UNITED STATES
NUCLEAR REGULATORY COMMISSION
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SAFETY EVALUATION BY THE OFFICE OF NUCLEAR REACTOR REGULATION

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

NORTHERN STATES POWER COMPANY

MONTICELLO NUCLEAR GENERATING PLANT

DOCKET NO. 50-263

1.0 INTRODUCTION

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

Upon identification of the weaknesses in MOV performance, significant industry and regulatory activities were initiated to verify the design-basis capability of safety-related MOVs in nuclear power plants. After completion of these activities, nuclear power plant licensees began establishing long-term programs to maintain the design-basis capability of their safety-related MOVs. This safety evaluation addresses the program developed by Northern States Power Company (the licensee) to verify periodically the design-basis capability of safety-related MOVs at the Monticello Nuclear Generating Plant.

2.0 REGULATORY REQUIREMENTS

The NRC regulations require that MOVs important to safety be treated in a manner that provides assurance of their intended performance. Criterion 1 to Appendix A, "General Design Criteria for Nuclear Power Plants," to Part 50 of Title 10 of the *Code of Federal Regulations* (10 CFR Part 50) states, in part, that structures, systems, and components important to safety shall be designed, fabricated, erected, and tested to quality standards commensurate with the importance of the safety functions to be performed. The quality assurance program to be applied to safety-related components is described in Appendix B, "Quality Assurance Criteria for Nuclear Power Plants and Fuel Reprocessing Plants," to 10 CFR

ENCLOSURE

Part 50. In Section 50.55a of 10 CFR Part 50, the NRC requires licensees to establish inservice testing (IST) programs in accordance with Section XI of the American Society of Mechanical Engineers (ASME) Boiler and Pressure Vessel Code.

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

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

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

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

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

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

The NRC staff is preparing safety evaluations on the response of each licensee to GL 96-05. The NRC staff intends to rely to a significant extent on an industry initiative to identify valve age-related degradation that could adversely affect the design-basis capability of safety-related MOVs (described in Section 3.0) where a licensee commits to implement that industry program. The NRC staff will conduct inspections to verify the implementation of GL 96-05 programs at nuclear power plants as necessary.

3.0 JOINT OWNERS GROUP PROGRAM ON MOV PERIODIC VERIFICATION

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

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

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

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

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

4.0 MONTICELLO GL 96-05 PROGRAM

On November 15, 1996, Northern States Power Company (NSP) submitted a 60-day response to GL 96-05 notifying the NRC that it would complete the actions requested by GL 96-05 for MOVs within the scope of the GL 89-10 program at Monticello. On March 13, 1997, the licensee submitted a 180-day response to GL 96-05 providing a summary description of the MOV periodic verification program planned to be implemented at Monticello. In a submittal dated March 23, 1998, the licensee updated its commitment to GL 96-05. On November 4, 1998, the licensee provided a response to a request for additional information regarding GL 96-05 forwarded by the NRC staff on September 10, 1998.

In its letter dated March 23, 1998, the licensee stated that it plans to continue participating in the JOG Program on MOV Periodic Verification as a member of the BWROG and plans to implement the program described in Topical Report NEDC-32719 (Revision 2). In its submittal dated March 13, 1997, the licensee described the implementation of the JOG program for implementation at Monticello. With respect to its interim MOV static diagnostic testing program, the licensee indicated in its letter dated November 4, 1998, that it had applied the BWROG methodology for ranking MOVs based on their safety significance as described in BWROG Topical Report NEDC-32264 and the NRC safety evaluation dated February 27, 1996. In its letter dated March 13, 1997, the licensee stated that it would begin implementation of the JOG program prior to the end of the cycle 18 refueling outage (early 1998). In a telephone conference on February 23, 1999, with the NRC staff, the licensee indicated that the JOG program is currently being implemented at Monticello.

5.0 NRC STAFF EVALUATION

The NRC staff has reviewed the information provided in the licensee's submittals describing the program to verify periodically the design-basis capability of safety-related MOVs at Monticello in response to GL 96-05. The staff also reviewed NRC Inspection Report (IR) 50-263/95003 which provided the results of an inspection to evaluate the completion of the licensee's program to verify the design-basis capability of safety-related MOVs in response to GL 89-10. Together with a letter from the licensee dated April 26, 1995, the NRC staff closed the review of the GL 89-10 program at Monticello in IR 95003. The NRC staff's evaluation of the licensee's response to GL 96-05 is described below.

5.1 MOV Program Scope

In GL 96-05, the NRC staff indicated that all safety-related MOVs covered by the GL 89-10 program should be considered in the development of the MOV periodic verification program. The NRC staff noted that the program should also consider safety-related MOVs that are assumed to be capable of returning to their safety position when placed in a position that prevents their safety system (or train) from performing its safety function; and the system (or train) is not declared inoperable when the MOVs are in their nonsafety position. In its letter dated November 15, 1996, the licensee stated that the actions requested by GL 96-05 would be completed for MOVs within the scope of the Monticello GL 89-10 MOV program.

In addition to detailed monitoring of MOVs within the scope of GL 89-10, the licensee stated in its letter dated March 13, 1997, that the GL 96-05 program at Monticello will address to a lesser extent those safety-related MOVs that are not within the scope of GL 89-10. The licensee noted that those MOVs would be addressed by (1) declaring the system (or train) inoperable when the MOV is in a nonsafety position, or (2) providing adequate confidence in the capability of the MOV to return to its safety position under design-basis accident conditions. In the telephone conference on February 23, 1999, the licensee stated that the applicable Limiting Conditions for Operation (LCO) in the plant Technical Specifications (TS) were entered for all but five safety-related MOVs outside the scope of GL 89-10 when those MOVs are placed in their nonsafety positions. The licensee indicated that those five safety-related MOVs outside of GL 89-10 for which the LCO is not entered were initially included in the GL 89-10 program, and that they had been evaluated and diagnostically tested according to the Monticello GL 89-10 program procedures. Further, although its letter dated March 13, 1997, suggested that torque switch adjustments of those MOVs might not be performed until the next scheduled maintenance activity, the licensee reaffirmed during the telephone conference that it would continue to ensure that the MOVs can return to their safety position if called upon to operate, or the applicable LCO would be entered, when in their nonsafety position.

The NRC staff considers the licensee to have made adequate commitments regarding the scope of its MOV program under GL 96-05.

5.2 MOV Assumptions and Methodologies

The NRC staff expects licensees to maintain the assumptions and methodologies used in the development of its MOV programs for the life of the plant (a concept commonly described as a "living program"). For example, the design basis of safety-related MOVs will need to be

maintained up to date, including consideration of any plant modifications or power uprate conditions.

In IR 95003, the NRC staff reviewed the licensee's justification for the assumptions and methodologies used in the MOV program in response to GL 89-10 at Monticello. With certain long-term aspects discussed in the following section, the staff determined that the licensee had adequately justified the assumptions and methodologies used in its MOV program. In its letter dated November 4, 1998, the licensee discussed ongoing activities, such as monitoring stem friction coefficient and reviewing motor actuator output, to update its MOV program assumptions and methodologies. During the telephone conference on February 23, 1999, the licensee noted that its power uprate program includes review of the design-basis conditions of certain MOVs. The NRC staff considers the licensee to have adequate processes in place to maintain the assumptions and methodologies used in its MOV program, including the design basis of its safety-related MOVs.

5.3 GL 89-10 Long-Term Items

When closing the NRC review of the GL 89-10 program at Monticello, the NRC staff discussed in IR 95003 several aspects of the licensee's MOV program to be addressed over the long term. In its submittal dated November 4, 1998, the licensee reported on the status of those GL 89-10 long-term items. For example, the licensee had reviewed the capability of eight MOVs that have a design-basis function to close under blowdown flow conditions and had applied the Electric Power Research Institute (EPRI) MOV Performance Prediction Methodology (PPM) in evaluating those MOVs. The licensee reported that three of those MOVs satisfied the EPRI MOV PPM calculations. The other five MOVs did not meet the EPRI MOV PPM calculations and the licensee had scheduled replacement of those valves during the next two refueling outages. In the telephone conference on February 23, 1999, and during follow-up telephone conferences on March 9 and March 11, 1999, the licensee discussed its preparation of operability evaluations for those five MOVs and its confidence that the MOVs could perform their safety functions until scheduled modifications are completed. As noted in IR 95003, the NRC staff is addressing the licensee's actions in response to GL 95-07, "Pressure Locking and Thermal Binding of Safety-Related Power-Operated Gate Valves," separately.

In IR 95003, the NRC staff found the licensee's program for trending MOV performance to be well developed and capable of tracking and evaluating data to maintain MOV design-basis capability. The NRC staff also discussed the trending of preventative and corrective maintenance. In its letter dated November 4, 1998, the licensee indicated additional qualitative and quantitative trending methods including periodic MOV static diagnostic testing and preventive maintenance activities, such as periodic stem lubrication, actuator gearcase grease inspection, and actuator refurbishment. In IR 95003, the NRC staff noted that the licensee prepared periodic trending reports on MOV performance.

In IR 95003, the NRC staff concluded that the licensee had demonstrated the design-basis capability of the safety-related MOVs at Monticello. Based on the licensee's submittals and discussions, the NRC staff considers the completed and ongoing long-term GL 89-10 actions at Monticello to be acceptable.

5.4 JOG Program on MOV Periodic Verification

In its letter dated March 23, 1998, the licensee updated its commitment to implement the JOG Program on MOV Periodic Verification as described in Topical Report NEDC-32719 (Revision 2). In a safety evaluation dated October 30, 1997, the NRC staff accepted the JOG program as an industry-wide response to GL 96-05 with certain conditions and limitations. The licensee's commitment to implement the JOG program includes (1) the JOG interim static diagnostic test program, (2) the JOG 5-year dynamic test program, and (3) the JOG long-term periodic test program. The NRC staff considers the commitments by the licensee to implement the JOG program at Monticello to be an acceptable response to GL 96-05 for valve age-related degradation. The licensee is responsible for reviewing and implementing the limitations and conditions discussed in the NRC safety evaluation dated October 30, 1997, in applying the JOG program at Monticello. This includes the coordination and feedback of test information obtained from the JOG dynamic test program. Where the licensee proposes to implement an approach at Monticello different from the JOG program, the licensee will be expected to notify the NRC and to provide justification for the proposed alternative approach.

In its submittal dated March 13, 1997, the licensee presented its interim MOV static diagnostic test program with a test frequency based on MOV risk prioritization and MOV performance margin. The MOV static diagnostic test frequency matrix at Monticello is consistent with the JOG recommendations. Guidance for the calculation of MOV margin is provided in the JOG Topical Report NEDC-32719 and the NRC safety evaluation dated October 30, 1997. In its letter dated November 4, 1998, the licensee reported that it had applied the BWROG methodology for ranking MOVs based on their safety significance as described in BWROG Topical Report NEDC-32264 and the NRC safety evaluation dated February 27, 1996. Based on the licensee's application of the BWROG methodology and the NRC safety evaluation dated February 27, 1996, the NRC staff considers the licensee's methodology for risk ranking of MOVs at Monticello to be acceptable.

The JOG program is intended to address most gate, globe, and butterfly valves used in safety-related applications in the nuclear power plants of participating licensees. The JOG indicates that each licensee is responsible for addressing any MOVs outside the scope of applicability of the JOG program. In the NRC safety evaluation dated October 30, 1997, the NRC staff specifies that licensees implementing the JOG program must determine any MOVs outside the scope of the JOG program (including service conditions) and justify a separate program for periodic verification of the design-basis capability of those MOVs. In its letter dated March 13, 1997, the licensee stated that it had reviewed the JOG program scope of applicability with respect to valve characteristics (valve type, disk and seat ring materials, guide rail and slot surface materials) and had determined that the JOG scope encompassed the applicable Monticello GL 96-05 MOVs. The NRC staff expects significant information to be obtained on the performance and potential degradation of safety-related MOVs during the interim static diagnostic test program and the JOG dynamic test program. As the test results are evaluated, the JOG might include or exclude additional MOVs with respect to the scope of its program. Although the test information from the MOVs in the JOG dynamic test program might not be adequate to establish a long-term periodic verification program for each MOV outside the scope of the JOG program, sufficient information should be obtained from the JOG dynamic test program to identify any immediate safety concern for potential valve age-related degradation during the interim period of the JOG program. Therefore, the NRC staff considers it acceptable for the licensee to apply its interim static diagnostic test program to GL 96-05 MOVs that might

be found to be outside the scope of the JOG program with the feedback of information during the JOG dynamic test program. Upon completion of the JOG dynamic test program and development of the JOG long-term MOV periodic verification criteria, the licensee will be expected to establish a long-term MOV periodic verification program for those MOVs outside the scope of the JOG program by applying information from the JOG program or additional dynamic tests, as necessary.

5.5 Motor Actuator Output

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

In its submittal dated November 4, 1998, the licensee stated that, in addressing the potential degradation of MOV actuator delivered thrust or torque, it would continue to (1) perform periodic static diagnostic testing of MOVs to confirm MOV capability and proper control switch settings consistent with previous commitments; (2) perform appropriate preventative maintenance activities such as stem lubrication, actuator gearcase grease inspection, and actuator refurbishment to provide reasonable confidence of proper actuator performance; and (3) apply appropriate margins to account for actuator degradations such as stem lubricant degradation, spring pack relaxation, and rate of loading. The NRC staff notes that several parameters can be obtained during MOV static and dynamic testing to help identify motor actuator output degradation when opening and closing the valve including, as applicable, capability margin, thrust and torque at control switch trip, stem friction coefficient, load sensitive behavior, and motor current. Further, plant-specific and JOG test information can provide support for the licensee's plan for monitoring MOV motor actuator output and its potential degradation. In IR 95003, the NRC staff discussed the importance of monitoring various MOV parameters (such as stem lubricant degradation) at Monticello, and reported that the licensee had established a trending program for MOV performance parameters. During the telephone conference on February 23, 1999, the licensee discussed several MOV parameters being monitored to provide assurance that degradation in MOV performance can be identified and indicated that no MOV performance degradation had been identified to date.

In its submittal dated November 4, 1998, the licensee stated that it had revised the methodology used in the Monticello MOV program for predicting the output of ac-powered Limitorque motor actuators in response to Limitorque Technical Update 98-01 and its Supplement 1. The licensee reported that it had implemented an approach developed by the Commonwealth Edison Company (ComEd) and had confirmed that the GL 96-05 ac-powered MOVs remain capable of performing their design-basis functions. The licensee will be expected to incorporate any changes in the ComEd methodology that might result from the Limitorque updated guidance. In Supplement 1 to Technical Update 98-01, Limitorque noted that a future technical update would be issued to address the application of dc-powered motors in MOVs. During the telephone conference on February 23, 1999, the licensee discussed its evaluation of dc-powered MOV output (including potential ambient temperature effects) and indicated that it

is participating in a BWROG activity to address the new industry information on dc-powered motor actuator output.

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

6.0 CONCLUSION

On the basis of this evaluation, the NRC staff finds that the licensee has established an acceptable program to verify periodically the design-basis capability of the safety-related MOVs at Monticello. Therefore, the staff concludes that the licensee has adequately addressed the actions requested in GL 96-05. The NRC staff may conduct inspections at Monticello to verify the implementation of the MOV periodic verification program is in accordance with the licensee's commitments, this NRC safety evaluation, the NRC safety evaluation dated October 30, 1997, on the JOG Program on MOV Periodic Verification, and the NRC safety evaluation dated February 27, 1996, on the BWROG methodology for ranking MOVs by their safety significance.

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