

December 29, 2000

Mr. Robert G. Byram  
Senior Vice President  
and Chief Nuclear Officer  
PP&L, Inc.  
2 North Ninth Street  
Allentown, PA 18101

SUBJECT: SAFETY EVALUATION OF LICENSEE RESPONSE TO GENERIC LETTER  
96-05, SUSQUEHANNA STEAM ELECTRIC STATION, UNITS 1 AND 2  
(TAC NOS. M97109 AND M97110)

Dear Mr. Byram:

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.

On November 18, 1996, PPL Susquehanna, LLC (the licensee, doing business at that time as Pennsylvania Power & Light Company), submitted a 60-day response to GL 96-05 notifying the NRC that it would implement the requested MOV periodic verification program at Susquehanna Steam Electric Station, Units 1 and 2. On March 17, 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 Susquehanna. In a letter dated September 17, 1998, the licensee revised its 180-day GL 96-05 response. On July 15, 1999, the licensee provided a response to a request for additional information regarding GL 96-05 forwarded by the NRC staff on April 12, 1999. On February 17, 2000, NRC management from Region I met with the licensee to discuss MOV topics. The licensee summarized the results of the meeting in a letter dated May 31, 2000, as supplemented by letter dated September 15, 2000. The September 15, 2000, letter corrected an administrative error in its May 31, 2000, letter.

The staff has reviewed the licensee's submittals and applicable NRC inspection reports for the MOV program at Susquehanna. The staff finds that the licensee has established an acceptable program to verify periodically the design-basis capability of the safety-related MOVs at Susquehanna through its commitment to all three phases of the Joint Owners Group (JOG) Program on MOV Periodic Verification with the alternatives and additional actions described in its submittals. As part of this review, the staff considers the licensee's specific alternatives to the JOG program to be acceptable. As discussed in the enclosed safety evaluation (SE), the staff concludes that the licensee is adequately addressing the actions requested in GL 96-05. The staff may conduct inspections at Susquehanna to verify the implementation of the MOV periodic verification program is in accordance with the licensee's commitments, this SE, the NRC SE dated October 30, 1997, on the JOG Program on MOV Periodic Verification, and the NRC SE dated February 27, 1996, on the Boiling Water Reactors Owners Group methodology for ranking MOVs by their safety significance.

Sincerely,

*/RA/*

Robert G. Schaaf, Project Manager, Section 1  
Project Directorate I  
Division of Licensing Project Management  
Office of Nuclear Reactor Regulation

Docket Nos. 50-387 and 50-388

Enclosure: Safety Evaluation

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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,"  
SUSQUEHANNA STEAM ELECTRIC STATION, UNITS 1 AND 2  
DOCKET NOS. 50-387 AND 50-388

## 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 the licensee to verify periodically the design-basis capability of safety-related MOVs at Susquehanna Steam Electric Station, Units 1 and 2.

## 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

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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 three refueling outages or 5 years from the issuance of the GL. 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 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 intends to rely to a significant extent on an industry initiative to identify valve age-related

degradation which 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 BWROG in its Licensing Topical Report NEDC-32719, "BWR Owners' Group Program on Motor-Operated Valve (MOV) Periodic Verification," and described by WOG and 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," 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 an SE 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 SE (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 (PWR) nuclear plants, 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 an SE accepting with certain conditions and limitations the WOG approach for ranking MOVs based on their risk significance. Licensees not applicable to 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 which 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, 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, BWROG submitted Licensing Topical Report NEDC-32719 (Revision 2) describing the JOG program on July 30, 1997. Similarly, CEOG and 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 an SE to 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. On October 19, 1999, the Babcock & Wilcox Owners Group (B&WOG) forwarded Topical Report MPR-1807 (Revision 2) to the NRC, and stated that B&WOG is now participating in the JOG Program on MOV Periodic Verification. In a letter dated May 15, 2000, the NRC staff informed B&WOG that Topical Report MPR-1807 is acceptable for referencing in B&WOG licensing applications to the extent specified and under the limitations delineated in the report and the associated NRC SE dated October 30, 1997.

#### 4.0 SUSQUEHANNA GL 96-05 PROGRAM

On November 18, 1996, PPL Susquehanna, LLC (the licensee, doing business at that time as Pennsylvania Power & Light Company), submitted a 60-day response to GL 96-05 notifying the NRC that it would implement the requested MOV periodic verification program at Susquehanna. On March 17, 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 Susquehanna. In a letter dated September 17, 1998, the licensee revised its 180-day GL 96-05 response. On July 15, 1999, the licensee provided a response to a request for additional information regarding GL 96-05 forwarded by the NRC staff on April 12, 1999. On February 17, 2000, NRC management from Region I met with the licensee to discuss MOV topics. The licensee summarized the results of the meeting in a letter dated May 31, 2000. The licensee forwarded a letter, dated September 15, 2000, to correct an administrative error in its May 31, 2000, letter.

In its letter dated September 17, 1998, the licensee described its revised MOV periodic verification program, including scope, planned testing, capability margin, and plans to implement the JOG program at Susquehanna. For example, the licensee described the interim MOV static diagnostic test program, dynamic diagnostic test program, preventive maintenance, trending and failure analysis, and MOV risk ranking. The licensee stated that it is implementing an MOV periodic verification program at Susquehanna. In its letter dated July 15, 1999, the

licensee compared its interim MOV static diagnostic test program to the JOG program. The licensee also described its alternative method for periodic verification of the butterfly valves in the GL 96-05 program at Susquehanna. In its letter dated May 31, 2000, the licensee clarified several aspects of the GL 96-05 program at Susquehanna, including the rising stem and butterfly valve periodic verification strategies, its justification for extending the static test frequency beyond 3 refueling cycles, and the statistical valve factor approach for non-testable valves. The licensee also stated that it expected to incorporate the results of the JOG dynamic test program into the MOV periodic verification program at Susquehanna by the later of December 31, 2003, or 6 months after closure of the JOG effort.

## 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 Susquehanna in response to GL 96-05. NRC Inspection Report 50-387, 388/96-13 (IR 96-13) provided the results of the inspection to evaluate the licensee's program to verify the design-basis capability of safety-related MOVs in response to GL 89-10. The staff closed the review of the licensee's GL 89-10 program in IR 96-13 based on verification of the design-basis capability of safety-related MOVs at Susquehanna. The 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 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 Inspection Report (IR) 91-80, the NRC staff reported that the scope of the licensee's MOV program at Susquehanna was consistent with the GL 89-10 recommendations. In IR 96-13, the staff did not identify any concerns regarding the scope of the licensee's GL 89-10 program. In its letter dated September 17, 1998, the licensee stated that the scope of the MOV periodic verification program at Susquehanna is identical to the GL 89-10 scope, and did not take exception to the scope recommendations of GL 96-05. The NRC staff considers that the licensee has made adequate commitments regarding the scope of its MOV program.

### 5.2 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 will need to be maintained up-to-date, including consideration of any plant modifications or power uprate conditions.

During the inspection documented in IR 96-13, 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 Susquehanna. The staff determined that the licensee had adequately justified the assumptions and methodologies used in its MOV program, with certain long-term items



discussed in the following section. The licensee's letters dated July 15, 1999, and May 31, 2000, indicated ongoing activities, such as (1) use of the Electric Power Research Institute (EPRI) MOV Performance Prediction Methodology (PPM) for 28-inch Lunkenheimer gate valves; and (2) disassembly of valves to verify adequate disk chamfers and body guide rib clearances. The 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 evaluating the GL 89-10 program at Susquehanna, the NRC staff discussed in IR 96-13 several items of the licensee's MOV program to be addressed over the long term. In its letter dated July 15, 1999, the licensee reported on the status of those long-term GL 89-10 aspects. For example, the licensee reworked the internals of four high-pressure core injection valves, four reactor water cleanup valves, and four residual heat removal (RHR) valves to ensure that adequate disk chamfers and body guide rib clearances exist to resolve valve predictability concerns. The licensee modified six MOVs to increase motor-actuator output capability to increase available margin, and plans to modify additional MOVs to increase their available margin during upcoming opportunities.

In its letters dated July 15, 1999, and May 31, 2000, the licensee reported that it is using a combination of the EPRI MOV PPM and capability margin to demonstrate that its Lunkenheimer gate valves are capable of operating under design-basis conditions. Using the EPRI MOV PPM results as the basis for the minimum required thrust, the Lunkenheimer gate valves at Susquehanna presently have minimum motor capability margins of approximately 18 percent and thrust margins at torque switch trip above 7 percent. These margins are able to accommodate valve factors of at least 0.83 based on motor capability and 0.75 based on thrust at torque switch trip. The licensee indicated that the torque switch for each of these MOVs is bypassed for 97 percent of the valve travel in the closing direction to provide full motor capability for almost the complete valve closing stroke.

In its letter dated May 31, 2000, the licensee stated that it has revised its approach in verifying the capability of the RHR shutdown cooling isolation valves F008 and F009. The licensee has determined that the EPRI MOV PPM is not applicable to those valves. As a result, the licensee is using a valve factor of 1.0 for the minimum required thrust at torque switch trip and 1.50 for the thrust requirements for motor capability until maintenance to chamfer the valve disks is completed.

In its letter dated July 15, 1999, the licensee reported that it continues to use a statistical approach to evaluate certain non-testable gate valves to demonstrate that the MOVs are capable of operating under design-basis conditions. At this time, the NRC staff has not accepted the EPRI Thrust Uncertainty Method referenced by the licensee in its submittal. Therefore, the licensee provided additional information in its letter dated May 31, 2000, to justify the use of its statistical approach specifically for Susquehanna. In particular, the licensee applied its statistical approach to 18 MOVs that were dynamically tested. Based on the licensee's justification, the NRC staff considers the approach in establishing thrust requirements for non-testable gate valves at Susquehanna to reasonably bound the dynamic test results.

In GL 89-10, the NRC staff identified pressure locking and thermal binding as potential performance concerns for safety-related MOVs. The staff completed its review of the licensee's actions in response to GL 95-07, "Pressure Locking and Thermal Binding of Safety-Related Power-Operated Gate Valves," in an SE dated November 1, 1999.

In IR 96-13, the NRC staff reported that the licensee's program to trend performance characteristics and failures of MOVs met the intent of GL 89-10. The licensee's letter dated September 17, 1998, and IR 96-13 discuss the qualitative and quantitative aspects of the licensee's program for trending MOV performance at Susquehanna. For example, the licensee evaluates as-found static and dynamic diagnostic test data (where available) for performance degradation. The licensee trends specific MOV parameters such as thrust, torque, stem friction coefficient, and MOV failures. The licensee periodically reviews the information in its MOV database to identify degradation trends, and the need for additional testing or maintenance. In its letters dated September 17, 1998, and May 31, 2000, the licensee stated that it performs annual trending assessments that determine capability margin and degradation trends.

With the licensee's ongoing MOV activities and trending program, no outstanding issues regarding the licensee's GL 89-10 program remain at Susquehanna.

#### 5.4 JOG Program on MOV Periodic Verification

In its letter dated September 17, 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 its letters dated September 17, 1998, July 15, 1999, and May 31, 2000, the licensee stated that it is using a combination of its own MOV dynamic test results and those from the JOG program to establish the MOV periodic verification program at Susquehanna. The licensee will incorporate any applicable degradation issues identified by the JOG program or Susquehanna dynamic testing into its MOV periodic verification program. The principle differences between the Susquehanna MOV periodic verification program and the JOG program are discussed below.

In its letters dated September 17, 1998, July 15, 1999, and May 31, 2000, the licensee noted that its interim MOV static diagnostic testing would be performed on a test interval based on the risk significance and capability margin of each GL 96-05 MOV. The interim static diagnostic test interval for rising stem MOVs ranges from 2 to 10 years based on capability margin, risk significance and the availability of degradation data. Further, the licensee stated in its letter dated July 15, 1999, that it would extend rising stem MOV retest frequencies beyond 6 years only if (1) the valves are categorized as low- or medium-risk significance; and (2) the valve and actuator degradation data are available or the MOV has significant margin to accommodate unknown degradation (25 percent each for valve, actuator, and stem factor for a total of 75 percent). The interim static diagnostic test interval for butterfly valves at Susquehanna ranges from 2 to 6 years. The NRC staff considers the interim static test matrix for GL 96-05 MOVs at Susquehanna to be an acceptable alternative to the JOG matrix.

In its letter dated July 15, 1999, the licensee stated that the butterfly valves (with the exception of the E Diesel Generator emergency service water butterfly valves) in its GL 89-10 program are being baseline dynamically tested with diagnostics to establish initial margins. In its September 17, 1998, letter, the licensee stated that the E Diesel Generator butterfly valves have a zero differential-pressure operating condition and that surveillance testing without

diagnostics is used to assure continued capability. In IR 50-387/94-14 and IR 50-388/94-15, the NRC staff considered this alternate testing approach for the E Diesel Generator butterfly valves reasonable because these valves are only required to perform a safety function when a surveillance test is being performed on the E Diesel Generator at Susquehanna. In its letter dated May 31, 2000, the licensee stated that five butterfly valves will be dynamically tested with diagnostics on a 6-year frequency to sample the performance of the total 18 GL 96-05 butterfly valves (other than the E Diesel Generator valves). The NRC staff considers the licensee's plans for periodic verification of the design-basis capability of the GL 96-05 butterfly valves at Susquehanna to be an acceptable alternative to the JOG approach.

In its letter dated May 31, 2000, the licensee discussed its justification for extending the interim MOV static test frequency at Susquehanna to greater than a three-cycle or 6-year interval. For example, the licensee noted that the test intervals for GL 96-05 butterfly valves and high-risk rising stem MOVs cannot be extended beyond three cycles. Further, the licensee does not extend the test intervals for valves categorized at Susquehanna as requiring greater scrutiny (e.g., GL 89-10 Supplement 3 valves, valves with Deloro discs, and rising-rotating valves). If valve-specific degradation data are not available, the licensee specifies that 25-percent margin is required for the valve, actuator, and stem factor (for a total of 75-percent margin) to extend the static test frequency beyond 3 cycles. Finally, the licensee obtains data from MOV static tests at varying frequencies and evaluates that data for adverse degradation trends. The NRC staff considers the licensee's justification of its interim MOV static test frequency to be acceptable.

In its letter dated September 17, 1998, the licensee stated that MOV risk ranking at Susquehanna is in agreement with the MOV risk-ranking methods presented in the BWROG Topical Report NEDC 32264 (Revision 2). The conditions and limitations discussed in the NRC SE dated February 27, 1996, apply to the JOG program at Susquehanna. The NRC staff notes that BWROG also provided an example list of risk-significant MOVs for consideration in applying the owners group methodology. Based on the licensee's summary, the NRC staff considers the licensee's methodology for risk-ranking MOVs at Susquehanna to be acceptable.

In an SE 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 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 staff considers the licensee's commitments in response to GL 96-05 to include implementation of all three phases of the JOG program at Susquehanna. The conditions and limitations discussed in the NRC SE dated October 30, 1997, apply to the JOG program at Susquehanna. The staff considers the commitments by the licensee to implement all three phases of the JOG program at Susquehanna with the alternatives as described in this SE to be an acceptable response to GL 96-05 for valve age-related degradation.

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. JOG indicates that each licensee is responsible for addressing any MOVs outside the scope of applicability of the JOG program. The NRC staff recognizes that JOG has selected a broad range of MOVs and conditions for the dynamic testing program. 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, 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 currently might be outside the scope of the JOG program with the feedback of information from the JOG dynamic test program to those MOVs. In the NRC SE dated October 30, 1997, the NRC staff stated 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.

### 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 SE 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 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. 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.

In its letters dated September 18, 1997, and July 15, 1999, the licensee indicated that it uses a combination of periodic static testing, dynamic testing, preventive maintenance, and data trending to identify actuator output degradations and ensure adequate actuator output capability for safety-related MOVs at Susquehanna to perform their design-basis functions. The licensee trends various MOV parameters including thrust or torque, and as-found static and dynamic diagnostic test results. The licensee also conducts preventive maintenance of GL 96-05 MOVs which includes routine lubrication of valve stems and gear box grease inspections.

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 its letter dated July 15, 1999, the licensee reported that it had prepared condition reports regarding ac-powered MOV output, and had revised its method to determine ac-powered actuator capability prior to the issuance of Limitorque Technical Update 98-01. The licensee noted that its method has been reviewed and accepted by Limitorque. In the ac-powered MOV output prediction method at Susquehanna, the licensee uses motor nameplate voltage, the voltage square law, and pullout efficiency to determine torque capability. The licensee obtained Limitorque review of its specific MOV configurations identified in the technical update and established corrective actions to address the long-term resolution of those MOV configurations. The licensee is also planning several modifications to improve capability margins for GL 96-05 MOVs at Susquehanna.

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 its

letter dated July 15, 1999, the licensee stated that it has revised the method for determining dc-powered motor actuator output at Susquehanna to require a 0.9 application factor in its calculations. The licensee also applies a 10 percent motor curve uncertainty when determining available motor start torque. The licensee is monitoring industry activities pertaining to MOV capability, and will evaluate any updated dc-powered MOV output 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.

## 6.0 CONCLUSION

The staff finds that the licensee has established an acceptable program to verify periodically the design-basis capability of the safety-related MOVs at Susquehanna through its commitment to all three phases of the JOG Program on MOV Periodic Verification with the alternatives and additional actions described in its submittals. As part of this review, the NRC staff considers the licensee's specific alternatives to the JOG program to be acceptable. Therefore, the staff concludes that the licensee is adequately addressing the actions requested in GL 96-05. The staff may conduct inspections to verify the implementation of the MOV periodic verification program is in accordance with the licensee's commitments in its submittals, this NRC SE, the NRC SE dated October 30, 1997, on the JOG Program on MOV Periodic Verification, and the NRC SE dated February 27, 1996, on the BWROG methodology for ranking MOVs by their safety significance.

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