
INSPECTION PROCEDURE 62708

MOTOR-OPERATED VALVE CAPABILITY

PROGRAM APPLICABILITY: IMC 2515 App B

62708-01 INSPECTION OBJECTIVE

01.01 The objective of this procedure is to assess the extent of performance issues and the adequacy of the licensee's evaluation associated with motor-operated valves (MOVs) when directed by Supplemental Inspection Procedure 95002, "Inspection for One Degraded Cornerstone or Any Three White Inputs in a Strategic Performance Area." This inspection procedure may be applied to commercially operating nuclear power plants licensed under 10 CFR Part 50 or Part 52.

62708-02 INSPECTION REQUIREMENTS

The scope of the inspection is focused on those specific requirements listed below that are necessary to accomplish the objective. The inspection plan will be consistent with the objectives of IP 95002. The inspection may involve an in-depth review of licensee activities such as MOV calculations, analyses, diagnostic test results, post-maintenance tests, corrective actions, preventive maintenance, and trending.

02.01 MOV Selection. Select a sample of risk-significant MOVs from more than one system of various valve sizes, types, and manufacturers if appropriate and possible.

02.02 MOV Program Scope. Ensure appropriate safety-related MOVs are included in the program by reviewing any scope changes since completion of the NRC review of the licensee's Generic Letter (GL) 89-10, "Safety-Related Motor-Operated Valve Testing and Surveillance," program, or initial plant startup if the nuclear power plant received its operating license under 10 CFR Part 50 after issuance of GL 89-10 or received its combined operating license (COL) under 10 CFR Part 52. (Appendix A to this inspection procedure provides guidance for reviewing the MOV program scope.)

02.03 Design Calculations. Review design documents and calculations for:

- a. MOV functional requirements under normal, abnormal, and accident conditions.
- b. Motor and actuator sizing.
- c. Methods for selecting, setting, and adjusting MOV switch settings; and modifications.

- d. Modifications to the system or valves that could affect the MOV's capability in the as-modified configuration.

02.04 Testing. Review test documents for adequacy of: procedures, equipment, training of personnel, acceptance criteria, and results. Observe actual testing of MOVs if the inspection schedule permits.

02.05 MOV Trending. Review MOV trend reports, failure analyses, corrective actions, nonconformance reports, or other plant documents that may indicate an MOV is not properly sized, maintained, or has improper switch settings.

02.06 Preventive Maintenance. Review MOV preventive maintenance documentation to determine whether it is appropriate for the frequency of operation, working environment, and operational experience.

02.07 Corrective Actions. Determine whether the licensee is periodically reviewing data on MOV failures and the effectiveness of the corrective actions.

02.08 Post-Maintenance Testing. Review a sample of MOV maintenance packages and verify that the post-maintenance tests and results demonstrate that the MOVs are capable of performing their design functions.

02.09 Operating Experience. Review the adequacy of licensee's processing and control of operating experience information and vendor notifications.

02.10 Periodic Verification. Review MOV periodic verification test results, both static and dynamic, and verify that information from these tests is incorporated into the design and setup calculations for safety-related MOVs.

02.11 Program Changes. Review changes made in programs affecting safety-related MOVs since completion of the NRC review or inspection of the GL 89-10, GL 95-07, "Pressure Locking and Thermal Binding of Safety-Related Power-Operated Gate Valves," and GL 96-05, "Periodic Verification of Design-Basis Capability of Safety-Related Motor-Operated Valves," programs, or initial plant startup for nuclear power plants licensed under 10 CFR Part 50 or Part 52 after issuance of these GLs.

62708-03 INSPECTION GUIDANCE

General Guidance

In response to the identification of plant-specific MOV performance issues, and as directed by the NRC's action matrix, the NRC staff may determine an inspection of the licensee's MOV program is appropriate using IP 62708. This inspection procedure may be implemented to assess the adequacy of calculations, analyses, switch settings, post-maintenance tests, corrective actions, preventive maintenance, and trending that are used to support MOV performance during normal, accident, and abnormal conditions. Review of other areas

associated with MOVs such as surveillance testing, operations, maintenance, and quality assurance and self-assessment, are addressed in the baseline inspection and other supplemental procedures as well.

Review the identified MOV performance issues when planning an inspection under this procedure. Prepare an inspection plan incorporating one or more of the specific inspection requirements outlined in Section 62708-02 that are considered necessary to achieve the objective of this procedure. When a weakness in any of these areas is identified, consider performing additional reviews to determine if significant weaknesses exist in the licensee's overall MOV program.

Changes that have been made affecting MOV programs since the closeout of GL 89-10, or initial plant startup for nuclear power plants licensed after issuance of GL 89-10, should also be considered during MOV sample selection. These changes may involve revised MOV design basis, plant modifications, power uprate, safety relief valve setpoint or tolerance changes, revised calculations, MOVs added to or removed from the MOV program, or the incorporation of new industry guidance into the MOV program.

Specific Guidance

03.01 MOV Selection. Consider MOV risk insights and performance during MOV selection. For example, review of MOV trend reports, nonconformance reports, licensee event reports, maintenance history, or other plant documents may indicate an MOV is not properly sized or has improper switch settings. Focus on MOVs that are categorized as high risk and low capability margin.

03.02 MOV Program Scope. Determine whether the licensee is applying the proper criteria when establishing the scope of MOV program. If the scope of an MOV program has been modified since the previous inspection, determine whether the licensee adequately justified the removal of any MOVs from the program. Review plant modifications and determine whether the new or modified MOVs were properly incorporated into the program. (Appendix A provides additional guidance regarding the scope of the licensee's MOV program.)

03.03 Design Calculations. Review the methods used for selecting, setting, and adjusting switches. Motor sizing calculations must consider degraded voltage and elevated ambient temperature conditions. Ensure the lowest motor terminal voltage commensurate with the design-basis conditions has been factored into the MOV program. Use of appropriate actuator efficiency and the proper application factor must be justified. Adequate bases must exist for stem factors, valve factors, load sensitive behavior, and other assumed parameters that are used in calculations for sizing actuators.

In Technical Update 93-03, Limatorque Corporation provided guidance on determining the effect of increased motor temperature on AC-powered actuator capability. In Technical Update 98-01 and its Supplement 1, Limatorque Corporation provided updated guidance for predicting the torque output of its AC-powered motor actuators. Commonwealth Edison developed a method for determining capability for AC-powered motor actuators that is based on a comprehensive motor and actuator test program. The NRC staff has reviewed and accepted the Commonwealth Edison methodology for estimating MOV motor-actuator output capability,

based on test data obtained by the licensee in plant-specific GL 96-05 safety evaluation (SE). The Electric Power Research Institute (EPRI) developed the MOV Performance Prediction Methodology (PPM) to define a bounding thrust (or torque) required to operate a gate, globe, or butterfly valve within the scope of the EPRI MOV PPM (EPRI TR-103237-R2, dated April 1997). The NRC staff concluded the EPRI MOV PPM constituted an acceptable methodology to predict thrust and torque requirements following the conditions and limitations in an SE dated March 15, 1996, and an SE supplement dated February 20, 1997.

On September 8, 1999, the Nuclear Energy Institute (NEI) submitted Addendum 2 to EPRI Topical Report TR-103237-R2, which described the development of the Thrust Uncertainty Method that takes into account conservatism in the EPRI MOV PPM to provide a more realistic (less bounding) estimate of the thrust required to operate gate valves than predicted by the PPM. In Supplement 3 (dated September 30, 2002) to the SER on the EPRI PPM, the NRC staff concluded that the Thrust Uncertainty Method developed by EPRI is acceptable for the prediction of minimum allowable thrust at control switch trip (or flow isolation) for applicable motor-operated gate valves under cold water applications within the scope of the Thrust Uncertainty Method, based on the NRC staff's review of Addendum 2 to the EPRI Topical Report as supplemented by NEI submittals dated January 5 and December 6, 2001, and June 10, 2002.

From 2004 to 2006, NEI submitted Addenda 3, 4, 5, 6, and 7 to the EPRI MOV PPM that the NRC staff reviewed with requests for additional information to NEI. In a letter dated February 24, 2009, the NRC staff forwarded to NEI Supplement 4 to the SER on the EPRI PPM. In the SER supplement, the NRC staff concluded that the PPM changes described in the PPM addenda improve the ability of licensees to predict the thrust and torque required to operate gate, globe, and butterfly valves, and that they are acceptable for reference by licensees.

The following is a list of some issues to be addressed and assumptions to be justified in MOV design calculations, as applicable:

- a. Valve factor (including area assumption).
- b. Stem friction coefficient.
- c. Load sensitive behavior (rate of loading).
- d. Margins for stem lubrication degradation and spring pack relaxation.
- e. Motor performance factors:
 1. Motor rating
 2. Efficiencies used in open and close directions
 3. Application factor
 4. Power factor used in degraded voltage calculations
 5. Ambient temperature
- f. Basis for extrapolation method of partial differential pressure thrust measurements.
- g. Torque switch repeatability.

- h. Use of Limitorque, Kalsi Engineering Inc., or other sources for increasing thrust and torque allowable limits.
- i. Equipment error.
- j. Degradation assumptions.
- k. Justification for grouping of MOVs for application of test data, performance characteristics, structural operating limits, and common-cause failure analyses.

Review the output capability calculations for the MOV actuators. The NRC staff discussed AC-powered MOV actuator capability in Information Notice (IN) 96-48, Supplement, "Motor-Operated Valve Performance Issues," which references Limitorque Technical Update 98-01 (updated by its Supplement 1). The NRC staff discussed DC-powered MOV actuator capability in RIS 2001-15, "Performance of DC-Powered Motor-Operated Valve Actuators," which references Boiling Water Reactor Owners Group (BWROG) Topical Report NEDC-32958, "BWR Owners Group DC Motor Performance Methodology - Predicting Capability and Stroke Time in DC Motor-Operated Valves." As noted in RIS 2001-15, the NRC staff considers the BWROG methodology to be applicable to DC-powered MOVs in both BWR and PWR nuclear power plants.

EPRI provides guidance for evaluating motor-operated gate, globe, and butterfly valves, and their performance, in EPRI Application Guide TR-106563-V1 and V2, "Application Guide for Motor-Operated Valves in Nuclear Power Plants."

During GL 89-10 program inspections, the NRC staff provided four acceptable methods a licensee could use to demonstrate the design-basis capability of safety-related MOVs. The four methods for demonstrating MOV capability, in descending order of acceptability were:

1. Dynamic flow testing with diagnostics of each MOV where practicable. Although the valve factor derived from the test data might be low because of minimal valve operating history or recent maintenance that exposed the Stellite valve material to air, the dynamic testing provided assurance that the valve performance was predictable. The licensee needs to consider an appropriate increase in the valve factor during its design-basis evaluation and setup based on test data from similar valves.
2. Application of the EPRI MOV PPM. This method was initially developed for those valves that could not be dynamically tested. The PPM required internal measurements to provide assurance that the valve performance was predictable. The NRC staff later accepted the use of the PPM even where dynamic testing for an MOV was practicable.
3. Where valve-specific dynamic testing was not performed and the PPM was not used, the staff accepted grouping of MOVs that were dynamic tested at the plant to apply the plant-specific test information to an MOV in the group. Using plant-specific data allowed the licensee to know the valve performance and maintenance history, and helped provide confidence that the valve performance was predictable.

4. The least preferred approach (with the most margin required) was the use of valve test data from other plants or research programs because the licensee would have minimal information regarding the tested valve and its history. In such cases, the NRC inspector should perform an available capability evaluation of the MOV to provide confidence that the MOV had sufficient capability margin considering the uncertainties in the source of the data.

Determine if the licensee has addressed the potential for pressure locking or thermal binding of MOVs within the scope of the program, such as by implementation of GL 95-07 or other justified means. Additional inspection guidance is provided in IP 62710, "Power Operated Gate Valve Pressure Locking and Thermal Binding."

Following the initial verification of MOV capability under design basis conditions, the MOV switch settings will need to be reverified if the MOV is replaced (which would constitute the need for a complete demonstration of design basis capability), modified, or overhauled to the extent that the existing test results might not be representative of the MOV in its modified configuration. Because of the interrelationship of various operating parameters, the performance of the MOV can be affected by routine maintenance work, such as valve packing adjustments.

03.04 Testing. Consider the following during the review of MOV test programs:

- a. Does the licensee use the best available MOV test data when sizing and setting its MOVs?
- b. Does the licensee consider industry test data?
- c. Does the licensee have justification for each assumption in its MOV calculations?
- d. Does the licensee assume a reasonable value, based on industry test data, for a parameter where it does not have plant-specific justification for the parameter?
- e. Does the licensee take action where the calculation predicts MOV capability problems?
- f. Does the licensee promptly evaluate test results to determine capability under design-basis conditions prior to declaring the MOV operable and returning it to service?
- g. Does the licensee have justification for the accuracy of its MOV diagnostic equipment?
- h. Does the licensee monitor test data to affirm assumptions?
- i. Does the licensee have justification for applying test data to valve groups?

The licensee must justify its approach if different than outlined above.

When observing MOV testing:

- a. Verify test equipment is setup and calibrated in accordance with vendor recommendations.
- b. Verify test personnel are qualified.
- c. Determine test equipment inaccuracies and test data accuracy.
- d. Verify test results are adequately reviewed prior to declaring MOVs operable.

When diagnostic equipment is used during MOV testing, verify the licensee justified its accuracy and has an adequate training program for personnel operating and analyzing information obtained. As part of the training, the licensee should ensure plant personnel understand the inherent sensitivities and limitations of the diagnostic equipment.

When ASME Code Case OMN-1, "Alternative Rules for Preservice and Inservice Testing of Active Electric Motor Operated Valve Assemblies in LWR Power Plants," or ASME OM Code, Mandatory Appendix III, "Preservice and Inservice Testing of Active Electric Motor Operated Valve Assemblies in Light-Water Reactor Power Plants," is implemented, review the licensee's consideration of extending the operation of MOVs from a quarterly frequency to every refueling outage. As discussed in *Federal Register* Notice 51370 (dated September 22, 1999) on page 51386, the licensee needs to have sufficient information from the specific MOV, or similar MOVs, to demonstrate that exercising on a refueling outage frequency does not significantly affect component performance. This information may be obtained by grouping similar MOVs and staggering the exercising of the MOVs in the group equally over the refueling interval. The licensee needs to reapply the quarterly frequency when degradation in the performance of a high-risk MOV is identified at an extended interval. Additionally, the licensee must implement diagnostic testing of those MOVs at an interval, which provides assurance of their design-basis capability. The licensee also needs to evaluate the performance results to determine if the risk ranking must be raised to a higher level.

Evaluate potential preconditioning of MOVs prior to test activities. Guidance on acceptable and unacceptable preconditioning is provided in several NRC documents, including NRC Inspection Manual Part 9900, Technical Guidance: Maintenance – Preconditioning of Structures, Systems, and Components Before Determining Operability; IN 97-16, "Preconditioning of Plant Structures, Systems, and Component Before ASME Code Inservice Testing or Technical Surveillance Testing;" and NUREG-1482, "Guidelines for Inservice Testing at Nuclear Power Plants."

03.05 MOV Trending. Verify the licensee is evaluating trends on quantitative and qualitative information on MOV performance. MOV data on failures and corrective actions should be periodically reviewed by the licensee as part of a monitoring and feedback effort to establish trends of MOV performance. In addition to plant specific data, the monitoring and feedback effort should include industry-wide MOV data. Examples of MOV parameters which may be trended include valve factor, stem factor (as-found and as-left), rate of loading (load sensitive behavior), actuator torque output, bearing coefficients, running load, motor current and voltage, torque switch settings, capability margin, and thrust and torque at control switch trip.

03.06 Preventive Maintenance. Verify the licensee has implemented periodic MOV preventive maintenance based on MOV frequency of operation, working environment, operational experience, and has an adequate training program for personnel conducting the maintenance. Examples of the licensee's preventive maintenance activities may include the following items:

- a. Checking for indications of grease or oil leakage from the various sealed joints and shaft protrusions.
- b. Checking the mounting flange and valve yoke for cracks or damage.
- c. Checking fasteners for tightness.
- d. Lubrication of valve stem, main gear case, and limit switches.
- e. Checking valve stem and stem nut threads for damage.
- f. Checking that the ball in the grease relief valve, if installed, is free to move.
- g. Sampling and analysis of the grease in main gear case.
- h. Checking spring pack for hardened grease.
- i. Checking that T-drains, if installed, are clear.
- j. Check limit switch compartment for cleanliness and general integrity of gears and wire terminals.

The licensee must implement vendor recommendations for preventive maintenance or have justification for its alternate approach.

03.07 Corrective Actions. Verify the licensee's administrative procedures require MOV failures, malfunctions, and deficiencies be promptly identified and corrected. Determine the adequacy of the licensee's analysis on MOV failures, justification of corrective actions, and trends for the selected MOVs. Review recent MOV failures and the resulting corrective actions. The licensee's failure analysis should include the results and history of each as-found deteriorated condition, malfunction, test, inspection, analysis, repair, or alteration. For example, the licensee might only make a torque switch adjustment to overcome an increased actuator load without identifying and correcting the cause of the increased actuator load. The application of a greater actuator torque without identifying and correcting the cause of the increased load requirement could lead to a repetitive or more serious failure. Validate the licensee performed the appropriate level of root cause analysis based on the significance of the MOV failure, malfunction, or deficiency.

03.08 Post-Maintenance Testing. Verify the licensee's procedures require MOVs to be properly tested prior to return to service following maintenance. Review selected MOV maintenance packages to ensure post-maintenance tests demonstrate the MOV is capable of

performing its design function. For example, stroking a valve following maintenance, which could have adversely affected the capability of the MOV to provide the required thrust or torque, does not demonstrate the MOV is capable of operating during design-basis conditions. When post-maintenance testing under design-basis conditions is not feasible, the licensee must use other methods to ensure the MOV is capable of performing its intended function following maintenance. If the licensee chooses not to test an MOV following maintenance, it must have a justification for why a test was not necessary to demonstrate the capability of the MOV. For example, it might be difficult to test an MOV following the adjustment of packing during plant operation because plant conditions prohibit the cycling of the MOV. An example of adequate basis for not testing the MOV following the adjustment of the packing is test data previously obtained demonstrated the MOV's thrust or torque capability is not adversely affected at specific packing adjustment settings, and should be verified by the inspector.

The NRC staff provided guidance on pre-lubrication of valves prior to inservice testing in a memorandum dated July 2, 1996, from F. J. Hebdon, NRR, to Jon R. Johnson, Region II. In the attachment to the memorandum, the staff states the performance of maintenance on a component to ensure its proper operation prior to conducting a test negates the validity of the test in assessing the operational readiness of the component. In ASME Code Case OMN-1, ASME states certain maintenance activities, such as stem lubrication, shall not be conducted if they might invalidate the as-found condition for inservice testing. Consider this guidance in evaluating the licensee's MOV program.

03.09 Operating Experience. Evaluate the consideration of experience from the individual plant and industry in the MOV program. Determine if the licensee is complying with Appendix A to 10 CFR Part 50 to supplement codes and standards found to be insufficient. Appendix B to this inspection procedure lists industry bulletins and NRC information notices that discuss operating experience with MOV performance. In addition, verify that the licensee's use of MOV lubricants is consistent with their qualification for the applicable service conditions, such as replacement interval, temperature, radiation, and humidity.

03.10 Periodic Verification. Evaluate the implementation of the program at the nuclear power plant to periodically verify MOV design-basis capability consistent with the NRC regulations in 10 CFR 50.55a(b)(3)(ii). The MOV periodic verification program in response to GL 96-05 is discussed in Appendix B to this IP.

Determine if the licensee's FSAR specifies the Joint Owners Group (JOG) Program on MOV Periodic Verification (discussed in Appendix B to this IP) will be implemented to satisfy the regulatory requirements to periodically verify the design-basis capability of MOVs. Review the specific attributes of the JOG program including proper classification of the valves, documentation of the valve material construction, service conditions, qualifying basis, and verification of proper valve factor being applied. An example of the performance of an inspection of an MOV periodic verification program can be found in NRC Inspection Procedure 95003 Supplemental Inspection Report 05000259/2011011, 05000260/2011011, and 05000296/2011011 (Part 1) for the Browns Ferry Nuclear Plant, dated November 17, 2011 (ADAMS Accession No. ML113210602).

Verify that the licensee is following the JOG program in risk ranking MOVs and classifying them based on valve type, construction, materials, service conditions, manufacturer, and their susceptibility to degradation. The JOG process had four classification categories:

Class A: Valves are not susceptible to degradation based on test data

Class B: Valves are not susceptible to degradation based on test data and engineering analysis

Class C: Valves are susceptible to degradation as shown by test data

Class D: Valves are not covered by the JOG program. Individual plants are responsible for justifying the periodic verification approach.

Verify the licensee has completed the MOV classification process, documented the results, and the results are consistent with the JOG classification. In particular, the MOVs in JOG Class A or Class B are determined to not be susceptible to degradation of valve operating requirements based on the JOG program, and are periodically tested to demonstrate that the actuator can satisfy the valve operating requirements. Also, verify MOVs in JOG Class C are periodically tested to demonstrate their design-basis capability.

For those MOVs in JOG Class D or where the licensee has not committed to implement the JOG program, verify the licensee has established a plant-specific periodic verification program to ensure their continued design-basis capability. In RIS 2011-13, "Followup to Generic Letter 96-05 for Evaluation of Class D Valves Under Joint Owners Group Motor-Operated Valve Periodic Verification Program," the NRC staff provides guidance for periodic verification of the design-basis capability of MOVs outside the scope of the JOG program. The licensee needs to have test data to support the periodic verification interval for those MOVs. NRC Inspection Report No. 50-361 and 362/99-18 (dated January 4, 2000) describes the NRC staff inspection of the GL 96-05 program at San Onofre Nuclear Generating Station, Units 2 and 3, which implemented a plant-specific MOV periodic verification program rather than the JOG program.

Review a sample of MOV periodic verification test results (both static and dynamic), and determine whether information from these tests is incorporated into the design and setup calculations for safety-related MOVs. In addition to valve operating requirements consistent with the JOG program, verify the licensee addresses actuator output capability as part of its long-term MOV program. Review the documentation regarding the periodic verification of MOV design-basis capability and confirm those commitments have been implemented.

Determine whether valve modifications have eliminated the original design basis capability of specific safety-related MOVs. The JOG program is intended to address valve degradation as it pertains to valve configuration, design, and system application. The JOG dynamic test program was not intended to provide data for justifying valve design-basis capability. If a valve in service has a disallowing modification, determine whether the licensee has obtained a new qualifying basis.

Contact the NRR or NRO (as applicable) Division of Engineering for assistance, if required, in evaluating the periodic verification of MOV design-basis capability for MOVs within the JOG program or outside its scope.

03.11 Program Changes. The licensee might have revised its MOV program since the previous NRC review or inspection. Discuss any MOV program changes with the licensee, and evaluate the justification of those changes consistent with the guidance in this IP.

62708-04 RESOURCES

This inspection procedure provides guidance that could be used to assess the entire MOV program or may be limited to specific inspection requirements identified in Section 62708-02. Based on the selected inspection requirements, estimate the resources necessary to perform the inspection. It is estimated a minimum of 16 hours will be needed to accomplish this procedure. If the nature of the problems prompting the inspection is extensive, requiring a more broad review, then more time will be required to accomplish the inspection. On average, it required two inspectors, knowledgeable of MOVs and GL 89-10 recommendations, approximately 70 hours of onsite inspection and 80 hours of offsite preparation to complete the GL 89-10 closeout inspection at each site.

Other factors that affect the amount of time required to complete the inspection are the knowledge and experience of the inspector(s) and the number of safety-related MOVs in each unit. It is recommended that inspector(s) knowledgeable of GL 89-10 and GL 96-05 recommendations and MOV mechanical and electrical characteristics perform the inspection. Some early-vintage units may have fewer than 30 safety-related MOVs, while later-vintage units may have more than 150 MOVs. Consider the number of safety-related MOVs when determining the amount of time needed to accomplish the inspection.

62708-05 REFERENCES

[GL 89-10](#), "Safety-Related Motor-Operated Valve Testing and Surveillance"

[GL 96-05](#), "Periodic Verification of Design-Basis Capability of Safety-Related Motor-Operated Valves"

[GL 95-07](#), "Pressure Locking and Thermal Binding of Safety-Related Power-Operated Gate Valves"

NRC [Bulletin 85-03](#) (November 15, 1985), "Motor-Operated Valve Common Mode Failures During Plant Transients Due to Improper Switch Settings," and Supplement 1 (April 27, 1988)

BWR Owners Group (BWROG) Report NEDC-32264A (Revision 2), "Application of Probabilistic Safety Assessment to Generic Letter 89-10 Implementation"

Westinghouse Owners Group (WOG) Report V-EC-1658 (Revision 1), "Risk Ranking Approach for Motor-Operated Valves in Response to Generic Letter 96-05"

ASME Standard QME-1-2007, "Qualification of Active Mechanical Equipment Used in Nuclear Power Plants."

ASME Code Case OMN-1, "Alternative Rules for Preservice and Inservice Testing of Active Electric Motor Operated Valve Assemblies in LWR Power Plants."

ASME Code Case OMN-11, "Risk-Informed Testing for Motor-Operated Valves."

Electric Power Research Institute (EPRI) MOV Performance Prediction Methodology (PPM), EPRI TR-103237-R2 (April 1997), and addenda.

NRC Safety Evaluation on EPRI MOV PPM, dated March 15, 1996, and supplements dated February 20, 1997, [September 30, 2002](#), and [February 24, 2009](#).

EPRI Application Guide TR-106563-V1: Gate and Globe Valves (Revision 1, September 1999), and V2: Butterfly Valves (October 1998), "Application Guide for Motor-Operated Valves in Nuclear Power Plants."

BWROG-06047, "JOG MOV PV Program Summary, MPR-2524, Revision A," December 11, 2006 ([ML063470526](#))

BWROG-07033, "JOG MOV PV Program Revised Data for Valve B22.4," June 20, 2007 ([ML071730468](#))

"Safety Evaluation for Joint Owners' Group Motor-Operated Valve Periodic Verification Program," September 25, 2006, (ML061280315) and its supplement, September 18, 2008 ([ML082480638](#))

MPR-2524-A, Rev. 1, "Joint Owners' Group (JOG) Motor Operated Valve Periodic Verification Program Summary," September 30, 2010 ([ML110680193](#))

[Information Notice 96-48, Supplement 1](#) (July 24, 1998), "Motor-Operated Valve Performance Issues."

[Information Notice 97-16](#), "Preconditioning of Plant Structures, Systems, and Component Before ASME Code Inservice Testing or Technical Surveillance Testing."

[Information Notice 2003-15](#), "Importance of Followup Activities in Resolving Maintenance Issues."

[Information Notice 2006-26](#), "Failure of Magnesium Rotors in Motor-Operated Valve Actuators."

[Information Notice 2006-29](#), "Potential Common Cause Failure of Motor-Operated Valves as a Result of Stem Nut Wear."

[Information Notice 2008-20](#), "Failures of Motor-Operated Valve Actuator Motors with Magnesium Alloy Rotors."

[Information Notice 2010-03](#), "Failures of Motor-Operated Valves Due to Degraded Stem Lubricant."

[Information Notice 2012-14](#), "Motor-Operated Valve Inoperable Due To Stem-Disc Separation."

[Information Notice 2013-14](#), "Potential Design Deficiency in Motor-Operated Valve Control Circuitry"

[Information Notice IN 2017-03](#), "Anchor/Darling Double Disc Gate Valve Wedge Pin and Stem-Disc Separation Failures"

NRC Inspection Report No. 50-361 and 362/99-18 (dated January 4, 2000) on GL 96-05 program at San Onofre Nuclear Generating Station, Units 2 and 3 ([ML003672750](#) and [ML003672773](#)).

NRC Inspection Procedure 95003 Supplemental Inspection Report 05000259/2011011, 05000260/2011011, and 05000296/2011011 (Part 1) for the Browns Ferry Nuclear Plant, dated November 17, 2011 ([ML113210602](#)).

NUREG-1482, "Guidelines for Inservice Testing at Nuclear Power Plants."

[Regulatory Guide 1.100 \(Revision 34\)](#), "Seismic Qualification of Electrical and Active Mechanical Equipment and Functional Qualification of Active Mechanical Equipment for Nuclear Power Plants."

[Regulatory Guide 1.192](#), "Operation and Maintenance Code Case Acceptability, ASME OM Code."

[Regulatory Issue Summary 2001-15](#), "Performance of DC-Powered Motor-Operated Valve Actuators," August 1, 2001.

[Regulatory Issue Summary 2011-13](#), "Follow up to Generic Letter 96-05 for Evaluation of Class D Valves Under Joint Owners Group Motor-Operated Valve Periodic Verification Program," January 6, 2012.

[Regulatory Issue Summary 2016-05](#), "Embedded Digital Devices in Safety-Related Systems"

Supplemental Inspection Procedure 95002, "Inspection for One Degraded Cornerstone or Any Three White Inputs in a Strategic Performance Area."

NRC Inspection Manual Part 9900, Technical Guidance: Maintenance – Preconditioning of Structures, Systems, and Components Before Determining Operability.

END

Appendix

- A. Considerations in Reviewing the Scope of Licensee MOV Program
- B. Procedure Background & General Information

APPENDIX A

CONSIDERATIONS IN REVIEWING THE SCOPE OF LICENSEE MOV PROGRAM

1. The scope of the MOV program extends to safety-related MOVs as defined in the NRC regulations. In GL 89-10, the staff requests licensees to determine the design basis for the operation of each safety-related MOV including the maximum differential pressure expected during both the opening and closing of the MOV for both normal operations and abnormal events, to the extent that these MOV operations and events are included in the existing approved design basis.
2. In Supplement 1 to GL 89-10, the staff stated safety-related MOVs which are always in their safety position, or have no affect on the operation of the safety train can be removed from the GL 89-10 program. However, containment isolation valves will always have a safety function to close regardless of their system performance requirements.
3. Safety-related MOVs that are placed in a position that prevents the safety-related system (or train) from performing its safety function must be capable of returning to their safety position, or the system (or train) must be declared inoperable and the appropriate plant technical specifications followed. (Discussed in Section 3.1.2 of NUREG-1482, "Guidelines for Inservice Testing at Nuclear Power Plants")
4. In the second footnote in GL 89-10, the staff states design-basis events are defined as conditions of normal operation, including anticipated operational occurrences, design-basis accidents, external events, and natural phenomena for which the plant must be designed to ensure the function delineated as "safety-related" can be performed. The staff further states in the footnote the design bases for each plant are those documented in pertinent licensee submittals, such as the final safety analysis report. In Bulletin 85-03, the staff requested BWR plants to ensure that MOVs in the Reactor Core Isolation Cooling system can perform their safety function.
5. The consideration of pipe breaks in conjunction with the ability of MOVs to close should be consistent with the staff's licensing review for the individual facility (i.e., in accordance with Standard Review Plan (SRP) Section 3.6.2).
6. Supplements 4 and 7 to GL 89-10 removed the recommendation that licensees of BWR and PWR nuclear plants, respectively, consider inadvertent positioning of MOVs as part of their GL 89-10 programs.
7. The consideration of long-term passive failures in piping should be consistent with the staff's licensing review for the individual facility and should be in accordance with SRP 3.6.1. Further, the licensee's evaluation of passive failures must consider valve and pump seal failures as discussed in SECY 77-439.
8. Licensees may rely on analysis results for each design-basis event and each system's required capability to satisfy event acceptance limits provided in the updated final safety analysis report (FSAR) where the licensee can demonstrate that the information in the updated FSAR is consistent with the licensing basis of the facility.

9. Licensees are required to meet the single failure criterion in the NRC regulations. Other criteria may also apply at the same time (e.g., loss of offsite power). Further, safety systems are required to meet the redundancy provisions of Appendix A to 10 CFR Part 50. The consideration of the single failure criterion as applied to anticipated operational transients should be consistent with the staff's licensing review for the individual facility.
10. The safe shutdown-licensing basis for each facility is defined in licensing documents. Valves that are operated during conditions below the safe shutdown-licensing basis are not required to be in the scope of the MOV program if the licensee does not have any other commitments that the MOV must operate during certain conditions. For example, if the safe shutdown-licensing basis is Hot Shutdown, valves that are operated during conditions below Hot Shutdown are not in the scope of the MOV program. However, the MOV would be included in the MOV program scope if the licensee has an Appendix R commitment that requires the MOV to operate during certain conditions.

END

APPENDIX B

PROCEDURE BACKGROUND & GENERAL INFORMATION

Background

The NRC regulations in Appendix A, "General Design Criteria for Nuclear Power Plants," to 10 CFR Part 50, "Domestic Licensing of Production and Utilization Facilities," require that structures, systems, and components (SSCs) important to safety be designed, fabricated, erected, and tested to quality standards commensurate with the importance of the safety functions to be performed. Appendix A to 10 CFR Part 50 states that where generally recognized codes and standards are used, they shall be identified and evaluated to determine their applicability, adequacy, and sufficiency; and shall be supplemented or modified as necessary to assure a quality product in keeping with the required safety function. Appendix A to 10 CFR Part 50 also requires that a quality assurance (QA) program be established and implemented in order to provide adequate assurance that these SSCs will satisfactorily perform their safety functions. Appendix B, "Quality Assurance Criteria for Nuclear Power Plants and Fuel Reprocessing Plants," to 10 CFR Part 50 specifies criteria for the QA program to provide adequate confidence in the capability of safety-related SSCs to perform their design-basis functions.

In 10 CFR 50.55a, the NRC regulations incorporate by reference the American Society of Mechanical Engineers (ASME) *Code for Operation and Maintenance of Nuclear Power Plants* (OM Code) for implementation of an inservice testing (IST) program for pumps, valves, and dynamic restraints used in nuclear power plants. The ASME OM Code (1995 Edition through 2006 Addenda) specifies the performance of stroke-time testing of power-operated valves on a quarterly frequency as part of the IST program. Based on operating experience and research results from motor-operated valves (MOVs), the NRC determined that the ASME OM provision for quarterly stroke-time testing was inadequate to provide reasonable assurance for the operational readiness of MOVs to perform their safety functions. Therefore, the NRC regulations in 10 CFR 50.55a(b)(3)(ii) supplement the testing requirements for MOVs in the ASME OM Code by requiring that licensees implementing the ASME OM Code as part of the IST program at their nuclear power plants shall also establish a program to ensure that MOVs continue to be capable of performing their design-basis safety functions. As discussed below, ASME updated the MOV testing provisions in the 2009 Edition of the ASME OM Code.

The NRC staff issued Generic Letter (GL) 89-10 (June 28, 1989), "Safety-Related Motor-Operated Valve Testing and Surveillance," in response to generic concerns regarding MOV performance. The generic letter requested 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.
- Trending MOV problems.

The NRC staff conducted inspections that reviewed documents containing the criteria above to satisfy the GL 89-10 programs at nuclear power plants licensed prior to issuance of GL 89-10. Documents that are used to demonstrate that MOVs are capable of operating during normal, accident, and abnormal conditions are required to meet the requirements of 10 CFR Part 50, Appendix B, and therefore, controls are required to be in place to ensure any revisions to the licensee's GL 89-10 program are properly maintained and available for review.

On August 17, 1995, the NRC issued GL 95-07, "Pressure Locking and Thermal Binding of Safety-Related Power-Operated Gate Valves," to request that licensees perform, or confirm that they had previously performed, (1) evaluations of the operational configurations of safety-related, power-operated (including motor-, air-, and hydraulically operated) gate valves for susceptibility to pressure locking and thermal binding; and (2) further analyses, and any needed corrective actions, to ensure that safety-related power-operated gate valves that are susceptible to pressure locking or thermal binding are capable of performing the safety functions within the current licensing basis of the facility. The NRC staff completed its review of licensees' actions in response to GL 95-07 in an SE for each reactor unit licensed prior to issuance of GL 95-07.

On September 18, 1996, the NRC issued GL 96-05, "Periodic Verification of Design-Basis Capability of Safety-Related Motor-Operated Valves," requesting each nuclear power plant licensee establish or ensure the effectiveness of a program to verify on a periodic basis that safety-related MOVs are operable within the current licensing bases of the facility. Nuclear power plant licensees developed an industry wide Joint Owners Group (JOG) Program on MOV Periodic Verification to develop a generic response to GL 96-05. The NRC staff accepted the industry topical report on the JOG Program on MOV Periodic Verification in an SER dated September 25, 2006, and its supplement dated September 18, 2008. Nuclear power plant licensees committing to apply the JOG program in response to GL 96-05 are responsible for implementing the applicable conditions in the SER and its supplement. The JOG program does not include actuator output capability as part of its long-term MOV program; therefore, the licensee will need to address this aspect of MOV periodic verification on a plant-specific basis. In Regulatory Issue Summary (RIS) 2011-13 (January 6, 2012), "Followup to Generic Letter 96-05 for Evaluation of Class D Valves Under Joint Owners Group Motor-Operated Valve Periodic Verification Program," the NRC staff provided guidance for licensees in providing periodic verification of the design-basis capability of safety-related MOVs outside the scope of the JOG program.

The NRC staff completed its review of licensee actions in response to GL 96-05 in an SE for each reactor unit licensed prior to issuance of GL 96-05. Each SE describes the MOV risk-ranking methodology that was reviewed and approved by the NRC staff when closing out GL 96-05. Plants participating in the JOG, which do not implement the appropriate risk ranking methodology, must justify their methodology as part of the implementation of the JOG program. Generic MOV risk insights for boiling water reactors (BWRs) may be obtained from BWR Owners Group (BWROG) Report NEDC-32264A (Revision 2), "Application of Probabilistic Safety Assessment to Generic Letter 89-10 Implementation." Generic MOV risk insights for Westinghouse plants may be obtained from Westinghouse Owners Group (WOG) Report V-EC-1658 (Revision 1), "Risk Ranking Approach for Motor- Operated Valves in Response to Generic Letter 96-05." The WOG MOV risk-ranking approach can also be used to provide insights for ranking MOVs in Combustion Engineering and Babcock & Wilcox design plants based on their

safety significance with the exception that the generic list of high-risk valves in WOG Report V-EC-1658 applies only to Westinghouse design plants.

Beginning with the 2009 Edition, the ASME OM Code replaces the quarterly MOV stroke-time testing requirements with a performance-based diagnostic testing program described in Appendix III, "Preservice and Inservice Testing of Active Electric Motor Operated Valve Assemblies in Light-Water Reactor Power Plants," to periodically verify that MOVs are capable of performing their design-basis safety functions. Through the specific MOV requirements in 10 CFR 50.55a or the updated ASME OM Code, licensees under 10 CFR Part 52 are required to establish a program that maintains the capability of their MOVs to perform the applicable design-basis safety functions.

Regulatory Guide (RG) 1.192, "Operation and Maintenance Code Case Acceptability, ASME OM Code," accepts with certain provisions the implementation of specific ASME OM Code Cases in lieu of the applicable provisions in the ASME OM Code as incorporated by reference in the NRC regulations. Licensees may implement the specific ASME OM Code Cases as accepted with certain provisions in specific revisions to RG 1.192 incorporated in 10 CFR 50.55a without submittal of a request for implementation of an alternative IST method to the NRC for review and authorization. With respect to MOVs, RG 1.192 accepts with certain provisions ASME OM Code Cases OMN-1, "Alternative Rules for Preservice and Inservice Testing of Active Electric Motor-Operated Valve Assemblies in Light-Water Reactor Power Plants," and OMN-11, "Risk-Informed Testing for Motor-Operated Valves," that provide an alternative to quarterly MOV stroke-time testing through a program of exercising and diagnostic testing on a periodic frequency. ASME used the provisions of OM Code Cases OMN-1 and OMN-11 in developing the performance-based MOV diagnostic testing requirements in Appendix III to the 2009 Edition of the ASME OM Code.

ASME Standard QME-1-2017, "Qualification of Active Mechanical Equipment Used in Nuclear Power Plants," includes provisions for the functional design and qualification of nuclear power plant active mechanical equipment (including MOVs). ASME prepared this revision to the QME-1 standard to incorporate lessons learned from valve operating experience and research programs. The NRC staff has accepted the use of ASME QME-1-2017 in Revision 4 to RG 1.100, "Seismic Qualification of Electrical and Active Mechanical Equipment and Functional Qualification of Active Mechanical Equipment for Nuclear Power Plants," with specific conditions.

Industry bulletins and NRC information notices alert licensees to operating experience issues with MOVs. For example, the NRC staff issued IN 2003-15, "Importance of Follow up Activities in Resolving Maintenance Issues," in response to degradation of MOVs caused by the failure to incorporate adequate instructions for motor pinion key connections in maintenance procedures at an operating nuclear power plant. The NRC staff issued IN 2006-26, "Failure of Magnesium Rotors in Motor-Operated Valve Actuators," in response to degradation of magnesium rotors in MOV motors at several nuclear power plants. The NRC staff issued IN 2006-29, "Potential Common Cause Failure of Motor-Operated Valves as a Result of Stem Nut Wear," in response to significant degradation of stem nuts in numerous MOVs that went unidentified until MOV

failures occurred at an operating nuclear power plant. The NRC staff issued IN 2008-20, "Failures of Motor-Operated Valve Actuator Motors with Magnesium Alloy Rotors," in response to degradation of MOV actuator motors with magnesium alloy rotors. The NRC staff issued IN 2010-03, "Failures of Motor-Operated Valves Due to Degraded Stem Lubricant," to alert licensees to potential adverse effects on MOV performance from degradation of lubricant used on valve stems. Limitorque (Flowserve Corporation) prepared a Safety Bulletin in June 2004 (following a tragic personnel accident at a fossil-fired power plant) to emphasize that the use of cheater bars or similar devices to operate MOV actuators is strictly prohibited. The NRC staff issued IN 2012-14, "Motor-Operated Valve Inoperable Due To Stem-Disc Separation," to inform addressees of recent operating experience involving an MOV that failed at the connection between the valve stem and disc. This operating experience revealed a weakness in the ASME OM Code requirements for verifying valve position indication. The NRC staff issued IN 2013-14, "Potential Design Deficiency in Motor-Operated Valve Control Circuitry", to inform addressees of recent operating experience involving incorrect limit switch setting which could lead to a valve remaining partially open after a close signal. The NRC staff issued IN 2017-03 "Anchor/Darling Double Disc Gate Valve Wedge Pin and Stem-Disc Separation Failures", to inform addressees of recent operating experience and Part 21 issue involving MOVs that failed at the connection between the valve stem and disc. The inspector should review these and more recent industry bulletins and NRC information notices for the latest information on operating experience with MOV performance.

END

Attachment 1
Revision History Table for IP 62708

Commitment Tracking Number	Accession Number Issuer Date Change Notice	Description	Description of Training Required and Completion Date	Comment Resolution and Closed Feedback Form Accession Number (Pre-Decisional, Non-Public Information)
	ML003706583 09/12/00 CN 00-018	Initial Issuance		
	ML13142A123 10/23/13 CN 13-026	The procedure was revised to update the background information of the document (Appendix B) and to make it more concise.	N/A	
	ML20189A571 07/16/20 CN 20-033	The procedure was revised to update the background information of the document (Appendix B), update hyperlinks, and add references. A five year periodic review has been completed.	N/A	N/A