U.S. NUCLEAR REGULATORY COMMISSION
REGION I

DOCKET/REPORT NO. 50-293/93-22

LICENSE NO. DPR-35

LICENSEE: Boston Edison Company
RFD No. 1
Rocky Hill Road
Plymouth, Massachusetts 02360

FACILITY NAME: Pilgrim Nuclear Power Station, Unit 1

INSPECTION DATES: December 13 - 17, 1993 at the Pilgrim Station
February 17, 1994 in the NRC Region I Office
March 22 - 25, 1994 at the Pilgrim Station

INSPECTORS: M. Buckley, Reactor Engineer, Region I
P. Drysdale, Sr. Reactor Engineer, Region I
T. Scarbrough, Sr. Mechanical Engineer, NRR
A. Trusty, NRC Consultant, INEL

Peter D. Drysdale, Sr. Reactor Engineer — Date: 4/7/94
Systems Section, Engineering Branch, DRS

APPROVED BY:

Eugene M. Kelly, Chief, — Date: 4/11/94
Systems Section, Engineering Branch, DRS

Area Inspected: This was an announced inspection to review BECo's motor-operated valve (MOV) program at Pilgrim Station developed under NRC Generic Letter 89-10 and to follow-up on findings from the NRC team inspection (50-293/92-80) performed in this area in March 1992.

Results: Considerable program development has occurred since the Part 1 inspection in March 1992. Progress in the MOV program continues on schedule and activities are well planned to ensure that the licensee will be able to meet the program completion date of April 1997. The licensee has placed appropriate emphasis on the GL 89-10, Supplement 3 MOVs, although some deviations from the BWR Owners Group recommendations still need to be reconciled (e.g., stem friction coefficients for high pressure injection steam supply MOVs). Most of the commitments made during the March 1992 team inspection have been fulfilled; however, additional NRC review of selected issues is expected, as specifically identified in Attachment 2.

The MOV calculations that have been completed adequately evaluated MOV design conditions. The worst case dynamic conditions and minimum valve thrust were appropriately derived from the design basis reviews. Although dynamic test procedures are being written, no dynamic testing has been accomplished to date at the Pilgrim Station. However, based on current projections, it is apparent that the necessary dynamic testing is scheduled to be completed by April 1997.

The licensee justified the operability of two MOVs with thrust and torque conditions beyond the design ratings established by the actuator's manufacturer (Limitorque). Acceptance of these conditions was principally based on the licensee's contract study by Kalsi Engineering of the thrust structural capability of Limitorque actuators. A management meeting was held in the NRC Region I office to review the licensee's basis for continued operability of the subject MOVs (the transparency slides used by the licensee are provided in Attachment 3 to this report). The licensee's analysis was determined to be an acceptable justification of operability for the two valves in question for the remainder of the current plant operating cycle.

An unresolved item involving leak rate testing and torque switch adjustments (92-80-02) was closed. Two new items were opened regarding pressure locking and thermal binding evaluations (93-22-01) and for the evaluation of the effects of elevated temperature upon AC motor starting torque (93-22-02).

DETAILS

From December 13 to 17, 1993, February 17, 1994, and March 22 to 25, 1994, the NRC staff conducted an inspection at the Pilgrim Nuclear Power Station (PNPS) of the motor-operated valve (MOV) program being implemented in response to Generic Letter (GL) 89-10, "Safety-Related Motor-Operated Valve Testing and Surveillance."

1.0 DESIGN BASIS REVIEW

The inspectors reviewed Nuclear Engineering Department Work Instruction NEDWI-429, "Documentation of Mechanical Design Basis Reviews for Determination of Maximum Differential and Line Pressure GL 89-10 Motor-Operated Valves," Rev. 1, (10/16/93), and design basis review calculation M-553, "Maximum Pressure Differential for Selected DC Motor Operated Valves," Rev. 0 (10/7/93). The MOVs selected for review were reactor core isolation cooling (RCIC) turbine steam supply isolation valves MO-1316 and MO-1317, high pressure coolant injection (HPCI) turbine steam supply valves MO-2301-4 and MO-2301-5, HPCI pump condensate storage tank suction valve MO-2301-6, and reactor water cleanup (RWCU) pump suction valve M0-1201-2.

NEDWI-429 required that the Final Safety Analysis Report (FSAR), Technical Specifications, normal operating procedures, surveillance procedures, and emergency operating procedures be reviewed to determine the worst case design basis conditions for each of the valves. The design basis reviews used the methodology provided in the BWR Owners Group Guideline where appropriate. Worst case conditions were determined for both the open and close directions of the MOVs during normal and design basis events.

The licensee's design basis review calculations documented the maximum differential pressure, design flow conditions, fluid temperature, and other design basis parameters for each of the selected MOVs. The inspectors concluded that the design basis review calculations adequately evaluated the design conditions as required by GL 89-10. At the time of this inspection, approximately 35 of the design basis calculations were completed. The cognizant engineer indicated that the remaining calculations were completed, but were still being reviewed and approved.

The inspectors reviewed deficiencies that were identified during the initial March 1992 NRC team inspection for GL 89-10 to determine whether the licensee had addressed these concerns. The licensee revised their design basis review calculations, revised current Nuclear Engineering Department Work Instruction (NEDWI) procedures, and also developed new procedures. For example, NEDWI-429 was revised to provide guidance for pressure input to the calculations as a result of reactor vessel pressure, tank levels, sump levels and pipe elevation. The licensee revised the differential pressure calculations for GL 89-10 Supplement 3 valves to include the fluid deceleration term, where appropriate. NEDWI-438, "GL 89-10 MOVs," Rev. 2 (10/19/92), was developed to provide guidance on how to determine available DC motor torque under degraded voltage conditions. The inspectors concluded that the licensee's actions to address these concerns were appropriate.

2.0 MOV SIZING AND SWITCH SETTINGS

To assess the licensee's MOV program, the inspectors reviewed NEDWI-430, "Thrust and Torque Calculations for the GL 89-10 Motor-Operated Valves," Rev. 2 (10/28/93), and the individual thrust/torque calculations for MOVs. The inspectors independently calculated the minimum required thrust. The licensee used the standard industry thrust equation to determine the minimum required thrust for GL 89-10 gate and globe valves. The worst case differential pressure used to determine the minimum thrust was derived from the design basis reviews. The licensee documented guidance for selecting valve factors in NEDWI-430.

The licensee's thrust calculations assumed a valve factor of 0.50 for flex wedge gate valves, 0.40 for parallel gate and double disk gate valves, and 1.10 for globe valves. The calculations used the mean seat area of the valves. A stem friction coefficient of 0.15 was assumed to determine output capability under degraded voltage conditions, and a 0.10 stem friction coefficient was assumed when verifying that the structural limits were not exceeded. The licensee intends to review future plant specific dynamic test data as a basis for justifying their 0.15 stem friction coefficient assumption. [Item 1, Attachment 2].

The inspectors noted that the setpoint calculation included a 3% margin to account for stem lubricant degradation and 10% to account for load sensitive behavior (also know as "rate-of-loading"). This valve was then adjusted to account for the diagnostic equipment inaccuracy and torque switch repeatability. Minimum and Maximum thrust values were documented on drawings MOV-1 and MOV-6. These drawings were controlled through a design change process that required engineering reviews and approvals. The maximum allowable thrust for several MOVs was not documented on these drawings. The cognizant engineer indicated that the weak link analysis was not complete. In the interim, the licensee was using the actuator rating as the maximum thrust for weak link. When the weak link information becomes available, the licensee intends to revise the thrust calculations and the drawings. Since the actuator may not be the limiting component in an MOV assembly, the licensee should reevaluate MOVs that have the weak link outside the actuator as more specific information is obtained. Previous overthrust conditions should also be identified if the actual actuator thrust is then found to have previously exceeded the weak link limit.

Dynamic test results were not available for review because dynamic testing of MOVs has not been conducted. The licensee had conducted static testing of MOVs during Refueling Outage Nine (RFO-9). The inspectors reviewed procedure 3.M.3-24 "VOTES 100 Operating Procedure," Rev. 2 (8/20/93). This procedure provides instructions for static and dynamic diagnostic testing of valve operators using VOTES diagnostic equipment and the associated transducers. The dynamic test acceptance criteria required that the valve successfully open and close, and that the calculated valve and stem factors be within the design basis assumptions. As appropriate, a problem report (PR) would be initiated if one of these criteria was not met. However, the procedure did not include acceptance criteria (e.g., the thrust margin needed to account for diagnostic uncertainties), or other requirements such as a review of specific parameters prior to returning a valve to operability. Further, the

procedure did not require a review of the diagnostic traces to look for significant abnormalities or anomalies that could affect design-basis performance. The cognizant engineer indicated that the procedure would be revised to include the appropriate acceptance criteria for both static and dynamic tests prior to conducting further tests. In addition, all diagnostic traces from previous static tests were independently evaluated for abnormalities and anomalies. [Item 2, Attachment 2].

The inspectors could not 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 licensee intends to develop a method for incorporating test results in their design basis calculations, and will adjust thrust calculations to reflect actual MOV performance under dynamic conditions.

The inspectors reviewed the operability evaluations for MOVs MO-2301-4 and MO-1301-17, that were documented in M-566, Rev. 1 (12/10/93) and M-594, Rev. 1 (12/9/93). The evaluations were based on normal reactor pressure, and the use of the measured packing load. These evaluations were not consistent with the guidelines specified in NEDWI-430 and were also inconsistent with the BWR Owner's Group guidelines which state that the lowest safety relief setpoint should be used for the steam line isolation valves in the HPCI and RCIC systems. Also, the licensee's evaluations did not include margin to account for load sensitive behavior, stem lubricant degradation, or margin for diagnostic equipment inaccuracies as required by NEDWI-430. The inspectors were concerned that the licensee did not have plant-specific dynamic test data to justify these deviations from the program guidance. The evaluations relied on a stem friction coefficient obtained during static testing. For example, the evaluation of MO-2301-4 used a measured stem friction coefficient of 0.08 instead of 0.15 as specified in NEDWI-430. The stem friction coefficient measured during static testing may not be representative of the coefficient present under design-basis conditions. However, the inspectors reviewed the licensee's operability assessment (using Pilgrim program assumptions) and agreed with the conclusion, with the exception that the available margins are less than those assumed by the licensee. In order to increase design margin for these MOVs, the licensee indicated that the actuator for both MOVs will be replaced during the Spring 1995 RFO-10 outage and both valve stems will also be replaced. [Item 3, Attachment 2].

The inspectors reviewed calculation M-569 "MOV Thrust/Torque Calculation For the RFO-9 MOVs," Rev. 1 (5/3/93) and identified five Supplement 3 MOVs that have adequate capability to perform their safety function, but may bring the motor to a locked rotor condition before tripping the torque switch. These MOVs were the RCIC turbine steam supply isolation valves MO-1316 and MO-1317, the HPCI turbine steam supply valves MO-2301-4 and MO-2301-5, the HPCI pump/condensate storage tank suction valve MO-2301-6, and RWCU pump suction valve MO-1201-2. The overthrust and overtorque conditions of MOVs MO-1201-2 and MO-1301-16 are addressed below.

3.0 OVERTHRUST AND OVERTORQUE OF MOTOR-OPERATED VALVES

The licensee had concluded that certain MOVs were operable with high torque and thrust conditions based on the results of a study by Kalsi Engineering of the thrust capability of Limitorque actuators. The inspectors raised concerns regarding the adequacy of the licensee's calculation M-547, Rev. 1 (4/16/93) to justify the operability of the reactor water cleanup (RWCU) letdown isolation valve MO-1201-2 and the reactor core isolation cooling (RCIC) steam isolation valve MO-1301-16, until planned modifications to these MOVs are performed. At the interim exit for the inspection on December 17, the NRC staff requested the licensee to provide an update to its response to Supplement 3 to GL 89-10, and to further justify the continued operability of MOVs MO-1201-2 and MO-1301-16. In addition, the licensee was requested to address their position that the overthrust and overtorque conditions did not constitute a design change.

Licensee Response

On January 7, 1994, the licensee updated the response to Supplement 3 to GL 89-10. With respect to RWCU valve MO-1201-2, the licensee provided the following information. The MOV was last overhauled in November 1992. The methodology to justify the continued operability of MO-1201-2 was based upon a November 25, 1991, report by Kalsi Engineering on the overthrust capability of Limitorque actuators and from a progress report dated January 11, 1993, from licensees sponsoring the Kalsi study. Hardware modifications to MO-1201-2 would be made in RFO-10 (April 1995).

With respect to RCIC valve MO-1301-16, the licensee provided the following information: This MOV had been last overhauled in November 1992. Calculations document the technical basis for the torque range associated with MO-1301-16. Hardware modifications would be made to MO-1301-16 in November 1994. Kalsi had reviewed the methodology used in the licensee's calculations for MOVs MO-1201-2 and MO-1301-16, and had concurred with the results.

On January 14, 1994, the staff received Rev. 3 to the licensee's M-547 calculation and a copy of the Kalsi Test Report. M-547, Rev. 3, documented that MO-1201-2 was overthrusting to 228% and overtorquing to 110%, and MO-1301-16 was overtorquing to 114.7%. Calculation M-547, Rev. 3, also established the allowable number of remaining cycles for MOVs MO-1201-2 and MO-1301-16 under the documented overthrust or overtorque conditions.

On February 17, 1994, the NRC held a public meeting with licensee personnel and its contractor (Kalsi) at the Region I office to discuss the licensee's action to resolve these overthrust and overtorque conditions (the transparency slides used by the licensee at the management meeting are attached to this report). The licensee stated that they were reviewing their position that the acceptance of the overthrust and overtorque conditions did not constitute a design change. The licensee was also considering a modification to

MO-1201-2 during the upcoming October 1994 mid-cycle outage. The licensee stated that the Pilgrim Technical Specifications require stroking of MO-1201-2 on a quarterly basis.

Licensee Evaluation of RWCU MOV MO-1201-2 Overthrust

Calculation M-547, Rev. 3, documents the rationale for demonstrating the capability of RWCU MOV MO-1201-2 to perform its safety function at 228% of the rated thrust. MO-1201-2 is equipped with a Limitorque SMB-00 actuator. The licensee uses the test of a single, similar, SMB-00 actuator to demonstrate the claimed capability.

The licensee's contractor (Kalsi) successfully tested a similar SMB-00 under the following conditions: 4000 cycles at 200% of rated thrust and 10 cycles at 341% of rated thrust (as part of motor stall testing). Kalsi determined an allowable thrust of 162% of actuator rating for 2000 cycles based on the single-sample reduction factor from the ASME Boiler and Pressure Vessel Code (Sections III and VIII, Division 2).

The licensee assumed the adjusted cycle versus percentage of rated thrust is log-linear between the above points and interpolated these data to deduce 145 cycles at 228% of rated thrust without any other operating history. The licensee estimated the number of cycles that this actuator has experienced at various thrust levels from operational records. After accommodating the past cycles, the licensee estimated that this actuator could withstand another 114 cycles at 228% thrust. The licensee concluded that this actuator would remain operable until April 1995 since it is expected to be cycled less than 30 additional times in the interim.

The licensee reports that MOV 1201-2 has undergone 20 successful cycles at the current overthrust condition. With quarterly inservice testing, the licensee will stroke MOV 1201-2 only a few cycles before October 1994. The SMB-00 actuator tested by Kalsi was found to survive at least ten cycles at 341% of its thrust rating. The NRC is confident that this analysis supports the operability of this component given the low number of cycles that it has seen and the low number of cycles that it is expected to incur by the time it is permanently replaced. However, additional justification would be needed to accept the full 145 cycles at the given overthrust condition. Notwithstanding the above, the NRC believes that it is appropriate for the licensee to perform inspections at the earliest opportunity in order to confirm the results of the analysis. At the exit meeting on March 25, 1994, the licensee committed to develop and perform inspections for any internal damage at the next mid-cycle maintenance outage.

In addition to the above mentioned issues related to rated thrust, the NRC staff considers the overtorque condition of MOV MO-1201-2 to be within an allowable of 110% of rated torque specified by Limitorque in a letter dated July 26, 1990.

Licensee Evaluation of RCIC MOV MO-1301-16 Overtorque

Calculation M-547, Rev. 3, documents the rationale for demonstrating the capability of RCIC MOV MO-1301-16 to perform its safety function at 114.7% of the rated torque. MO-1301-16 is equipped with a Limitorque SMB-000 actuator. The licensee uses the test of a single similar SMB-000 actuator to demonstrate the claimed capability.

The licensee's contractor (Kalsi) tested a similar SMB-000 at 117% of its torque rating. Under this torque condition, the worm in the tested actuator failed after 755 open/close valve cycles, the replacement worm failed after 2458 valve cycles, and the second replacement worm failed after 1648 valve cycles. The licensee determined that MO-1301-16 experiences significantly fewer worm revolutions under loaded conditions for each valve cycle than the actuator tested by Kalsi because of the design of the test apparatus. Based on a comparison of the number of worm revolutions under loaded conditions, the licensee concluded that, if the test actuator failed after 755 valve cycles at 117% torque, MO-1301-16 could withstand 3097 cycles at this overtorque condition.

The licensee assumed the adjusted cycle versus percentage of rated torque is log-linear between 200% torque for one cycle (Limitorque one-time allowable torque limit) and 117% torque for 3097 cycles. The license estimated the number of cycles that this actuator has experienced at various torque levels from operational records. After accommodating the past cycles and including additional margin, the licensee estimated that this actuator could withstand another 297 cycles at 114.7% torque. Therefore, the licensee concluded that this actuator would remain operable through April 1995, as this actuator is expected to cycle less than 20 additional times in the interim.

In its letter dated July 26, 1990, Limitorque allows its actuators to undergo torque to 110% of rating without a cycle limitation and to 120% of rating for 100 cycles. The staff considers the licensee's analysis of the Kalsi-tested actuator to provide support for Limitorque's July 1990 letter. Notwithstanding the above, the NRC believes that it is appropriate for the licensee to perform inspections at the earliest opportunity in order to confirm the results of the analysis. At the exit meeting on March 25, 1994, the licensee committed to develop and perform inspections for any internal damage at the next mid-cycle maintenance outage.

The licensee reported that MO-1301-16 has experienced 10 successful cycles at 114.7% of its torque rating. With quarterly inservice testing, MO-1301-16 will undergo only a few additional cycles before October 1994. Therefore, the NRC staff concludes that there is reasonable assurance to justify continued operation until October 1994.

NRC Review of the Licensee's Design Control and Deficiency Resolution Processes

During the onsite follow-up inspection, the inspector reviewed the licensee's administrative and engineering procedures for controlling design changes, plant modifications, problem reporting, and deficiency resolutions.

Nuclear Engineering Services Department procedure NESD 3.02, "Preparation, Review Verification, Approval, and Revision of Design Documents for Plant Design Changes," is the licensee's principal procedure for controlling modifications and plant design change (PDC) packages. The procedure provides detailed instructions for engineers preparing PDCs and specifies all work activities required to process a modification to plant equipment. A safety evaluation is required during development of the conceptual design stage for all PDCs. Licensee engineering personnel stated that PDCs were not prepared for MOVs MO-1201-2 and MO-1301-16 because there was not physical change made to the equipment. Changing the maximum thrust and torque output for these MOVs was accomplished through a revision to the design calculation (M-547) to demonstrate their capability to withstand a limited number of cycles at the higher stress levels. Consequently, the MOVs were not subjected to the formal design change process that is prescribed by NESD 3.02.

NESD 3.05, "Design Calculations," established methods and instructions for preparing, reviewing, approving, and controlling engineering design analyses. Before revising a design document, an engineer must determine and document the need to perform a safety evaluation. A safety evaluation is required for a modification to the plant or if there is a change in the ability of equipment to perform its safety-related function. BECo engineers who changed calculation M-547 considered that these two conditions were not met and documented that a safety evaluation was not required for the overthrust and overtorque conditions.

Nuclear Organization Procedure NOP83E5, "Safety Reviews," describes how safety evaluations are performed. Once a safety evaluation is determined to be necessary, the licensee uses a preliminary evaluation checklist (PEC) to determine if an unreviewed safety question is involved. The instructions for completing a PEC provide guidance for the types of design changes that require a safety evaluation.

Based upon a review of the above procedures and documents, the inspector concluded that the licensee's program requirements for conducting safety evaluations should be clarified. The licensee agreed that earlier screening would be appropriate when the root cause of a discrepancy is identified and when a revised calculation or design change is contemplated. The licensee agreed that the PEC checklist should be incorporated into the initial steps of the design calculations procedure NESD 3.05 and the engineering work instruction for performing operability evaluations. The PEC checklist provides sufficient screening criteria to determine if a safety evaluation is necessary. This item was satisfactorily addressed by the licensee's commitment to revise the appropriate procedures.

4.0 FOLLOWUP TO THE GL 89-10 PART 1 INSPECTION (Section numbers in parentheses refer to the related section numbers in inspection report 50-293/92-80)

4.1 Address the Prioritization of Valves (Section 2.1)

The licensee has 90 safety related valves in the Generic Letter 89-10 program of which 32 receive an automatic signal to change position and 23 of which are included in plant operator actions. All 55 valves that are expected to change position to fulfill their safety function are considered Priority 1 valves for the Generic Letter 89-10 program. The licensee has committed to have testing completed for Priority 1 valves by the end of RFO-10 (1995). The safety-related valves that could be mispositioned include 28 Priority 2 and 7 Priority 3 MOVs. Testing of the Priority 2 and 3 MOVs will be completed before the end of RFO-11 (1997). Three MOVs have been removed from the program because they have been removed from the plant permanently. Currently there are 36 dynamic tests scheduled. The classification of high pressure coolant injection system and reactor core cooling system valves have been reevaluated and met the recommendations of GL 89-10 and its supplements. This item is satisfactorily resolved.

4.2 Verify Valve Operability Based on MUG Diagnostic Equipment Test Results (Section 2.3)

Problem Report 92.0223 (MOVATS Part 21 Report) was written to resolve the MOVATS review of disc data that identified 3 valves with low thrust: MO-1301-49, MO-1001-36A & -36B. MO-1001-49 is required to open as its safety function is bypassed, and was votes tested satisfactory in RFO-9. The RHR suppression pool cooling block valves 1001-36A and -36B were surveillance tested in 1987 when both valves closed against pump head and flow. Calculation M-597, which incorporates the results of the 1987 flow tests, shows the valves' (MO-1001-36A and -36B) margin with diagnostic inaccuracies incorporated. The licensee has incorporated MOVATS and VOTES equipment inaccuracies as identified by industry information for MOVs in the GL 89-10 program. This item is satisfactorily resolved.

4.3 Revise Supplement 3 Response to the NRC for Reactor Water Cleanup Valve MO-1201-5 (Section 2.5)

During the Part 1 inspection (92-80), the NRC determined that BECo planned to revise their response to Generic Letter 89-10, Supplement 3. This revision was to include an update to the status of MO-1201-5, a 6-inch Anchor Darling gate valve in the reactor water cleanup system, to show that the MOV had sufficient capacity.

The inspector reviewed the licensee's revised responses to Supplement 3 of GL 89-10 (4/14/92, 2/18/92, and 1/7/94). The revisions stated that the licensee did not believe that extrapolation to a higher thrust was necessary and that licensee believes that INEL test 11, which indicated 12,000 lbs required at 1000 psid in the closing direction, to be the most

appropriate because it did not end with nitrogen gas flow and the degradation to the valve would have already occurred. By applying the same test results to MO-1201-5, the licensee calculated the valve factor to be 0.433. Based on this methodology, adequate margin is provided. However, the licensee still plans to review the EPRI test data released in December 1993 after it is validated. [Item 4, Attachment 2]

4.4 Clarify Discrepancy Between GL 89-10 Response and Nuclear Organization Procedure Regarding Testing Where Practical (Section 2.6)

Action "c" of the Generic Letter 89-10 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 MOV. 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.

Nuclear Organization Procedure NOP92M1, "MOV Program," Section 6.4.1.3.d, allowed MOVs that have low differential pressure (d/p) and large actuator margins not to be d/p tested. The basis for not testing shall be documented in the Nuclear Engineering Services Department (NESD) design calculation. In the January 15, 1990, response to the Generic Letter 89-10, 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." Although the cognizant engineer stated during the Part 1 inspection that inconsistency between the documents would be reviewed and resolved, no action had been taken. The MOV program manager stated that dynamic testing would be done as stated in the January 15, 1990, response to the Generic Letter 89-10. When the status of NOP92M1 was identified to the licensee by the inspector the licensee initiated a Nuclear Organization Controlled Document Change Notice (CDCN) to delete the current Section 6.4.1.3.d entirely. The licensee corrected this situation and made the program requirements for dynamic testing consistent with the intent of the GL 89-10.

4.5 Revise Maintenance Procedures (Section 2.8)

Maintenance Procedure 8.Q.3-8, "Limitorque Type SB/SMB Valve Operator Maintenance," used to conduct preventive and corrective maintenance for motor-operator valves was under revision during the Part 1 inspection. Maintenance personnel stated that because the lubrication of valve stems and verification of the quality of the stem lubricant were important for preventive maintenance, current schedules would be revised to include lubrication of valve stems. Procedure 8.Q.3-8, "Limitorque Type SB/SMB valve operator Maintenance," Rev. 15 (8/20/93), step 15, has been revised to include lubrication of valve stems. This action will allow proper maintenance of valve stem for the GL 89-10 program MOVs. This item is resolved.

4.6 Perform Torque Calculations for Overthrusted Valve (Section 2.8)

During the Part 1 team inspection, the inspectors noted that MO-2301-25 had been overthrusted to 33,500 lbs (139%), but it had not been evaluated for excess actuator torque. The design maximum ratings for this SMB-0 actuator are 24,000 lbs of thrust and 500 ft-lbs of torque. The licensee performed a torque evaluation using a coefficient of friction of 0.15 indicating a 600 ft-lbs torque for MO-2301-35 because of an overthrust of 33,500 lbs (139% overthrust). Subsequent review of the Limitorque SMB-0 torque switch setting chart for extra heavy spring pack at a setting of 1.5 showed torque to be approximately 480 ft-lbs. This valve was reset during refueling outage RFO-8 after preventative maintenance, an overhaul, and a satisfactory NDE inspection were completed. This MOV was tested during RFO-8 and the test data indicated that the valve thrusted at 18,944 lbs with actuator torque at 200 ft-lbs. Since this is within the design limits for this type actuator, this item is resolved.

4.7 Develop an MOV Trending Program (Section 2.9)

A trending program has been incorporated into the licensee's MOV program as committed during the Part 1 team inspection. Technical Support Work Instruction TSWI-007, "MOV Plant Performance Monitoring," Rev. 1 (8/5/92), established degradation codes for the MOVs for various parameters used to determine MOV performance. These included degradation of the torque switch, limit switch, and spring pack; stem and lubrication concerns; motor concerns; actuator sizing; and excessive thrust forces that could indicate MOV problems. TSWI-007 was revised during this inspection to provide a definition of a "Baseline Diagnostic Test." The revision also included a requirement to document trend data, to change the alert point for parallel gate valve's valve factor to >0.4, and to change the equipment error in stem factor equations. It was apparent that the revised work instruction will effectively trending MOV performance and will facilitate the prediction of MOV problems as the program implementation progresses and as more static and dynamic test results become available. The inspectors concluded overall that this was a positive program attribute.

4.8 Conduct Inspection for Fiber Spacers (Section 2.11)

Limitorque Corporation warned licensees in a Part 21 Notification dated September 29, 1989, that SMB-000 and SMB-00 actuators with cam-type torque switches and fiber spacers under the contact bridge could fail. The failure mode was a loosening of the contact screws anchoring the contact bridges to the body of the torque switch. At that time, Limitorque knew of only three failures of this torque switch configuration which represented less than one tenth of one percent of the total population of these switches. Limitorque recommended that these torque switches be replaced during the next available maintenance period.

The licensee initiated Problem Report 89.2241 to track and determine if the fiber spacers torque switches were being used at the Pilgrim plant. During the inspection of the all SMB-000 and SMB-00, actuators fiber spacers were found on MO-4084, MO-4085, MO-3800, MO-1001-21, MO-1001-32, MO-1301-22, Motor-Operated Valves and their torque switches replaced. Procedure 8.Q.3-8, "Limitorque Type SB/SMB Valve Operator Maintenance," directs a technician to check for fiber spacers when doing maintenance on MOVs. The identification and replacement of SMB-00 and SMB-000 MOV torque switches with fiber spacers resolves this concern.

4.9 (Open) Pressure Locking/Thermal Binding of Gate Valves

The phenomenon of valve pressure locking is caused by pressure in the valve bonnet 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 valve when high pressure fluid is trapped in the valve bonnets or when excessive binding forces occur.

The licensee is performing evaluations for the pressure locking and thermal binding conditions while design basis calculations are performed. During the initial screening, MO-1301-17, "RCIC Steam Isolation Valve," was identified as having the potential for thermal binding, and MO-2301-8 "HPCI Injection Valve" for pressure locking. The corrective actions to be taken for these MOVs were still being evaluated by the licensee; therefore, this issue is unresolved pending the completion of any necessary modifications (UNR 50-293/93-22-01).

4.10 (Open) Ambient Temperature Effects on AC Motors

Limitorque's Technical Update 93-03 provided the licensee with additional information for 10 CFR Part 21 for starting torque at elevated temperature for Reliance 3 phase AC motors, where motor output torque could be reduced below nominal. The licensee has not completed this evaluation for all MOVs in the GL 89-10 program. During an initial screening of potential problems, 12 MOVs were identified as marginal with respect to starting torque. A more detailed evaluation showed MOV 1400-4B having marginal capacity after taking into account inaccuracies, rate of loading and 3% degradation. This MOV is being considered for modification to increase its safety margin, but currently there were no modifications planned for MOVs based on temperature effects alone. This item is open pending NRC review of the completed evaluations and any necessary modifications (UNR 50-293/93-22-02).

4.11 (Closed) UNR 50-293/92-80-02; Local Leak Rate Tests with Torque Switch Adjustments

On July 17, 1991, MO-1001-34A, "RHR Suppression Chamber Block Valve Loop A," failed to fully close during surveillance testing after an adjustment to the packing. The torque switch setting was increased and subsequently the valve closed. A local leak rate test was performed on May 13, 1991, but not after the switch adjustment. The root cause analysis did not confirm that the increase packing load was the cause of valve failure. A satisfactory local leak rate test was done on April 21, 1993, indicating that the torque switch setting increase satisfied the seating thrust for the valve. The licensee has revised the MOV maintenance procedure 8.Q.3-8, "Limitorque Type SB/SMB Valve Operator Maintenance," to require diagnostic testing and verification that required thrust is maintained or a local leak tested be done when doing MOV maintenance in which the seating thrust capability is affected. This action should assure 10 CFR 50, Appendix J, containment isolation MOV leak rates are addressed when making torque switch setting adjustments.

5.0 MANAGEMENT MEETINGS

The inspector met with licensee management representatives throughout the course of the inspection as identified in Attachment 1. A management meeting was held on February 17, 1994, in the NRC Region I office to review operability concerns related to two MOVs at the Pilgrim Station. A copy of the slides used by BECo is attached to this report. The preliminary findings and conclusions were discussed with BECo management and staff on March 25, 1994. The licensee acknowledged the inspection findings and accepted the final results.

Attachments:
1. Persons Contacted
2. Part 1 Team Inspection Commitments for NRC Follow-Up Review

ATTACHMENT 1

PERSONS CONTACTED

Boston Edison Company

	Name	Title
	G. Basilesco	Senior Compliance Engineer
*	J. Bellefeuille	Deputy Plant Manager
*	T. Boulette	Senior Vice President, Nuclear
	R. Fairbank	Manager, Regulatory Affairs
	A. Flanagan	Senior Public Information Representative
	R. Gay	Senior Compliance Engineer
*	C. Goddard	Deputy Engineering Manager
*	P. Hamilton	Licensing Division Manager
*	J. Jerz	MOV Project Manager
*	E. Kraft, Jr.	Vice President, Nuclear Operations
*	P. Markson	Communications Specialist
	G. O'Conner	Sr. Fluid Sys. & Mech. Components Engineer
*	V. Oheim	Engineering Manager
*	R. O'Neill	Technical Programs Division Manager
	J. Quinn	Senior QA Engineer
	W. Rothert	General Manager, Technical
*	L. Schmeling	Plant Manager
	R. Sheridan	Senior QA Engineer
*	B. Sullivan	Senior Licensing Engineer
	T. Sullivan	Operations Section Manager
*	T. White, Jr.	Principal Systems & Analysis Engineer
*	M. Williams	Senior QA Engineer

United States Nuclear Regulatory Commission

	J. Durr	Branch Chief, DRS
	P. Eapen	Section Chief, DRS
	R. Eaton	Project Manager, NRR
	M. Hodges	Division Director, DRS
*	E. Kelly	Section Chief, DRP
	D. Kern	Resident Inspector
*	J. Macdonald	Senior Resident Inspector
	M. Mayfield	Acting Deputy Division Director, DRS
	M. Modes	Section Chief, DRS
	J. Norberg	Branch Chief, NRR
	T. Scarbrough	Senior Mechanical Engineer, NRR
	J. Shedlosky	Project Engineer, DRP

* Attended the exit meeting on March 25, 1994

ATTACHMENT 2

PART 1 TEAM INSPECTION COMMITMENTS FOR NRC FOLLOW-UP REVIEW

1) Section 2.0: The licensee will review future plant specific dynamic test data as a basis for justifying the stem friction coefficient assumption for each MOV. The NRC will review these data and the validation of design assumptions.

2) Section 2.0: Diagnostic procedure 3.M.3-24 will be revised to include appropriate acceptance criteria for both static and dynamic tests. All diagnostic traces from previous static tests were independently evaluated for abnormalities and anomalies. The NRC will review future test results and use of this procedure.

3) Section 2.0: The stem friction coefficient measured during static testing may not be representative of the coefficient present under design-basis conditions. In order to increase design margin for HPCI and RCIC steam isolation MOVs, the licensee plans to replace the actuator for both valves during the April 1995 RFO-10 outage. Both valve stems will also be replaced and subject to further NRC inspection.

4) Section 4.3: The licensee applied INEL test results to RWCU valve MO-1201-5 to calculate a valve factor of 0.433. The licensee will review the applicability of the final EPRI test data to this MOV. The NRC expects to independently evaluate the results of the licensee's review of the EPRI test data.

Safety-Related Motor-Operated Valve Testing and Surveillance
NRC Generic Letter 89-10

NRC Staff Presentation - February 17, 1994

Pilgrim Station
01/90 to 05/95

ATTACHMENT 3

Safety-Related MOV Testing and Surveillance

Safety-Related MOV Testing and Surveillance (Project Scope)

90 Safety-Related MOVs are included in the Program.

55 Priority I MOVs

Valves that must change position from their normal line-up to perform their safety function. The position change may be either automatic or by operator action.

35 Priority II MOVs

This group is considered less safety significant since the valve is in its safe position as part of the normal system line-up.

Safety-Related MOV Testing and Surveillance (Project Schedule)

NRC schedule per Generic Letter 89-10

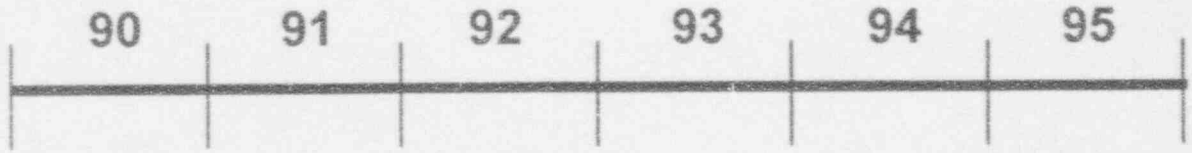
Complete the initial test program by June 1994 or three refueling outages after December 28, 1989, which ever is later.

Current BECo. Schedule via LTP.

Complete the Priority I scope by RFO 10 (4/95).

Complete the total scope by RFO 11 (4/97).

Safety-Related MOV Testing and Surveillance
(Project Schedule, cont.)



Schedule Summary

Design Basis Reviews — N — A

PMs and Diagnostic Testing — RFO8 | MCO9 | RFO9 | MCO10 | RFO10

	RFO8	MCO9	RFO9	MCO10	RFO10
Inspections	40	35	44	34	45
Overhauls	08	07	14	06	15
Static Tests	17	16	21	22	39
Dynamic Tests				15	19

Modifications

Engineering — S — A

Material Procurement — O — A

Implementation — MCO10: 20 | RFO10: 56

Safety-Related MOV Testing and Surveillance
(NRC Staff Technical Concerns, MOV 1201-02)

MOV 1201-02 'RWCU In-board Containment Isolation'

Concern 1:

The ability / reliability of the actuator to withstand thrust loadings which exceed the industry upper bound of 162%.

Response:

BECo. Calculation M547 employs a conservative methodology which combines test data and analytical solutions to determine allowable fatigue cycles.

Calculations indicate 760 available cycles. Applying the ASME margin factor of 5.24 indicates 145 allowable cycles. Expected cycles prior to actuator replacement will be approximately 30.

Calculation M547 represents an interim reconciliation of current hardware capability versus full GL89-10 design margin. Hardware modifications are planned and scheduled for the purpose of increasing design margin.

Safety-Related MOV Testing and Surveillance (NRC Staff Technical Concerns, MOV 1201-02)

MOV 1201-02 'RWCU In-board Containment Isolation'

Concern 2:

Continued IST surveillances increase the risk of potential hardware failure.

Response:

The MOV is cycled quarterly to demonstrate that the stroke time is within specified acceptance criteria. The number of remaining surveillances are negligible compared to the allowable cycles.

Surveillance testing should identify any related degradation. There has been no evidence of degradation since the last actuator overhaul and inspection, 11/92.

Safety-Related MOV Testing and Surveillance (NRC Staff Technical Concerns, MOV 1201-02)

MOV 1201-02 'RWCU In-board Containment Isolation'

Concern 3:

The current modification schedule (RFO10, 4/95), allows the MOV to remain in a degraded condition for an extended period of time thus increasing the risk of potential hardware failure.

Response:

Engineering and procurement activities continue in-order to be prepared to replace the MOV in MCO10 (10/94). Implementation of design and fabrication requirements, which incorporate the lessons learned from GL89-10, may preclude schedule acceleration.

Removing the RWCU system from service eliminates an alternate decay heat removal system.

Conservative engineering analysis and IST surveillances continue to demonstrate that the hardware will perform it's safety function.

Safety-Related MOV Testing and Surveillance
(NRC Staff Technical Concerns, MOV 1301-16)

MOV 1301-16 'RCIC In-board Containment Isolation'

Concern 1:

The ability / reliability of the actuator to withstand torque loadings which exceed the industry upper bound of 110%.

Response:

BECo. Calculation M547 employs a conservative methodology which combines test data and analytical solutions to determine allowable fatigue cycles.

Calculations indicate 3007 available cycles. Applying the ASME margin factor of 5.24 indicates 574 allowable cycles. Expected cycles prior to actuator replacement will be approximately 20.

Calculation M547 represents an interim reconciliation of current hardware capability versus full GL89-10 design margin. Hardware modifications are planned and scheduled for the purpose of increasing design margin.

Safety-Related MOV Testing and Surveillance
(NRC Staff Procedural Concerns, MOV 1201-02)

MOV 1201-02 'RWCU In-board Containment Isolation'

Concern 1:

The significant increase in the thrust design limit should constitute a design change and thus a safety evaluation under 10CFR50.59.

Response:

Engineering analysis, which provides a basis for increasing the vendor's published ratings, does not constitute a change to a system, structure or component as described in the FSAR.

Component form, fit, and function have not changed as a result of the engineering analysis.

Safety-Related MOV Testing and Surveillance
(NRC Staff Procedural Concerns, MOV 1201-02)

MOV 1201-02 'RWCU In-board Containment Isolation'

Concern 2:

The significant increase, in the thrust design limit, raises the question of indeterminate operability per guidance provided in GL91-18.

Response:

In accordance with PNPS procedures, a prompt determination of operability was made each time the thrust value increased.

The thrust value increased as a result of generic industry issues related to test equipment accuracy.

In each case, engineering analysis demonstrated that the MOV would continue to perform it's design basis safety function.

Safety-Related MOV Testing and Surveillance
(Presentation Summary)

NRC Staff concerns are well understood and have been thoroughly addressed via detailed calculations and proposed modifications.

Detailed calculations, which combine engineering analysis and test data, demonstrate that extended torque and / or thrust ratings are acceptable and conservative.

The calculations represent an interim reconciliation of current hardware capability versus full GL89-10 design margin and not a permanent reconciliation.

The MOVs in question will continue to perform their design basis safety function. Permanent modifications are on schedule and will increase design margin consistent with GL89-10 guidance.