May 30, 2001

Mr. Garry L. Randolph
Vice President and Chief Nuclear Officer
Union Electric Company
Post Office Box 620
Fulton, MO 65251

SUBJECT: CALLAWAY PLANT, UNIT 1 - GENERIC LETTER 96-05, "PERIODIC VERIFICATION OF DESIGN-BASIS CAPABILITY OF SAFETY-RELATED MOTOR-OPERATED VALVES" (TAC NO. M97027)

Dear Mr. Randolph:

On September 18, 1996, the 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.

In letters dated November 6, 1996 (ULNRC-03487), December 12, 1996 (ULNRC-3507), March 13, 1997 (ULNRC-3548), July 28, 1999 (ULNRC-04075), and March 30, 2001 (ULNRC-04430), Union Electric Company responded to the GL. On March 29 through April 2, 1999, the NRC staff conducted an inspection of the GL 96-05 MOV periodic verification program being implemented at Callaway with the results of that inspection documented in NRC Inspection Report 50-483/99-04 dated April 27, 1999.

The staff has reviewed the above letters and applicable NRC inspection reports for the MOV program at Callaway. As discussed in the enclosed safety evaluation, the staff concludes that Union Electric Company has adequately addressed the actions requested in the GL and has established an acceptable program to verify periodically the design-basis capability of the safety-related MOVs at Callaway. Therefore, the staff considers GL 96-05 to be closed for Callaway, although additional inspections at Callaway may be conducted to verify that the implementation of the program is in accordance with the licensee's commitments, as discussed in the enclosed safety evaluation.

Sincerely,

/RA/

Jack Donohew, Senior Project Manager, Section 2
Project Directorate IV
Division of Licensing Project Management
Office of Nuclear Reactor Regulation

Docket No. 50-483

Enclosure: Safety Evaluation

cc w/encl: See next page

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* EMEB Memo dated April 5, 2001.

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SAFETY EVALUATION BY THE OFFICE OF NUCLEAR REACTOR REGULATION

RESPONSES TO GENERIC LETTER 96-05, "PERIODIC VERIFICATION OF

DESIGN-BASIS CAPABILITY OF SAFETY-RELATED MOTOR-OPERATED VALVES"

UNION ELECTRIC COMPANY

CALLAWAY PLANT, UNIT 1

DOCKET NO. 50-483

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 (SE) addresses the program developed by Union Electric Company (the licensee) to verify periodically the design-basis capability of safety-related MOVs at the Callaway 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 Part 50. In Section 50.55a

of 10 CFR Part 50, the NRC requires licensees to establish inservice 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, "Safety-Related Motor-Operated Valve Testing and Surveillance," dated June 28, 1989, 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 actions, 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 conducting inspections to verify the implementation of GL 96-05 programs at nuclear power plants as necessary. The NRC staff is preparing an SE on the response of each licensee to GL 96-05, and this SE addresses the responses to GL 96-05 for Callaway.

3.0 CALLAWAY GL 96-05 PROGRAM

In a letter dated November 6, 1996, Union Electric Company (the licensee) stated that it considered all actions requested in GL 96-05 to be closed for the Callaway Plant based on the NRC's acceptance of its GL 89-10 program. In response to an NRC letter dated November 29, 1996, the licensee stated in its letter dated December 12, 1996, that it would supplement its initial GL 96-05 response to address industry and NRC information related to MOV performance that had become available since completion of the GL 89-10 program at Callaway. In a letter dated March 13, 1997, the licensee asserted that its MOV periodic verification program was a suitable, valid, and effective program for assuring the continuing operability of safety-related MOVs based on its review of industry and NRC information. On March 29 through April 2, 1999, the NRC staff conducted an inspection of the GL 96-05 program being implemented at Callaway with the results of that inspection documented in NRC Inspection Report (IR) 50-483/99-04, dated April 27, 1999. In a letter dated June 18, 1999, the staff requested additional information on the GL 96-05 program at Callaway, and, in a letter dated July 28, 1999, and a supplemental letter dated March 30, 2001, the licensee provided additional information on its MOV program.

The supplemental letter of March 30, 2001, was based on discussions held by the staff with the licensee in conference calls on December 18, 2000, January 16, 2001, and March 21, 2001. Information provided by the licensee for these conferences is provided in ADAMS Accession No. ML010090110.

In response to GL 89-10, the licensee tested 103 of the 148 MOVs in the GL 89-10 program at Callaway under dynamic conditions to determine the operating requirements of those valves. The licensee conducted the dynamic tests of the MOVs in their as-found condition, where possible, to reflect the performance of aged valve surfaces resulting from long service history. The licensee predicted the operating requirements for non-dynamically tested valves in the GL 89-10 program through such methods as the use of the Electric Power Research Institute (EPRI) MOV Performance Prediction Methodology (PPM) or grouping with other dynamically-tested valves at Callaway. The licensee's approach was intended to establish bounding values for the operating requirements for its safety-related MOVs.

As part of its MOV periodic verification program, the licensee has established a static diagnostic test interval of 6 years or 4 refueling cycles for MOVs in its GL 96-05 program. In addition, the licensee will conduct static testing every refueling cycle, and dynamic testing every three refueling outages, for torque-controlled rising-stem (gate and globe) valves in its GL 96-05 program that do not have at least 25 percent capability margin above their design operating requirements. The licensee establishes the capability of its limit-controlled rising-stem valves

and butterfly valves in its GL 96-05 program based on bounding assumptions and other actions. The licensee supported its MOV periodic test method and frequency based on repetitive dynamic testing of specific MOVs at Callaway that revealed no significant valve degradation over the test interval, and its frequency of 18 months for valve stem lubrication and actuator gearbox grease sampling. The licensee prepares MOV performance indicator reports following each refueling outage to provide a qualitative and quantitative trending review of MOV performance.

4.0 NRC STAFF EVALUATION

Under GL 96-05, the NRC staff has reviewed the information provided in the licensee's submittals and IR 99-04, discussed in the previous section, describing the program at Callaway to verify periodically the design-basis capability of safety-related MOVs. In IR 94-02 (dated February 18, 1994), the staff documented its inspection of the completion of the GL 89-10 program at Callaway to verify initially the design-basis capability of safety-related MOVs. Following the review of submittals by the licensee subsequent to that inspection, the staff notified the licensee in a letter dated June 8, 1994, that it had closed the review of the GL 89-10 program at Callaway.

The NRC staff's evaluation of the licensee's response to GL 96-05 at Callaway 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 nonsafety position.

In IR 99-04, the NRC staff reported that the MOV program at Callaway consisted of 148 safety-related MOVs. The staff found that the scope of the licensee's MOV program remained the same as under GL 89-10. Based on the inspection review, the staff determined that the scope of the licensee's MOV program was consistent with the recommendations of GL 96-05.

In its letter of November 6 and December 12, 1996, the licensee stated its commitment to a periodic verification program of the design basis capabilities of safety-related MOVs. In its letter of March 13, 1997, the licensee described its GL 96-05 MOV program including the program scope. The MOV program scope was also indicated in the plant documentation reviewed by the staff during the inspection documented in IR 99-04. In its submittals to the NRC on GL 96-05, the licensee has not taken exception to the MOV program scope in GL 96-05. Because the licensee did not identify any exceptions regarding program scope and the staff did not identify any concerns about program scope in the inspection, the staff considers the licensee to have made adequate commitments regarding the scope of its MOV program.

4.2 MOV Assumptions and Methodologies

Licensees maintain the assumptions and methodologies used in the development of their 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 are maintained up-to-date, including consideration of any plant modifications or power uprate conditions.

In IR 99-04, the NRC staff evaluated the licensee's justification for the assumptions and methodologies used in the MOV program at Callaway, and the maintenance of those assumptions and methodologies. For example, the staff reported that the licensee had updated its MOV program and calculations in response to new information and design changes at Callaway. With the actions underway at Callaway, the staff considers the licensee to have adequate processes in place to maintain the assumptions and methodologies used in its MOV program.

4.3 GL 89-10 Long-Term Items

Through IR 94-02 and its letter dated June 8, 1994, the NRC closed the review of the GL 89-10 program at Callaway based on the licensee's actions to verify the design-basis capability of its safety-related MOVs. In the letter dated June 8, 1994, the staff listed several of the licensee's long-term plans for the GL 89-10 program at Callaway. For example, the licensee planned to obtain MOV dynamic test information to confirm that its program assumptions would be sufficient to compensate for any anticipated performance degradation. In a letter dated September 7, 1995, the licensee reported the results of dynamic tests of several MOVs at Callaway to evaluate potential age-related degradation. The staff reviewed the licensee's actions to address the GL 89-10 long-term items during the inspection documented in IR 99-04, and did not identify any concerns with those actions. Also in GL 89-10, the staff noted pressure locking and thermal binding as potential performance concerns for safety-related MOVs. The staff completed the review of the licensee's actions at Callaway in response to GL 95-07, "Pressure Locking and Thermal Binding of Safety-Related Power-Operated Gate Valves," in an SE dated September 2, 1999.

In GL 89-10, the NRC recommended that MOV performance be trended on a long-term basis. In IR 99-04, the staff noted that the licensee has procedures in place at Callaway for the preparation of MOV performance indicator reports following each refueling outage to provide a qualitative and quantitative trending review of MOV performance. In particular, these reports provide (1) a summary of MOV diagnostic test results; (2) a description of the current setup of all safety-related MOVs; (3) a listing of major MOV work completed; (4) a summary of MOV problem reports; (5) a compilation of trends addressing stroke time, stem factor, motor current, thrust at control switch trip, unseating loads, and running loads; (6) proposed actions to improve MOV capability margins; and (7) planned actions to enhance the overall MOV program.

With the licensee's ongoing trending program, no outstanding issues regarding the licensee's GL 89-10 program remain at Callaway

4.4 Valve Operating Requirements

In IR 99-04, the NRC staff reported that the licensee tested 103 of the 148 MOVs in the GL 89-10 program at Callaway under dynamic conditions to determine the valve operating requirements. The licensee conducted dynamic tests of the MOVs in their as-found condition, where possible, to reflect the performance of aged valve surfaces resulting from long service history. The licensee predicted the operating requirements for non-dynamically tested valves through such methods as the use of the EPRI MOV PPM or grouping with other tested MOVs at Callaway. The licensee has established a margin of 25 percent between the thrust required to operate individual torque-controlled gate and globe (rising-stem) valves in its GL 96-05 program and the thrust delivered by the MOV motor actuator to accommodate valve age-related degradation. The licensee establishes the capability of its limit-controlled rising-stem valves and butterfly valves in its GL 96-05 program based on bounding assumptions and other actions.

To verify its program assumptions, the licensee conducted repeat dynamic tests of several rising-stem and butterfly valves at Callaway that revealed no age-related degradation. In addition to these MOV repeat dynamic tests, the licensee obtained MOV performance information from the similarly designed Wolf Creek nuclear plant and the industry's Motor-Operated Valve Users' Group. The licensee supported its MOV program assumptions and margins as sufficient to bound potential age-related valve degradation for the remaining operating life of the plant based on its MOV dynamic test diagnostic methodology, its testing of MOVs with long service histories under as-found conditions, and its methods to predict operating requirements for non-dynamically tested valves.

In IR 99-04, the staff determined that it would need additional information to evaluate the actual setup requirements and capabilities of the safety-related MOVs at Callaway to complete the review of the licensee's GL 96-05 program. The licensee submitted detailed data on the capability of its GL 96-05 MOVs in its letters dated July 28, 1999, and March 30, 2001. The licensee is continuing its goal of maintaining at least 25 percent margin for the torque-controlled rising-stem valves in the GL 96-05 program. In its letter dated March 30, 2001, the licensee discussed its current setup of limit-controlled rising-stem valves and butterfly valves in its GL 96-05 program to bound potential age-related degradation based on the availability of full motor actuator capability throughout the valve stroke. For example, the licensee has a goal of maintaining a positive capability margin assuming a 0.2 stem/stem nut coefficient of friction for the limit-controlled rising-stem valves with corrective action initiated if margin cannot be maintained assuming a 0.15 stem coefficient of friction. As a change from the approach described in its letter dated September 7, 1995, the licensee specifies that a positive capability margin be maintained for butterfly valves in the GL 96-05 program assuming a 30 percent HBC gearbox efficiency. In support of this approach, the licensee indicated that its limit-controlled butterfly valves (or their seating surfaces) are typically replaced, with subsequent differential pressure testing, as a result of inadequate leak test results prior to significant bearing friction degradation. For butterfly valves that cannot be differential pressure tested, the licensee applies a bounding bearing coefficient of friction based on tests of similar valves in establishing the design torque operating requirement.

Using the information in the licensee's submittals dated July 28, 1999, and March 30, 2001, the staff performed independent calculations to evaluate the capability of the GL 96-05 MOVs at

Callaway at their current setup conditions in terms of their percentage margin above the design requirements. The staff also calculated the "valve factors" that the rising-stem GL 96-05 MOVs at Callaway could achieve at their current setup conditions as a measure of their performance capability. The staff identified certain GL 96-05 MOVs with low capability margin that the licensee is planning to address through monitoring or planned modifications. From its review, the staff determined that the setup conditions of the GL 96-05 MOVs at Callaway are adequate when considered with the planned actions by the licensee.

Based on this information, the licensee has established an acceptable program for establishing operating requirements for MOVs in the GL 96-05 program at Callaway.

4.5 Motor Actuator Output

As noted in IR 99-04, the licensee monitors motor actuator output of the MOVs in the GL 96-05 program at Callaway through periodic static diagnostic testing. The MOV parameters monitored by the licensee to identify potential degradation include thrust, torque, motor current, stem friction coefficient, and stroke time, as appropriate. In its MOV predictive performance reports, the licensee documents the test results and their relationship to applicable limits in monitoring MOV performance. The licensee also conducts preventive maintenance to address potential MOV output degradation. For example, the licensee lubricates the valve stem of each GL 96-05 MOV with an active safety function each fuel cycle. The licensee also samples the grease in the main gearbox of each MOV actuator in the GL 96-05 program each fuel cycle unless longer intervals are justified. The licensee performs additional MOV preventive maintenance every 72 months including evaluation of electrical connections, fasteners, switch settings, limit switch grease, motor current, and oil or packing leaks.

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 IR 99-04, the NRC staff reported that the licensee had revised its MOV calculation methodology at Callaway to incorporate this updated guidance. In responding to the technical update, the licensee identified several MOVs where use of measured stem friction coefficient (instead of the typically-used bounding value) was necessary to demonstrate design-basis capability. The licensee also identified seven rising-stem MOVs that, although able to perform their safety function, might not be able to trip their torque switch upon completing the valve closure stroke at the existing setting. The staff noted that the licensee planned to perform appropriate corrective action (including torque switch setting adjustments or modifications) for its GL 96-05 MOVs during the refueling outage in the spring of 2001. In its letter dated March 30, 2001, the licensee provided additional information on its plans to improve the capability of certain MOVs in light of its review of Limitorque Technical Update 98-01.

In its letter dated July 17, 1998, forwarding Technical Update 98-01, Limitorque indicates that a future technical update will be issued to address the application of dc-powered MOVs. In IR 99-04, the NRC staff reported that the licensee had initiated a review of the capability of the five dc-powered MOVs in the GL 96-05 program at Callaway in light of the new information on dc-powered MOV output. In its letter dated March 30, 2001, the licensee stated that it will address the recent industry information on dc-powered MOV output following Limitorque review of the new information. Any MOV operability concerns that might be identified in the future will

be processed in accordance with established regulatory requirements and plant-specific commitments.

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

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 Callaway. Therefore, the staff concludes that the licensee has adequately addressed the actions requested in GL 96-05. The staff may conduct inspections at Callaway to verify that the implementation of the MOV periodic verification program is in accordance with the licensee's commitments in its submittals and addressed in this SE. Changes to these commitments would be reported to the NRC in accordance with Nuclear Energy Institute (NEI), "Guideline for Managing NRC Commitments," dated June 9, 1995, in which safety significant changes would be discussed with the NRC before the change is made.

Principal Contributor: Thomas Scarbrough

Date: May 30, 2001