U. S. NUCLEAR REGULATORY COMMISSION
REGION I

Report No. 50-443/91-81

Docket Nos. 50-443

License No. NPF-86

Licensee: Public Service Company of New Hampshire
Post Office Box 300
Seabrook, New Hampshire 03874

Facility Name: Seabrook Station

Inspection At: Seabrook, New Hampshire

Inspection Conducted: December 2-6, 1991

Inspection Team Members: T. Koshy, NRR
C. Myers, Region V
M. Holbrook, Contractor

for Maitri Banerjee, Team Leader, Division of Reactor Projects — 1/28/92 (date)

Approved by: Dr. P. K. Eapen, Chief, Systems Section, Engineering Branch, DRS — 1/29/92 (date)

Inspection Summary: See the Executive Summary.

TABLE OF CONTENTS

EXECUTIVE SUMMARY

The Nuclear Regulatory Commission conducted a team inspection at the Seabrook Station on December 2-6, 1991, to assess the program developed by the licensee in response to NRC Generic Letter 89-10, "Safety-Related Motor-Operated Valve Testing and Surveillance." The generic letter and it's supplements (1, 2, and 3) provide guidelines for the licensees to develop adequate programs that will ensure design-basis operability of safety-related motor-operated valves (MOV).

The team observed strengths in the licensee's management support to the MOV program, and in the area of diagnostic test capabilities. The licensee's initiatives in developing a multi-channel, direct stem mounted strain gauge diagnostic system was noteworthy. The personnel involved with the program showed good knowledge and technical capabilities. The licensee has developed a good training facility in support of the generic letter program. The MOV program was being developed to meet the schedule recommended in the generic letter.

The licensee intends to perform design basis differential pressure testing for a minimum of 20% of the MOVs in the program. Testing on 17 MOVs was completed during the first refueling outage. Some of the concerns identified were the lack of adequate Quality Assurance (QA) measures for the diagnostic test system error analysis, lack of auditable documentation for the use of vendor supplied test results, maintenance procedures that could allow inadvertent change to the torque switch setpoint, and the frequency for periodic verification of certain MOVs that did not meet the generic letter recommendations. The licensee acknowledged the concerns listed in Table 1.

There were no violations or deviations identified during this inspection. The team concluded that, with a few exceptions, the licensee has developed an MOV program that meets the guidance in GL 89-10.

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 are selected, set and maintained properly. On June 13, 1990, the staff issued Supplement 1 to GL 89-10 to provide the results of public workshops. In Supplement 2 (issued on August 3, 1990) to GL 89-10, the staff stated that inspections of programs developed in response to GL 89-10 would not begin until January 1, 1991. In response to concerns raised by the results of NRC-sponsored MOV tests, the staff issued Supplement 3 to GL 89-10 on October 25, 1990, which requested that boiling water reactor licensees evaluate the capability of MOVs in certain systems, as applicable. In Supplement 3, the staff indicated that all licensees should consider the information obtained from the NRC-sponsored tests in the development of the generic letter program, as applicable. 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 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 GL 89-10.

2.0 Seabrook Station's Generic Letter 89-10 Program

In their letter, dated January 2, 1990, to the U.S. Nuclear Regulatory Commission, New Hampshire Yankee (NHY) responded to the generic letter. The licensee stated that they planned to extend their existing IE Bulletin 85-03 Program to include applicable MOVs in safety related systems and consider criteria provided in the generic letter. In this determination, the licensee provided their position regarding each generic letter recommendation and made no additional commitment regarding differential pressure or flow testing. The NRC staff acknowledged that commitment in a reply on August 10, 1990. Consistent with Item 1 of GL 89-10 and the response to Question 44 in Supplement 1 to GL 89-10, the NRC staff stated that the licensee should incorporate any differences between their program and the generic letter in the licensee's program description. The staff also reiterated the need for testing "safety-related" MOVs under design basis full flow and differential pressure conditions when practicable.

The team reviewed the licensee's response to the generic letter and documentation describing the program established. The inspectors also discussed the program details with licensee personnel. The results of this inspection as related to each element of Generic Letter 89-10 are described below.

2.1 Scope and Administration of the Generic Letter Program

The Generic Letter guideline for the licensee's Program is to include all safety-related MOVs including the position-changeables, in safety-related piping systems. Through Supplement 1 to the generic letter, the staff defined "position-changeable" as any MOV in a safety-related piping system that is not blocked from inadvertent operation from the control room.

The overall program description for Seabrook is provided in Station Procedure ES1850.003, Rev. 0, "Motor-Operated Valve Performance Monitoring," which is considered by the licensee to be their program document. The scope of Seabrook Station's Generic Letter 89-10 MOV Program, as described in Station Procedure ES1850.003, Rev. 0, Change No. 03, meets the intent of the generic letter.

The team reviewed selected piping and instrumentation diagrams (P&IDs), plant procedures including the emergency operating procedures, Technical Specifications, and the Final Safety Analysis Report to verify that the scope of the licensee's MOV program meets the recommendations of the GL. The inspectors selected and verified that the safety related MOVs in the residual heat removal, safety injection, service water, containment spray, chemical and volume control, and emergency feedwater systems were selected and verified to be included in the MOV program.

The licensee prioritized all 257 station MOVs into four categories based on their safety significance as determined by a review of the Seabrook Station Probabilistic Safety Assessment (SSPSA). Priority 1, 2 and 3 (a total of 122) valves are included in the generic letter program. Priority 4 MOVs are not included in the generic letter program.

Several non-safety related valves in safety-related systems have been categorized as priority 4 MOVs. These valves were preliminarily determined to be outside the scope of GL 89-10 and, therefore, classified as priority 4. Formal documentation justifying the exclusion of these valves from the generic letter program was not available at the time of this inspection. The licensee stated that these valves will be evaluated further as part of the GL 89-10 program and formal documentation will be established to justify the exclusion of the priority 4 valves.

The letdown flow control valves in the chemical and volume control system, CS-HCV-189 and CS-HCV-190 were classified as priority 4. While not required for safe shutdown of the plant, these valves are assumed in the High Energy Line Break (HELB) analysis to be in a particular position to limit flow after the line break. The licensee stated that a review of the HELB analysis would be performed and these valves would be included in the generic letter program, if necessary.

Engineering Evaluation 91-07, "Motor-Operated Valve Design Basis Review," which recommended the deletion of two non-safety related valves, SW-V-44 and CC-V-434 from the GL 89-10 program, was reviewed. These valves were originally categorized as priority 2 valves. Valve SW-V-44 is normally open and not required to be repositioned during abnormal or emergency operating procedures. Inadvertent operation of the valve is prevented by removing the power supply to the valve operator. Removal of valve CC-V-434 from the program was recommended due to this valve being required to be operated in the emergency response procedures in a backup role only to provide cooling water to the excess letdown heat exchanger. The inspectors noted no concerns with these evaluations.

The licensee recognizes the safety significance of its MOV program and has devoted appropriate resources to develop an effective program. The licensee uses the existing line organization to implement their MOV program. The System Support Department, which includes the system engineers, has the overall responsibility to test and maintain the MOVs. A designated MOV engineer is responsible for management of the MOV signature data and assisting the system engineers in this area. This person also maintains an overall cognizance of industry development.

The licensee has assigned knowledgeable personnel to the program with a specific engineer responsible for the coordination of the MOV diagnostic test program. Overall, the licensee's MOV program scope and administration are consistent with the guidelines provided in GL 89-10.

2.2 Design Basis Reviews

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

The licensee has completed the design basis review for 41 MOVs in the generic letter program. The licensee intends to complete the design basis reviews for the remaining MOVs prior to testing. The methodology for determining differential pressure was established and documented in SBC-428, Rev. 1, "Maximum Differential Pressure Calculations for Motor Operated Valves" and included calculations for the 41 MOVs addressed during refueling outage RFO1. This document indicated that the licensee reviewed the Final Safety Analysis Report, Technical Specifications, operating, emergency, abnormal, and surveillance procedures to determine the plant design basis, and possible valve mispositioning events prior to establishing the worst case differential pressure. The licensee also addressed the effect of mispositioning other valves in determining the worst case differential pressure for the MOVs in the program.

The licensee determined valve design differential pressures based on original plant design, and calculated maximum differential pressures based on the design basis review. In most cases, the more conservative design differential pressure was used for determining a given MOV's minimum required thrust. Based on a sample of calculations completed for the program's first 41 MOVs, the the calculated maximum differential pressures were determined in a detailed and conservative manner. However, in two cases, the licensee used the lower, but still conservative, values provided by the design basis review in lieu of design differential pressures due to limitations in actuator capability. The overall level of conservatism in the differential pressure calculations varied based on the method selected.

The licensee was updating the voltage calculations using a computer program. The design input included the maximum normal operating load at minimum grid voltage and the accident starting loads or the loads sequenced on to the emergency diesel generator. The impedance of the MOV cables was calculated using 90 degree C conductor temperature. The licensee was revising this calculation to account for the effects of higher accident temperatures on cable impedance to further verify the adequacy of the power cables. The licensee stated that they would evaluate the effects of high ambient temperature on motor performance as part of an ongoing study performed by Limitorque. The licensee would also include the thermal overload (TOL) resistance in revision to the degraded voltage calculations.

The licensee determined the maximum allowable thrust based on the limiting value of the structural limits, actuator capability, springpack capabilities,and motor output capability under degraded voltage conditions. The maximum allowable thrust is reduced by a "square root of the sum of the squares" combination to account for diagnostic equipment inaccuracies and torque switch repeatability. Consistent with GL 89-10 guidelines, the licensee established an ongoing review to identify generic letter MOVs that would not be bounded by the existing seismic analysis. As of the time of this inspection, the licensee had identified four MOVs requiring additional analysis.

From the above, the inspectors concluded that the licensee's design basis review methodology was consistent with the guidelines provided in the GL.

2.3 Diagnostics Systems

The licensee has recently developed a multi-parameter, nonintrusive diagnostic system, In-Situ Test Evaluation Analysis and Diagnostic (INSTEAD) based primarily on the use of strain gauges mounted directly on the valve stem to measure actuator output. This system employed up to 12 channels and use 2 methods to derive thrust measurements. The licensee had previously utilized MOVATS diagnostic equipment during testing in response to IE Bulletin 85-03.

Where space and access allow the permanent installation of strain gauges directly on the valve stem, the licensee derives thrust from the output of a Wheatstone bridge strain gauge configuration (two axial and two transverse oriented). The output thrust is analytically determined based on the strain gauge manufacturer's correlation and bridge configuration. Installation of the strain gauges is controlled to assure alignment within specified tolerances to achieve the overall measurement accuracy. Therefore, no in situ calibration check of the installed strain gauges is performed against a reference standard. The strain gauge method is considered by the licensee as the preferred method.

For MOVs with restricted access which prohibits the installation of strain gauges, the licensee derives thrust from the measurement of springpack displacement. This method (called a comparison method) compares a reference load cell output against measured springpack displacement using a linear variable differential transformer (LVDT) to establish a calibrated correlation. During subsequent torque switch adjustment and dp testing, only springpack displacement is monitored as a measure of thrust.

The licensee utilizes these methods, as required, to adjust torque switch settings within specified target bands, to evaluate the results of dp testing, to assure excess margin for design basis capability and to diagnostically monitor and troubleshoot MOV performance. However, the licensee had not used both methods simultaneously during testing. As a result, these diverse methods are not used in verifying assumed stem factors and coefficients of friction.

The licensee also utilizes a load cell method to establish the opening torque switch thrust setpoint during diagnostic testing. However, the licensee had not correlated the load cell thrust with strain gauge thrust. The licensee stated that they would enhance the diagnostic method by cross checking the data using diverse measurement capabilities.

The licensee's overall thrust determination error includes the measurement system accuracy and the repeatability of the actuator torque switch. Consistent with Limitorque recommendations, the licensee has chosen 5% uncertainty for torque ranges in excess of 50 ft lb and 10% uncertainty for torque ranges at or below 50 ft lb. The "square root of the sum of the square" method was used to compile overall accuracy. The inspector found that the licensee incorporated a specific combined overall error in their determination of target thrust requirements for each specific valve.

The licensee tabulated the overall measurement compensation due to the inaccuracy and repeatability for 33 MOVs tested. Using the strain gauge method, the error penalty applied ranged from 7%-42%. Using the comparison method, the error penalty ranged from 15%-20%. The inspector found that the licensee consistently quoted accuracy in percent of full scale in all cases except for LVDT instrument for which accuracy was supplied as 5% of the reading. The licensee indicated that their measurement system accuracy and overall thrust determination error had been substantiated during testing at INEL. The inspector found that the licensee appropriately interpreted and incorporated stated accuracy within their program.

The licensee had not established design controls for the error analyses. The licensee had no procedure which described the method by which overall accuracy would be accounted for within their control of switch setpoints. The inspector discussed this weakness with licensee representatives and emphasized the need to implement all GL 89-10 MOV program elements within established quality measures, including those applicable to control setpoint loop error determination. The licensee stated that quality assurance measures will be established for the control of switch setpoint error analysis by April 30, 1992.

The licensee's development of a diagnostic test system with the capability of diverse measurement was noteworthy; however, the licensee needs to correlate the data from various techniques and implement quality measures for the instrument accuracy determination to take full advantage of this system.

2.4 MOV Switch Settings and Setpoint Control

Action "b" of Generic Letter 89-10 recommended that licensees review, and revise as necessary, the methods for selecting and setting all MOV switch settings. These switch settings should enable the MOV to perform its safety function and/or to survive and recover from a valve mispositioning event.

The licensee's MOV switch setting document, "Motor Operated Valve Sizing and Calculation Guideline," dated November 19, 1991, SBC-432, Rev. 2, "Motor Operated Valve Thrust Calculation", and SBC-477, Rev. 0, "Refueling Outage 1 MOV Min/Max Torque Switch Settings," were reviewed. The licensee had completed sizing and switch setting calculations for the 41 MOVs that were addressed during RFO1. The licensee stated that all thrust calculations would be completed for the remaining MOVs prior to testing.

Westinghouse, Velan, Crane Aloyco, and Edwards had provided Seabrook with specific equations to be used for determining required thrust for their respective MOVs. These equations were reviewed and found to be similar to the industry standard thrust equations with the exception that some of the equations utilized a disc friction coefficient instead of the commonly used valve factor that forms part of the industry standard equation. Vendor specified values for valve friction coefficients, valve factors, and stem friction coefficients were also used. Thrust results from these equations were generally conservative because of Seabrook's use of conservative design differential pressure values.

Seabrook's methodology included an added step to relate the vendor equation thrust results to the industry standard thrust equation and determine an apparent valve factor. This was done to demonstrate their method's level of conservatism in a manner comparable to other industry efforts and to show that the thrust requirements would encompass higher valve factors. The calculated required thrust values were input into the industry standard equation and apparent valve factors were derived using the calculated maximum differential pressure (which in general is lower than the valve design pressure) that came from the licensee's design basis review. This effort was documented in SBC-472, Rev. 0, "RFO1 MOV Equivalent Valve Factor and Thrust Margin Calculation" for 41 MOVs. A review of this document revealed a range of valve factors from approximately 0.40 to more then 2.0 for rising stem gate valves with a majority between 0.50 and 0.80.

Seabrook is assuming a 0.30 valve factor for some of its Velan gate valves. The licensee is also using disc friction coefficients provided by their other valve vendors. The use of a valve factor of 0.30 has been shown to be nonconservative in some industry MOV tests and NRC research. The inspectors used the peak unseating thrust that resulted from differential pressure tests of SI-V77 and SI-V102 to back calculate the disc friction coefficients so that comparison could be made to the values provided by the valve vendor. SI-V77 had a resultant disc friction coefficient that was lower than specified by the vendor, but SI-V102's disc friction coefficient was higher (0.466 versus vendor's value of 0.424). This resulted from testing of identical valves under near identical test conditions and indicated that the base assumptions used to determine the torque switch settings for SI-V102 need reevaluation on the part of the licensee. The licensee stated that they would include the results of their design basis tests to validate the assumed valve factors or friction coefficients.

As stated above, the licensee's methods were generally conservative. However, during review of SBC-477, "Refueling Outage 1 MOV Min/Max Torque Switch Settings," it was noted that SI-V77 and SI-V102 were determined to have inadequate actuator torque capacity when using Limitorque's standard equation for determining output capability under degraded voltage conditions. In lieu of these results, SBC-477 referred to test results that had been conducted by Limitorque for Westinghouse which indicated that an adequate thrust margin existed at 80% degraded voltage conditions. This information was transmitted to Seabrook in Westinghouse Electric Corporation letter, NAH-3219, dated February 19, 1987. The licensee did not have any documentation that specified the test methods used or how actuator output capability was measured. The guidance provided in GL 89-10, Supplement 1, question response 44, was that the licensees should maintain auditable documentation. This item will remain unresolved pending the licensee's documentation of the basis for the Westinghouse test results transmitted on February 17, 1987. (Unresolved item 50-443/91-81-01)

Seabrook uses 0.15 for stem friction coefficient strictly on the basis of vendor recommendation and without further technical justification. If the valve vendor did not provide a recommendation, then the licensee assumed a value of 0.20. The assumption of 0.15 as the stem friction coefficient is only valid if specific maintenance and lubrication requirements and frequencies are implemented to ensure the continued high efficiency of torque to thrust conversion. The licensee stated that they would justify the use of 0.15 for a stem friction coefficient in their generic letter program by April 30, 1992.

The licensee did not include margin to account for rate of loading effects under high differential pressure and flow conditions. The licensee indicated that rate of loading would be taken into account by comparing the thrust delivered by the actuator during high pressure conditions to the thrust delivered during static conditions. The licensee also stated that the test results would be applied to MOVs that cannot be tested at worst case differential pressure conditions.

Rising stem MOVs in Seabrook's generic letter program are typically seated in the closing direction using the torque switch. Torque switches are normally bypassed for the first 20% to 30% of valve travel. Limit switch seating was used for selected MOVs with Limitorque SB actuators. Seabrook's diagnostic system allowed technicians to set the limit switches in a manner that ensured hard seat contact without relying on inertia to achieve valve closure. The licensee's justification for limit seating with SB actuators was appropriate.

Limit seating was also used with one non-SB actuator on the head vent valve, RCV-323. The licensee was unable to identify the basis for limit seating this valve. The SMB-000 actuator used on this valve does not feature a compensating spring above the stem nut as in the SB actuator. As a result, the limit switch is adjusted to actuate before complete valve closure, relying on inertia to complete the valve stroke. The licensee identified that the valve did not have a specific leak tightness criteria. Nonetheless, the licensee stated that they would review and revise the control design of RCV-323 to assure its capability under design basis conditions.

Generic letter Section b. addresses the setting of overload switches. The contacts of the thermal overload (TOL) relay can be used in the valve control circuit either to interrupt current to the closure coil, initiate an overload alarm or both. The licensee has chosen to trip the motor on overload and is currently in the process of modifying the control circuits for identifying the overload trip from other trips.

Licensee's calculation 9763-3-ED-00-28-F, Rev. 2, "Motor Control Circuit Protection for Assessing the Adequacy of the Thermal Overloads" was reviewed. The sizing criteria were as follows:

1. When carrying full load current the motor will not trip in a time period less than three times the stroking time of the MOV.

2. When carrying locked rotor current, the thermal overload relay should actuate in a time within the motor's limiting time for carrying locked rotor current.

If it was not possible to achieve both, the latter criterion was to be relaxed. The licensee design was consistent with the regulatory position addressed in Regulatory Guide 1.106, Rev. 0, "Thermal Overload Protection for Electric Motors on Motor Operated Valves," The inspectors' review of selected examples confirmed implementation of these criteria.

The full load current used in the above referred calculation was actual measured test current with 10% margin or name plate full load current with 25% margin. The inspectors selected six MOVs (RH-V-32, RH-V-70, SI-V-77, SI-V-102, MS-V-205) that were tested under differential pressure to determine the adequacy of the current values assumed. In the case of MOV SI-V-77 the average current was 25.7% higher than the name plate value. This indicated that 25% margin to name plate data may not be adequate in all cases. The licensee had only a few cases where the name plate data was utilized. Also, due to the additional margin available within the TOL relay selection process, there was no immediate concern. The licensee agreed to review the calculations for all the motors where name plate data were used for sizing the TOL. This is an unresolved item pending NRC review of the licensee's action to establish the adequacy of thermal overloads (Unresolved 50-443/91-81-02).

In accordance with technical specification requirements, 25% of the overload relays are tested in every refueling outage to verify the performance. The team did not identify any other discrepancies in the thermal overload selection process.

The torque switch settings are controlled through a licensee drawing, 1-NHY-25000, Rev. 12. The limit switch positions are identified in control wiring diagram/schematics. Station Procedure ES1850.003, Rev. 0, "Motor-Operated Valve Performance Monitoring," specifies the bypass setting of torque switches. The team reviewed licensee procedures MS0519.24, "Setting Limit Switches - Westinghouse MOVs," and MS0514.13, "Butterfly MOVs - Limit Switch Verification using Strain Gauge Measurements," that address setting and verification of limit switches. The team randomly selected a sample of valves and verified compliance to the licensee's criteria. No discrepancies were identified.

A review of drawing 1-NHY-250000 revealed that in most cases torque switch dial settings rather than thrust values were specified. For the drawing data sheets which did specify thrust values, there were six setpoints specified for each MOV: a minimum dial setting, a maximum dial setting, an open thrust, a closed thrust, a reduced voltage thrust, and a maximum thrust. Note 11 of the drawing stated that required thrust values and maximum thrust values are to be adjusted for diagnostic technique error. The licensee stated that this drawing was being revised to add thrust setting for all MOVs.

The adjusted setpoints were tabulated in the licensee's program description, ES1850.003; however, the dial settings were not included in ES1850.003. Only the target thrust range was specified as the controlled setpoint. The maximum thrust setpoint in Figure 10.1 was based on the maximum design value from 1-NHY-250000 which included inertia. The licensee's approach to controlling torque switch settings relied on the maximum dial setting to assure degraded voltage capability, since the maximum thrust setting could exceed the reduced voltage thrust limit. The licensee's control of torque switch settings required control of both the maximum dial setting and the min/max thrust.

Licensee's procedure MS0519.05, Rev. 3, "Corrective Maintenance of Limitorque Valve Actuator Type SMB-00," paragraph 8.33a, described the technique for balancing the torque switch. The balancing adjustment of the torque switch was used to adjust thrust within acceptable ranges. However, the licensee did not establish adequate control to ensure that the maximum allowable torque switch dial setting was not exceeded during such balancing adjustment. The licensee stated that they would review this matter and establish necessary controls to prevent exceeding the maximum torque switch dial setting.

The team also reviewed the licensee program for maintaining these setpoints. The licensee's post maintenance test guidelines are documented in figure 10.3 of Station Procedure ES1850.003. This procedure allowed monitoring of the motor current for certain maintenance activities and specified 130% of the full load current to be the acceptance criteria for assessing operability. This criterion was also applicable to actuator and motor replacement. However, this 130% criterion is outside the thermal overload trip setpoint criterion of 125% of full load current. Moreover, such an increase in current is indicative of problems elsewhere in the valve that reduces the motor's available capacity to supply additional torque required for overcoming differential pressure conditions across the valve. The licensee stated that they would review this matter and generate an acceptance value that is consistent with the functional requirements.

The licensee's methods for determining switch settings were generally conservative. However, the assumptions of the setpoint methodology were not fully justified or documented. The acceptance criteria, in some cases, were inconsistent with the functional requirements, and the controls for switch settings, in some cases, had the potential for adversely affecting safe operation during design basis accident conditions.

2.5 MOV Testing

Action "c" of the generic letter recommended that licensees test MOVs 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 MOV capability can be justified. With the two-stage approach, a licensee would evaluate the capability of the MOV using the best data available (including testing under maximum achievable differential pressure and flow) and then work to obtain applicable test data within the schedule of the generic letter.

In their January 2, 1990, response, the licensee indicated that differential pressure or flow testing would not be repeated for those MOVs that were adequately tested during preoperational and startup testing unless deemed appropriate based on the circumstances of the particular MOV. The licensee further stated that current commitments regarding MOV differential pressure (dp) testing were described in their FSAR and in their responses to IEB 85-03. No additional commitment regarding differential pressure and flow testing was contained in their response. Subsequent to this letter, the licensee recognized that most MOVs were tested during startup at maximum practical differential pressures and flows without using any diagnostic equipment to quantify available margins. Since the preoperational test data did not quantify available margins for the MOVs, the licensee decided not to incorporate this data in the GL program as stated in their letter dated January 2, 1990.

The team reviewed the licensee's use of prior test data in the development of GL program. The prior test data were considered historical information and would not be used as part of the GL 89-10 program for verification of design basis capability.

In their January 2, 1990, response to the generic letter, the licensee also deferred any commitment to completing the schedule for testing until June 30, 1990. In their program description, the licensee had established a schedule to baseline static test all GL 89-10 MOVs by June 1994. The program description further identified that differential pressure testing would be performed whenever practical and that a target of 20% of the safety related MOVs to be differential pressure (dp) tested will be tested at full dp conditions. During the inspection, the licensee also provided a detailed schedule showing one third of this testing to be performed during each of the first three refueling outages. This schedule is consistent with the generic letter recommendation. The licensee further explained that 20% was the minimum number they intend to test at design basis conditions. The licensee has completed dp testing of 17 MOVs, with 7 completed during the recent refueling outage (OR01). The licensee agreed to clarify their commitment regarding full dp testing and incorporate it in the program document as appropriate.

The licensee discussed their plan to group MOVs for testing but had not developed the criteria for grouping or selecting 20% of the MOVs for testing, as part of their program. The licensee agreed to provide the grouping, selection, and exclusion criteria to NRC by March 1, 1992, and include these criteria in the program description. The licensee also agreed to notify the NRC of any planned changes in current commitments and to establish adequate justification on site for NRC review, as outlined in GL 89-10.

Licensee procedure ES91-1-56, "Differential Pressure Test of MSIV Bypass, MS-V-205," which established the plant conditions during testing and the licensee's procedure MS0514.16, "Testing of Rising Stem MOVs using the NHY Method," which the licensee had established to obtain diagnostic data during dp testing were reviewed. Both procedures were adequately detailed to obtain data for signature analysis; however, neither procedure contained any acceptance criteria for the diagnostic data that ensures operability under all conditions including degraded voltage. The licensee stated that they would develop clear guidance and acceptance criteria for evaluating MOV capability using diagnostic data. Licensee personnel provided the inspectors with a draft change to their program that would include this review as part of the testing program's acceptance criteria.

The licensee had developed a schedule to perform design basis dp testing for 20% of the GL program MOVs. However the licensee needs to clarify their intent regarding the GL recommendation of testing MOVs wherever practicable, and document the grouping/exclusion criteria. The test procedure needs to be enhanced with clear acceptance criteria.

2.6 Periodic Verification of MOV Capability

Action "d" of the generic letter recommended that the licensees prepare or revise procedures to ensure that adequate MOV switch settings are established and maintained throughout the life of the plant. Paragraph "j" of the generic letter recommended the establishment of a surveillance interval commensurate with the safety function of the MOV as well as its maintenance and performance history. The surveillance interval should not exceed 5 years or 3 refueling outages. Further, the capability of the MOV has to be verified if the MOV is replaced, modified, or overhauled to an extent that the test results are not representative of the MOV.

The licensee had prepared procedures to establish and maintain MOV switch settings. In their program description (ES1850.003, Rev. 0), the licensee identified that periodic testing would be performed as scheduled surveillances for the remaining life of the plant. The frequency of periodic testing would be established based on the priority assigned to the specific MOV. However, only the surveillance interval for priority 1 MOVs (a total of 49 safety-related MOVs) had been established consistent with the generic letter recommendation of 5 years or 3 refueling outages. The licensee had designated 8 years or 6 refueling outages for priority 2 MOVs (45 safety-related and 4 non-safety related) and 10 years or 8 refueling outages for priority 3 MOVs (24 safety related). The licensee stated that they would justify the frequency for priority 2 and 3 MOVs in the generic letter program.

The licensee indicated that periodic testing will be conducted with the MOV in the as-found condition to capture performance data representative of service degradation.

The licensee indicated that scheduling of periodic verification would be coordinated with required inservice testing (IST) to minimized equipment unavailability but that the objective of the two programs would remain independent.

The licensee demonstrated an understanding of the periodic verification requirement. However, the frequency of periodic verification of priority 2 and 3 MOVs needs to be justified.

2.7 MOV Maintenance and Post Maintenance Testing

Station Procedure ES1850.003 delineated the program requirements for performing periodic preventive maintenance (PM), inspection, corrective maintenance, and post maintenance testing. The licensee has developed procedures for preventive and corrective maintenance on various models of Limitorque and Rotork actuators. The portions of the following procedures were reviewed and found to be detailed and comprehensive.

MS0519.01	Inspection, Testing and PM of MOVs with Limitorque Type SMB, SB, SBD, and SMC Actuators
MS5020.02	Inspection/PM of Rotork Valve Actuators
MS0519.05	Corrective Maintenance of Limitorque Valve Actuator Type SMB-00
MS0519.26	Corrective Maintenance of Rotork Valve Actuators

The procedures included specific checks for evidence of springpack relaxation in Limitorque actuators. According to the licensee, no incidence of gross springpack relaxation had been experienced in any Limitorque actuators causing the springpacks to be replaced.

Procedure MS 0519.01, Rev. 03, "Inspection, Testing and Preventive Maintenance for Motor-Operated Valves with Limitorque SMB, SB, SBD and SMC Actuators" was reviewed. This procedure implemented the vendor recommendations on routine maintenance of Limitorque operators regarding visual inspection, grease sampling, stem lubrication and motor insulation resistance testing. According to the licensee, their work control requirements specify diagnostic testing prior to PM activities to capture as-found conditions.

The licensee performs the preventive maintenance and inspection on safety related MOVs every two refueling outages or three years, whichever is longer. However, the vendor recommends a minimum inspection period of 18 months. The licensee agreed to revise the MOV program document and provide justification for the PM interval that is beyond vendor recommendation.

The procedures for the adjustment of Rotork actuators did not caution against manual operation inadvertently affecting the limit switch settings. When manually operated beyond the position at which the limit switch had been intentionally set, the switch setting is inadvertently changed to the new position. The licensee acknowledged the inspector's concern and committed to review and revise their procedures to include appropriate caution. The licensee stated that training would also be enhanced to ensure that maintenance and operations personnel were aware of the potential for inadvertently affecting the switch settings.

The post maintenance test (PMT) requirements are established by the responsible system engineer during the preparation of maintenance work requests for MOVs. PMT following MOV maintenance is performed in accordance with licensee procedure MA 3.5 and additional guidelines are defined in the licensee's program description, ES1850.003, Figure 10.3. Diagnostic testing was generally specified for maintenance categories which could alter the existing test data supporting the design basis capability of the MOV. However, several significant types of MOV maintenance were categorized as minor maintenance and did not require diagnostic PMT. Specifically, diagnostic testing was not required following motor replacement in Limitorque actuators, valve stem packing adjustment or replacement, or actuator limit switch adjustment or replacement (for limit seated MOVs). The licensee representatives stated that the PMT matrix in ES1850.003 would be reviewed and revised to specify diagnostic testing for such maintenance activities.

The maintenance procedures were, in general, found to be of good quality. The licensee plans to justify the PM interval that is beyond vendor recommendation and enhance the PMT requirements after maintenance of certain MOVs.

2.8 MOV Failures, Corrective Actions, and Trending

Action "h" of the generic letter recommended that licensees analyze each MOV 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.

The licensee's program document requires that any MOV failure which results in declaring the component inoperable be evaluated and documented in accordance with the Station Operating Experience Manual. MOV performance trending is an attribute of the licensee's diagnostic test program. The program also requires review of minor degradations for trends. This review is done via the licensee's work control program and documented in completed work packages. Guidelines for root cause analysis are delineated in Station Procedures OE 4.2, "Cause and Failure Analysis," and OE 4.3, "Root Cause Analysis." The failure data are reviewed and trended on an annual basis and reported in the System Performance Annual Report. The licensee also reviews the industry data system for MOV failures.

Two root cause analyses were reviewed to determine the licensee's effectiveness in this regard. The first one was a draft report to address 27 lubrication related deficiencies. The second report was on RHR train B discharge cross connect valve V-21. Neither of these analyses revealed the cause of the failure or the deficiencies. It was concluded that the licensee has developed procedures to perform MOV failure root cause analysis; however, additional attention was required to assure that the root causes of the failures or the deficiencies were adequately documented.

2.9 Training and Control of Contractors

The licensee's MOV training courses, facilities, and knowledge of their training personnel relative to the implementation of the GL 89-10 program were evaluated. The licensee has developed a comprehensive training program for meeting the intent of the generic letter. The program included a well-equipped training facility with MOVs that represented various types of plant applications, diagnostic equipment, and knowledgeable instructors. The station staff has acquired substantial knowledge on MOVs through the in-house development of the diagnostic equipment. The use of the maintenance procedures is also included in the lesson plan. The job performance measure in the training sessions included special attention to critical evolutions and precautions.

The licensee has trained 25 system engineers on MOVs. This encompasses more than half of the plant system engineers who regularly interact with plant modifications and maintenance. The licensee has specialized training for diagnostic testing, and currently has five electricians qualified. Contractor help was used during the last refueling outage to perform MOV preventive maintenance. A special training was offered to those contractors before conducting this activity. A review of the qualifications of the technicians for several selected MOV work packages indicated that these personnel were adequately qualified. The team concluded that the licensee has a very good training program to support MOV testing and surveillance, and considered the licensee's MOV training program to be a strength.

2.10 Industry Experience and Vendor Information

The team reviewed the licensee's vendor information program to assess its effectiveness in disseminating industry data into the various areas of the MOV program. The review of the maintenance procedures indicated that the licensee has incorporated the EPRI maintenance guidelines and the illustrations. The current revisions of these guidelines on MOVs were maintained at the maintenance supervisor's office.

The disposition of selected NRC Information Notices on MOVs was reivewed. The licensee's disposition was verified through documentation review and physical inspection of selected valves. The licensee adequately addressed notices on improper lubricants, loosening of locknuts, deficiencies in wiring, and degraded motor leads.

The licensee's disposition of Limitorque Maintenance Update 88-2 and 90-1 on hydraulic lock did not clearly indicate adequate response. This problem develops from the trapped grease in the springpack assembly that leads to incompressibility of the springpack. The 1990 update on the subject problem stated that Limitorque would make modifications to the springpack assembly for all future shipments. However, the licensee was unable to confirm the MOVs installed at the station were modified. The licensee stated that they would review this matter and ensure that the concern is adequately resolved as part of the GL program.

The MOV control wiring at the Seabrook Station was reviewed for a configuration that could lead to MOV failure before controls are transferred to the remote shutdown panel during a fire. MOV wiring design for M1-V-142 was reviewed on a sampling basis and ascertained that the controls for this valve are not susceptible for such failure.

The team concluded that the licensee has established a program to review and incorporate vendor information and industry experience; however, the licensee needs to evaluate the springpack hydraulic lock of Limitorque actuators and incorporate the necessary changes in the program.

2.11 Schedule

In GL 89-10, the staff requested that licensees complete all actions initiated to satisfy the generic letter recommendations by June 28, 1994, or 3 refueling outages after December 28, 1989, whichever is later. The licensee's schedule is to complete this action by the third refueling outage currently scheduled for March 1994; this is consistent with the GL recommendation.

3.0 Walkdown

The overall external conditions of 12 accessible MOVs and the interior of the limit switch compartment of MOV (AS-V-176) were examined. In the case of AS-V-176, the actuator was not oriented with the motor axis horizontal as recommended by the manufacturer. The actuator was oriented with the motor axis vertical and the springpack at the lowest point. A small oil leak was noted at the springpack area and oil was coming out of the external grease relief port. The inspector discussed the potential for hydraulic lock occurring with the actuator oriented in such a fashion. The licensee stated that they had not experienced any occurrences of hydraulic locking on that valve or any other valve in the plant. The licensee attached a deficiency tag on the operator and decided to inspect the grease condition and review the orientation of the actuator to resolve the issue.

A small packing leak on MS-V-204 and a small oil leak on SW-V-20 were found during this walkdown. The licensee attached deficiency tags and initiated work requests for inspection.

Several MOV control switches in the control room were fixed position switches which did not spring return to neutral when released by the operator. The concern is that the valve may be damaged due to excessive seating thrust generated during short stroking of the valve if manual operation is attempted with the switch in the closed position. The licensee plans to review their maintenance and operations procedures to ensure that the controls are adequate to preclude this potential damage. Further, the licensee indicated that the topic would be included in training to assure that personnel are aware of the potential maloperation.

4.0 Conclusions

The licensee has taken measures towards establishing an MOV program that is consistent with the guidelines of NRC Generic Letter 89-10. The inspection team observed that the administration and engineering efforts for the program were good; the personnel involved were knowledgeable and demonstrated good technical capabilities; the licensee was proactive in developing an improved diagnostic technique; they have developed a good training facility in support of the GL program; and they have planned to perform design basis differential pressure testing for 20% of the valves as a minimum. The licensee also plans to improve the program further, as summarized in Table 1. The licensee's program schedule is consistent with the GL recommendation.

5.0 Exit Meeting

The inspectors met with those denoted in Appendix A on December 6, 1991, to discuss the preliminary inspection findings as detailed in this report.

6.0 Unresolved Items

Unresolved items are matters for which more information is required to ascertain whether they are acceptable, violations or deviations. Two unresolved items are discussed in Section 2.4 of this report.

APPENDIX A

Persons Contacted

Licensee

* P. Brown, Principal Engineer, YAEC
* J. Connolly, Regulatory Compliance Eng., NHY
* G. Desrochers, Electrical Maintenance Supervisor, NHY
* W. Diprofio, Assistant Station Mgr., NHY
* M. Kenney, System Support Mgr., NHY
* G. Kline, Technical Support Mgr. NHY
* D. Moody, Station Manager, NHY
* P. O'Leary, Engineer Tech., NHY
* T. Pocko, NRC Coordinator, NHY
* P. Searfoorce, MOV System Engineer, NHY
* G. Sessler, Sr. Project Engineer, NHY
* J. Vargas, Manager and Engineer, NHY

Nuclear Regulatory Commission

N. Dudley, Senior Resident Inspector - Seabrook
* J. Durr, Chief, Eng. Branch
* P. Eapen, Chief, Systems Section
* G. Edison, Sr. Project Mgr.
* T. Frye, Reactor Engineer

* Denotes those present at the exit meeting held on December 6, 1991.

TABLE 1

Licensee Plans and Commitments for Further Program Improvements

Scope

- Justify the exclusion of priority 4 MOVs from the program.
- Review the HELB analysis to verify that CS-HCV-189 and CS-HCV-190 may be excluded from the GL program.

Design Basis Review

- Revise the terminal voltage calculation to account for accident environmental temperature on cable impedance. Evaluate effect of high ambient temperature on motor performance and TOL resistance and include it in a revision to the degraded voltage calculation.
- Continue seismic analysis of GL MOVs.

Diagnostic Systems

- Establish design control measures for error analysis by April 30, 1992 and describe the method for determining the overall accuracy of the control switch setpoints.
- Enhance the diagnostic methods by cross checking of the data from diverse measurements.

MOV Switch Settings and Setpoint Control

- Validate the assumed valve factors or friction coefficients using the design basis test results and justify use of 0.15 as stem friction coefficient by April 30, 1992.
- Justify the use of Westinghouse test results for thrust measurements at 80% degraded voltage calculations (re. Westinghouse letter NAH-3219, dated February 19, 1987).
- Ensure that the design basis test results are applied to MOVs that can not be tested at the design basis differential pressure or flow conditions.
- Incorporate information in a recent NRC Information Notice on offset butterfly MOVs into the GL program as appropriate.
- Review and revise as appropriate the control design of RCV-323 to assure its capability under design basis conditions.

- Review and revise the torque switch balancing procedure and establish the necessary controls to prevent exceeding the maximum dial setting.

- Revise drawing 1-NHY-250,000 to add thrust setpoint for all MOVs in the GL program.

- Verify that 25% margin to the nameplate data for TOL sizing is adequate in all cases.

- Review the motor current acceptance criterion of 130% of full load current and generate an acceptance value that supports the functional requirements.

MOV Testing

- Clarify the commitment regarding full dp testing, provide the exclusion, grouping and selection criteria used for MOV testing by March 1, 1992, and revise the program description as appropriate, and notify NRC of any planned changes to current commitments.

- Develop clear guidance and acceptance criteria for evaluating MOV capability using diagnostic data to ensure operability under all conditions including degraded voltage.

Periodic Verification

- Review the priority 2 and 3 MOVs to justify frequency of periodic verification.

Maintenance and Post Maintenance Testing

- Revise the MOV program and provide justification for extension of the preventive maintenance and inspection period beyond vendor recommendation.

- Revise the procedure for adjustment of Rotork operator and training module as appropriate to caution against inadvertently changing limit switch setpoint.

- Revise the PMT requirements (Figure 10.3 in ES1850.003) to ensure diagnostic testing after significant MOV maintenance like motor replacement, limit switch adjustment or replacement (for limit seated MOVs), and valve stem packing adjustment or replacement.

MOV Failures, Corrective Action and Trending

- Ensure the effectiveness of the root cause analysis for MOV failures.

Industry Experience and Vendor Information

- Review and resolve the concerns identified in Limitorque maintenance updates 86-2 and 90-1.

Walkdown

- Inspect the grease condition in ASV-176 which had grease leakage from the springpack area and review orientation of the actuator.

- Review maintenance and operation procedures to ensure adequate control for switch positioning to preclude short stroking and include this information in the MOV training program.