque switch bypass was in effect for the complete open stroke (except for two MOVs for which the bypass was set for 25% of the open stroke) to prevent high unseating loads from prematurely stopping valve operation. The valves stop when the limit switch opens. The open limit switch was set at approximately 95% of the open stroke for gate and globe valves. The majority of motor-operated valves also have the torque switch bypassed for 98% of the closing stroke. At this point the torque switch was reinstated into the control circuit to allow thrust seating of the valve. Two parallel disk gate valves in the recirculation loops were limit seated in the closing direction.

The current configuration control of motor-operated valve torque switch settings was reviewed. The motor-operated valves can be divided into two groups based on the method used to adjust torque switches. The first group has the torque switches settings control based on a minimum and maximum dial setting on the torque switch. Adequate torque switch settings are verified for these valves by maintaining the torque switch dial setting between the minimum and maximum. The second group of valves have minimum and maximum thrust requirements established. For these valves the torque switches are adjusted using diagnostic test equipment. Deficiencies were identified for the control of torque switch for both groups of valves.

The required minimum and maximum torque switch dial settings and thrust values are documented on drawings MOV-1 through MOV-6. These drawings are controlled through a design change process that required engineering reviews and approvals. The licensee had identified, based on a review of documented torque switch settings, that a number of valves appeared to have torque switches which were set below the minimum required value. In addition, the inspection team identified two valves which appeared to be set below the minimum required thrust value when diagnostic equipment uncertainty was included.

A Plant Condition Adverse to Quality report PCAQ 91-85 identified 24 MOVs whose torque switch settings as documented on Maintenance Work Requests indicated that the MOV had a torque switch setting which differed from the design documents. Although this condition had been identified during the MOV self assessment, and the PCAQ was written on April 5, 1991, the

PCAW had not been dispositioned by the time of the NRC team inspection. BECo staff performed an inspection to validate the settings for several valves. The torque switch setting were increased for three residual heat removal system valves 1001-43C (RHR shutdown cooling suction valve), 1001-36A (RHR to Torus), and 1001-26A (RHR to containment spray). The licensee performed VOTES testing of the valves and calculations which indicated that the valves would have been capable of performing their intended safety functions with the as-found torque switch settings. These calculations have been reviewed and were acceptable. The failure to take timely corrective action to resolve this issue is an apparent violation of NRC requirements (NRC Violation 50-293/92-80-01).

The second group of valves torque switches are set based on operator thrust using diagnostic test equipment. The method used to set the motor-operated valve torque switches using diagnostic testing equipment was inadequate. MOVATS published diagnostic test equipment inaccuracy was not included in setting motor operated valve torque switches. This oversight resulted in torque switches set marginally above the minimum required thrust setting for a number of safety-related valves. Two valves, one in the core spray system (valve #1400-04A) and one in the reactor core isolation cooling system (valve #1301-53) were determined to be inoperable due to the inadequate minimum thrust when uncertainties were included. Calculations and diagnostic equipment tests performed following the inspection indicated, however, that these valves would have performed their intended safety function prior to torque switch adjustment.

2.5 Supplement 3 Response

The licensee identified a total of six motor-operated valves in the HPCI, RCIC, and RWCU systems which were included in the scope of Supplement 3 to Generic Letter 89-10. BECo concluded that each supplement 3 motor-operated valve had the ability to function under design basis conditions.

BECo calculation M-503, "Evaluation of MOVs in Support of GL 89-10 Supplement 3 Response," provided a basis for the operability determination of the supplement 3 valves. Selected sections of the Supplement 3 valve operator sizing calculation were independently verified by the inspection team.

The minimum thrust requirements used in calculation M-503 were based on information provided in NRC Information Notice 90-40. The results from the Idaho National Engineering Laboratory (INEL) testing of a 6-inch Walworth and 6-inch Anchor Darling gate valves were applicable to their reactor water cleanup valves, MO 1201-2 and MO 1201-5, respectively. The INEL Walworth valve blowdown test conditions for the MO 1201-2 valve were

similar to plant blowdown conditions. Therefore, the test thrust results could be directly applied. The INEL test for the Anchor Darling valve was conducted at 990 psid and resulted in a required thrust of 20,000 lbf. The design basis differential pressure for valve MO 1201-5 was 1135 psid. The test results were not properly extrapolated to the 1135 psid design basis condition. When appropriately extrapolated, the minimum required thrust was approximately 23,000 lbf for MO 1201-5. This placed the required thrust limit above the actuator output capability identified in engineering calculation M-503 (21,972 lbf). The licensee revised the operator sizing calculation using motor stall torque capability instead of motor start torque. Using the motor stall torque resulted in the an available thrust marginally above the required thrust. The licensee stated that the Supplement 3 response to the NRC would be amended by April 25, 1992 to reflect the changes to the previous supplement 3 response for this valve. The revised response should also include an evaluation of the impact of a detailed DC degraded voltage calculation, effects of stroke time versus technical specification requirements, and consider motor thermal effects which may occur due to operating near motor stall conditions.

2.6 Motor-Operated Valve Testing

Action "c" of the generic letter recommended that licensees test motor-operated valves in situ under their design-basis differential pressure and flow conditions. If testing in situ under those conditions is not practicable, the NRC allows alternate methods to be used to demonstrate the capability of the motor-operated valve. The NRC suggested a two-stage approach for a situation where neither design-basis testing in situ is practicable nor an alternate method of demonstrating motor-operated valve capability can be justified. With the two-stage approach the capability for the motor-operated valve is evaluated using the best data available and then continue the efforts to obtain valve specific test data within the schedule of the generic letter.

Plans for conducting design-basis differential pressure testing have not been clearly established. In the January 15, 1990 response to the generic letter BECo states in part that "Pilgrim Station will perform Generic Letter 89-10 recommended testing to the fullest extent that is reasonably practical and which will neither place the plant in an unsafe condition or damage equipment." this position is consistent with the generic letter recommendations. However, different test criteria are provided in a draft Nuclear Organizational Procedure, "Motor Operated Valve Program," Section 6.4.1.3. This procedure allows valve to be excluded from the test program based on grouping of similar valves and where large actuator margins exist. The cognizant engineer stated that inconsistency between the documents would be reviewed and resolved.

2.7 Periodic Verification of MOV Capability

Action "d" of the generic letter recommended that licensees prepare or revise procedures to ensure that adequate motor-operated valve switch settings are established and maintained throughout the life of the plant. Paragraph "j" of the generic letter recommended that the surveillance interval be commensurate with the safety function of the motor-operated valve as well as its maintenance and performance history. But in no case should the interval exceed 5 years or 3 refueling outages. Further, the capability of the motor-operated valve has to be verified if the motor-operated valve is replaced, modified, or overhauled to an extent that the test results are not representative of the motor-operated valve performance.

The licensee currently plans to periodically test motor-operated valves by stroking the valves under static conditions. The relationship between the performance of a motor-operated valve under static conditions and design-basis conditions is not clearly established; therefore, at this time, it is not clear that a static test would verify valve performance under design-basis dynamic conditions. The licensee acknowledged this concern and stated that the position to periodically test motor-operated valves under static conditions would be reevaluated following the dynamic test program.

2.8 MOV Maintenance and Post Maintenance Testing

Procedure 8.Q.3-8, "Limitorque Type SB/SMB Valve Operator Maintenance" is used to conduct preventive and corrective maintenance for motor-operated valves. This procedure and the procedures used for motor-operated valve overhauls are currently being revised. The revised procedures were not available for review during this inspection.

All safety and non-safety related motor-operated valves were overhauled during the seventh refueling outage. BECo currently plans to overhaul safety related MOVs on a once every three refueling outage frequency. The practice of frequently overhauling motor-operated valves is a program strength.

Environmentally Qualified (EQ) MOVs will be inspected every refueling outage. The inspection includes cleaning and lubricating the valve stem. A program has not yet been developed for the inspection of the non-EQ valve stem lubrication. The licensee maintenance personnel were aware of the need to verify the quality of the stem lubricant and stated that preventative maintenance schedules would be revised to include lubrication of valve stems.

BECo has a designated MOV system engineer. The system engineer was knowledgeable of motor-operated valve maintenance activities and other aspects of the generic letter program. The designation of a dedicated MOV engineer is a Generic Letter 89-10 program strength.

The inspections performed by BECo as a result of a valve operator overstress events were appropriate and in accordance with Limitorque recommendations. However, when the high pressure coolant injection valve MO 2301-25 was subjected to a high thrust a resultant potential over-torque condition was not evaluated. The cognizant engineer stated that a torque calculation on the affected valve would be performed.

2.9 MOV Failures, Corrective Actions, and Trending

Action "h" of the generic letter recommended that licensees analyze each motor-operated valve failure and justify corrective action. The results and history of each as-found deteriorated condition, malfunction, test, inspection, analysis, repair or alteration should be documented and maintained.

Nuclear Organization Procedure NOP 83A9, "Management Corrective Action Process," is currently used to document evaluations and corrective actions associated with plant equipment problems, including those involving MOVs. Equipment hardware problems are resolved through the use of Failure and Malfunction Reports (F&MRs). The Potential Condition Adverse to Quality, (PCAQ) form is also used to document actual or suspected detrimental conditions such as errors in controlled documents or actual or suspected failures to comply with applicable rules or regulations.

All Failure and Malfunction Reports associated with motor-operated valve failures written within the last two years were reviewed by the team. Several Plant Conditions Adverse to Quality reports regarding motor-operated valves were also reviewed. The Plant Conditions Adverse to Quality reports reviewed were written to document findings of a BECo self-assessment of the Pilgrim MOV program which was conducted in April 1991. The disposition of a problem identified on a trouble tag on reactor core isolation cooling valve MO 1301-25 was also reviewed.

In general, the root cause evaluations and corrective actions reviewed were thorough. However, the following findings are examples where corrective actions were not adequate or timely:

F&MR 91-327 documented a problem with the residual heat removal system block valve MO 1001-34A failing to fully close during surveillance testing performed on July 17, 1991. This valve is a primary containment isolation valve. The control switch was operated four times before the valve fully closed. The root cause of the failure was attributed to a packing adjustment and the torque switch setting was increased to correct the problem. The packing and torque switch adjustments were performed subsequent to the last local leak rate test which was performed on May 13, 1991. The root cause analysis did not confirmed that increased packing loads was the root cause of the failure. A local leak rate test was not performed following the torque switch adjustment to ensure seat integrity and seating force was adequate. The licensee staff stated that the station policy is not to perform local leak rate tests on motor-operated valves if the torque switch setting is increased. Local leak rate test are performed if the torque switch setting is decreased. Diagnostic test equipment was not used to establish if the increase in torque switch setting produced the seating thrust which existed during the last local leak rate test. Therefore the previous local leak rate test is invalid. The station policy of not conducting local leak rate tests after increasing torque switch settings is an unresolved item (NRC Unresolved Item 50-293/92-80-02).

During the performance of valve stroke timings on the reactor core isolation cooling system valve MO-1301-25, the valve closing time decreased significantly from the previous reference value (from approximately 45 seconds to 35 seconds). This test was performed on August 8, 1991 following maintenance. The test acceptance criterion was that the valve close in less than 55 seconds, however, in accordance with the Inservice Test (IST) Program the results must also be evaluated for any sign of erratic behavior. The results were reviewed by personnel in the IST group, however, the engineer assumed the data was in error and did not initiate any corrective action. On October 17, 1991 the quarterly valve stroke test was performed with similar results, i.e., fast stroke time, and again no corrective action was initiated. On January 17, 1992 the test was again performed at which time the erratic behavior was finally identified and an investigation initiated.

The licensee has adequate corrective action programs in place to document and accomplish corrective actions for motor-operated valve failures. It appears that a good job is done in documenting motor-operated valve failures; however, subsequent corrective actions are not always accomplished in a timely manner.

This was particularly evident by the performance of a motor-operated valve program self-assessment in 1991. The self assessment focused on motor-operated valve maintenance and testing performed following the seventh refueling outage. The review included maintenance requests and diagnostic test results. The self assessment had findings in the areas of design document discrepancies, switch settings, invalidation of previous test results, MOV over stress events, and vendor calculation reviews. The assessment was very thorough and identified safety significant findings. The finding were appropriately entered into the stations corrective action program; however, the disposition of a number of the findings of the self assessment lacked timely resolution.

The licensee had not developed a motor-operated valve trending program. The licensee staff stated that a trending program consistent with the recommendations of Generic Letter 89-10 would be developed. The current absence of a GL 89-10 trending program is a program weakness.

2.10 Motor-Operated Valve Training

The licensee's motor-operated valve training courses, facilities, and knowledge of training personnel relating to the implementation of the GL 89-10 program were evaluated. The licensee requires that all personnel including contractors involved in the motor-operated valve program complete training prior to performing maintenance or testing on motor-operated valves. Training includes classroom as well as hands on performance and is Institute of Nuclear Power Operations (INPO) accredited.

Contractors, in-house maintenance mechanics, and electricians are provided training in the use of diagnostic testing. This training is conducted by the vendors and audited by the BECo training department. Currently, only VOTES testing is performed in the plant. Babcock and Wilcox provided a 4 day VOTES training course. Verification of contractor qualifications is made prior to course instruction. Training regarding diagnostic equipment addressed both collecting and analyzing data.

Qualification of personnel to perform maintenance or testing in the duty area of motor-operated valves is based on successful completion of tasks. Tasks are designed to lead a craft person through a progression of motor-operated valve training modules for development of a strong working knowledge. Training modules were thorough and provided good instruction in many motor-operated valve areas. Areas include valve actuators, limit and torque switch adjustments, and troubleshooting. Instruction was also provided for industry events. Following classroom training a practical factors test is conducted to verify hands on training. Upon successful completion of this initial training, refresher training is provided every 18 months to maintain certification. The training program is a strong attribute of the motor-operated valve program.

Training for motor-operated valves and VOTES diagnostic test equipment is provided in the Industrial Park Training Center. The facility was well equipped and lesson plans thorough and well organized. The training program for motor-operated valves is a program strength.

2.11 Industry Experience and Vendor Information

Guidance is provided in NUREG 0737 for developing procedures to assure that important information on operating experience is provided to operators and is incorporated into plant operating procedures and training programs. The vendor information program with regard to motor-operated valves was reviewed.

The Nuclear Organization Procedure NOP84A4, Revision 2, "Equipment Technical Information Program", implements the process for evaluating industry experience and vendor information. The Nuclear Management Support Department at the site has the responsibility for incorporating information into the Equipment Technical Information Program. However, Limitorque has been providing the maintenance updates directly to the technical staff rather than to the Nuclear Management Support Department.

The industry experience and vendor information program was not implemented until January 1992, and was not reviewed during this inspection.

The Limitorque Maintenance Updates and 10 CFR Part 21 notifications reviewed were received and actions were taken to implement recommendations. However, in one isolated case the actions taken to implement the recommendations of a Part 21 Notification from Limitorque dated September 29, 1989, regarding fiber spacers in torque switches was not completed in a timely manner. This Part 21 Notification recommended that affected torque switches be replaced during the next available maintenance period. As of the time of this inspection the licensee had not inspected 20 valves to determine if

the valve operators contain fiber spacers. The licensee prioritized the valves for inspection based on the probability of containing the fiber spacers. Nine high priority valves were inspected where four torque switches were identified with fiber spacers. These four torque switches were replaced. The licensee stated that the remaining 11 valves which had not been inspected would be inspected during the mid-cycle outage.

2.12 Schedule

In the January 15, 1990 response to Generic Letter 89-10, the licensee stated that valve testing would begin during refueling outage 9 and require three refueling outages to complete. Refueling outage 9 is scheduled to begin in the second quarter of 1993. The licensee stated that their current goal was to complete testing during the next two refueling outages. This goal is consistent with the recommendations of the generic letter.

The licensee has developed a schedule for the Generic Letter 89-10 Program. The current schedule does not extend to program completion and does not provide adequate detail. The licensee had identified the need to provide additional details to the current schedule, and stated that a more detailed schedule would be developed.

The Generic Letter 89-10 Program schedule is provided to the NRC two times a year in the Long Term Program item #487. The Long Term Program indicates that the commencement of design basis reviews of motor-operated valves has been delayed. The original plan was to commence design basis reviews in the first quarter of 1991. At the time of this inspection the vendor to perform the design basis reviews had not been selected. The design basis reviews are the starting point for motor-operated valve calculations and the first step in the Generic Letter 89-10 program. It appears that enhanced management attention is required to assure that the Generic Letter 89-10 Program is completed in a timely manner.

3.0 Walkdown

During a motor operated valve walkdown inspection of several motor-operated valves, it was noted that the valve stems were clean and appeared to be properly lubricated. The motor-operated valve cleanliness was generally good.

The team inspected the limit switch compartments of valves MO-1400-4A and MO-1301-53. The condition of the switches and general condition of the valves was good.

4.0 Conclusions

The management attention provided to the Generic Letter 89-10 Program was weak. This was evident in the failure to disposition Plant Conditions Adverse to Quality reports regarding the configuration control of torque switch settings and the delays in Generic Letter 89-10 activities such as the development of design basis reviews. A substantial effort remains in the development and implementation of the program. Program strengths were identified in the areas of motor-operated valve overhaul schedule, training, and staff dedication. Program weaknesses were identified in a number of areas the most significant being the loss of control of torque switch settings. Other weaknesses were the lack of adequate detail in the design basis review and operator sizing calculation work instructions, and the error was in the Supplement 3 response to the NRC for a reactor water cleanup valve.

5.0 Exit Meeting

The team met with those denoted in Appendix A on March 13, 1992, to discuss the preliminary inspection findings as detailed in this report.

APPENDIX A

BECO Persons Contacted

Licensee

* J. Alexander, Training Manager
* J. Bellefeuille, Tech. Section Mgr.
* E. Boulette, Vice President Nuclear Operations
* W. Clancy, Deputy Plant Manager
* M. Dave, Sr. QA Eng.
* N. Desmond, Compliance Div. Mgr.
* L. Dooley, Tech. Training Section Mgr.
* R. Fairbank, NED Mgr.
* M. Green, Sr. Test Eng.
* J. Jerz, Project Manager
* E. Kraft Jr., Plant Mgr.
* P. Manderino, Code Test Supv.
* H. Oheim, Regulatory Affairs Mgr.
* G. O'Conner, Sr. Mech. Engr.
* J. Purkis, Acting Maint. Section Mgr.
* C. Sorensen, Elec. Maint. Supv.
* B. Sullivan, Sr. Licensing Engineer
* E. Wagner, Vice President Nuclear Engineering
* W. Whitaker, Maint. Training

Nuclear Regulatory Commission

* Dr. P. K. Eapen, Chief, Systems Section
* R. Eaton, NRR-Project Manager
* A. Keller, Resident Inspector - Pilgrim
* D. Kern, Resident Inspector - Pilgrim
* J. Linville, Chief-Projects Branch 3

* Denotes presence at exit meeting held at Pilgrim Nuclear Power Station on March 13, 1992.

TABLE 1

Licensee Plans and Commitments for Further Program Improvements

Section 2.1 Scope and Administration of the Program

- Address the prioritization of valves.

Section 2.2 Design Basis Reviews

- Provide detailed guidance for reactor vessel pressure and other parameters used in design basis reviews.
- Document instructions for fluid deceleration term used in BWR Owners Group guidelines.
- Develop work instructions to determine minimum voltage for DC motor-operated valves.

Section 2.3 Diagnostics Systems

- Verify valve operability based on MUG diagnostic equipment test results.

Section 2.4 MOV Switch Settings and Setpoint Control

- Include valve factor assumptions in work instructions.
- Incorporate methodology to feedback of dynamic test results.
- Establish valve diameter to use in sizing calculations.
- Justify stem friction coefficient assumptions.
- Add guidance for rate-of-loading and torque switch repeatability into test procedures.

Section 2.5 Supplement 3 Response

- Revise supplement 3 response to the NRC for reactor water cleanup valve MO 1201-5.

Section 2.6 Motor-Operated Valve Testing

- Clarify discrepancy between GL 89-10 response and Nuclear Organization Procedure regarding testing where practical.

Section 2.8 MOV Maintenance and Post Maintenance Testing

- Revise maintenance procedures.
- Perform torque calculation for over thrust valve.

Section 2.9 MOV Failures, Corrective Actions, and Trending

- Develop a MOV trending program.

Section 2.11 Industry Experience and Vendor Information

- Conduct inspection for fiber spacers.