U. S. NUCLEAR REGULATORY COMMISSION
REGION I

Docket No.	50-336
License No.	DPR-65
Report No.	50-336/98-04
Licensee:	Northeast Nuclear Energy Company
Facility:	Millstone Unit 2
Dates:	September 14-18, 1998
Inspectors:	D. Dempsey, Reactor Engineer, DRS
Accompanying Personnel:	M. Holbrook, NRC Contractor, INEEL
Approved By:	Eugene M. Kelly, Chief Systems Engineering Branch Division of Reactor Safety

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EXECUTIVE SUMMARY

Millstone Unit 2
NRC Motor-Operated Valve Inspection 50-336/98-04

Based on the results of this inspection, the NRC is closing its review of the Generic Letter (GL) 89-10, "Safety-Related Motor-Operated Valve Testing and Surveillance," program at Millstone Unit 2.

- NNECo's use of the EPRI PPM to establish MOV thrust requirements was an acceptable approach to calculate the design basis thrust requirements for a majority of the MOVs at Millstone 2. Alternate test plans clearly identified valves that require additional work to fully justify current MOV switch settings. NNECo established adequate plans to resolve several technical issues. Based on the items that are being tracked by NNECo's commitment action tracking program, the inspectors considered the ATPs to be acceptable for closure of the NRC's review of the Millstone 2 GL 89-10 program. (Section E1.1)

- Corrective actions for outstanding MOV technical issues and previous GL 89-10 program-related violations were acceptable. Significant items lists (SIL) items 20.2 through 20.6 were closed. SIL items 20.1 and 20.7, pertaining to completion of certain pre-startup MOV tests and resolution of pressure locking for the containment sump isolation valves, respectively, remained open. (Sections E8.1 through E8.10)

Report Details

III. Engineering

E1. Motor-Operated Valve Program Review (TI 2515/109) (SIL Item 20)

E1.1 Justification of MOV Program Assumptions

a. Inspection Scope

On June 28, 1989, the NRC issued Generic Letter (GL) 89-10, "Safety-Related Motor-Operated Valve Testing and Surveillance," which requested 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 information and guidance on the development of programs. Previous inspections at Millstone Unit 2 (MP2) were conducted based on guidance contained in NRC Temporary Instruction 2515/109, "Inspection Requirements for Generic Letter 89-10."

The purposes of this inspection were to: (1) Complete the NRC's review of the MP2 GL 89-10 program, and (2) Determine the MOV program's acceptability for supporting safe plant restart in accordance with significant items list (SIL) item 20. The review included Northeast Nuclear Energy Company's (NNECO) "Millstone Motor Operated Valve Program Manual," and supporting documents that formalized the completion of the MOV program at MP2. The inspectors also reviewed selected calculations that established MOV thrust requirements, and engineering studies and evaluations pertaining to valve factors, load sensitive behavior, stem friction coefficients, and aging degradation, focusing on the valves listed below. The documents reviewed during the inspection are listed at the end of this inspection report.

2-CS-16.1A	Containment sump suction isolation
2-MS-65A	No. 1 steam generator main steam isolation valve bypass
2-RB30.1A	Reactor building component cooling water supply containment isolation
2-RB-37.2A	Reactor building component cooling water return containment isolation
2-RC-403	Pressurizer power-operated relief valve (PORV) block
2-RC-405	Pressurizer power-operated relief valve (PORV) block
2-SI-616	High pressure safety injection header to loop 1A injection
2-SI-624	No. 2 safety injection tank outlet
2-SI-627	High pressure safety injection header to loop 1B injection
2-SI-636	High pressure safety injection header to loop 2A injection
2-SI-651	Shutdown cooling suction header containment isolation

b. Observations and Findings

General

NNECo significantly revised Millstone 2's GL 89-10 program to incorporate results obtained from the Electric Power Research Institute's (EPRI) MOV performance prediction model (PPM). While all but one of the MOVs at MP2 were set up using the EPRI methodology, the PPM was not applicable directly to all of the valves. Therefore, alternate approaches (referred to as alternate test plans - ATPs) were applied to those valves. ATP valves were discussed in calculation 89-078-02570M2, "MP2 MOV Alternate Test Plans and Differential Pressure Test Selection Methodology."

MOV Thrust Requirements

The MOV population at MP consisted mostly of Velan gate and unbalanced plug globe valves. NNECo used the PPM to establish the design-basis thrust requirements for all but one of the 52 MOVs in its GL 89-10 program, including valves that otherwise could have been dynamically tested. However, the EPRI methodology was not directly applicable to four of the valves. Thus the following ATPs were developed to resolve long-term PPM applicability issues:

High Temperature/Compressible Flow for Globe Valves: The NRC safety evaluation (SE) of EPRI topical report TR-103237, "EPRI MOV Performance Prediction Program," states that the globe valve model is not applicable to: (1) fluids that exceed 150°F under pumped-flow conditions, and (2) compressible fluid flow. Steam generator main steam isolation valve bypass valves 2-MS-65A and 2-MS-65B are required to operate under high temperature compressible fluid conditions and are not practicable to test dynamically. Therefore, PPM results are not directly applicable to these valves. NNECo considered the PPM results to be best available data, and committed to test dynamically a duplicate valve under steam blowdown conditions. Action Request (A/R) 98017292-02 was opened to track completion of this testing.

Balanced Plug Globe Valve: The PPM does not apply to auxiliary feedwater pump turbine trip throttle valve 2-MS-464 because the balanced plug globe valve design was not included in the EPRI test program. NNECo committed to dynamically test this valve at near design-basis conditions during plant startup. The test is tracked by A/R 98007513. In addition, the valve will be dynamically retested during the next refueling outage to verify that the selected valve factor remains bounding and to assess whether subsequent dynamic testing will be needed. This activity is being tracked under A/R 98017292-04.

Stainless on Stainless Guide Material for Temperatures > 100°F and Inverted Guides: Charging header containment isolation valve 2-CH-429 is a 2-inch solid-wedge Vegan gate valve that is constructed with stainless steel disc guide tabs that slide in a stainless steel guide slot that is part of the valve body (commonly known as "inverted guides"). Fluid temperatures for this valve would exceed 100°F. The

P.M. is not directly applicable because this guide material combination was not tested under conditions exceeding 100°F, and valves with inverted guides were not included in PERI's test program. NNECo noted that this valve does not experience system flow under accident conditions and that differential pressure will not buildup until the valve disc is sliding on the downstream seating surface. Thus, the guides would not experience significant loading. Because the disc and seat ring surfaces are overlaid with Stellite 6, the P.M. would apply when the disc is sliding on the seat ring. Based on these observations, the licensee decided that use of the P.M. was fully justified and that no further actions were required to address the guide configuration questions. However, the inspectors noted that 2-CH-429 is operated during normal operations under significant flow conditions when fluid temperatures exceed 100°F. While the normal operating differential pressure of 624 psid is significantly less than the accident closing pressure of 2575 psid, it still would result in significant loading of the guide surfaces. Therefore, it will be necessary to monitor industry testing (e.g., the Joint Owners Group (JOG) periodic verification program or other MOV testing programs) in the long term to verify valve performance. NNECo initiated A/R 98017292-05 to track resolution of these issues.

Stellite 21 on Stellite 6 Seat Material: PERI's test program did not validate the P.M. for valves which have Stellite 21 on Stellite 6 seating surfaces. This would affect feedwater pump discharge valves 2-FW-38A and 2-FW-38B and feed regulating valve block valves 2-FW-42A and 2-FW-42B. It is impracticable to dynamically test these valves under the conditions needed to validate use of the P.M.. For the short term, the licensee plans to evaluate available industry data to compare the performance of Stellite 21 on Stellite 6 to industry test data for Stellite 6 on Stellite 6. If data are not available, NNECo intends to monitor industry test efforts as part of its periodic verification program. These actions are being tracked by A/R 98017292-03.

- Unwedging: The NRC SE includes a condition that P.M. users compare unwedging data to the P.M. hand-calculation method for predicting unwedging thrust requirements. The comparison for five MP2 MOVs was documented in calculation 89-078-0266M2, "MP2 Static and Dynamic Test Data Analysis." NNECo found that the actual dynamic unseating loads for all five of the valves were less than the PERI-predicted cracking loads. Valve-specific test information resolved a potential concern with the predicted unwedging thrust requirement for valve 2-CH-429, which exceeded the actuator's open capability. The testing determined that the actual cracking loads for 2-CH-429 were much lower than predicted and well within the actuator's open direction capability.

  NNECo used the P.M. hand calculations to establish the minimum thrust requirements for eight Anchor/Darling double-disc gate valves at MP2. PERI's methodology for Anchor Darling double disc gate valves determined that the wedge orientation affects the thrust requirements when wedging is required. Having the lower wedge downstream is the preferred direction; if the lower wedge is upstream, the thrust requirements are higher. Inspection Report 50-423/98-82 documented that NNECo was unable to demonstrate the wedge

orientation of double-disc gate valves at Millstone 3. Corrective action No. 9 of Condition Report M3-98-0792 required verification of the proper orientation of all double-disc gate valves in MP2's GL 89-10 program. As of this inspection, NNECo had verified the wedge orientation of only containment sump header isolation valves 2-CS-16.1A and 2-CS-16.1B. However, the target thrust calculations for all eight of the Anchor/Darling double-disc gate valves were calculated assuming the worst-case disc orientation, which is conservative under all conditions. The inspectors considered this approach to be acceptable for GL 89-10 program closure.

Load Sensitive Behavior

NNECO's load sensitive behavior assumptions include a bias margin of 5.6% and a random margin of 26.4%, which is combined with other random errors using the square-root sum of the squares methodology. The licensee based the assumptions on results published by PERI. NNECO also performed a statistical analysis of in-plant testing that supported the use of PERI's load sensitive behavior values. The inspectors noted that the licensee decision to use the P.M. in lieu of dynamic testing resulted in a limited amount of data available to support its technical assumptions. The licensee will need to verify that its load sensitive behavior analysis remains bounding as future in-plant dynamic tests are performed. Section 6.2.1.1 of the Unit 2 ATP includes a requirement to incorporate the results of any future globe valve dynamic tests into existing load sensitive behavior databases, and to determine if any actions are required based on this additional data.

Stem Friction Coefficient

NNECO assumed a design stem friction coefficient assumption of 0.20 based on a statistical analysis of site-specific closing test data that resulted in a friction coefficient of 0.18 at a 95% confidence level. The inspectors noted that only a limited amount of data were available to support Unit 2's stem friction coefficient assumption. NNECo will need to augment its stem friction coefficient analysis as future in-plant dynamic tests are performed to ensure that its design assumption remains bounding.

The target thrust calculations for feedwater block valves 2-FW-38A, 2-FW-42A, and 2-FW-42B did not use the design stem friction coefficient assumption of 0.20. Rather, the thrust calculations used assumed values that ranged from 0.173 to 0.18. The Millstone 2 ATP requires that the stem friction coefficients for these valves be verified by testing prior to plant startup. This action is being tracked by A/R 98010538.

Limitorque Actuator Efficiencies

Limitorque Corporation recently issued Technical Update 98-01 (including Supplement 1), which provides guidance for determining the output of Limitorque actuators. This guidance stipulated the use of actuator pullout efficiencies and application factors of 0.90. Special configurations needing additional analysis were also identified, including: (1) 25 ft-lb, 3600 rpm, frame 56 motors; (2) 60 ft-lb, 1800 rpm, frame 56 motors; (3) SMB-1 actuators with a 66:1 worm gear ratio; and (4) all motors that operate at less than 70% of rated voltage. Condition Report M2-98-2247 was issued by the licensee to review this guidance and to assess the impact on the Millstone 2 MOV program. Since MP2's target thrust calculations already used actuator pullout efficiencies and 0.90 application factors, NNECo's review focused on identifying any MOVs that would be classified as special applications. Based on this review, the following actions were identified:

- Nine valves fell into the 25 ft-lb/3600 rpm/frame 56 or 60 ft-lb/1800 rpm/frame 56 classifications. All of these actuator motors have been tested on a dynamometer to determine their capabilities at reduced voltages. The motor test data provided conservative torque values which were used in the associated target thrust calculations. Based on the use of these tests, the NNECo considered this issue to be resolved.

- Five valves have SMB-1 actuators with 66:1 worm gear ratios. For these valves, the licensee applied information evaluated by Commonwealth Edison (NUREG/CP-0152, "Evaluation of Existing PERI and INEL Test Data to Determine the Worm to Worm Gear Coefficient of Friction in Limitorque Actuators," I. Garza, ComEd), which indicated that it was necessary to derate the published SMB-1 pullout efficiency for 66:1 worm gear ratios by 10%. This reduced the published pullout efficiency from 0.35 to 0.315. The inspectors verified that the reduced efficiencies were used in the current target thrust calculations for these MOVs. NNECo also issued A/R 98017292-01 to track any additional industry developments related to actuator efficiencies associated with SMB-1 actuators with 66:1 worm gear ratios.

- Shutdown cooling suction header containment isolation valve 2-SI-651 must operate with a worst-case degraded voltage of 64%. NNECo dynamometer tested the motor at 63% of rated voltage and found the output torque to be greater than that assumed in the target thrust calculations. Therefore, this MOV met design requirements.

c. Conclusions

NNECo's use of the PERI P.M. to establish MOV thrust requirements was an acceptable approach to calculate the design basis thrust requirements for a majority of the MOVs at Millstone 2. Alternate test plans clearly identified valves that require additional work to fully justify current MOV switch settings. NNECo established adequate plans to resolve several technical issues, including: (1) high temperature/compressible flow for globe valves, (2) thrust requirements for balanced plug globe valves, (3) applicability of the P.M. to valves with stainless-on-stainless guides with temperatures >100°F, (4) applicability of the P.M. to valves with inverted guides, and (5) applicability of the P.M. to valves with Stellite 21 on Stellite 6 seat material. Based on the items that are being tracked by NNECo's commitment action tracking program, the inspectors considered the ATPs to be acceptable for closure of the NRC's review of the Millstone 2 GL 89-10 program.

E8. Miscellaneous Engineering Issues

E8.1 (Closed) EEI 50-336/96-05-09(E1 96-183-04063) and SIL Item 20.3: Improper consideration of negative load sensitive behavior

Inspection Report 50-245, 336, 423/96-05 documented several instances in which NNECo failed to follow procedures for evaluation of negative load sensitive behavior. Section 3.2.7 of Project Instruction (PI) 13, "Evaluation of Dynamic Test Results," cautioned against the use of negative load sensitive behavior to increase actuator capability at control switch trip because "negative" load sensitive behavior is not well understood and testing has not been performed to ensure that this additional thrust is always available under dynamic conditions. Contrary to this guidance, several dynamic test evaluations of valve 2-MS-202 took credit for a measured -13.95% load sensitive behavior to determine that the valve was operable. Upon further review, the licensee also found that negative load sensitive behavior had been credited for an additional 23 MOVs. These actions were a violation of the test control requirements of 10 CFR 50, Appendix B, Criterion XI. Corrective action included revising PI-13 calculation instructions to preclude the use of negative load sensitive behavior. The inspectors verified that the instructions were in place and were being followed.

E8.2 (Closed) Followup Item 50-336/95-01-01 Item 2 and SIL Item 20.1: Complete load sensitive behavior and stem friction coefficient analyses

NNECo had not completed its technical justifications for load sensitive behavior and stem friction coefficient. The inspectors reviewed calculation 89-078-0266M2, "MP2 Static and Dynamic Test Data Analysis," in which load sensitive behavior and stem friction coefficients of MP2 MOVs are analyzed. As discussed in Section E1.1 of this report, additional testing will be performed prior to plant startup to augment this calculation. This inspector follow up item is considered closed based on the licensee's current analyses. While this followup item is closed, SIL item 20.1 remains open pending completion of the licensee's pre-startup tests of valves 2-FW-

44, 2-MS-201, and 2-MS-202 for rate of loading and dynamic stem friction coefficient, and valves 2-FW-38A, 2-FW-42A, and 2-FW-42B for static stem friction coefficient. The licensee agreed to summarize the results of the tests in a letter to the NRC.

E8.3 (Closed) Followup Item 50-336/95-01-01 Item 6: Justify all non-dynamically tested MOV valve factors (SIL Item 20.1)

NNECo was applying a generic 0.90 valve factor in the thrust calculations of some non-dynamically tested MOVs. The licensee currently uses the PERI P.M. as the primary method to establish MOV thrust requirements. However, the P.M. is not directly applicable to all of the MOVs at MP2. As discussed in Section E1.1 of this report, NNECo developed alternate test plans that require additional dynamic testing to resolve P.M. applicability issues involving: (1) high temperature/compressible flow for globe valves, and (2) balanced plug globe valve designs. This followup item is closed based on the specifics contained in the licensee's ATPs. However, SIL item 20.1 will remain open pending completion of a dynamic test of valve 2-MS-464 to verify the valve factor (1.1) that is assumed in the current target thrust calculation. NNECo agreed to inform the NRC in a letter of the results of the dynamic test.

E8.4 (Closed) Followup Item 50-336/97-203-16: Power-operated relief valve block valve design basis differential pressure

Pressurizer power-operated relief valve (PORV) block valves 2-RC-403 and 2-RC-405 have a safety function to close to isolate a leaking or stuck open PORV. Based on memorandum NE-92-SAB-380, dated November 5, 1992, NNECo assumed a reactor coolant system (RCS) pressure of 2250 psig to calculate the valves' minimum thrust requirements. This pressure was qualitatively derived by balancing the RCS depressurization rate with a stuck open PORV against RCS makeup capability and system repressurization as the block valves close. The NRC considered the memorandum to be an inadequate basis for design. The current revision of calculation 89-078-890ES, "Millstone Unit 2 MOV System and Functional Design Basis Review," continues to use this differential pressure value. However, calculation 89-078-01682M2, "Evaluation of Stem Thrust Requirements for 2-RC-403 and 2-RC-405," dated January 21, 1998, assumed a maximum differential pressure of 2385 psig to calculate the closing thrust requirements. This higher value was based on the "maximum operating area pressure" shown on the RCS pressure/temperature limits curve in the emergency operating procedures.

In a recent GL 89-10 program assessment conducted by the Nuclear Oversight Group, the licensee questioned the technical basis of the new differential assumption, and initiated condition report (CR) M2-98-2449 to resolve the issue. During the inspection, the licensee stated that it planned to change the current Unit 2 MOV design approach, which is based on procedure requirements and limits, and use the philosophy at Unit 3, which assumes the maximum possible system pressure. This effort is intended to decouple design basis calculations from

changeable (and less limiting) operating procedures. As a result, the new PORV block valve differential pressure will be 2560 psig (pressurizer Code safety valve setting plus lift tolerance). The inspectors determined that valves 2-RC-403 and 2-RC-405 were capable of closing against the proposed differential pressure.

During review of calculation 89-078-01702M2, "Target Thrust/Torque Calculation for 2-RC-403, 2-RC-405," the inspectors noted that an incorrect motor-actuator efficiency (0.4 versus 0.35) was applied to calculate the capability of valve 2-RC-405. NNECo failed to change the efficiency following a design change that modified the motor-actuator gear set. The error did not affect valve operability adversely, and the licensee initiated CR M2-98-2774 to correct the calculation. Failure to update the calculation to reflect the valve modification was contrary to NRC design control requirements. However, this failure constitutes a violation of minor significance and is not subject to formal enforcement action.

E8.5 (Closed) Unresolved Item 50-336/96-05-10: Update station battery load calculations and Updated Final Safety Analysis Report table

This item involved electrical calculations pertaining to auxiliary feedwater pump turbine trip throttle valve 2-SV-4188 (now valve 2-MS-464), including: (1) use of starting current versus locked rotor current to calculate minimum actuator motor terminal voltage; and (2) an apparent inconsistency among the minimum motor terminal voltage calculation, the associated station battery load profile, and the load profile shown in Table 8.5-1 of the Updated Final Safety Analysis Report (UFSAR). NNECo currently uses locked rotor current to calculate MOV minimum terminal voltages. Change 31, Revision 0 of calculation PA89-078-272E2, "MP2 MOV Voltage Drop Calculation," assumed a locked rotor current of 23 amperes derived from the vendor's motor curve to calculate a worst case motor terminal voltage of 65 vdc (52% of rated voltage) for valve 2-MS-464. NNECo's evaluation concluded that the motor would function properly at this low terminal voltage. The calculation's assumption and method was consistent with industry practice and GL 89-10 recommendations.

The Millstone 2 station battery load profiles are being updated to reflect GL 89-10 program changes as well as station blackout effects. NNECo is tracking the associated update of UFSAR Table 8.5-1 as a Mode 4 startup item under Action Request 97016554 1. The licensee's actions addressed the questions posed by this item acceptably No violations of NRC requirements were identified.

E8.6 (Closed) Violation 50-336/97-203-17: Thermal binding of turbine-driven auxiliary feedwater pump steam admission valves

In 1995 NNECo concluded that normally open turbine-driven auxiliary feedwater pump steam admission valves 2-MS-201 and 2-MS-202 were susceptible to thermal binding if closed for downstream maintenance or testing during hot operations. Procedure OP-2322, "Auxiliary Feedwater System," was changed to require periodic cycling of the valves. However, these instructions were deleted inadvertently in a subsequent procedure revision. CR M2-97-1573 was initiated to track corrective actions. The procedure was corrected and the responsible procedure writer was counseled regarding the lack of attention to detail involved in the omission. NNECo's corrective actions were acceptable.

E8.7 (Closed) EEI 50-336/95-08-04 (E1 95-031-01023) and SIL Item 20.6: Control of purchased services

This escalated enforcement item involved failure to initiate timely reviews and corrective actions for vendor engineering reports pertaining to pressure locking of containment sump isolation valves 2-CS-16.1A/B. Specifically, there existed no documented evidence, as required by procedures, that a 1990 vendor technical evaluation of pressure locking and thermal binding of Millstone 2 gate valves was reviewed by NNECo until 1994. In response to the violation in 1995, the licensee performed a self-assessment of its controls over purchased engineering services. NNECo found that: (1) procedure guidance was fragmented and poorly organized; (2) methods of initiating and controlling vendor engineering work were informal and inconsistent among engineering its groups; (4) rigorous reviews of outputs were not routinely performed or documented. Proposed corrective actions included revising and clarifying procedures; conducting training, particularly to emphasize NNECo's ultimate responsibility for the accuracy and correctness of engineering outputs; and performance of followup assessments.

The inspectors reviewed Chapter 8, "Engineering Vendor Interfaces," of the Millstone Design Control Manual, and procedure NGP 6.05, "Processing and Control of Purchased Material, Equipment, Parts, and Services." The revised procedures provided clear and detailed guidance for the performance and documentation of vendor engineering design products. Training materials and task qualification records for design engineers adequately covered the procedures as well as the events that precipitated the violation. During the inspection the licensee was conducting another self-assessment of purchased service controls to evaluate the effectiveness of the corrective actions. Through review of recent MOV calculations performed by MPR Associates, Inc. for the Millstone 2 GL 89-10 program, the inspectors concluded that NNECo adequately implemented current vendor interface and control requirements. NNECo's corrective actions for this violation were acceptable.

E8.8 (Closed) EEI 50-336/96-05-11(E1 96-183) and SIL Item 20.2: Inaccurate Generic Letter 89-10 program closure report

The information presented in Millstone 2 report "Generic Letter 89-10 Design Basis Closure," dated November 9, 1995, was incomplete and inaccurately portrayed the design basis capability margins of approximately half of the valves in the licensee's MOV program. On April 16, 1998, the NRC exercised enforcement discretion and no Notice of Violation was issued for this matter.

In its causal analysis (Adverse Condition Report 9631), NNECo determined that the GL 89-10 program lacked sufficient guidelines regarding the methodology for calculating margin for different MOV control configurations, and that it had inadequately verified that the margin tables contained in the closure report reflected the values that had been generated in other calculations. MOV engineers, support staff, and contractors were given training to emphasize the importance of providing complete and accurate information to the NRC, and this training was incorporated into the design engineering training manual at Millstone 2. Standard methods for determining valve capability margins were developed and added to Project Instruction (PI) 9, "Determination of Stem Thrust Requirements," and calculation 97-MOV-01012MG, "Technical Justification/Methodology For Preparation of Millstone Units 1,2,&3 MOV Thrust/Torque Calculations and Test Analysis." During review of target thrust/torque calculations, the inspectors verified that capability margins were calculated in accordance with these methods. In a letter to the NRC dated September 15, 1998, the licensee notified the NRC that GL 89-10 program closure reports would no longer be generated. NNECO's corrective actions and the commitment change regarding closure reports were acceptable.

E8.9 (Closed) EEI 60-336/98-05-01(E1 95-031-02013), EEI 50-336/98-05-03(E1 95-031-01013) and SIL Items 20.4 and 20.5: Containment sump header isolation valve corrective actions

NNECo failed to identify and correct promptly long standing leakage through containment sump header check valve 2-CS-15A. The leakage contributed to filling the bonnet of isolation valve 2-CS-16A rendering the valve susceptible to pressure locking under design basis accident conditions. In addition, the licensee did not perform adequate or timely susceptibility evaluations for pressure locking of valves 2-CS-16.1A and 2-CS-16.1B. NNECo attributed the failures primarily to corrective action program process weaknesses and lack of institutionalized multi-disciplinary reviews of complex technical issues. For example, leakage through check valve 2-CS-15A did not meet the corrective action system reporting threshold at that time, and system engineers typically did not review all discrepancy reports pertaining to their systems.

As embodied in the current system engineering handbook, management expectations regarding system engineer responsibilities now include evaluations of component deficiencies that may impact system operation. The threshold for initiating condition reports and evaluating potential conditions adverse to quality has been lowered significantly and management expectations have been repeatedly

reinforced in training programs and in various site communications. The current corrective action program requires multi-disciplined management review of all condition reports to ensure timely evaluations, accurate determinations of failure modes and causal factors, and corrective actions plans with measurable results. NNECo's corrective actions adequately addressed the causes of these violations. Resolution of the technical issues associated with valves 2-CS-16.1A/B is discussed in Section E8.10 of this report under Licensee Event Report 97-34, "Containment Sump Isolation Valves are Susceptible to Pressure Locking." (SIL Item 20.7)

E8.10 (Open) LER 50-336/97-34-00 (Item 98-068) and SIL Item 20.7: Containment Sump Isolation Valves are Susceptible to Pressure Locking

During an engineering review of a proposed modification to preclude pressure locking of containment sump isolation valves 2-CS-16.1A and 2-CS-16.1B, NNECo identified an error in its previous pressure locking susceptibility evaluation. That evaluation incorrectly assumed that 37 psig would exist in the primary containment when the valves received a sump recirculation actuation signal (SRAS) to open, whereas NNECO subsequently determined that containment pressure could be as low as 0 psig. Combined with a thermally-induced 30 psig increase in valve bonnet pressure, NNECO postulated a maximum differential pressure of 84 psig across the valves disks. Using standard industry equations for double disk gate valves, the valves would not develop sufficient thrust to open under these conditions.

In April 1998, NNECO performed pressure locking tests of both sump isolation valves under SPROC 97-2-16, "Pressure Locking Margin Test of Containment Sump Isolation Valves." Valve 2-CS-16.1A opened at 14,535 pounds-force (lbf) of thrust with 135 psig entrapped in the bonnet, and valve 2-CS-16.1B opened at 29,754 lbf with 145 psig in the bonnet. By back-calculating an apparent valve factor from the test data, NNECo estimated that the valves were capable of opening with maximum bonnet pressure of 233 psig. The special test results provide acceptable prima facie support that the valves could have opened under design basis accident conditions.

As a result of the special tests, NNECo is reconsidering a previous commitment to modify the valves (commitment number B16956.01). Any changes in the licensee's commitments will be reviewed by the Office of Nuclear Reactor Regulation under GL 95-07, "Pressure Locking and Thermal Binding of Safety-Related Power-Operated Gate Valves." This LER and SIL Item 20.7 remain open pending NRC review of NNECo's calculations and the results of that evaluation.

E8.11 Review of Final Safety Analysis Report

Discovery of a licensee operating its facility in a manner contrary to the Updated Final Safety Analysis Report (UFSAR) description highlighted the need for a special focused review that compares plant practices, procedures, and/or parameters to the UFSAR descriptions. While performing the inspections discussed in this report, the inspectors reviewed MP2 UFSAR Sections 4.3.5 (Pressurizer), 4.3.7 (Valves), 5.2.8

(Containment Isolation System), 14.2 (Decrease in Heat Removal by the Secondary System), 14.6.2 (Radiological Consequences of a Main Steam Line Failure Outside Containment), 14.6.5 (Loss of Coolant Accidents), and 9.4 (Reactor Building Closed Cooling Water System). The inspectors verified that the wording in the UFSAR was consistent with the observed plant practices, procedures, and parameters.

X1 Exit Meeting Summary

NNECo representatives were informed of the purpose and scope of the inspection at an entrance meeting conducted on September 14, 1998. Findings were discussed periodically with the licensee throughout the course of the inspection. The inspectors met with the principals listed below on September 18, 1998, at which time a final exit meeting was conducted to summarize the preliminary exit findings. The licensee acknowledged the preliminary inspection findings and conclusions, with no exceptions taken. The bases for the inspection conclusions did not involve proprietary information, nor was any such information included in this inspection report.

PARTIAL LIST OF PERSONS CONTACTED

Northeast Nuclear Energy Company

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J. Law	Supervisor, Site MOV Project
C. Clement	Significant Items List Coordinator
R. Joshi	Manager, Unit 2 Regulatory Compliance

U.S. Nuclear Regulatory Commission

D. Beaulieu	Senior Resident Inspector, Millstone Unit 2
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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 92903	Followup - Engineering

ITEMS OPENED, CLOSED, AND DISCUSSED

Closed

50-336/96-05-09	EEI	Improper consideration of negative load sensitive behavior (EA 96-183-04063)
50-336/95-01-01	IFI	Item 2 - Complete load sensitive behavior and stem friction coefficient studies
50-336/95-01-01	IFI	Item 6 - Justify valve factors for nondynamically tested valves
50-336/97-203-16	IFI	PORV block valve design basis differential pressure
50-336/96-05-10	URI	Update station battery load profile and FSAR table
50-336/97-203-17	VIO	Thermal binding of AFW turbine steam admission valves
50-336/95-08-04	EEI	Control of purchased services (EA 95-031-01023)
50-336/96-05-11	EEI	Inaccurate GL 89-10 closure report (EA96-183)
50-336/95-08-01	EEI	Untimely corrective action for 2-CS-15A leakage (EA 95-031-02013)
50-336/95-08-03	EEI	Untimely corrective action for pressure locking of containment sump isolation valves (EA 95-031-01013)

Discussed

50-336/97-34-00	LER	Containment sump isolation valves susceptible to pressure locking (Item 98-068)

LIST OF ACRONYMS USED

ATP(s)	Alternate test plan(s)
CFR	Code of Federal Regulations
EEI	Escalated enforcement item
EPRI	Electric Power Research Institute
GL	Generic Letter
IFI	Inspector followup item
lbf	pounds-force
LER	Licensee Event Report
MOV(s)	Motor-operated valve(s)
MP2	Millstone Unit 2
NNECo	Northeast Nuclear Energy Company
PORV	Power-operated relief valve
PPM	Performance prediction methodology
psid	pounds per square inch - differential
psig	pounds per square inch - gage
RCS	Reactor coolant system
SIL	Significant items list

SRAS	Sump recirculation actuation signal
UFSAR	Updated Final Safety Analysis Report
URI	Unresolved item
vdc	Volts, direct current

LIST OF DOCUMENTS REVIEWED

Calculations

89-078-890ES, "MOV System and Functional Design Basis Review for 2-CS-16.1A/B," Revision 4, Change 5, dated January 20, 1998

89-078-01687M2, "Millstone Unit 2 Minimum Required Stem Thrust Calculation for MOV 2-CS-16.1A and 2-CS-16.1B Using EPRI PPM Methodology," Revision 0, Change 1, dated March 6, 1998

89-078-873ES, "Target Thrust/Torque Calculation For 2-CS-16.1A, 2-CS-16.1B," Revision 2, Change 2, dated August 20, 1998

98-MOV-02370M2, "MOV System and Functional Design Basis Review for 2-MS-201 and 2-MS-202," Revision 0, dated September 15, 1998

89-078-01696M2, "Evaluation of Stem Thrust Requirement for 2-MS-201 and 2-MS-202 at Millstone Unit 2," Revision 0, dated March 26, 1998

89-078-855ES, "Target Thrust/Torque Calculation For 2-MS-201, 2-MS-202," Revision 5, dated March 20, 1998

98-MOV-02368M2, "MOV System and Functional Design Basis Review for 2-FW-44," Revision 0. dated March 4, 1998

89-078-01693M2, "Evaluation of Stem Thrust Requirements for 2-FW-44 at Millstone Unit 2," Revision 0, Change 1, dated August 7, 1998

89-078-865ES, "Target Thrust/Torque Calculation For 2-FW-44," Revision 6, dated May 14, 1998

97-MOV-01012Mg, "Technical Justification/Methodology For Preparation of Millstone Units 1,2,& MOV Thrust/Torque Calculations And Test Analysis," Revision 3, Change 1, dated September 10\998

89-078-883ES, "Target Thrust/Torque Calculation For 2-SV-4188 (2-MS-464)," Revision 3, dated April 15, 1998

97-ENG-0184 E2, "MP2 Thermal Overload Relays for MOVs on Safety Related MCCs," Revision 1, Change 20, dated September 9, 1998

PA89-078-272E2, "MP2 MOV Voltage Drop Calculation," Revision 0, Change 31, dated April 6, 1998

89-078-02570M2, "MP2 MOV Alternate Test Plans and DP Test Selection Methodology," Revision 0, Change 1, dated September 17, 1998

98-MOV-02369-M2, "MOV System and Functional Design Basis Review for 2-MS-65A/B," Revision 0, dated May 27, 1998

92-RPS-842ES, "Target Thrust/Torque Calculation For 2-MS-65A, 2-MS-65B," Revision 5, dated May 27, 1998

89-078-01694M2, "Evaluation of Stem Thrust Requirements for 2-MS-65A and 2-MS-65B at Millstone Unit 2," Revision 0, dated May 27, 1998

89-078-01702M2, "Target Thrust/Torque Calculation For 2-RC-403, 2-RC-405," Revision 3, dated July 6, 1998

89-078-01681M2, "Evaluation of Stem Thrust Requirement for 2-RC-403 and 2-RC-405 at Millstone Unit 2," Revision 0, dated April 25, 1998

89-078-890ES, "MOV System and Functional Design Basis Review for 2-RC-403 & 405," Revision 4, Change 17, dated April 25, 1998

89-078-01698M2, "Minimum Required Stem Thrust Calculation for MOV 2-RB-30.1A/37.2A Using EPRI PPM Methodology," Revision 1, dated August 28, 1998

89-078-875ES, "Target Thrust/Torque Calculation For 2-RB-30.1A, 2-RB-37.2A," Revision 7, dated September 11, 1998

89-078-890ES, "MOV System and Functional Design Basis Review (RB-30.1A/B, RB-37.2A/B)," Revision 4, Change 2, dated August 13, 1997

89-078-01714M2, "Evaluation of Stem Thrust Requirements for 2-SI-616, 617, 626, 627, 636, 637, 646, 647 at Millstone 2," Revision 1, dated January 30, 1998

89-078-922ES, "Target Thrust/Torque Calculation for 2-SI-617, 2-SI-627, 2-SI-637, 2-SI-647," Revision 5, dated May 28, 1998

98-078-890ES, "MOV System and Functional Design Basis Review for 2-SI-616, 626, 636, 646, 617, 627, 637, 647," Revision 4, Change 25, dated January 27, 1998

89-078-01722M2, "Minimum Required Stem Thrust Calculation for MOV 2-SI-651 and 2-SI-652 Using EPRI PPM Methodology," Revision 0, Change 2, dated March 23, 1998

89-078-882ES, "Target Thrust/Torque Calculation For 2-SI-651, 2-SI-652," Revision 6, dated September 11, 1998

89-078-877ES, "Target Thrust/Torque Calculation For 2-SI-614, 2-SI-624, 2-SI-634, 2-SI-644," Revision 3, Change 2, dated April 15, 1998

89-078-01706M2, "Evaluation of Stem Thrust Requirements for 2-SI-614, 2-SI-624, 2-SI-634, 2-SI-644 at Millstone 2," Revision 0, Change 2, dated April 14, 1998

89-078-890ES, "MOV System and Functional Design Basis Review for 2-SI-614, 2-SI-624, 2-SI-634, 2-SI-644," Revision 4, Change 27, dated March 12, 1998

98-078-879ES, "Target Thrust/Torque Calculation For 2-SI-616, 2-SI-626, 2-SI-636, 2-SI-646," Revision 7, dated May 18, 1998

89-078-01714M2, "Evaluation of Stem Thrust Requirements for 2-SI-616, 617, 626, 627, 636, 637, 646, 647 at Millstone 2," Revision 1, dated January 30, 1998

89-078-890ES, "MOV System and Functional Design Basis Review for 2-SI-616, 626, 636, 646, 617, 627, 637, 647," Revision 4, Change 25, dated January 27, 1998

97-ENG-01840E2, "MP2 Thermal Overload Relays for MOVs on Safety Related MCCs," Revision 1, Change 13, 1998

89-094-01546M3, "MP3 MOV Alternate Test Plans and DP Test Methodology," Revision 1, dated February 10, 1998

T-01154-S2, "MP2 RBCCW LOCA Overpressure Prevention," Revision 0, dated February 9, 1996

89-078-02666M2, "MP2 MOV Static and Dynamic Test Data Analysis," Revision 0, dated September 11, 1998

Modifications

DCN No. DM2-03-0344-97, "RBCCW System - Installation of Intersystem LOCA Relief Valves, dated October 20, 1997

DCN No. DM2-00-0820-97, "Replacement of the Limitorque Actuator Spring Pack on MOVs 2-RB-30.1A and 2-RB-37.2A," dated September 5, 1997

DCR No. M2-97018, "RBCCW System - Installation of Intersystem LOCA Relief Valves," dated August 8, 1997

Specification SP-M2-ME-0020, "RBCCW Intersystem LOCA Relief Valves," dated May 21, 1997

Technical Evaluations

M2-EV-98-0049, "Motor Operated Valve Stroke Time Requirements - Millstone Unit 2," Revision 0, dated February 19, 1998

Procedures

Design Control Manual, Chapter 8, "Engineering Vendor Interfaces," Revision 6, dated June 25, 1998

NGP 6.05, "Processing and Control of Purchased Material, Equipment, Parts, and Services," Revision 9, dated March 25, 1998

SPROC 97-2-16, "Pressure Locking Margin Test of Containment Sump Header Isolation Valves," Revision 2, dated February 4, 1998