May 15, 2001

Mr. S. K. Gambhir
Division Manager - Nuclear Operations
Omaha Public Power District
Fort Calhoun Station FC-2-4 Adm.
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Fort Calhoun, NE 68023-0399

SUBJECT: SAFETY EVALUATION OF LICENSEE RESPONSE TO GENERIC LETTER 96-05, "PERIODIC VERIFICATION OF DESIGN-BASIS CAPABILITY OF SAFETY-RELATED MOTOR-OPERATED VALVES," FORT CALHOUN STATION, UNIT NO. 1 (TAC NO. M97049)

Dear Mr. Gambhir:

On September 18, 1996, the Nuclear Regulatory Commission (NRC) issued Generic Letter (GL) 96-05, "Periodic Verification of Design-Basis Capability of Safety-Related Motor-Operated Valves," requesting each nuclear power plant licensee to establish a program, or to ensure the effectiveness of its current program, to verify on a periodic basis that safety-related motor-operated valves (MOVs) continue to be capable of performing their safety functions within the current licensing bases of the facility.

By letter dated November 15, 1996, Omaha Public Power District (OPPD) provided its 60- and 180-day response to the recommendations of GL 96-05 and described its long-term MOV periodic verification program for Fort Calhoun Station. By letter dated January 25, 2001, OPPD provided additional information regarding its long-term MOV periodic verification program in response to a request from the NRC staff dated December 13, 2000.

The NRC has reviewed the licensee's submittals and applicable NRC inspection reports for the MOV program at Fort Calhoun. Based on our review, the staff finds that OPPD has established an acceptable program to verify periodically the design-basis capability of the safety-related MOVs at Fort Calhoun. As discussed in the enclosed safety evaluation (SE), the staff concludes that OPPD is adequately addressing the actions requested in GL 96-05. The NRC staff may conduct additional inspections at Fort Calhoun to verify the implementation of the MOV periodic verification program is in accordance with OPPD's commitments and this SE.

With the issuance of the enclosed SE, TAC No. M97049 is closed. If you have any questions regarding the SE, please contact me at (301) 415-1445.

Sincerely,

/RA/

Alan B. Wang, Project Manager, Section 2
Project Directorate IV & Decommissioning
Division of Licensing Project Management
Office of Nuclear Reactor Regulation

Docket No. 50-285

Enclosure: Safety Evaluation

cc w/encl: See next page

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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"

OMAHA PUBLIC POWER DISTRICT

FORT CALHOUN STATION, UNIT NO.1

DOCKET NO. 50-285

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 its 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, in-service 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 (SE) addresses the program developed by Omaha Public Power District (OPPD/the licensee) to verify on a periodic basis the design-basis capability of safety-related MOVs at the Fort Calhoun Station.

2.0 REGULATORY REQUIREMENTS

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

of 10 CFR Part 50, the NRC requires licensees to establish in-service testing (IST) programs in accordance with the American Society of Mechanical Engineers (ASME) *Boiler and Pressure Vessel Code*, and more recently the ASME *Code for Operation and Maintenance of Nuclear Power Plants*.

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 3 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 7 supplements to GL 89-10 that provided additional guidance and information on MOV program scope, design-basis reviews, switch settings, testing, periodic verification, trending, and schedule extensions. GL 89-10 and its supplements provided only limited guidance regarding MOV periodic verification and the measures appropriate to assure preservation of design-basis capability. Consequently, the staff determined that additional guidance on the periodic verification of MOV design-basis capability should be prepared.

On September 18, 1996, the NRC staff issued GL 96-05, "Periodic Verification of Design-Basis Capability of Safety-Related Motor-Operated Valves," requesting each licensee 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 GL 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 an SE on the response of each licensee to GL 96-05. The NRC staff is conducting inspections to verify the implementation of GL 96-05 programs at nuclear power plants as necessary.

3.0 FORT CALHOUN GL 96-05 PROGRAM

By letter dated November 15, 1996, OPPD provided its response to the recommendations of GL 96-05 and described its long-term MOV periodic verification program for Fort Calhoun Station. By letter dated January 25, 2001, the licensee provided additional information regarding its long-term MOV periodic verification program in response to a request from the NRC staff dated December 13, 2000.

In its letter dated November 15, 1996, the licensee stated that it had previously established, in response to GL 89-10, a periodic verification program that ensures that affected MOVs are capable of performing their safety functions within the current licensing basis of Fort Calhoun. The licensee stated that it had determined that no changes were necessary as a result of GL 96-05. The licensee noted that it was considering possible alternative approaches to the current MOV program at Fort Calhoun. One possible approach was to include ranking the GL 96-05 MOVs based on their risk significance and capability margin in order to determine a frequency for periodic verification testing. The licensee stated that it would notify the NRC in writing if such changes were implemented.

The licensee stated in its letter dated November 15, 1996, that it will perform periodic verification testing of MOVs in the GL 96-05 program at Fort Calhoun every 5 years or 3 refueling outages, whichever is longer. This testing will consist of static diagnostic testing and full flow dynamic testing of each GL 96-05 MOV with certain exceptions. The particular exceptions include dynamic testing of 3 of the 8 high pressure safety injection (HPSI) MOVs, and 2 of the 4 low pressure safety injection (LPSI) MOVs. In addition, it is not practical to dynamically test in-situ the pressurizer power-operated relief valve (PORV) block valves HCV-150 and HCV-151. For these valves the switches are set based on prototype test data. It is not practical to test dynamically under full flow conditions, containment sump isolation valves HCV-383-3 and HCV-383-4. For these valves the switches are set based on analytical techniques with periodic testing using a hydrostatic pump. Shutdown cooling isolation valves HCV-347 and HCV-348 cannot be tested at greater than 50 percent of full design flow. For these valves the switches are set using analytical techniques with periodic testing under partial flow conditions. Volume control tank outlet valve HCV-218-2 could only achieve 20 percent of design-basis differential pressure during testing. For this valve the switch is set using analytical techniques.

In its letter dated January 25, 2001, the licensee provided specific information on the margin available in the capability of the PORV block valves HCV-150 and HCV-151, the shutdown cooling isolation valves HCV-347 and HCV-348, and the volume control tank outlet valve HCV-218-2. The licensee stated that potential valve factor degradation of these MOVs will be monitored through changes in various MOV performance parameters. For example, the licensee monitors packing friction, motor current, and variations in running load for cumulative valve effects. The licensee also evaluates information received from dynamic testing of other GL 96-05 MOVs for applicability to these MOVs. The licensee reviews industry information notices, operating experiences, and industry work group notices; and includes this information

in the Fort Calhoun MOV program, as applicable. These MOVs undergo stroke-time testing in accordance with the Fort Calhoun IST program (HCV-150 and HCV-151 every quarter; and HCV-347, HCV-348, and HCV-218-2 every refueling outage), and diagnostic testing every 3rd refueling cycle under the GL 96-05 program.

4.0 EVALUATION

The NRC staff has reviewed the information provided in the licensee's submittals describing the program at Fort Calhoun to verify periodically the design-basis capability of safety-related MOVs in response to GL 96-05. The staff also reviewed NRC inspection reports (IRs) 50-285/91-22, 94-05, 96-08, and 97-13 which provided the results of inspections at Fort Calhoun to evaluate the licensee's program in response to GL 89-10 to verify the design-basis capability of safety-related MOVs. In a letter dated December 14, 1994, the staff closed its review of GL 89-10 at Fort Calhoun based on the NRC inspection results and licensee submittals. The staff's evaluation of the licensee's response to GL 96-05 is described below.

4.1 MOV Program Scope

In GL 96-05, the NRC staff indicated that all safety-related MOVs covered by the GL 89-10 program should be considered in the development of the MOV periodic verification program. The staff noted that the program should consider safety-related MOVs that are assumed to be capable of returning to their safety position when placed in a position that prevents their safety system (or train) from performing its safety function; and the system (or train) is not declared inoperable when the MOVs are in their non-safety position.

In its letter dated November 15, 1996, the licensee stated that no changes to its MOV program in response to GL 89-10 at Fort Calhoun were found to be necessary as a result of GL 96-05. In IR 94-05, the NRC staff reported that the licensee's MOV program included 27 safety-related MOVs, and 2 non-safety related MOVs that the licensee considered to be in a special test category. The staff did not identify any concerns with the scope of the MOV program at Fort Calhoun. In its letter dated January 25, 2001, the licensee stated that all GL 96-05 MOVs that are stroke-time tested on a quarterly basis had been analyzed and tested to prove their capability to reposition. The licensee also stated that its operating procedures specify that the pressurizer PORVs be declared inoperable when the applicable PORV block valve HCV-150 or HCV-151 is closed.

The NRC staff concludes that the licensee has made adequate commitments regarding the scope of its MOV program at Fort Calhoun.

4.2 MOV Assumptions and Methodologies

Licensees maintain their assumptions and methodologies used in the development of MOV programs consistent with the plant configuration throughout the life of the plant (a concept commonly described as a "living program.") For example, the design basis of safety-related MOVs is maintained up-to-date, including consideration of any plant modifications or power uprate conditions.

In IR 94-05 and in reviewing follow-up submittals by the licensee, the NRC staff evaluated the licensee's justification for the assumptions and methodologies used in the MOV program at Fort Calhoun, and the maintenance of those assumptions and methodologies based on the licensee's review of in-plant and industry information. In its letter dated January 25, 2001, the licensee described the actions to address new information on ac-powered MOV actuator output. The NRC staff concludes that the licensee has adequate processes in place to maintain the assumptions and methodologies used in its MOV program, including the design basis of its safety-related MOVs.

4.3 GL 89-10 Long-Term Items

In its letter dated December 14, 1994, the NRC staff closed its review of the MOV program in response to GL 89-10 implemented at Fort Calhoun based on the licensee's actions to verify the design-basis capability of its safety-related MOVs. The Fort Calhoun MOV program included long-term items in response to GL 89-10 as described in IR 94-05; NRC letter dated December 14, 1994; and licensee letters dated June 16, 1994, and October 14, 1994. These long-term MOV activities have been completed or are ongoing at Fort Calhoun. For example, the NRC staff reported in IR 96-08 that the licensee had provided additional training to maintenance personnel on the proper lubrication of valve stems; replaced an MOV valve stem and repaired a packing leak; and created a preventive maintenance effort to inspect the material condition of accessible valves on a 6-month frequency. Also, the staff reported in IR 96-08 that the licensee had addressed the potential for low voltages being supplied to certain MOVs in its GL 89-10 program. In IR 97-13, the staff reported that the licensee had reviewed its calculations for all safety-related MOVs to ensure that torque switch repeatability was properly addressed with other MOV parameter uncertainties. In its letter dated February 27, 1998, the licensee described actions being taken to address the identification of open safety functions for certain shutdown cooling suction valves, and close safety functions for certain HPSI and LPSI valves.

In GL 89-10, the NRC staff identified pressure locking and thermal binding as potential performance concerns for safety-related MOVs. The NRC staff completed the review of the licensee's actions in response to GL 95-07, "Pressure Locking and Thermal Binding of Safety-Related Power-Operated Gate Valves," at Fort Calhoun in an SE dated May 10, 1999.

In GL 89-10, the NRC staff recommended that MOV performance be trended on a long-term basis. In its letter dated January 25, 2001, the licensee described qualitative and quantitative aspects of its trending of MOV performance. For example, the licensee stated that key MOV parameters are monitored to identify unusual and adverse trends that may affect the operability of MOVs. Trended parameters include torque and thrust at control switch trip; total thrust and torque; running motor current; motor current at the end of the valve stroke; stem friction coefficient; thrust and torque required to overcome differential pressure; and torque switch setting. The licensee plots these parameters for each MOV to help assess the changes over the test interval. The licensee evaluates individual test results against specific criteria, including maximum allowable thrust and torque; control switch trip output versus predicted degraded voltage stall output; thrust margin; measured versus calculated packing load; stem coefficient of friction; and stroke time. The licensee documents MOV problems and discrepancies, and tracks the resolution of identified issues. The licensee also tracks actions taken in response to MOV operating experience found to be applicable to Fort Calhoun.

With the licensee's ongoing implementation of its MOV testing plans and trending program, no outstanding issues regarding the licensee's GL 89-10 program remain at Fort Calhoun.

4.4 Valve Operating Requirements

In its letter dated November 15, 1996, the licensee stated that it would test the MOVs in the GL 96-05 program at Fort Calhoun to verify their capability every 5 years or 3 refueling outages, whichever is longer. The licensee will perform static and full flow dynamic diagnostic testing for each GL 96-05 MOV to identify changes in valve operating requirements with certain exceptions. In particular, the licensee will dynamically test 3 of 8 HPSI MOVs and 2 of 4 LPSI MOVs as part of a grouping approach consistent with the guidance in Supplement 6 to GL 89-10. The licensee stated that the HPSI and LPSI MOVs with the lowest capability margin will be dynamically tested, which will help identify any near-term performance concerns. The licensee determined that PORV block valves HCV-150 and HCV-151; containment sump isolation valves HCV-383-3 and HCV-383-4; shutdown cooling isolation valves HCV-347 and HCV-348; and volume control tank outlet valve HCV-218-2 are not practical to test under full-flow dynamic conditions. Therefore, the licensee uses a combination of static testing, hydrostatic testing, and partial flow testing using diagnostic equipment to monitor the operating requirements for these valves. In its letter dated January 25, 2001, the licensee discussed the valve factor assumptions for these MOVs and their current setup margin above the minimum operating requirements. The licensee increased the setup margin for some of these MOVs during the spring 2001 outage. The licensee evaluates information received from dynamic testing of GL 96-05 MOVs at Fort Calhoun for applicability to MOVs that cannot be dynamically tested. The licensee also reviews industry information notices, operating experiences, and industry work group notices; and includes this information in the Fort Calhoun MOV program, as applicable.

By using a combination of static and dynamic diagnostic testing; setup margin above minimum operating requirements to help bound potential valve age-related degradation; and evaluation of plant-specific test results and generic industry information, the NRC staff concludes that the licensee is implementing an acceptable test program to monitor the valve operating requirements for the GL 96-05 MOVs at Fort Calhoun.

4.5 Motor Actuator Output

As stated in its letter dated November 15, 1996, the licensee will test the MOVs in its GL 96-05 program to verify their capability every 5 years or 3 refueling outages, whichever is longer. In its letter dated January 25, 2001, the licensee described the diagnostic monitoring of MOV performance to identify degradation in motor actuator output. For example, the licensee trends torque and thrust at control switch trip; total thrust and torque; running motor current; motor current at the end of the valve stroke; and stem friction coefficient. The licensee plots the parameters for each MOV to help assess the changes in motor actuator output over the test interval. The licensee also evaluates individual test results against criteria (including maximum allowable thrust and torque; control switch trip output versus predicted degraded voltage stall output; thrust margin; measured versus calculated packing load; stem coefficient of friction; and stroke time) to identify specific MOV output deficiencies

In IR 94-05, the NRC staff discussed its review of the preventive maintenance procedures at Fort Calhoun. As a result of improvements during the previous inspection, the staff considered the procedures to be well written and comprehensive. In its letter dated January 25, 2001, the licensee stated that valve stem cleaning and lubrication are performed at Fort Calhoun every refueling outage on all GL 96-05 MOVs. The licensee also performs actuator lubricant sampling and analysis, and actuator inspections every third refueling outage.

In Technical Update 98-01 and its Supplement 1, Limitorque Corporation provided updated guidance for predicting the torque output of its ac-powered motor actuators. In response to the updated guidance on ac-powered MOV motor actuator output, the licensee stated in its letter dated January 25, 2001, that it had re-reviewed the calculations for the GL 96-05 MOVs. For example, the licensee ensured that actuator pullout efficiency was used in MOV calculations rather than the less conservative value for actuator run efficiency. The licensee revised certain MOV calculations, and also replaced the motors on two MOVs. The licensee reported that the Fort Calhoun GL 96-05 program does not include any dc-powered MOVs.

The NRC staff concludes that the licensee has established sufficient means to monitor MOV motor actuator output and its potential degradation at Fort Calhoun.

5.0 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 Fort Calhoun. Therefore, the staff concludes that the licensee has adequately addressed the actions requested in GL 96-05. The NRC staff may conduct inspections to verify the implementation of the MOV periodic verification program is in accordance with the licensee's commitments and this SE.

Principal Contributor: T. Scarbrough

Date: May 15, 2001