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REGION I

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Licensee: North Atlantic Energy Service Corporation

Facility: Seabrook Generating Station, Unit 1

Location: Post Office Box 300  
Seabrook, New Hampshire 03874

Inspection Period: September 21-25, 1998

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## EXECUTIVE SUMMARY

Seabrook Generating Station, Unit 1  
NRC Inspection Report 50-443/98-08

The NRC is closing its review of North Atlantic Energy Service Corporation (NAESC) Motor-Operated Valve (MOV) Generic Letter 89-10 program at the Seabrook Station and will review the long-term MOV program under GL 96-05, "Periodic Verification of Design-Basis Capability of Safety-Related Motor-Operated Valves."

- NAESC has demonstrated the design-basis capability of its safety-related MOVs, provided adequate justification for its assumptions of valve factor, stem friction coefficient, and rate of loading in its GL 89-10 program, and undertaken significant margin-improvement modifications to strengthen of their program.
- NAESC implemented an effective tracking and trending program that had been visibly utilized to improve valve performance and reduce valve failures. The scope and use of the tracking and trending program is considered a strength of the MOV Program.
- NAESC's use of up-to-date industry test data to establish more conservative motor actuator capabilities was a notable engineering strength of the GL 89-10 program.

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## Report Details

### III. Engineering

#### E1 **Motor-Operated Valve Program Review (TI 2515/109)**

##### Background

On June 28, 1989, the NRC issued Generic Letter (GL) 89-10, "Safety-Related Motor-Operated Valve Testing and Surveillance," requesting licensees to establish a program to ensure that switch settings for safety-related motor-operated valves (MOVs) were selected, set, and maintained properly. Seven supplements to the GL have been issued to provide additional guidance and clarification. NRC inspections of licensee actions implementing the provisions of the GL and its supplements have been conducted based on the guidance provided in NRC Temporary Instruction 2515/109, "Inspection Requirements for Generic Letter 89-10," which is divided into Part 1, "Program Review," Part 2, "Verification of Program Implementation," and Part 3, "Verification of Program Completion."

The NRC completed the Part 1 and 2 inspections in December 1991 as documented in NRC Inspection Report (IR) 91-81 and in May 1994 as documented in NRC IR 94-11, respectively. The Part 3 inspection (IR 96-11), conducted in the Fall 1996, was unable to closeout the review of Seabrook's GL 89-10 program due to concerns in the justifications for specific assumptions. This inspection was to complete the verification of the Seabrook Station MOV program and to resolve remaining MOV open items.

#### E1.1 MOV Program Scope - (Closed) IFI 96-011-02, Scope Change for Thermal Barrier Cooling Valves

##### a. Inspection Scope (2515-109/92701)

The inspectors reviewed the justification for the removal of the reactor coolant pump thermal barrier component cooling water MOVs (3-inch 1500#, Velan flex-wedge gate valves) from the Seabrook GL 89-10 program. (IFI 50-443/96-11-02.)

##### b. Observations and Findings

The reactor coolant pump thermal barrier component cooling water isolation valves were removed from the GL 89-10 program through Commitment Change Request 96-04. Since Seabrook has a unique cooling system design with an independent loop located inside the containment, the updated final safety analysis report (UFSAR) indicated that these valves are nonsafety-related and not credited in any accident analyses. Further, they do not provide a barrier for radiological release to the environment and are maintained deenergized during normal operation, with their breakers open at the respective motor control centers. Since these valves do not perform an active safety function, they are not required to be included in the GL 89-10 Program.

c. Conclusion

The inspectors did not identify any concerns with the removal of the reactor coolant pump thermal barrier component cooling water isolation valves from the GL 89-10 program.

E1.2 Technical Assumptions - (Closed) IFI 96-11-03, Justify Technical Assumptions Regarding Valve Factor, Stem Friction Coefficient, and Rate of Loading

a. Inspection Scope

IR 96-11 documented concerns regarding the design-basis operability of some untestable MOVs based on insufficiently justified assumptions for valve factor, load sensitive behavior, and stem friction coefficient. The inspectors assessed North Atlantic's justifications for assumptions used in MOV thrust calculations that form the basis for determining the design-basis requirements.

b. Observations and Findings

Valve Factors

In response to the inspection findings in IR 96-11, NAESC prepared Engineering Evaluation (EE) EE-98-028, "Update Of Valve Set Up Adequacy For Rising Stem Motor-Operated Valves That Are Impractical To Dynamically Test," to evaluate the acceptability of technical assumptions for MOVs that are not practical to be dynamically tested under design basis conditions. This evaluation adjusted many valve factors to reflect test data from Seabrook and other sources. NAESC initiated an action report (AR 98-017657) to update EE SS-EV-960019, "Valve Set Up Adequacy For Motor-Operated Valves That Are Impractical To Dynamically Test," to reflect the basis for the adjusted valve factors identified in EE-98-028.

NAESC indicated that the Electric Power Research Institute (EPRI) MOV Performance Prediction Methodology (PPM) will be applied to 10 untestable MOVs to provide additional support for thrust prediction and performance, including blowdown conditions where applicable. The MOVs to be evaluated using the EPRI PPM are:

- RC-V122 and V124 - pressurizer power-operated relief valve (PORV) block valves;
- CBS-V8 and V14 - containment sump isolation valves to the containment building spray (CBS) and residual heat removal (RHR) pumps;
- CS-LCV112D and E - suction isolation valves from the refueling water storage tank (RWST) to the charging pumps; and
- RC-V22, V23, V87 and V88 - RHR suction isolation valves from the reactor coolant system (RCS) hot legs.

### Stem Friction Coefficient

Based upon the evaluation of dynamic and static test data, NAESC increased its stem friction coefficient assumption to 0.20 with the following two exceptions:

- (1) the emergency feedwater (EFW) flow control valves use a stem friction coefficient of 0.15 based on dynamic testing of Rotork actuator valves
- (2) RHR cold leg isolation valve to RCS loops 3 and 4 uses a stem friction coefficient greater than 0.20 based on actual test data

Further, NAESC contracted an independent verification of its test data (Foreign Print 24863, Issue 01, dated 10/6/98). The inspectors found the evaluation and independent verification to be sound and the stem friction coefficient assumptions to be acceptable.

In response to concerns raised in IR 96-11, NAESC has justified its initial preventive maintenance and lubrication intervals of 2 refueling outages or 3 years (whichever is longer) with provisions for reducing these intervals as necessary in Engineering Evaluation EE-98-030, "Evaluation of MOV Preventative Maintenance Frequency for Actuator Inspections." The inspectors concluded that NAESC adequately justified the preventative maintenance and lubrication intervals.

### Rate of Loading

Foreign Print (FP) 24859, "MOV Rate of Loading Evaluation," documents the basis for the evaluation of test data supporting the rate of loading assumptions. The rate of loading assumption for all untestable valves that close under torque switch control is increased by 5% for bias uncertainty and 20% for random uncertainty. The stem friction coefficient of 0.20 (which bounds dynamic test data) accounts for load sensitive behavior in the opening direction and for limit control in the close direction. An exception was the use of a reduced assumption for rate of loading for the EFW flow control valves which is based on specific test data, as described above. Additional dynamic testing to provide further support for the rate of loading assumptions is planned for Refueling Outage 06. The inspectors considered the rate of loading assumptions to be acceptable.

### Margin

The inspectors reviewed EE-98-028, which identified the margin and available valve factor for gate and globe valves not dynamically tested in their safety direction, sample dynamic test information, which demonstrated the capability of dynamically tested gate and globe valves at Seabrook, and EE-98-029, "Evaluation of NRC Generic Letter 89-10 Motor Operated Butterfly Valve Capability," which NAESC's demonstrates margin based on dynamic test data from 23 out of 28 butterfly valves. The inspectors considered NAESC's demonstration of margin for its GL 89-10 MOVs to be acceptable.

In IR 96-11, the NRC noted the licensee's commitment to dynamically test 15 additional MOVs in order to obtain more site-specific performance data. The inspectors found the licensee to be implementing those testing plans. Dynamic MOV tests were conducted during RFO5 and additional tests are scheduled for RFO6. In addition to testing, NAESC has implemented modification to improve the design basis capabilities of several MOVs. Descriptions of the modifications are documented in Design Change Request (DCR) 97-021, "RFO5 Motor-Operated Valve Design Changes," and DCR 98-0009, "RFO6 Motor-Operated Valve Design Changes."

c. Conclusions

The inspectors concluded that NAESC has demonstrated the design-basis capability of its safety-related MOVs and provided adequate justification for its assumptions of valve factor, stem friction coefficient, and rate of loading in its GL 89-10 program. Inspection Follow-up Item 50-443/96-11-03 is closed. NAESC has undertaken significant margin-improvement modifications to strengthen of their MOV Program.

E1.3 MOV Performance Trending

a. Inspection Scope

The inspectors reviewed Section 3.10 "Trending" of procedure ES 1850.003, "Motor Operated Valve Performance Monitoring," to assess NAESC's program for tracking and trending of MOV failures and performance.

b. Observations and Findings

Procedure ES 1850.003 required both failure trending and performance trending of GL 89-10 MOVs. Specifically, Section 3.10.1, "MOV Failure Analysis Trending," required MOV failures that result in declaring the component inoperable be evaluated and documented in accordance with the Seabrook Station Operating Experience Manual. These failures are trended on an annual basis and documented in systems' annual performance reports. MOV failure trending data had been collected since 1988 and has shown significant improvement in demand failures of safety-related MOVs, reducing the number of failures from 18 per year in 1988 to one in 1998.

The purpose of MOV performance trending, as documented in Section 3.10.6 of procedure ES 1850.003, is to ensure that switch settings remain adequate throughout the life of the plant. The scope of the trending program has been adequate to detect meaningful trends in valve performance. The running load data gathered on the Fisher Controls butterfly valves was used to justify replacing the packing gland followers during RFO3 and the running load data gathered since the replacement has shown marked improvement.

c. Conclusions

NAESC implemented an effective tracking and trending program that had been visibly utilized to improve valve performance and reduce valve failures. The scope and use of the tracking and trending program is considered a strength of the MOV Program.

**E7 Quality Assurance in Engineering Activities**

**E7.1 Independent Assessment**

The inspectors reviewed the results of independent assessments conducted by the Nuclear Safety and Oversight Group during Seabrook's RFO4 and RFO5, and the actions taken to address issues identified. The review included the following documents and associated findings followup:

- Quality Assurance Surveillance Report (QASR) #95-00059, Engineering Activities completed in support of RFO4
- QASR # 97-0028, Perform Surveillance of MOV Differential Pressure Test Analysis process in support of RFO5
- "Review of Modification Package DCR 97-021," dated May 22, 1997

The inspectors concluded that the Nuclear Safety and Oversight Group's assessment was technically detailed and the MOV personnel provided adequate follow-up.

**E8 Miscellaneous Engineering Issues**

**E8.1 (Closed) P21 50-443/93-051 & 93-061: Limitorque Declutch System Anomaly**

The inspectors reviewed NAESC's response to the 10 CFR Part 21 notification submitted by the Limitorque Corporation on December 7, 1992. Limitorque tested the actuators under acceleration conditions of 7.6, 4.6, and 4.8 g and discovered that a potential exists for a declutching malfunction to occur during sine dwell tests in the vertical axis of the operator, covering the range of frequencies between 10 and 21 Hertz. Washington Public Power Supply System performed additional seismic testing on the actuators which indicated that the declutching threshold is 4.8 g. No declutching occurred at multi frequency tests (in the range of 10 to 21 Hertz) below 4.8 g.

The safe shutdown earthquake for the Seabrook Station had a peak acceleration level of 0.25 g. The peak acceleration level for the operating basis earthquake was 0.13 g. The magnitude of the seismic event required to produce the declutching anomaly is greater than the qualification magnitude of the earthquake conditions established for the Seabrook Station. The inspectors concluded that NAESC appropriately determined that this Part 21 notification did not apply at Seabrook.



## E8.2 (Closed) P21 50-443/93-060: Limitorque Housing Cover Screws

The inspectors reviewed the 10 CFR Part 21 notifications dated October 1992, and November 23, 1992, regarding Limitorque SBD-1 housing covers and mounting bolts. By letter dated November 23, 1992, Limitorque excluded the SB-1 actuators. Thread engagement of the screws for the housing cover only allowed for an overload factor of the actuator of 2.24 times the thrust rating, while Limitorque permitted a stall thrust of 2.5 times the Limitorque rating for one time only. The recommended corrective action was for licensees to determine if SBD-1 actuators could develop stall thrusts above the 2.24 times rating in particular applications and, if so, replace the existing 6.5 inch screws with screws 7.0 inch screws.

NAESC determined that there were no affected SBD-1 actuators at Unit 1 and any actuator in storage or in the unfinished portions of Unit 2 will be reviewed under procedure PM5.4, "Obtaining U2 Materials," which establishes guidance governing the practice of obtaining materials from Unit 2 for use in Unit 1. After reviewing the unit 1 valve list and Procedure PM5.4, the inspectors concluded that NAESC appropriately determined that this Part 21 notification of potential defective housing cover mounting screws for Limitorque size SBD-1 motor operators did not affect the MOVs in use at Seabrook.

## E8.3 Degraded Voltage Update

NAESC re-evaluated the degraded voltage capability of its safety-related MOVs beginning at the degraded grid relay setpoint and revised Calculation 9763-3-ED-00-02-F (Revision 6, February 20, 1998), "Voltage Regulation," which performed voltage drop studies for safety-related MOVs at the degraded bus voltage setpoints. NAESC justified the degraded voltage evaluation for specific MOVs in EE-98-028. The inspectors reviewed the calculation and evaluation and concluded the actions taken were appropriate and the degraded voltage calculations were acceptable.

## E8.4 Generic Letter 96-05, "Periodic Verification of Design-basis Capability of Safety-Related Motor-Operated Valves"

In a letter dated April 8, 1998, NAESC updated its response to GL 96-05, "Periodic Verification of Design-Basis Capability of Safety-Related Motor-Operated Valves." As discussed in that letter, NAESC is participating in the Joint Owners Group (JOG) Program on MOV Periodic Verification. NAESC is following the JOG program described in the Westinghouse Owners Group Topical Report MPR-1807 (Revision 2, July 1997), "Joint BWR, Westinghouse and Combustion Engineering Owners' Group Program on Motor-Operated Valve (MOV) Periodic Verification," and the NRC safety evaluation on the JOG program dated October 30, 1997.

The scope of NAESC's long-term MOV program is consistent with the recommendations of GL 96-05. As described in an internal NAESC memorandum dated October 1, 1998, NAESC performed risk ranking of its safety-related MOVs and evaluated its method to ensure consistency with the methodology described in Westinghouse Owners Group Engineering Report V-EC-1658, "Risk Ranking

Approach for Motor-Operated Valves in Response to Generic Letter 96-05," and the limitations and conditions in the NRC Safety Evaluation dated April 14, 1998. The inspectors discussed the MOV risk ranking methodology applied at Seabrook with NAESC and NRR probabilistic risk assessment (PRA) staff. The inspectors noted that NAESC had lowered the risk ranking of the pressurizer PORV block valves MOVs RC-V122 and V124 from the Medium to the Low risk category based on the improvements in MOV performance resulting from implementation of the GL 89-10 program.

NAESC has established a program for trending of motor actuator output and has incorporated the guidance in Limitorque Technical Update 98-01 and its Supplement 1 by applying a Commonwealth Edison Company (ComEd) methodology to evaluate MOV motor actuator output. NAESC indicated that any changes to the ComEd methodology resulting from the new guidance on motor actuator output will be addressed in its MOV program. NAESC's use of up-to-date industry test data to establish more conservative motor actuator capabilities was a notable engineering strength of the GL 89-10 program.

Within the scope of the review performed on site, the inspectors concluded that the actions to date by NAESC were appropriate, and no technical concerns were identified. The NRC Office of Nuclear Reactor Regulation (NRR) will use this information in preparing a safety evaluation on NAESC's response to GL 96-05.

E8.5 Generic Letter 95-07, "Pressure Locking and Thermal Binding of Safety-Related Power-Operated Gate Valves"

The inspectors reviewed NAESC's actions to address pressure locking and thermal binding of safety-related gate valves. The following documents were reviewed:

- Operations procedure OX1406.02, "Containment Spray Pump and Valve Quarterly Operability & 18 Month Position Indication Testing"
- Operations procedure OS1000.04, "Plant Cooldown from Hot Standby to Cold Shutdown"
- DCR 95-023, "Valve Modifications to Prevent Pressure Locking"
- MMOD 95-509, "CBS Sump Isolation Valve Modifications"

An engineering evaluation performed by NAESC identified 14 valves that were subject to pressure locking and/or thermal binding. Modifications were performed on 10 valves to alleviate the potential for problems. For the remaining four valves, operating procedures were revised.

NAESC determined that valves RC-V22/V23/V87/V88, RH-V32/V70, and SI-V77/V102 were potentially subject to liquid entrapment pressure locking. Valves RC-V22/V23/V87/V88, and RH-V32/V70 were also potentially subject to differential pressure locking. The design changes described in DCR 95-023 provide a vent path from the bonnet cavity of these valves back to the process fluid line, via the valve stem leakoff connection.

Containment sump isolation valves CBS-V8 and CBS-V14 had also been identified by NAESC as susceptible to pressure locking. It was postulated that if liquid became entrapped in the valve bonnet and was subsequently heated due to the increased temperature following a loss of coolant accident, the valve could be prevented from opening due to excessive bonnet pressure. Modification MMOD 95-509 provided a vent path for the bonnet pressure to the upstream piping to ensure the continued capability of these valves.

Operation procedure OX1406.02 noted that valve CBS-V11 had been identified as being susceptible to pressure locking and thermal binding. Operators were directed in the procedure to cycle the valve following a containment building sump pump run to eliminate the potential for the phenomena to occur.

Precaution 3.19 of operating procedure OS1000.04 warns the operators that the power-operated relief valve (PORV) block valves, RC-V122 and RC-V124, are susceptible to thermal binding. It states that if a PORV block valve is closed at temperature and a subsequent cooldown is undertaken, the block valve is considered to be inoperable.

Within the scope of the review performed on site, the inspectors found the susceptible valves were properly screened, the modifications performed were appropriate, the technical approaches (including calculations) were sound, and no valve functionality problems were identified. The NRR will use this information in preparing a safety evaluation on NAESC's response to GL 95-07.

#### E8.6 MOV Implementation Programs Year 2000 (Y2K) Readiness

The NRC issued Information Notice 98-30, "Effect of the Year 2000 Computer Problem on NRC Licensees and Certificate Holders," to remind all licensees of the potential problems their computer systems and software may encounter as a result of the change to the year 2000. NAESC established a Y2K readiness team to review the computer systems and software for Y2K readiness. The inspectors verified that the MOV diagnostic and trending software were considered by the Seabrook Y2K readiness team and a schedule was in place for those software applications not Y2K compliant.

#### E8.7 Facility Walkdown

The inspectors completed a facility walkdown and surveyed MOVs for position of actuators, potential grease leakage, plugging of the "T" drains in the motor casing, and general facility housekeeping. Two items were identified requiring NAESC action. Work Request 98-14851 was generated to determine the source of the grease leak in the actuator of service water valve 1-SW-V-20, and an Adverse Condition Report was generated and completed to address improperly installed insulation blankets on the yoke structures of valves 1-AS-V-176 and 176. Upon notification, NAESC took appropriate action to address concerns.

V. Management Meetings**X1 Exit Meeting**

The inspectors presented the inspection results to members of licensee management, following the conclusion of the inspection on September 25, 1998. NAESC acknowledged the findings presented. Based on findings from this and previous inspections and the identified MOV actions to be performed by NAESC, NRC is closing its review of the GL 89-10 program at Seabrook and will review NAESC's long-term MOV program under GL 96-05.

## PARTIAL LIST OF PERSONS CONTACTED

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## INSPECTION PROCEDURES USED

TI-2515/109 Inspection Requirements for Generic Letter 89-10, "Safety-Related Motor-Operated Valve Testing and Surveillance"  
 IP 92701 Follow-up

## ITEMS OPENED, CLOSED, AND DISCUSSED

Closed

50-443/93-051	P21	Limitorque Declutch Anomaly
50-443/93-060	P21	Limitorque Housing Cover Screws
50-443/93-061	P21	Limitorque Declutch Anomaly
50-443/96-011-02	IFI	Review MOV Program Scope Change for Thermal Barrier Cooling Valves
50-443/96-011-03	IFI	Justify Technical Assumptions regarding Valve Factor, Stem Friction Coefficient, and Rate of Loading

## PARTIAL LIST OF DOCUMENTS REVIEWED

- Commitment Change Request 96-04, "Deletion of Thermal Barrier Loop Motor Operated Valves from NRC Generic Letter 89-10 Test Program," dated 9-23-96
- DCR 95-023, "Valve Modifications to Prevent Pressure Locking,"
- DCR 97-0021, Design Change Notice 12, "RF05 Motor-Operated Valve Design Changes," dated 10/97
- EE 98-028, "Update Of Valve Set Up Adequacy For Rising Stem Motor-Operated Valves That Are Impractical To Dynamically Test", Revision 0, dated 9/98
- EE-98-029, "Evaluation of NRC Generic Letter 89-10 Motor Operated Butterfly Valve Capability," Revision 1, dated 9/98.
- EE-98-030, "Evaluation of MOV Preventive Maintenance Frequency for Actuator Inspections," Revision 00, dated 9/98.
- ES 1859.003, "Motor Operated Valve Performance Monitoring," Rev. 02, dated 3/24/97
- Foreign Print 24859, "MOV Rate of Loading Evaluation," dated 9/98.
- Foreign Print 24863, "Seabrook MOV Stem Friction Data," dated 10/98.
- MMOD 95-509, "CBS Sump Isolation Valve Modifications"
- "Nuclear Safety Oversight Integrated Refueling Outage Report (OR05)," dated 7/97
- Operations procedure OX1406.02, "Containment Spray Pump and Valve Quarterly Operability & 18 Month Position Indication Testing," Rev. 09 Chg. 04
- Operations procedure OS1000.04, "Plant Cooledown from Hot Standby to Cold Shutdown," Rev. 06 Chg. 05
- PM5.4, "Obtaining U2 Materials," Rev. 17 Chg. 01
- Quality Assurance Surveillance Report 97-0028, "Perform Surveillance of Motor Operated Valve Differential Pressure Test Analysis process in support of OR05," dated 7/11/97
- Quality Assurance Surveillance Report 95-00059, "Engineering Activities completed in support of OR04"
- "Review of Modification Package DCR 97-021," performed by Duke Engineering & Services, dated 5/22/97
- SE-EV-960019, "Valve Set Up Adequacy for Motor-Operated Valves that are Impractical to Dynamically Test," Revision 1, dated 10/96
- SE-EV-96-0020, "Evaluation of Differential Pressure Conditions for Motor-Operated Valves," Revision 0, dated 9/96

## LIST OF ACRONYMS

CBS	containment building spray
ComEd	Commonwealth Edison Company
CS	charging system
DCR	design change request
EE	engineering evaluation
EFW	Emergency Feedwater
EPRI	Electric Power Research Institute
<i>g</i>	acceleration of gravity (you remember, 9.81 m/sec <sup>2</sup> )
GL	Generic Letter
IFI	Inspection Follow-up Item
IR	Inspection Report
MOV	Motor-Operated Valve
NAESC	North Atlantic Energy Service Corporation
P21	10 CFR Part 21
PDR	Public Document Room
PORV	power-operated relief valve
PPM	MOV Performance Prediction Methodology
RFO	refueling outage
RCS	reactor coolant system
RHR	residual heat removal
RWST	refueling water storage tank
UFSAR	Updated Final Safety Analysis Report
Y2K	Year 2000