U.S. NUCLEAR REGULATORY COMMISSION

REGION I

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Licensee:	Niagara Mohawk Power Corporation 301 Plainfield Road Syracuse, New York 13212
Facility:	Nine Mile Point, Units 1&2
Dates:	October 7 - November 15, 1996
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EXECUTIVE SUMMARY

Nine Mile Point
MOV Inspection Report 96-15

This inspection evaluated for closure the Nine Mile Point Unit 2 (NMP-2) motor-operated valve (MOV) program that was implemented in response to NRC Generic Letter (GL) 89-10, "Safety-Related Motor-Operated Valve Testing and Surveillance." The NRC was unable to close its review of the NMP-2 program because of insufficient justifications for important design inputs pertaining to motor operated valve (MOV) performance under design-basis conditions. The Unit 1 (NMP-1) program was also evaluated during the course of this inspection, although the program is not committed to be completed until spring 1997.

Engineering

- Niagara Mohawk (NMPC) attempted to obtain site-specific dynamic test data for a reasonable sample of the testable valve population. (Section E1.1)

- The licensee demonstrated MOV design-basis capability sufficient for plant startup from the current outage. Because NMPC had insufficient plant-specific or industry data to justify the valve factor assumptions applied to a number of MOV groups, additional information will be needed for GL 89-10 program closure. (Sections E1.3 and E2.1)

- NMPC's assumptions for load sensitive behavior and stem coefficient of friction were based on analysis of test data from the EPRI performance prediction program that did not bound the results of plant-specific tests. (Sections E1.4 and E1.5)

- NMPC did not appear to have implemented an MOV performance trending program at NMP-2 that met the intent of the its maintenance procedure or GL 89-10. (Section E2.2)

- An apparent violation of the design control requirements of 10 CFR 50, Appendix B was identified concerning NMPC's use of an incorrect design input in a calculation of MOV actuator capability. The error resulted in an inappropriate decision to defer modifications to preclude pressure locking of four risk-significant motor-operated gate valves. (Section E8.1)

- The inspectors concluded that the MOVs at NMP-1 were adequately setup to ensure current operability. (Section E8.5)

- An unresolved item was identified concerning the adequacy of NMPC's design-basis assumptions regarding multiple hot short scenarios at both NMP units. An unresolved item concerning implementation of an MOV periodic verification program was closed. (Sections E2.3 and E8.4)

Report Details

E1 Conduct of Engineering

E1.1 Generic Letter 89-10 Motor-Operated Valve Program Review

a. Inspection Scope (TI 2515/109)

The inspectors reviewed Niagara Mohawk Power Company's (NMPC) "Motor Operated Valve Program Description for Nine Mile Point Nuclear Station Unit 2," dated June 24, 1994; report NER-2M-008, "GL 89-10 Dynamic Test Data Reconciliation and Valve Grouping Verification," dated August 30, 1995; and supporting documents associated with the safety-related motor-operated valves (MOVs) in the Nine Mile Point Unit 2 (NMP-2) Generic Letter (GL) 89-10 program. From these documents, a sample of valves was selected representing the licensee's methods of verifying design-basis capability, including: (1) valve-specific dynamic test at, or near, design-basis conditions; (2) valve-specific test, linearly extrapolated to design-basis conditions; and (3) in-plant or industry information obtained from dynamic tests of similar MOVs. The inspectors reviewed special test packages and engineering evaluations for the following MOVs:

2CSH*MOV105	HPCS Minimum Flow Isolation Valve
2CHS*MOV107	HPCS Injection Valve
2CSL*MOV104	LPCS Injection Valve
2RHS*MOV4C	RHR C Minimum Flow Isolation Valve
2SWP*MOV599	Turbine Building Isolation Valve

b. Findings and Observations

The GL 89-10 program at NMP-2 included 177 MOVs. During the course of implementing the program, NMPC modified approximately 40 MOVs to increase thrust output capability. In addition, 129 motor-actuators were refurbished, and the remaining overhauls are scheduled for completion during the next refueling outage. Seventy-two valves were considered to be testable under dynamic conditions and 42 MOVs actually were dynamically tested. However, only about 25 of the tests produced data of sufficient quality to determine valve factors, and only 11 tests resulted in meaningful load sensitive behavior information.

c. Conclusions

NMPC attempted to obtain site-specific dynamic test data for a reasonable sample of the testable valve population. The relatively small amount of usable data obtained increased the licensee's need to obtain applicable data from other industry sources.

E1.2 Operator Sizing and Switch Setting Assumptions

a. Inspection Scope

The inspectors reviewed valve packages and other documents that established the thrust requirements for MOVs in the NMPC GL 89-10 program, including:

- NER-2M-003 Generic Letter 89-10 Dynamic Testing Valve Grouping
- NER-2M-008 Dynamic Test Data Reconciliation and Valve Grouping Verification
- NER-2M-006 EPRI MOV Performance Prediction Program Evaluation For Gate Valves (EPRI Project 3343-15)
- NER-2M-002 Prioritize MOVs Within The Scope Of NRC GL 89-10 For Testing

The purpose of the review was to assess the justifications for assumptions used in MOV thrust calculations that form the basis for determining the design-basis requirements.

b. Observations and Findings

NMPC's thrust calculations typically utilized the standard industry equations. Orifice diameter measurements were used to calculate valve seat area. Valve factors were based on the highest of (1) an actual test valve factor, (2) a design-basis assumption of 0.5 for gate valves and 1.1 for globe valves, or (3) EPRI (Electric Power Research Institute) test data. A factor of 15% was factored into target thrust values to account for load sensitive behavior, and a stem friction coefficient of 0.15 was used to determine actuator output thrust capability. During valve setup, a bias margin was included to cover diagnostic equipment uncertainty and torque switch repeatability.

c. Conclusions

NMPC appropriately considered the effects of torque switch repeatability and diagnostic equipment uncertainty. However, as outlined in sections E1.3, E1.4, and E1.5 of this report, the inspectors concluded that the licensee's design assumptions for valve factor, load sensitive behavior, and stem friction coefficient were not sufficiently justified for GL 89-10 program closure.

E1.3 Valve Factor and Grouping

a. Inspection Scope

The inspectors reviewed MOV program documents and dynamic test results to assess how NMPC developed the valve factors utilized in the MOV program. The inspectors also discussed the licensee's grouping methodology with program engineers.

b. Observations and Findings

NMPC divided NMP-2's MOVs into 57 valve groups based on valve manufacturer, type, and ANSI pressure class. The licensee attempted to use some site-specific diagnostic test data to justify the valve factors applied to the non-dynamically tested MOVs. However, NMPC did not have sufficient test results to cover all of the valve groups adequately. The inspectors identified 13 groups containing testable valves in which the number of dynamically tested MOVs did not satisfy the guidance for statistical significance of GL 89-10, Supplement 6 (30% of the group tested, no less than 2). This reduced the amount of test data available for application to MOVs that were not practicable to test under dynamic conditions. In the alternative, the licensee performed its own statistical analysis of selected friction coefficients obtained from the EPRI Performance Prediction Program (PPP). The inspectors had the following concerns with NMPC's application of the EPRI data:

- The EPRI test program did not perform a sufficient number of tests on each individual valve type to permit the application of a statistical approach. This resulted in a wide variation in disc friction coefficients.

- EPRI disc friction coefficients may not be reliably used as individual data points due to (1) lack of valve preconditioning (in some cases), and (2) the general practice of removing apparent parasitic loads from the measured force requirements before calculating the apparent friction coefficient. Removal of parasitic loads results in nonconservative thrust requirements if the disc friction coefficient is applied to a different valve and the parasitic loads are not added back into the minimum thrust requirement.

- NMPC used the friction coefficients identified by EPRI at flow isolation. Due to the uncertainty in nature of determining the flow isolation point, the NRC considers flow isolation friction coefficients to be limited to the specific valve. As noted in the NRC Safety Evaluation (SE) of Electric Power Research Institute Topical Report TR-103237, "EPRI Motor-Operated Valve Performance Prediction Program," dated March 15, 1996, EPRI stated that "...the model output for flow isolation is a 'theoretical' flow isolation position that is for information only and is not to be used to establish thrust requirements in accordance with the EPRI methodology."

- The licensee applied the EPRI mean seat area-based friction coefficients to NMP-2 thrust calculations that utilized valve orifice diameter. Due to the licensee's smaller disc area term, the EPRI data was utilized nonconservatively.

The NRC's endorsement of the EPRI performance prediction model (PPM) (with the caveats stated in the SE) covered only use of the PPM software; the SE did not accept use of individual disc friction coefficients contained in the PPP. Therefore, the inspectors did not consider to be acceptable the valve factor justifications based on EPRI friction coefficients used in the licensee's grouping methodology.

Typically, NMPC's valve groups included valves subject to similar fluid conditions. However, the valves in the following groups contained MOVs that could experience blowdown flow conditions.

- Group GG contained two, 8-inch, Velan, 600 psi globe valves (2WCS*MOV102 and 2WCS*MOV112) in the reactor water cleanup system. The lowest available valve factor was 2.19.

- Group AA contained two, 10-inch, Velan, 900 psi flexible-wedge gate valves (2ICS*MOV121 and 2ICS*MOV128) in the reactor core isolation cooling system (2ICS*MOV128). The lowest available valve factor in the group was 0.64.

The inspectors noted that EPRI pumped-flow test results may not be appropriate to apply to valves that may need to close under blowdown flow conditions. Section IV of the EPRI PPM safety evaluation states that "...extrapolation of test data from pumped-flow conditions to blowdown conditions (as typically performed in MOV programs) might not be sufficient to ensure that a gate valve can operate under its design-basis conditions." The inspectors considered NMPC's current available margins to be adequate for GL 89-10 program closure. However, the NRC expectation is that licensees will monitor on-going industry efforts to learn more about MOV performance under blowdown conditions as part of a GL 96-05 periodic verification program. In addition, the licensee should evaluate the EPRI recommendations concerning internal clearances and valve guide and seat edge treatments.

During the inspection, NMPC consolidated the 57 original MOV groups into 36 new groups by combining valves of similar manufacture, size, and fluid conditions. The licensee also augmented its valve factor justifications for nontestable MOVs by (1) obtaining test data from other plants and the EPRI PPP, and (2) reconstituting previously rejected plant-specific tests. The valve factors applied to several groups were increased significantly as a result of the new information. NMPC also performed a sensitivity study of MOV capability assuming a 25% bias for load sensitive behavior (see Section E1.4), and readjusted the torque switches of several MOVs to obtain acceptable performance margins. The inspector reviewed the new information and concluded that the valves had adequate margin for plant startup from the current refueling outage.

While the available margins were acceptable for plant startup, the valve factor justifications for five of the new groups remained unacceptable for GL 89-10 program closure:

- Group V03 (former groups BB and CC) contained two, 900 psi Velan flexible-wedge gate valves in the reactor core isolation cooling (RCIC) system. A valve factor of 0.5 was applied to the group based on a tested valve factor of 0.32 (valve 2ICS*MOV124), a single test at another facility, and the EPRI PPP. However, neither the industry test valve factor (0.69) nor the EPRI PPP friction coefficient (0.56) supported the valve factor selected for the group.

- Group V06 (former group AA) contained two, 10-inch 900 psi Velan flexible-wedge gate valves in the RCIC system. The valves are not practical to test and must close under high energy line break (steam blowdown) conditions. NMPC raised the group valve factor from 0.5 to 0.6, but had no plant-specific or industry data to justify the assumption. The valves are controlled by the limit switch in the close direction (torque switch is bypassed). The inspector concluded that the valves had adequate isolation capability, based on motor output capacity. In the long term, the licensee should refine its assessment of required thrust and valve capability using the EPRI PPM, and consider the EPRI recommendations regarding edge treatments to improved the predictability of performance under blowdown conditions.

- Group GL01 (former groups R and S) contained three, 10-inch and 12-inch 900 psi Anchor/Darling globe valves in the high pressure core spray (HPCS) system. Two of the valves were tested, but usable valve factor data (0.95) was acquired from only one valve, 2CSH*MOV112. One additional industry test, with a valve factor of 1.03, was preferred by NMPC to justify the valve factor of 1.1 applied to this group. Valve 2CSH*MOV110, pump test return to the condensate storage tank, did not have an adequate capability margin, assuming a generic load sensitive behavior factor of 25% for nontested valves. The licensee committed to obtain valve-specific dynamic test data for the valve during the next regularly scheduled HPCS system surveillance test in the first quarter of 1997.

- Group GL06a (former groups PP and SS) contained five, small 1500 psi Velan globe valves in main steam and RCIC system steam service. Only one valve (2ICS*MOV159) in the group was testable, and the valve factor obtained was questionable. NMPC provided no test data to support the valve factor of 1.1 assigned to the group. After changing the motor-actuator gear set in main steam drain valve 2MSS*MOV208, all of the valves in the group had adequate capability, on paper, to support plant startup. However, prior to GL 89-10 closure, the licensee should review industry information to ensure that these globe valves are not outliers with valve factors greater than 1.1.

- Group GL06a (former group HH) contained two, 6-inch 600 psi Velan globe valves in the main steam system. Both valve are impractical to test under design-basis conditions, and only two industry tests were cited to support the group valve factor assumption of 1.1. Assuming a load sensitive behavior value of 25%, valve 2MSS*MOV111 had only a 1.8% capability margin, while in-series valve 2MSS*MOV112 had a negative (-) margin of 9.1%. The latter valve is opened only briefly for periodic inservice testing (IST), or infrequently if the RCIC system turbine is out of service. The licensee changed the IST procedure to ensure that at least one valve will remain shut during surveillance testing. The operational restriction will remain in effect until modifications to improve valve capability are implemented.

c. Conclusions

NMPC had insufficient plant-specific or industry data to justify the valve factor assumptions applied to a significant number of valve groups. By consolidating the groups, reconstituting several dynamic tests, acquiring additional industry test information, and implementing various margin enhancement actions, the licensee demonstrated MOV design-basis capability sufficient for plant startup from the current outage. However, additional applicable valve factor information will be needed for GL 89-10 program closure.

E1.4 Load Sensitive Behavior

a. Inspection Scope

Load-sensitive behavior is defined as a change in MOV output due to a change in stem friction forces under dynamic conditions. The inspectors reviewed the information contained in valve dynamic test packages and NMPC documents NER-2M-006 and NER-2M-008 to assess the licensee's load-sensitive behavior assumptions.

b. Observations and Findings

Because of a small plant-specific data base (11 MOVs), NMPC did not consider that sufficient site-specific data existed to determine statistically an appropriate load sensitive behavior margin. Instead, the licensee analyzed EPRI PPP data and concluded through engineering judgement that a 15% margin was reasonable given the experience at other nuclear facilities. However, the NRC stated in the EPRI PPM safety evaluation that a 25% rate of loading margin appropriately bounds most PPM gate valve data. The inspectors also performed a statistical analysis of the NMPC data that resulted in a 95% confidence level value of 23%.

NMPC's initial switch setting methodology incorrectly assumed that load sensitive behavior was a random phenomenon, and included its 15% margin as part of a square root sum of the squares method for combining random uncertainties. The licensee addressed this issue by applying a 15% bias error in its minimum required thrust calculations.

The inspectors noted that the licensee's method of calculating load sensitive behavior involved removing observed running loads from the thrust measured at control switch trip (CST) during the dynamic test (called "Tavail" by the licensee). The licensee then added back the sum of the packing loads measured during static test and the calculated stem rejection force (based on the maximum observed differential pressure during the dynamic test). The inspectors considered the licensee's method to be slightly nonconservative. During a dynamic test, running load is a combination of the packing load the stem rejection load at a given point of the valve stroke. NMPC's method does not account for the increase in upstream line pressure that occurs as the valve closes, and thus does not remove fully the stem rejection forces present at CST before adding back the static test packing load and the analytically-derived stem rejection load. This error results in an incorrect increase in "Tavail", and a corresponding small decrease in the apparent rate of loading. The inspectors informed the licensee that the erroneous method will need to be corrected, and the load-sensitive behavior data adjusted prior to GL 89-10 program closure.

During review of the licensee's dynamic test data, the inspectors identified instances in which the load sensitive behavior exceeded the assumed 15% margin. Prior to returning valves to service, the licensee evaluated each MOV using the observed value. However, the licensee did not feed the higher values back into the design-basis thrust calculations. This "feedback" is needed to ensure that design-basis thrust calculations accurately establish the minimum requirements for future torque switch adjustments. The licensee agreed to revise its thrust calculations to reflect as-measured load sensitive behavior.

At the inspectors's request, NMPC evaluated its current valve capability margins assuming a 25% load sensitive behavior factor. As discussed in Section E1.3, corrective actions were required for some MOVs to provide additional capability prior to plant startup.

c. Conclusions

NMPC's treatment of load sensitive behavior was unacceptable for GL 89-10 program closure. However, the licensee was able to demonstrate adequate capability margins for its safety-related MOVs prior to startup from the current refueling outage.

E1.5 Stem Coefficient of Friction

a. Inspection Scope

The inspectors reviewed the information in NMPC documents NER-2M-006 and NER-2M-008, and valve test packages to assess the licensee's program assumption for stem friction coefficient.

b. Observations and Findings

NMPC assumed a 0.15 stem friction coefficient in its design-basis thrust calculations. The inspectors found that the licensee based the assumption on EPRI PPP test data rather than on plant-specific test results. The inspectors noted that the methodological error made in determining "Tavail" for rate of loading applied also to stem friction coefficient calculations (see Section E1.4).

The inspectors performed a statistical evaluation of the NMP-2 stem friction coefficient data and determined that the mean of the static test results (128 data points) was 0.124, with a standard deviation of 0.035, resulting in a mean plus 2 standard deviation value of 0.194. A similar analysis of the 21 plant-specific dynamic test data points resulted in a mean of 0.131, with a standard deviation of 0.045 for a final value of 0.221. The inspectors concluded that the licensee's stem friction coefficient assumption was not justified by the results of plant-specific tests.

The inspectors noted, however, that the licensee applied a torque window, as well as a thrust window, to set its MOV torque switches. This method reduced the need to know a particular stem friction coefficient value. An abnormally high stem friction coefficient would become evident during valve setup when the technician is unable to obtain adequate thrust levels without exceeding the maximum allowed torque. The inspectors also noted the licensee always included a load sensitive behavior margin in its setup irrespective of the direction of valve travel. This reduced any concern for travel in the open direction when the torque switch is bypassed. However, given the weaknesses identified in NMPC's treatment of load sensitive behavior, the need to establish a firm technical basis for the stem friction coefficient assumption remains.

c. Conclusions

NMPC based its stem friction coefficient assumption on an evaluation of test data derived from the EPRI PPP rather than on plant-specific test results. The licensee's method of calculating the coefficient from dynamic test data was nonconservative, and the generic friction coefficient applied to untestable valves was not bounded by in-situ test results. Consequently, NMPC's stem friction coefficient assumption was not acceptable for GL 89-10 program closure.

E2 Engineering Support of Facilities and Equipment

E2.1 Motor-Operated Valve Design-Basis Capability

a. Inspection Scope

The inspectors reviewed dynamic test evaluation packages and associated test reports for the selected MOVs. The purpose of this review was to assess NMPC's efforts to establish design-basis capability for all MOVs in its GL 89-10 program.

b. Observations and Findings

Gate and Globe Valves

The inspectors identified several valve groups in which individual valves had low apparent thrust margin.

- Group AAA contained four, 16-inch, Velan, 300 psi, flexible-wedge gate valves. The available valve factors all were less than 0.6. None of the valves were practical to test, and NMPC obtained applicable industry test data that justified a valve factor of 0.5 for this group. In addition, the torque switch for containment spray isolation valve 2RHS*MOV15B was adjusted to increase motor-actuator output capability.

- Group BB contained one, six-inch, Velan, 900 psi, flexible-wedge gate valve (2ICS*MOV126). The available valve factor was 0.53. The licensee subsequently was able to demonstrate adequate capability margin for plant startup. As discussed in Section E1.3, however, the assumed valve factor was not adequately justified for GL 89-10 program closure.

- Group CCC consisted of four, six-inch, Velan, 300 psi, flexible-wedge gate valves. Valve 2RHS*MOV4C had an available valve factor of only 0.45. NMPC justified the valve factor assumed for this group with conservatively reconstituted plant-specific dynamic test data. The torque switch of valve 2RHS*MOV4C was adjusted prior to plant startup, increasing the available valve factor to greater than 0.6.

Butterfly Valves

The NMP Unit 2 GL 89-10 program contains 43 quarter-turn valves including 6 ball valves manufactured by Contromatics, 31 butterfly valves manufactured by Clow, and 6 butterfly valves manufactured by Posi-Seal. Group QT01 included the 6 Contromatic ball valves which are limit controlled, operate under low differential pressure conditions, and have more than 100% margin above the manufacturer's torque requirement predictions. Group QT02 included 2 eighteen-inch 150-lb class Posi-Seal butterfly valves which are limit controlled, operate under low pressure air service, and have more than 100% margin above the manufacturer's torque

requirement predictions. Group QT02a included 4 eighteen-inch 300-lb class Posi-Seal butterfly valves which have an open safety function, low differential pressure flow conditions, and more than 100% margin above the manufacturer's open torque requirement prediction. The Clow butterfly valves are torque-seated, instead of the more typical limit-switch control design. Group QT03 included 29 Clow butterfly valves ranging from 18 to 36 inches in size and 150/300-lb ratings with low differential pressure conditions. The licensee conducted dynamic testing of 11 of the 29 MOVs. Group QT03a included 2 twenty-inch 150-lb Clow butterfly valves that have gas service with low differential pressure and greater than 50% margin above the manufacturer's torque requirement predictions. The inspectors did not identify any immediate concerns regarding the non-dynamically tested valves. For closure of the NRC staff's review of the GL 89-10 program, the licensee will need to establish a plan to verify the manufacturer's torque requirement predictions or to maintain the available margins presented during the inspection.

c. Conclusions

The licensee demonstrated valve capability margins that were adequate for plant startup from the current refueling outage. For GL 89-10 program closure, additional technical information will be needed to justify the valve factor assumed for valve 2ICS*MOV126, and a plan to verify that the vendor-recommended butterfly valve torque switch settings are appropriate should be developed.

E2.2 Trending of MOV Failures and Test Results

a. Inspection Scope

The inspector reviewed maintenance procedure N2-MAP-MAI-0302, "Trending of MOV Performance and Review of MOV Diagnostic Test Data," dated August 12, 1996, and the NMP-2 Independent Safety Engineering Group (ISEG) Activity Report for September 1996.

b. Observations and Findings

The provisions of the NMP-2 motor-operated valve trending procedure met the intent of GL 89-10. However, the inspector noted that no bi-yearly trend data report had been generated or evaluated pursuant to step 3.2.6.c of the procedure. The inspector was informed that the requirement to produce a trend report had been added to the procedure in June 1995, and that the first report would be prepared by June 1997.

Trending program implementation was not inspected directly during this inspection. The licensee stated that valve test performance had been reviewed for adverse trends on a valve-specific basis. However, the inspector noted that the NMP-2 ISEG recently concluded that the current trending practices had not evaluated thoroughly a potential trend involving MOV over-torque or over-thrust events, and were not consistent with the intent of the trending procedure. This matter will be tracked administratively under NMP Unit 1 Followup Item (IFI) 50-220/95-11-07.

c. Conclusions

The inspector concluded that NMPC did not appear to have implemented an MOV performance trending program at NMP-2 that met the intent of the its maintenance procedure or GL 89-10.

E2.3 Potential for Loss of Remote Shutdown Capability During a Control Room Fire

a. Inspection Scope:

The inspectors reviewed NMPC's actions regarding a potential design deficiency identified in NRC Information Notice (IN) 92-18, "Potential for Loss of Remote Shutdown Capability During a Control Room Fire." The IN discussed the inadvertent, uncontrolled operation MOVs caused by multiple short circuits (hot shorts) occurring in control cables during a control room fire.

b. Observations and Findings

At NMP-2, the licensee considered that the redundancy of the alternate shutdown capability adequately addressed the requirements of 10 CFR 50, Appendix R, and that the multiple failures described in the IN were beyond the design basis of the plant. In addition, NMPC performed a comprehensive probabilistic study of the concern and concluded that the scenarios discussed in the IN were highly improbable.

The licensee re-opened its review of the IN at NMP-1 and identified a historical condition involving potential spurious closure of shutdown cooling system containment isolation valves 38-01 and 38-13. The postulated condition could have rendered the valves incapable of being re-opened to achieve cold shutdown in 72 hours as required by the Unit 1 Technical Specifications. The licensee changed the design of the valve controls in 1995 to preclude the event. NMPC reported the condition to the NRC per 10 CFR 50.72 on November 1, 1996. Licensee review of the issue was ongoing at the end of the inspection.

c. Conclusions

The inspectors identified no immediate operability concerns at either NMP unit. The adequacy of NMPC's design-basis assumptions regarding multiple hot short scenarios at Unit 2 and the final disposition of the matter at Unit 1 are an unresolved item (50-220;410/96-15-01) pending further interpretation of IN 92-18 and 10 CFR 50, Appendix R.

E7 Quality Assurance in Engineering Activities

a. Inspection Scope

The inspectors reviewed quality assurance audits and surveillances, and independent assessments of the motor-operated valve program performed during the past three years.

b. Observations and Findings

NMPC commissioned ERIN Engineering and Research, Inc. to perform a GL-89-10 program closure review at NMP-2 in September 1996. ERIN conducted a comprehensive assessment of the program, and its findings closely paralleled many of those independently identified by the NRC during this inspection. The inspectors considered the ERIN assessment to have been a good initiative.

In September 1996, the NMP-2 Independent Safety Engineering Group (ISEG) reviewed several major aspects of the GL 89-10 program, including (1) Design-basis engineering reviews, (2) MOV switch setting validation, (3) periodic surveillance and preventive maintenance, (4) baseline MOV setup and diagnostic testing, and (5) root cause evaluation and preventive actions. ISEG's observations concerning valve performance trending are discussed in Section E2.2.

No quality assurance audits of the GL 89-10 program per se were performed by the licensee. However, aspects of the program were assessed as part audits of other activities, such as refueling outage project and task management audit No. 96005, dated April 29, 1996. The inspectors found that the deviation/event reports initiated as a result of the April 1996 audit were dispositioned appropriately. Quality Assessment Services also performed frequent surveillances of program activities. While most of the surveillances were technically oriented, many assessed programmatic themes, such as extrapolation of test data, diagnostic equipment calibration, and motor-actuator sizing calculation quality as well. In the aggregate, the audits and surveillances provided an appropriate level of oversight to the NMP-2 GL 89-10 program.

c. Conclusions

The licensee provided an appropriate level of independent oversight of the GL 89-10 program at NMP-2.

E8 Miscellaneous Engineering Issues

E8.1 (Closed) Unresolved Item 50-410/93-21-02; Violation 50-410/95-11-01; Followup Item 50-410/95-11-08 Pressure Locking of Gate Valves

a. Inspection Scope

These items involved pressure locking of gate valves at NMP-2. The NMPC response to GL 95-07, NMPIL 1032, "Generic Letter 95-07 Pressure Locking and Thermal Binding of Safety-Related Power-Operated Gate Valves," dated February 13, 1996, contained a list of susceptible valves judged by the licensee to not require modification to preclude pressure locking. The following risk-significant MOVs were included in the list:

2CHS*MOV107	High pressure core spray injection
2ICS*MOV126	Reactor core isolation cooling injection
2RHS*MOV25A	Containment spray loop A inboard isolation
2RHS*MOV25B	Containment spray loop B inboard isolation

The inspector independently calculated the required thrust and motor-actuator capability of the valves, and reviewed the following NMPC documents pertaining to the capability of these MOVs to overcome the pressure locking forces postulated to occur under design-basis accident conditions:

- Calculation A10.1-AD-003, "Pressure Locking Evaluation of MOVs," dated June 15, 1995
- NER-2M-007, "Pressure Locking/Thermal Binding of Safety-Related Power-Operated Gate Valves," Revision 1, dated August 26, 1996
- MPR-1691, "Evaluation of MOV Pressure Locking Effects," dated November 7, 1995
- NEP-DES-340, "Design Calculations," Revision 7, dated August 16, 1994

b. Observations and Findings

In June 1995, the NRC issued a Notice of Violation for failure to identify and correct promptly a condition adverse to quality concerning the susceptibility to pressure locking of high pressure core spray (HPCS) system valves 2CHS*MOV107 and 2CHS*MOV118. As documented in NRC Inspection Report 50-220 & 410/95-11, the violation was cited, in part, because NMPC had not performed calculations to confirm its judgement that the valves were not susceptible to pressure locking. The licensee performed calculation A10.1-AD-003 in response to the NRC finding. In the calculation, NMPC determined thrust requirements both assuming valve disk leakage (i.e., the "credible" case), and assuming the valves to be leak tight (i.e., the

"noncredible" case). NMPC compared the required thrusts to calculated motor-actuator capability and concluded that the valves were operable in the short term based on the "...present material state of the valves" (i.e., the credible case). Regarding valve 2CHS*MOV107, the NRC considered the licensee's position to be acceptable.

Recognizing the NRC position, documented Supplement 6 of GL 89-10, that valve leakage was not an acceptable approach to assessing long-term design-basis capability of susceptible MOVs, NMPC contracted MPR Associates to perform a long-term operability evaluation of susceptible valves at NMP-2 in accordance with the guidelines in GL 95-07. The results of the evaluation were documented in MPR-1691 in November 1995. Using these results, the licensee again concluded that the valves were "...highly likely of being able to perform their required opening functions when required to do so and additional modifications are not presently considered warranted." This conclusion was based on: (1) calculated motor-actuator capability, and (2) the judgement that the methodology utilized by MPR Associates in calculating required thrust was "extremely conservative."

The inspector performed independent calculations of required thrust using the method developed by Commonwealth Edison and design inputs and test data contained in NMPC documents. The results were roughly comparable to those reached by MPR Associates and the licensee's "noncredible" case. However, the inspector identified that NMPC incorrectly used run efficiency to calculate motor-actuator capability, causing the licensee to overestimate motor-actuator output thrust. Using pullout efficiency, the inspector concluded that the valves likely were not capable of overcoming design-basis pressure locking conditions without assuming disk leakage. The licensee subsequently agreed with this assessment and modified the valves to eliminate their susceptibility to pressure locking prior to startup from the refueling outage.

10 CFR Part 50, Appendix B, Criterion III, "Design Control," requires that measures shall be established to assure that the design basis for components is correctly translated into specifications, drawings, procedures, and instructions. Design control measures shall provide for verifying or checking the adequacy of design, such as by the performance of design reviews. This requirement is implemented by Section B.3 of the NMPC Quality Assurance Program Topical Report (NMPC-QATR-1), Nine Mile Point Nuclear Station Units 1 & 2 Operations Phase. Section B.3 of NMPC-QATR-1 states, in part, that design controls apply to preparation, review, and revision of design documents, and that Nuclear Engineering Department responsibilities include preparation, review, and approval of design inputs and engineering analyses. Nuclear Engineering Procedure NEP-DES-340, Design Calculations, step 2.1 requires the discipline supervisor to review calculation assumptions, and the validity of their application. Step 2.3 of the procedure requires the calculation checker/reviewer to check calculation assumptions.

The inspector considered motor-actuator efficiency to be a design input for calculating the performance characteristics of MOVs. NMPC's failure properly to identify the inappropriate use of run efficiency during the performance of

calculation A10.1-AD-003 resulted in overestimation of the design-basis capability of valves 2CHS*MOV107, 2ICS*MOV126, 2RHS*MOV25A, and 2RHS*MOV25B. As a result, the valves likely would not have operated under design-basis pressure locking conditions. This is an apparent violation (EEI 50-410/96-15-02) of the design control requirements of 10 CFR 50, Appendix B.

c. Conclusions

Utilization of an incorrect design input in a calculation of design-basis MOV capability resulted in a licensee decision to defer modifications to preclude pressure locking of four risk-significant motor-operated gate valves. The licensee modified the valves prior to startup from the refueling outage. Further NRC evaluation of NMPC's actions regarding pressure locking and thermal binding of safety-related valves will be conducted under GL 95-07 and item EEI 50-410/96-15-01.

E8.2 (Open) Followup Item 50-410/95-11-05: Revise MOV switch setting and capability calculations based on industry and site-specific test data. This item included: (1) establishment of an appropriate approach to address load sensitive behavior; (2) justification of the generic stem friction coefficient assumption; (3) revision of design-basis thrust calculations to reflect measured load sensitive behavior; and (4) screening of globe valve thrust calculations for the appropriate area term. Items (1) through (3) are discussed in Sections E1.4 and E1.5 of this report. NMPC analyzed the safety-related globe valves at NMP-2 for seat-based versus guide-based behavior, and incorporated the appropriate area terms into its design-basis thrust calculations. This item remains open pending review the MOV program assumptions regarding load sensitive behavior and stem friction coefficient.

E8.3 (Open) Followup Item 50-410/95-11-06: Analyze dynamic test data for all valves in the GL 89-10 program. This item included: (1) consistency of NMPC's grouping methodology with the minimum test recommendations of GL 89-10, Supplement 6; (2) evaluation of diagnostic equipment uncertainty when open thrust measurements are outside of the VOTES sensor calibration range; and (3) technical justification of "large" extrapolations of dynamic test results to design-basis conditions. Item (1) is discussed in Section E1.3 of this report. While no valve operability concerns were identified, items (2) and (3) were not reviewed in detail during this inspection.

E8.4 (Closed) Followup Item 50-410/95-11-04: Establish a program to verify periodically the design-basis capability of safety-related MOVs. NMPC's plan for periodic verification of MOV capability is documented in NER-2M-009, "Periodic Verification." Under the plan, starting with at the next refueling outage (RFO6), 57 high risk-significance valves will be tested statically every five years or three refueling outages, whichever is greater. Beginning with the current refueling outage (RFO5), three additional MOVs will be tested dynamically. NMPC intends to evaluate the dynamic test results to (1) justify assumed valve factors, (2) validate the valve degradation program assumptions, and (3) determine the need for, and

value of, periodic dynamic testing. The remaining MOVs will be tested statically such that each MOV is tested at least once every 10 years. The inspector considered the licensee's periodic verification plan to be acceptable for GL 89-10 program closure. Further NRC review of this matter will be conducted under GL 96-05, "Periodic Verification of Safety-Related Motor-Operated Valves."

E8.5 Nine Mile Point Unit 1 Motor-Operated Valve Review

a. Inspection Scope

In light of the programmatic deficiencies identified at NMP-2, the inspectors reviewed a sample of risk-significant MOVs at Unit 1 to assess current operability. The review included technical assumptions, current capability margins, and design-basis thrust calculations for the following valves:

31-07	High pressure reactor feedwater isolation
31-08	High pressure reactor feedwater isolation
33-02R	Reactor water cleanup isolation
39-09R	Emergency condenser steam isolation
39-10R	Emergency condenser steam isolation
40-01	Core spray isolation
40-09	Core spray isolation

b. Observations and Findings

The GL 89-10 program at NMP-1 is scheduled for completion at the end of the next refueling outage in Spring 1997. The technical assumptions used to setup the MOVs were based on industry test results and limited plant-specific data, and included: (1) a generic gate valve factor of 0.5 (with exceptions), (2) a stem coefficient of 0.2, and (3) a load sensitive behavior bias term of 10%. The inspectors considered the assumptions to be reasonable, but found the licensee's justifications to be largely qualitative; viz. more rigorous analysis will be needed to achieve program closure quality. The licensee had modified susceptible MOVs to preclude pressure locking.

The inspectors identified an error in the design-basis thrust calculation for feedwater isolation valve 31-07 in which run versus pullout efficiency had been used to assess actuator motor capability. The licensee subsequently identified similar errors in the calculations for feedwater isolation valve 31-08 and containment vent and purge valve 201-31. The licensee declared valve 201-31 inoperable pending additional evaluation, and imposed administrative controls to maintain the valve in its required safe position. The feedwater valve calculation errors did not adversely affect current operability.

The inspectors concluded that the sampled MOVs currently were operable based on the following considerations:

- Valves 31-07 and 31-08 are nontestable 14-inch, 900 psi Rockwell/Edwards equiwedge gate valves. The assigned valve factor is 0.45, based on a single EPRI steam blowdown test, and the available valve factors are 0.52 and 0.56, respectively. The stem friction coefficients measured during static testing were well below the assumed value of 0.2, and the torque switches are bypassed during 95% of the closed valve stroke.

- Valve 33-02R is a nontestable, 6-inch, 900 psi Anchor-Darling double disk gate valve. The assumed valve factor is 0.5, and the available valve factor is 0.61. The measured stem friction coefficient was 0.13 compared to the 0.2 value assumed in the design-basis thrust calculation.

- Valves 39-09R and 39-10R are nontestable, 8-inch, Rockwell/Edwards equiwedge gate valves. The assumed valve factor is 0.5 and the available valve factors are 0.56 and 0.54, respectively. The measured stem friction coefficients were less than the assumed valve of 0.2.

- Valves 40-01 and 40-09 are 12-inch, Crane 900 psi flexible- wedge gate valves. The valve factors derived from dynamic tests of the valves were less than the 0.5 value used to determine the design-basis thrust requirements. In addition, the measured stem coefficients of friction were well below the assumed value of 0.2.

c. Conclusions

The inspectors concluded that the MOVs at NMP-1 were adequately setup to ensure current operability.

E8.6 Review of Updated Final Safety Analysis Report

A recent 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 review that compares plant practices, procedures, and/or parameters to the UFSAR descriptions. While performing the inspections documented in this report, the inspector reviewed motor-operated valves in the RHR-containment spray, RCIC, and HPCS systems, and Sections 6.2 and 6.3 of the UFSAR that related to this area. The inspectors verified that the UFSAR wording was consistent with the observed plant practices and procedures.

V. Management Meetings

X1 Exit Meeting Summary

NMPC was informed of the scope and purpose of this inspection at an entrance meeting on October 7, 1996. Observations and findings were discussed with NMPC representatives during the course of the inspection, including a technical meeting held in Region I on October 18, and telephone conferences conducted on October 15, 22, 23, and 24. The issues discussed in this report were discussed again with NMPC in a November 15, 1996 telephone exit meeting. No proprietary materials were reviewed during this inspection. NMPC did not dispute the inspection findings at the exit meeting.

X2 Management Meeting

On October 25, 1996, a management meeting with NMPC was conducted at the NRC Region I office to discuss the status of the NMP motor-operated valve testing program and commitments relative to Generic Letter 89-10.

PARTIAL LIST OF PERSONS CONTACTED

Licensee

D. Baker	Supervisor, Licensing
J. Conway	Plant Manager - NMP-2
D. Hanretty	Supervisor, NMP-2 Project Managers
M. McCormick	Vice President - Nuclear Safety Assessment Services
C. Terry	Vice President - Nuclear Engineering

NRC

D. Dempsey	Reactor Engineer, DRS
T. Scarbrough	Senior Mechanical Engineer, NRR/EMEB

INSPECTION PROCEDURES USED

TI 2515/109:	Inspection Requirements for Generic Letter 89-10, Safety-Related Motor-Operated Valve Testing and Surveillance

ITEMS OPENED, CLOSED, AND DISCUSSED

Opened

50-410/96-15-01	URI	potential for loss of remote shutdown capability during a control room fire
50-410/96-15-02	EEI	failure to verify or check MOV pressure locking calculation inputs

Closed

50-410/93-21-02	URI	pressure locking/thermal binding of safety-related gate valves
50-410/95-11-01	VIO	failure to identify and correct susceptibility to pressure locking of two MOVs
50-410/95-11-08	IFI	pressure locking/thermal binding of safety-related gate valves
50-410/95-11-04	IFI	establish MOV periodic verification program

Discussed

50-410/95-11-05	IFI	revise MOV switch setting and capability calculations
50-410/95-11-06	IFI	analyze dynamic test data for GL 89-10 program valves
50-220/95-11-07	IFI	trending of MOV failures and performance

LIST OF ACRONYMS USED

ANSI	American National Standards Institute
CFR	Code of Federal Regulations
EEI	Escalated Enforcement Item
EPRI	Electric Power Research Institute
GL	Generic Letter
HPCS	High Pressure Core Spray
IFI	Inspection Followup Item
ISEG	Independent Safety Engineering Group
LPCS	Low Pressure Core Spray
MOV	Motor-Operated Valve
NMP	Nine Mile Point
NMPC	Niagara Mohawk Power Corporation
NRC	Nuclear Regulatory Commission
PPM	Performance Prediction Model
PPP	Performance Prediction Program
RCIC	Reactor Core Isolation Cooling
RFO	Refueling Outage
RHR	Residual Heat Removal