UNITED STATES
NUCLEAR REGULATORY COMMISSION
WASHINGTON, D.C. 20555-0001

SAFETY EVALUATION BY THE OFFICE OF NUCLEAR REACTOR REGULATION

LICENSEE RESPONSE TO GENERIC LETTER 96-05, "PERIODIC VERIFICATION OF DESIGN-BASIS CAPABILITY OF SAFETY-RELATED MOTOR-OPERATED VALVES"

SEABROOK STATION, UNIT NO. 1

DOCKET NO. 50-443

1.0 INTRODUCTION

Many fluid systems at nuclear power plants depend on the successful operation of motor-operated valves (MOVs) in performing their safety functions. Several years ago, MOV operating experience and testing, and research programs sponsored by the nuclear industry and the U. S. Nuclear Regulatory Commission (NRC), revealed weaknesses in a wide range of activities (including design, qualification, testing, and maintenance) associated with the performance of MOVs in nuclear power plants. For example, some engineering analyses used in sizing and setting MOVs did not adequately predict the thrust and torque required to operate valves under their design-basis conditions. In addition, inservice tests of valve stroke time under zero differential-pressure and flow conditions did not ensure that MOVs could perform their safety functions under design-basis conditions.

Upon identification of the weaknesses in MOV performance, significant industry and regulatory activities were initiated to verify the design-basis capability of safety-related MOVs in nuclear power plants. After completion of these activities, nuclear power plant licensees began establishing long-term programs to maintain the design-basis capability of their safety-related MOVs. This safety evaluation addresses the program developed by North Atlantic Energy Service Corporation (North Atlantic/licensee) to verify periodically the design-basis capability of safety-related MOVs at the Seabrook Station, Unit 1.

2.0 REGULATORY REQUIREMENTS

The NRC regulations require that MOVs important to safety be treated in a manner that provides assurance of their intended performance. Criterion 1 to Appendix A, "General Design Criteria for Nuclear Power Plants," to Part 50 of Title 10 of the *Code of Federal Regulations* (10 CFR Part 50) states, in part, that structures, systems, and components important to safety shall be designed, fabricated, erected, and tested to quality standards commensurate with the importance of the safety functions to be performed. The quality assurance program to be applied to safety-related components is described in Appendix B, "Quality Assurance Criteria for Nuclear Power Plants and Fuel Reprocessing Plants," to 10 CFR Part 50. In Section 50.55a of 10 CFR Part 50, the NRC requires licensees to establish inservice testing (IST) programs in accordance with Section XI of the American Society of Mechanical Engineers (ASME) Boiler and Pressure Vessel Code.

In response to concerns regarding MOV performance, the NRC staff issued Generic Letter (GL) 89-10 (June 28, 1989), "Safety-Related Motor-Operated Valve Testing and Surveillance," which requested that nuclear power plant licensees and construction permit holders ensure the capability of MOVs in safety-related systems to perform their intended functions by reviewing MOV design bases, verifying MOV switch settings initially and periodically, testing MOVs under design-basis conditions where practicable, improving evaluations of MOV failures and necessary corrective action, and trending MOV problems. The staff requested that licensees complete the GL 89-10 program within approximately three refueling outages or 5 years from the issuance of the generic letter. Permit holders were requested to complete the GL 89-10 program before plant startup or in accordance with the above schedule, whichever was later.

The NRC staff issued seven supplements to GL 89-10 that provided additional guidance and information on MOV program scope, design-basis reviews, switch settings, testing, periodic verification, trending, and schedule extensions. GL 89-10 and its supplements provided only limited guidance regarding MOV periodic verification and the measures appropriate to assure preservation of design-basis capability. Consequently, the staff determined that additional guidance on the periodic verification of MOV design-basis capability should be prepared.

On September 18, 1996, the NRC staff issued GL 96-05, "Periodic Verification of Design-Basis Capability of Safety-Related Motor-Operated Valves," requesting each licensee to establish a program, or ensure the effectiveness of its current program, to verify on a periodic basis that safety-related MOVs continue to be capable of performing their safety functions within the current licensing bases of the facility. In GL 96-05, the NRC staff summarized several industry and regulatory activities and programs related to maintaining long-term capability of safety-related MOVs. For example, GL 96-05 discussed non-mandatory ASME Code Case OMN-1, "Alternative Rules for Preservice and Inservice Testing of Certain Electric Motor Operated Valve Assemblies in LWR Power Plants, OM Code 1995 Edition; Subsection ISTC," which allows the replacement of ASME Code requirements for MOV quarterly stroke-time testing with exercising of safety-related MOVs at least once per operating cycle and periodic MOV diagnostic testing on a frequency to be determined on the basis of margin and degradation rate. In GL 96-05, the NRC staff stated that the method in OMN-1 meets the intent of the generic letter with certain limitations. The NRC staff also noted in GL 96-05 that licensees remain bound by the requirements in their code of record regarding MOV stroke-time testing, as supplemented by relief requests approved by the NRC staff.

In GL 96-05, licensees were requested to submit the following information to the NRC:

a. within 60 days from the date of GL 96-05, a written response indicating whether or not the licensee would implement the requested actions; and

b. within 180 days from the date of GL 96-05, or upon notification to the NRC of completion of GL 89-10 (whichever was later), a written summary description of the licensee's MOV periodic verification program.

The NRC staff is preparing safety evaluations on the response of each licensee to GL 96-05. The NRC staff intends to rely to a significant extent on an industry initiative to identify valve age-related degradation which could adversely affect the design-basis capability of safety-related MOVs (described in Section 3.0) where a licensee commits to implement that industry program.

The NRC staff will conduct inspections to verify the implementation of GL 96-05 programs at nuclear power plants as necessary.

3.0 JOINT OWNERS GROUP PROGRAM ON MOV PERIODIC VERIFICATION

In response to GL 96-05, the Boiling Water Reactor Owners Group (BWROG), Westinghouse Owners Group (WOG), and Combustion Engineering Owners Group (CEOG) jointly developed an MOV periodic verification program to obtain benefits from the sharing of information between licensees. The Joint Owners Group (JOG) Program on MOV Periodic Verification is described by the BWROG in its Licensing Topical Report NEDC-32719, "BWR Owners' Group Program on Motor-Operated Valve (MOV) Periodic Verification," and described by the WOG and the CEOG in their separately submitted Topical Report MPR-1807, "Joint BWR, Westinghouse and Combustion Engineering Owners' Group Program on Motor-Operated Valve (MOV) Periodic Verification." The stated objectives of the JOG Program on MOV Periodic Verification are (1) to provide an approach for licensees to use immediately in their GL 96-05 programs, (2) to develop a basis for addressing the potential age-related increase in required thrust or torque under dynamic conditions, and (3) to use the developed basis to confirm, or if necessary to modify, the applied approach. The specific elements of the JOG program are (1) providing an "interim" MOV periodic verification program for applicable licensees to use in response to GL 96-05, (2) conducting a dynamic testing program over the next 5 years to identify potential age-related increases in required thrust or torque to operate gate, globe, and butterfly valves under dynamic conditions, and (3) evaluating the information from the dynamic testing program to confirm or modify the interim program assumptions.

The JOG interim MOV periodic verification program includes (1) continuation of MOV stroke-time testing required by the ASME Code IST program, and (2) performance of MOV static diagnostic testing on a frequency based on functional capability (age-related degradation margin over and above margin for GL 89-10 evaluated parameters) and safety significance. In implementing the interim MOV static diagnostic test program, licensees will rank MOVs within the scope of the JOG program according to their safety significance. The JOG program specifies that licensees need to justify their approach for risk ranking MOVs. In Topical Report NEDC 32264, "Application of Probabilistic Safety Assessment to Generic Letter 89-10 Implementation," the BWROG described a methodology to rank MOVs in GL 89-10 programs with respect to their relative importance to core-damage frequency and other considerations to be added by an expert panel. In a safety evaluation dated February 27, 1996, the NRC staff accepted the BWROG methodology for risk ranking MOVs in boiling water reactor nuclear plants with certain conditions and limitations. In the NRC safety evaluation (dated October 30, 1997,) on the JOG Program on MOV Periodic Verification, the NRC staff indicated its view that the BWROG methodology for MOV risk ranking is appropriate for use in response to GL 96-05. With respect to Westinghouse-designed pressurized water reactor nuclear plants, the WOG prepared Engineering Report V-EC-1658, "Risk Ranking Approach for Motor-Operated Valves in Response to Generic Letter 96-05." On April 14, 1998, the NRC staff issued a safety evaluation accepting with certain conditions and limitations the WOG approach for ranking MOVs based on their risk significance. Licensees not applicable to the BWROG or WOG methodologies need to justify their MOV risk-ranking approach individually.

The objectives of the JOG dynamic test program are to determine degradation trends in dynamic thrust and torque, and to use dynamic test results to adjust the test frequency and method

specified in the interim program if warranted. The JOG dynamic test program includes (1) identification of conditions and features which could potentially lead to MOV degradation, (2) definition and assignment of valves for dynamic testing, (3) testing valves three times over a 5-year interval with at least a 1-year interval between valve-specific tests according to a standard test specification, (4) evaluation of results of each test, and (5) evaluation of collective test results.

In the last phase of its program, the JOG will evaluate the test results to validate the assumptions in the interim program to establish a long-term MOV periodic verification program to be implemented by licensees. A feedback mechanism will be established to ensure timely sharing of MOV test results among licensees and to prompt individual licensees to adjust their own MOV periodic verification program, as appropriate.

Following consideration of NRC staff comments, the BWROG submitted Licensing Topical Report NEDC-32719 (Revision 2) describing the JOG program on July 30, 1997. Similarly, the CEOG and the WOG submitted Topical Report MPR-1807 (Revision 2) describing the JOG program on August 6 and 12, 1997, respectively. On October 30, 1997, the NRC staff issued a safety evaluation to the BWROG, CEOG and WOG accepting the JOG program with certain conditions and limitations as an acceptable industry-wide response to GL 96-05 for age-related valve degradation.

4.0 SEABROOK GL 96-05 PROGRAM

On November 15, 1996, North Atlantic submitted a 60-day response to GL 96-05 notifying the NRC that it would establish a program to meet the intent of the generic letter. On March 18, 1997, the licensee submitted a 180-day response to GL 96-05 providing a summary description of the MOV periodic verification program planned to be implemented at Seabrook. In a submittal dated April 6, 1998, the licensee updated its commitment to GL 96-05.

In its letter dated March 18, 1997, the licensee stated that its MOV periodic verification program developed under GL 89-10 would continue to be implemented during Refueling Outage RF-05 (May 1997). In particular, the licensee planned the performance of static diagnostic tests of 41 safety-related MOVs and dynamic diagnostic tests of 10 safety-related MOVs during that refueling outage. The licensee specified that the MOV periodic verification program developed in response to GL 96-05 would be fully implemented for the start of Refueling Outage RF-06 (planned for March 1999).

In its submittal dated April 6, 1998, the licensee committed to continue its participation in the JOG MOV Periodic Verification Program as a member of the Westinghouse Owners Group and to implement the program elements described in the Topical Report MPR-1807 (Revision 2) describing the JOG program. In its submittal dated March 18, 1997, the licensee described its MOV periodic verification program, including scope, existing and planned testing, capability margin, and implementation of the JOG program at Seabrook. For example, the licensee described the interim MOV static diagnostic test program at Seabrook as applying the same MOV risk and margin threshold values as identified in the JOG topical report. The licensee also stated that dynamic testing of selected MOVs would be performed under its MOV periodic verification program. The licensee stated that adjustments would be made to its GL 96-05 program based on the test results and recommendations from the JOG testing program. On

April 6, 1998, the licensee noted its commitment to dynamically test 15 safety-related, rising-stem MOVs as part of its completion of the GL 89-10 program at Seabrook. Also, in its April 6, 1998, letter the licensee committed to test safety-related MOVs not covered by the JOG program consistent with its MOV periodic verification program.

5.0 NRC STAFF EVALUATION

The NRC staff has reviewed the information provided in the licensee's submittals describing the program to verify periodically the design-basis capability of safety-related MOVs at Seabrook in response to GL 96-05. The staff also reviewed NRC Inspection Report 50-443/96-11 which provided the results of an inspection to evaluate the licensee's program to verify the design-basis capability of safety-related MOVs in response to GL 89-10. The staff performed a followup inspection in September 1998 and closed the NRC review of the GL 89-10 program at Seabrook in NRC Inspection Report 50-443/98-08. The NRC staff's evaluation of the licensee's response to GL 96-05 is described below.

5.1 MOV Program Scope

In GL 96-05, the NRC staff indicated that all safety-related MOVs covered by the GL 89-10 program should be considered in the development of the MOV periodic verification program. The staff noted that the program should consider safety-related MOVs that are assumed to be capable of returning to their safety position when placed in a position that prevents their safety system (or train) from performing its safety function; and the system (or train) is not declared inoperable when the MOVs are in their non-safety position. In its submittal dated March 18, 1997, the licensee stated that its MOV periodic verification program consisted of the same MOV population as its GL 89-10 program, including MOVs that may be placed in their non-safety position during surveillance testing and are assumed to be operable in that position. As noted in NRC Inspection Report 50-443/98-08, the staff determined that the scope of the licensee's MOV program is consistent with the recommendations of GL 96-05.

5.2 MOV Assumptions and Methodologies

The NRC staff expects licensees to maintain the assumptions and methodologies used in the development of its MOV programs for the life of the plant (a concept commonly described as a "living program"). For example, the design basis of safety-related MOVs will need to be maintained up to date, including consideration of any plant modifications or power uprate conditions. In NRC Inspection Reports 50-443/96-11 and 98-08, the staff evaluated the licensee's justification for the assumptions and methodologies used in the MOV program at Seabrook, and the maintenance of those assumptions and methodologies based on the licensee's review of in-plant and industry information. The NRC staff considers the licensee to have adequate processes in place to maintain the assumptions and methodologies used in its MOV program, including the design basis of its safety-related MOVs.

5.3 GL 89-10 Long-Term Items

In NRC Inspection Report 50-443/96-11, the NRC staff noted that the licensee had committed (1) to perform dynamic testing of 15 additional MOVs during the next two refueling outages as part

of its MOV periodic verification program in order to obtain additional site-specific performance data; and (2) to revise its governing GL 89-10 program procedure to strengthen certain administrative controls for engineering evaluations and dynamic test acceptance criteria. In NRC Inspection Report 50-443/98-08, the staff found the licensee to be implementing its MOV dynamic testing plans with several tests conducted during Refueling Outage RF-05 and additional tests scheduled for RF-06. The staff determined the licensee to have adequately addressed the items identified during the previous inspection, including improving its justification for assumptions for valve factor, stem friction coefficient, and rate of loading in its GL 89-10 program. The staff also noted that the licensee had implemented modifications to improve the design-basis capabilities for several MOVs. The staff indicated that the licensee's actions in response to GL 95-07, "Pressure Locking and Thermal Binding of Safety-Related Power-Operated Gate Valves," would be addressed in a separate safety evaluation on GL 95-07.

As discussed in NRC Inspection Report 50-443/98-08, the staff reviewed the MOV performance trending program established by the licensee at Seabrook. As part of this program, the licensee has developed extensive computerized databases of MOV work history, as-found and as-left static and dynamic diagnostic test data, performance trends, and stem friction coefficient. In this program, the licensee performs qualitative and quantitative trending of MOV performance with a report prepared each year. In NRC Inspection Report 50-443/98-08, the staff determined that the licensee had implemented an effective tracking and trending program that had been visibly used to improve valve performance and reduce valve failures.

In NRC Inspection Report 50-443/98-08, the staff concluded that the licensee had demonstrated the design-basis capability of its safety-related MOVs at Seabrook. With the licensee's ongoing implementation of its MOV testing plans and trending program, no outstanding issues regarding the licensee's GL 89-10 program remain at Seabrook.

5.4 JOG Program on MOV Periodic Verification

In its letter dated April 6, 1998, the licensee committed to implement the JOG Program on MOV Periodic Verification. In a safety evaluation dated October 30, 1997, the NRC staff accepted the JOG program as an industry-wide response to GL 96-05 with certain conditions and limitations. The licensee's commitment to implement the JOG program includes (1) the JOG interim static diagnostic test program, (2) the JOG 5-year dynamic test program, and (3) the JOG long-term periodic test program. The NRC staff considers the commitments by the licensee to implement the JOG program at Seabrook to be an acceptable response to GL 96-05 for age-related valve degradation. The licensee is responsible for reviewing and implementing the limitations and conditions discussed in the NRC safety evaluation dated October 30, 1997, in applying the JOG program at Seabrook. This includes the coordination and feedback of test information obtained from the JOG dynamic testing program. Where the licensee proposes to implement an approach at Seabrook different from the JOG program, the licensee will be expected to notify the NRC and to provide justification for the proposed alternative approach.

In its submittal dated March 18, 1997, the licensee indicated that it is implementing the interim MOV static diagnostic test program based on risk significance and capability margin of each specific MOV using the guidance provided in the JOG program. In its submittal dated April 6, 1998, the licensee described its methodology for ranking MOVs within the scope of GL 96-05 at Seabrook based on their risk significance. During the inspection in September 1998, the NRC

staff reviewed the licensee's approach for MOV risk ranking in comparison to the methodology developed by the Westinghouse Owners Group and the example list of risk-significant MOVs provided by the owners group. Based on the staff review as described in NRC Inspection Report 50-443/98-08, the staff considers the licensee's methodology for risk ranking MOVs at Seabrook to be reasonable. In reviewing the sample list of risk-significant MOVs provided by the owners group, the staff noted that the licensee had lowered the risk ranking of the pressurizer power-operated relief valve (PORV) block valves at Seabrook from medium- to low-risk based on the improvements in MOV performance resulting from implementation of the GL 89-10 program. The staff recommends that the service conditions of the pressurizer PORV block valves be considered when the licensee reviews MOV failure rates during the planned update of the probabilistic risk assessment at Seabrook in 1999.

The JOG program is intended to address most gate, globe and butterfly valves used in safety-related applications in the nuclear power plants of participating licensees. The JOG indicates that each licensee is responsible for addressing any MOVs outside the scope of applicability of the JOG program. In the NRC safety evaluation dated October 30, 1997, the NRC staff specifies that licensees implementing the JOG program must determine any MOVs outside the scope of the JOG program (including service conditions) and justify a separate program for periodic verification of the design-basis capability of those MOVs. In its letter dated April 6, 1998, the licensee stated that MOVs not covered by the JOG program will be tested consistent with its MOV periodic verification program. The NRC staff recognizes that the JOG has selected a broad range of MOVs and conditions for the dynamic testing program. Consequently, the NRC staff expects significant information to be obtained on the performance and potential degradation of safety-related MOVs during the interim static diagnostic test program and the JOG dynamic test program. As the test results are evaluated, the JOG might include or exclude additional MOVs with respect to the scope of its program. Although the test information from the MOVs in the JOG dynamic test program might not be adequate to establish a long-term periodic verification program for each MOV outside the scope of the JOG program, sufficient information should be obtained from the JOG dynamic test program to identify any immediate safety concern for potential valve age-related degradation during the interim period of the JOG program. Therefore, the NRC staff considers it acceptable for the licensee to apply its interim static diagnostic test program to GL 96-05 MOVs that currently might be outside the scope of the JOG program with the feedback of information from the JOG dynamic test program to those MOVs. Upon completion of the JOG dynamic test program and development of the JOG long-term MOV periodic verification criteria, the licensee will be expected to establish a long-term MOV periodic verification program for those MOVs outside the scope of the JOG program by applying information from the JOG program or additional dynamic tests, as necessary.

5.5 Motor Actuator Output

The JOG program focuses on the potential age-related increase in the thrust or torque required to operate valves under their design-basis conditions. In the NRC safety evaluation dated October 30, 1997, on the JOG program, the NRC staff specifies that licensees are responsible for addressing the thrust or torque delivered by the MOV motor actuator and its potential degradation. Although the JOG does not plan to evaluate degradation of motor actuator output, significant information on the output of motor actuators will be obtained through the interim MOV static diagnostic test program and the JOG dynamic test program.

During the inspection in September 1998 at Seabrook, the NRC staff determined that the licensee had established a trending program to monitor MOV motor actuator output and its potential degradation. Parameters obtained by the licensee during MOV static and dynamic testing that can help identify motor actuator output degradation when opening and closing the valve include, as applicable, capability margin, thrust and torque at control switch trip, stem friction coefficient, load sensitive behavior, and motor current. For example, the licensee is monitoring as-left and as-found stem friction coefficient to identify stem lubricant degradation.

In Technical Update 98-01 and its Supplement 1, Limitorque Corporation provided updated guidance for predicting the torque output of its motor actuators. The licensee has addressed this guidance by applying a methodology developed by Commonwealth Edison Company (ComEd) to predict motor actuator output. As noted in NRC Inspection Report 50-443/98-08, the licensee will incorporate any changes to the ComEd methodology that might result from the Limitorque updated guidance.

The NRC staff considers the licensee to have established sufficient means to monitor MOV motor actuator output and its potential degradation.

6.0 CONCLUSION

On the basis of this evaluation, the NRC staff finds that the licensee has established an acceptable program to verify periodically the design-basis capability of the safety-related MOVs at Seabrook. Therefore, the staff concludes that the licensee has adequately addressed the actions requested in GL 96-05. The NRC staff may conduct inspections to verify the implementation of the MOV periodic verification program is in accordance with the licensee's commitments; this NRC safety evaluation; the NRC safety evaluation dated October 30, 1997, on the JOG Program on MOV Periodic Verification; and the NRC safety evaluation dated April 14, 1998, on the Westinghouse Owners Group methodology for ranking MOVs by their risk significance.

Principal Contributor: T. Scarbrough, NRR

Date: December 2, 1998