

# NRC INSPECTION MANUAL

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## INSPECTION PROCEDURE 71111 ATTACHMENT 21N.02

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### DESIGN-BASIS CAPABILITY OF POWER-OPERATED VALVES UNDER 10 CFR 50.55A REQUIREMENTS

Effective Date: 01/01/2021

PROGRAM APPLICABILITY: IMC 2515 App A

CORNERSTONE:           Initiating Events  
                              Mitigating Systems  
                              Barrier Integrity

INSPECTION BASES:       IMC 0308 Attachment 2

#### SAMPLE REQUIREMENTS:

Sample Requirements		Minimum Baseline Sample Completion Requirements		Budgeted Range	
Sample Type	Section	Frequency	Sample Size (per site)	Samples (per site)	Hours per Site
POV Review	03	Triennial	8	8-12	210 +/- 32

#### 71111.21N.02-01   INSPECTION OBJECTIVE

To assess the reliability, functional capability, and design basis of risk-important power-operated valves (POVs) as required by **Title 10 of the Code of Federal Regulations (10 CFR) 50.55a** and applicable 10 CFR Part 50, Appendix A and Appendix B, requirements.

#### 71111.21N.02-02   GENERAL GUIDANCE

##### 02.01 Sample Selection

In performing this inspection, the inspectors will select a sample of POVs for detailed review of the applicable licensee activities. The inspectors may expand the sample to determine the design-basis capability of other POVs if concerns are identified with implementation of licensee activities. Appendix A of this procedure, "Background Information on Design-Basis Capability of Power-Operated Valves," Appendix B of this procedure, "Detailed Inspection Guidance for Power-Operated Valve Sample," and Appendix C of this procedure, "Power-Operated Valve Inspection Capability Information," provide additional guidance for the performance of this inspection.

In preparation for this inspection, regional inspectors should consult with subject matter experts from the NRC headquarters Division of Engineering and External Hazards/Mechanical Engineering and Inservice Testing Branch, along with the Regional Senior Reactor Analyst (SRA) and use risk insights to identify approximately 30 valves to consider for more detailed inspection. The inspector will then request that the licensee provide design-basis capability information for those POVs including their function, safety significance, sizing and setting calculation assumptions, and operating margin. **The request for information from the licensee should occur at least 3 months ahead of the inspection preparation week.** See Appendix C to this inspection procedure for guidance on appropriate information to request from the licensee for **motor-operated valve (MOV)** and **air-operated valve (AOV)** design-basis capability.

Select approximately 8-12 from the 30 POVs for detailed review and assessment of their operational readiness to perform their design-basis functions. As applicable to the specific POV and its valve type, the selection should be based on performance assumptions (such as valve factor, stem friction coefficient, rate of loading, degraded voltage, bearing torque coefficient, and uncertainties) and margin assessment. With the appropriate approvals from Regional Management per IMC 2515, the sample size may be expanded based on inspection experience with specific types of POVs.

- See Appendix A of this procedure for background information on the design-basis capability of POVs in nuclear power plants.
- See Appendix B of this procedure for detailed POV inspection guidance.
- See Appendix C of this procedure for examples of POV design-basis capability information.

## 02.02 Site Visit

If necessary, the team leader (TL) may make a site visit/information gathering trip to the nuclear power plant to be inspected. Purposes of the site visit are to: (a) discuss with the licensee the scope of the planned inspection; (b) obtain advance information to review in preparation for the inspection; (c) ensure that the information to be reviewed is available at the beginning of the inspection; and (d) verify that logistical issues (such as obtaining both site and computer system access and arranging the location of the inspection team working area) will be resolved prior to inspector arrival. **It is recommended that the TL performs this trip at least one month prior to the onsite portions of the inspection.** The TL shall make arrangements to transfer inspection-related information to other NRC staff assigned to the inspection.

## 71111.21N.02-03 INSPECTION SAMPLES

### Specific Guidance

Sections 03.a – 03.d of this procedure indicate the areas that the inspector shall review for each POV selected for detailed review and assessment. The purpose of this activity is to evaluate the functional capability of the POV sample and verify that the licensee's activities provide reasonable assurance of the design-basis capability of POVs to perform their safety functions.

a. Scope

**Determine whether the sampled POVs are being tested and maintained in accordance with NRC regulations along with the licensee’s commitments and/or licensing bases.**

Specific Guidance:

1. Identify the current licensing basis of the sampled POVs with the licensee.
2. Verify that the sampled POVs are being tested and maintained per the applicable regulatory requirements, such as 10 CFR 50.55a (Inservice Testing (IST)), 10 CFR 50.49 (environmental qualification), 10 CFR 50.69 (Risk-informed Categorization and Treatment of Structures, Systems and Components for Nuclear Power Reactors) and Appendix B to 10 CFR Part 50 (quality assurance).
3. Confirm that the licensee is following the applicable ASME *Operation and Maintenance Code* (OM Code) as incorporated by reference in 10 CFR 50.55a for the IST program for the sampled POVs.
4. Confirm that the licensee is implementing its applicable commitments to provide reasonable assurance of POV capability, as described in Generic Letter (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.”

b. Design

**Determine whether the sampled POVs are capable of performing their design-basis functions.**

Specific Guidance:

1. Verify design documents and calculations for POV functional requirements under normal, abnormal, and accident conditions demonstrate design functionality is maintained.
2. Confirm the adequacy of POV operating requirements and actuator sizing; methods for selecting, setting, and adjusting POVs, as applicable; and modifications to the system or valves that could affect the POV capability in the as-modified configuration.

c. Testing

**Determine whether testing of the sampled POVs is adequate to demonstrate the capability of the POVs to perform their safety functions under design-basis conditions.**

Specific Guidance:

1. Ensure that preservice testing (PST) and IST procedures satisfy the ASME OM Code as incorporated by reference in 10 CFR 50.55a.
2. Confirm proper test acceptance criteria.
3. Evaluate test results for sampled POVs.
4. If testing is conducted during the inspection, review ongoing testing activities for the sampled POVs and evaluate the test results for those POVs.

d. Maintenance and Corrective Actions

**Evaluate maintenance activities including a walkdown of the sampled POVs (if accessible).**

Specific Guidance:

1. Review available POV monitoring reports, failure analyses, corrective actions, nonconformance reports, or other plant documents that may indicate that a POV is not properly sized, has improper settings, or is not properly maintained, as applicable.
2. Review POV preventive maintenance to determine whether it is appropriate for the frequency of operation, working environment, and operating experience.
3. Determine whether the licensee is periodically reviewing information related to POV failures and the effectiveness of their corrective actions.
4. Review a sample of POV maintenance packages and determine whether the post-maintenance tests and results demonstrate that the POVs are capable of performing their design-basis functions.
5. Review the adequacy of licensee's processing and control of POV operating experience information and vendor notifications.
6. Evaluate the implementation of the licensee's activities at the nuclear power plant to periodically verify POV design-basis capability.
7. Review significant changes made to the testing and maintenance programs for the sampled POVs since previous NRC reviews or inspections.

71111.21N.02-04 REFERENCES

American Society of Mechanical Engineers (ASME) *Operation and Maintenance of Nuclear Power Plants*, Division 1, OM Code: Section IST, and Code Cases.

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

ASME Standard QME-1-2017, "Qualification of Active Mechanical Equipment Used in Nuclear Facilities."

[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)

*Federal Register*, 64 FR 51370, "Industry Codes and Standard; Amended Requirements," September 22, 1999.

*Federal Register*, 82 FR 32934, "Incorporation by Reference of American Society of Mechanical Engineers Codes and Code Cases," July 18, 2017.

*Federal Register*, 86 FR 26540, "American Society of Mechanical Engineers 2015-2017 Code Editions Incorporation by Reference," May 4, 2020.

[Generic Letter \(GL\) 89-10](#), "Safety-Related Motor-Operated Valve Testing and Surveillance," June 28, 1989, and seven supplements (June 13, 1990; August 3, 1990; October 25, 1990; February 12, 1992; June 28, 1993; March 8, 1994; and January 24, 1996).

[GL 95-07](#), "Pressure Locking and Thermal Binding of Safety-Related Power-Operated Gate Valves," August 17, 1995.

[GL 96-05](#), "Periodic Verification of Design-Basis Capability of Safety-Related Motor-Operated Valves," September 18, 1996.

[Information Notice \(IN\) 92-83](#), "Thrust Limits for Limitorque Actuators and Potential Overstressing of Motor-Operated Valves," December 17, 1992.

[IN 96-48](#), "Motor-Operated Valve Performance Issues," August 21, 1996, and Supplement 1, July 24, 1998.

[IN 97-16](#), "Preconditioning of Plant Structures, Systems, and Components Before ASME Code Inservice Testing or Technical Specification Surveillance Testing," April 4, 1997.

[IN 2003-15](#), "Importance of Followup Activities in Resolving Maintenance Issues," September 5, 2003.

[IN 2006-03](#), "Motor Starter Failures due to Mechanical-Interlock Binding," January 25, 2006.

[IN 2006-15](#), "Vibration-Induced Degradation and Failure of Safety-Related Valves," July 27, 2006.

[IN 2006-29](#), "Potential Common Cause Failure of Motor-Operated Valves as a Result of Stem Nut Wear," December 14, 2006.

[IN 2008-20](#), "Failures of Motor-Operated Valve Actuator Motors with Magnesium Alloy Rotors," December 8, 2008.

[IN 2010-03](#), "Failures of Motor-Operated Valves Due to Degraded Stem Lubricant," February 3, 2010.

[IN 2012-06](#), "Ineffective Use of Vendor Technical Recommendations," April 24, 2012.

[IN 2012-14](#), "Motor-Operated Valve Inoperable Due To Stem-Disc Separation," July 24, 2012.

[IN 2013-14](#), "Potential Design Deficiency in Motor-Operated Valve Control Circuitry," August 23, 2013.

[IN 2014-11](#), "Recent Issues Related to the Qualification and Commercial Grade Dedication of Safety-Related Components," September 19, 2014.

[IN 2015-13](#), "Main Steam Isolation Valve Failure Events," December 10, 2015.

[IN 2016-05](#), "Operating Experience Regarding Complications from a Loss of Instrument Air," April 27, 2016.

[IN 2016-09](#), "Recent Issues Identified When Using Reverse Engineering Techniques in the Procurement of Safety-Related Components," July 15, 2016.

[IN 2017-03](#), "Anchor/Darling Double Disc Gate Valve Wedge Pin and Stem-Disc Separation Failures," June 15, 2017.

[Inspection Manual Part 9900](#), "Technical Guidance on Maintenance – Preconditioning."

[Inspection Procedure \(IP\) 61726](#), "Surveillance Observations."

[IP 62708](#), "Motor-Operated Valve Capability."

[IP 62710](#), "Power-Operated Gate Valve Pressure Locking and Thermal Binding."

[IP 71111.22](#), "Surveillance Testing."

Joint Owners Group, Topical Report MPR-2524-A, "Joint Owners Group (JOG) Motor Operated Valve Periodic Verification Program Summary," November 2006 (ADAMS Accession No. ML063490194).

Licensee Event Report 424/2012-005-00, "Main Steam Isolation Valve Failure," dated November 29, 2012, submitted by Southern Nuclear Operating Company (ADAMS Accession No. ML12339A190).

Nuclear Energy Institute, "Joint Owners Group Air Operated Valve Program Document," Revision 0, March 27, 2001 (ADAMS Accession No. ML020360091).

Nuclear Energy Institute, "Joint Owners Group Air Operated Valve Program Document," Revision 1, March 27, 2001 (ADAMS Accession No. ML010950310).

NRC Inspection Procedure 95003 Supplemental Inspection Report 05000259/2011011, 05000260/2011011, and 05000296/2011011 (Part 1) for Browns Ferry Nuclear Plant, dated November 17, 2011 (ADAMS Accession No. ML113210602).

NRC Inspection Report No. 50-275/2016010 AND 50-323/2016010, for Diablo Canyon Power Plant Units 1 and 2, dated October 3, 2016 (ADAMS Accession No. ML16277A340).

NRC Inspection Report No. 50-361 and 362/99-18, for San Onofre Nuclear Generating Station, Units 2 and 3, dated January 4, 2000 (ADAMS Accession Nos. ML003672750 and ML003672773).

NRC Inspection Report No. 50-237 and 249/2012008 for Dresden Nuclear Power Station, Units 2 and 3, dated April 23, 2012 (ADAMS Accession No. ML12114A356).

NRC letter, Eugene V. Imbro, "Comments on Joint Owners' Group Air Operated Valve Program Document," October 8, 1999 (ADAMS Accession No. ML020360077).

NRC Safety Evaluation Report, "Final Safety Evaluation on Joint Owners' Group Program on Motor-Operated Valve Periodic Verification," September 25, 2006, with supplement, September 18, 2008 (ADAMS Accession Nos. ML061280315 and ML082480638).

[NUREG-1482](#), "Guidelines for Inservice Testing at Nuclear Power Plants."

[Regulatory Guide \(RG\) 1.100, Revision 3](#), "Seismic Qualification of Electrical and Active Mechanical Equipment and Functional Qualification of Active Mechanical Equipment for Nuclear Power Plants," September 2009.

[RG 1.100, Revision 4](#), "Seismic Qualification of Electrical and Active Mechanical Equipment and Functional Qualification of Active Mechanical Equipment for Nuclear Power Plants," May 2020.

[RG 1.106, Revision 2](#), "Thermal Overload Protection for Electric Motors on Motor-Operated Valves," February 2012.

[RG 1.175](#), "An Approach for Plant-Specific, Risk-Informed Decisionmaking: Inservice Testing," August 1998.

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

[RG 1.200](#), Revision 2, "An Approach for Determining the Technical Adequacy of Probabilistic Risk Assessment Results for Risk-Informed Activities," March 2009.

[Regulatory Issue Summary \(RIS\) 2000-03](#), "Resolution of Generic Safety Issue 158, Performance of Safety-Related Power-Operated Valves under Design Basis Conditions," March 15, 2000.

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

[RIS 2007-06](#), "Regulatory Guide 1.200 Implementation," March 22, 2007.

[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," January 6, 2012. Special Inspection Report 05000400/2012008 (dated July 12, 2012) on the MSIV failure at Shearon Harris Nuclear Power Plant (ADAMS Accession No. ML12194A281).

Standard Review Plan Section 3.9.6, "Functional Design, Qualification, and Inservice Testing Programs for Pumps, Valves, and Dynamic Restraints," Revision 3, dated March 2007.



## APPENDIX A, "BACKGROUND INFORMATION ON DESIGN-BASIS CAPABILITY OF POWER-OPERATED VALVES"

### Regulations

The NRC regulations in Appendix A, "General Design Criteria for Nuclear Power Plants," to Part 50, "Domestic Licensing of Production and Utilization Facilities," in Title 10, "Energy," of the *Code of Federal Regulations* (10 CFR Part 50) 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. The NRC regulations in 10 CFR 50.2, "Definitions," specify that safety-related SSCs mean those SSCs that are relied upon to remain functional during and following design basis events to assure (1) the integrity of the reactor coolant pressure boundary; (2) the capability to shut down the reactor and maintain it in a safe shutdown condition; or (3) the capability to prevent or mitigate the consequences of accidents which could result in potential offsite exposures comparable to the applicable guideline exposures set forth in the NRC regulations.

The NRC regulations in 10 CFR 50.55a, "Codes and standards," require, in part, that licensees conduct inservice tests to verify the operational readiness of valves, whose function is required for safety. Among the valves with safety functions addressed by these regulations are power-operated valves (POVs) including motor-operated valves (MOVs), air-operated valves (AOVs), hydraulic-operated valves (HOVs), solenoid-operated valves (SOVs), pyrotechnic-operated valves (squib valves), and other valves with power actuators.

In 10 CFR 50.55a, the NRC regulations incorporate by reference the American Society of Mechanical Engineers (ASME) *Operation and Maintenance of Nuclear Power Plants*, Division 1, OM Code: Section IST (commonly referred to as the OM Code) for implementation of preservice testing (PST) and inservice testing (IST) activities for pumps, valves, and dynamic restraints used in nuclear power plants. Paragraph ISTA-1100, "Scope," in Subsection ISTA, "General Requirements," of the ASME OM Code states, in part, that its PST and IST requirements apply to valves that are required to perform a specific function in shutting down a reactor to the safe shutdown condition, in maintaining the safe shutdown condition, or in mitigating the consequences of an accident. The NRC uses the licensee's description of safe shutdown as defined in each plant's licensing basis. As of **June 2020**, the NRC regulations incorporate by reference up to the 2017 Edition of the ASME OM Code.

The NRC regulations in 10 CFR 50.55a(f)(4)(i) require that the IST program comply with the ASME Code edition and addenda incorporated by reference in the NRC regulations the



specified time period (currently 12 months) before fuel load and each 10-year IST program update interval (or acceptable ASME OM Code Cases).

The NRC regulations in 10 CFR 50.49, "Environmental Qualification of Electric Equipment Important to Safety for Nuclear Power Plants," require licensees to establish a program for qualifying the safety-related electric equipment and other electric equipment important to safety within the scope of 10 CFR 50.49.

The NRC regulations in 10 CFR 50.65, "Requirements for Monitoring the Effectiveness of Maintenance at Nuclear Power Plants," require licensees to monitor the performance or condition of SSCs in a manner sufficient to provide reasonable assurance that these SSCs are capable of fulfilling their intended functions.

### ASME OM Code

The ASME OM Code (1995 Edition through 2006 Addenda) specified the performance of stroke-time testing of MOVs on a quarterly frequency as part of the IST program. Based on MOV operating experience and research results, the NRC determined that the ASME OM provision for quarterly stroke-time testing was inadequate to provide reasonable assurance of 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. Beginning with the 2009 Edition, the ASME OM Code replaces the quarterly MOV stroke-time testing requirements with periodic exercising and 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.

The ASME OM Code (1995 Edition through 2015 Edition) specifies the performance of stroke-time testing of AOVs on a quarterly frequency as part of the IST program. In the 2017 Edition, the ASME OM Code includes Mandatory Appendix IV, "Preservice and Inservice Testing of Active Pneumatically Operated Valve Assemblies in Nuclear Reactor Power Plants," which requires quarterly stroke time testing and preservice performance assessment testing (PAT) for all AOVs within the scope of the IST program, and periodic PAT for AOVs with high safety significance up to a maximum interval of 10 years.

### Regulatory Response

On June 28, 1989, the NRC staff issued Generic Letter (GL) 89-10, "Safety-Related Motor-Operated Valve Testing and Surveillance," in response to operating experience concerns regarding MOV performance. In GL 89-10, the NRC staff 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 NRC staff conducted inspections to review the development, implementation, and results of GL 89-10 programs.

On September 18, 1996, the NRC issued GL 96-05, "Periodic Verification of Design-Basis Capability of Safety-Related Motor-Operated Valves," requesting that each nuclear power plant 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 response to GL 96-05, nuclear power plant licensees developed an industry-wide Joint Owners Group (JOG) Program on MOV Periodic Verification. The NRC staff accepted the industry topical report on the JOG Program on MOV Periodic Verification in a safety evaluation report (SER) dated September 25, 2006, (ADAMS Accession No. ML061280315) and its supplement dated September 18, 2008 (ADAMS Accession No. ML082480638). MPR-2524-A (November 2006), "Joint Owners Group (JOG) Motor Operated Valve Periodic Verification Program Summary," (ADAMS Accession No. ML063490194) updates the topical report to reflect the NRC final SER, and includes the JOG response to NRC staff requests for additional information and the final SER as appendices to the report. 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. 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 conducting periodic verification of the design-basis capability of safety-related MOVs outside the scope of the JOG program. The JOG program evaluates degradation of the operating requirements for valves such that the lessons learned from the JOG program can be applied to valves with any power actuators. The JOG program does not include actuator output capability as part of its MOV program such that the licensee will need to address this aspect of MOV periodic verification on a plant-specific basis.

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 reviewed the response to each licensee to GL 95-07 and prepared an SER describing its review.

### Operating Experience

On March 15, 2000, the NRC issued RIS 2000-03, "Resolution of Generic Safety Issue 158: Performance of Safety-Related Power-Operated Valves Under Design Basis Conditions," to discuss the application of lessons learned from MOV operating experience and research programs to POVs with other than motor actuators. For example, RIS 2000-03 includes a list of attributes for a successful POV design capability and long-term periodic verification program. RIS 2000-03 also describes the development of a JOG program on AOV periodic verification testing, and NRC staff comments on that program. The NRC received a copy of Revision 0 of the program document in a letter from the Nuclear Energy Institute (NEI) on July 19, 1999 (ADAMS Accession No. ML020360091). The NRC staff provided comments on the JOG AOV program and its implementation in a letter to NEI, dated October 8, 1999 (ADAMS Accession No. ML020360077). NEI provided Revision 1 to the JOG AOV program to the NRC staff in a letter dated March 27, 2001 (ADAMS Accession No. ML010950310).

In RIS 2000-03, the NRC staff stated that it closed Generic Safety Issue (GSI) 158 on the basis that the NRC regulations provided adequate requirements to ensure verification of the design-basis capability of POVs at nuclear power plants and that no new regulatory requirements were needed. The NRC staff noted that it would continue to work with industry groups on an industry-wide approach to the POV issue, and to provide timely, effective, and efficient resolution of the concerns regarding POV performance. The NRC staff also stated that it would continue to monitor licensees' activities to ensure that POVs at nuclear power plants are capable of performing their specified safety-related functions under design-basis conditions. This inspection procedure is part of the ongoing effort by the NRC staff to monitor the licensees' activities to ensure the design-basis capability of safety-related POVs at nuclear power plants.

Regulatory Guide (RG) 1.192, "Operation and Maintenance Code Case Acceptability, ASME OM Code," as incorporated by reference in the NRC regulations, accepts with certain provisions the implementation of specific ASME OM Code Cases in lieu of the applicable provisions in the ASME OM Code. Licensees may implement the specific ASME OM Code Case accepted in RG 1.192, as incorporated in 10 CFR 50.55a, without submittal of a request for implementation of an alternative IST method for review and authorization by the NRC. RG 1.192 includes the NRC staff positions on Code Cases for testing of POVs, including MOVs and AOVs. 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 applied 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. With the development of Appendix III in the ASME OM Code, ASME has limited the application of OM Code Cases OMN-1 and OMN-11 to earlier editions and addenda of the ASME OM Code. ASME OM Code Case OMN-12, "Alternative Requirements for Inservice Testing Using Risk Insights for Pneumatically and Hydraulically Operated Valve Assemblies in Light-Water Reactor Power Plants," allows a nuclear power plant licensee to implement a performance-based periodic testing program for AOVs in lieu of the quarterly stroke-time testing specified in the ASME OM Code.

RG 1.106 (Revision 2), "Thermal Overload Protection for Electric Motors on Motor-Operated Valves," describes acceptable methods for the application of thermal overload protection devices that are integral with the motor starter for MOV motors. A lesson learned from operating experience and testing programs for MOVs is that significant valve operating requirements can occur as a result of high differential pressure and fluid flow conditions. For example, tilting of a valve disc in a gate valve because of high differential pressure and flow can cause metal grinding or binding that result in operating requirements much greater than those associated with sliding friction. Subsequent to initial accident conditions, the high differential pressure and fluid flow conditions might be significantly reduced during later stages of an accident. Therefore, a motor that is shut off by a thermal overload device might be capable of operating the valve later when the fluid conditions are less severe (such as lower differential pressure and flow). The need for an MOV to operate immediately at the outset of an accident or whether the safety function can be performed later during an accident may be considered in sizing and setting thermal overload devices. RG 1.106 (Revision 2) describes several alternatives to provide assurance that safety-related MOVs whose motors are equipped with thermal overload protection devices will perform their safety functions. The licensee should have justification for its use of MOV thermal overload protection devices.

## Other Guidance

In response to GL 89-10, the Electric Power Research Institute (EPRI) developed the MOV Performance Prediction Methodology (PPM) to determine dynamic thrust and torque operating requirements for gate, globe, and butterfly valves used in nuclear power plants. EPRI described the methodology in Topical Report TR-103237 (Revision 2, April 1997), "EPRI MOV Performance Prediction Program." On March 15, 1996, the NRC staff issued an SER accepting the EPRI MOV PPM with certain conditions and limitations. IN 96-48, "Motor-Operated Valve Performance Issues," and its Supplement 1 indicated that lessons learned from the EPRI program were applicable to valves with other types of actuators.

On February 20, 1997, the NRC staff issued a supplement to the SER on general issues and two unique gate valve designs. On April 20, 2001, the staff issued Supplement 2 to the SER on Addendum 1 to EPRI Topical Report TR-103237 addressing an update of the computer model.

On September 8, 1999, 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 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.

ASME Standard QME-1-2007, "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 POVs). ASME prepared the 2007 Edition of 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-1-2007 in Revision 3 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. In 2017, ASME published ASME Standard QME-1-2017, "Qualification of Active Mechanical Equipment Used in Nuclear Facilities," to provide updated qualification provisions for pumps, valves, and dynamic restraints. In Revision 4 (May 2020) to RG 1.100, the NRC staff accepts the use of ASME QME-1-2017 with specific conditions. The licensing of the design and qualification requirements of nuclear facilities varied over the years. Many older operating facilities do not have a specific docketed commitment to the ASME QME-1 Standard. Inspection staff should confirm the licensee's commitments before comparing the licensee's activities to the QME-1 Standard.

## APPENDIX B, "DETAILED INSPECTION GUIDANCE FOR POWER-OPERATED VALVE SAMPLE"

This appendix contains detailed guidance for the inspection of nuclear power plant licensee activities to provide reasonable assurance of the design-basis capability of power-operated valves (POVs) to perform their safety functions that should be reviewed and/or referenced as inspectors implement this procedure.

### 71111.21N.02B-01. Sample Selection

In performing this inspection, the inspectors will select a sample of POVs for detailed review of the applicable licensee activities. The inspectors may expand the sample and evaluate programmatic aspects of the POV design-basis capability if concerns are identified with implementation of the licensee activities.

With the assistance from subject matter experts, the regional SRA, and use of risk insights from staff members, the inspector will identify approximately 30 POVs among multiple systems for preparation of the POV capability information as described in this inspection procedure. The sample should include motor-operated valves (MOVs), air-operated valves (AOVs), and additional types of POVs (hydraulic-operated valves (HOVs), solenoid-operated valves (SOVs), and pyrotechnic-actuated (squib) valves) based on the plant design, maintenance, testing activities, operating experience, identified generic weaknesses, and risk significance. The inspector should include squib valves in the passive core cooling system if the inspection will be conducted at a nuclear power plant with a passive core cooling system licensed under 10 CFR Part 52, "Licenses, Certifications, and Approvals for Nuclear Power Plants." The inspector may consider SOVs within a sampled AOV or HOV as part of the SOV sample.

Where possible, the inspector should maximize the inspection effectiveness by evaluating areas involving multiple inspection requirements as follows:

Component Risk. Either the licensee's probabilistic risk assessment (PRA) report or the NRC's SAPHIRE tool might reveal insights on important systems and components. The inspector should discuss the planned inspection with the Regional SRA staff during preparation for this inspection to obtain information on risk insights and issues related to the nuclear power plant to be inspected.

System Maintenance. POVs with a high incidence of corrective maintenance are appropriate candidates for sample selection. The inspector might identify these components through discussions with the resident inspectors, or plant maintenance or operations personnel; by a review of previous inspection reports; or through a search of licensee event reports (LERs), the site corrective action database or system health reports.

The selection of POVs should include consideration of various valve sizes, types (e.g., gate, globe, and butterfly), and manufacturers, to evaluate the adequacy of the licensee's approach for maintaining the design-basis capability of each valve type. The POV sample may be expanded based on the inspection findings where concerns are raised regarding the capability of specific POVs to perform their design-basis safety functions. Prior to the inspection, the inspector should request that the licensee provide design-basis capability information for approximately 30 safety-related POVs. The valve capability information should include safety

function, safety significance, sizing and setting calculation assumptions, and operating margin. See Appendix C to this inspection procedure for information related to MOV and AOV design-basis capability.

If the licensee is implementing risk-informed activities for its POVs, the inspector should contact the Regional SRA or NRC headquarters staff in the Division of Engineering and External Hazards responsible for the IST program review, as appropriate, to determine whether any high safety-significant nonsafety-related POVs should be included in the sample. The purpose of this interface is to ensure inspector awareness of any NRC safety evaluation(s) for a specific license amendment or 10 CFR 50.55a relief or alternative request that may need to be reviewed in preparation for the inspection.

## 71111.21N.02B-02 POV Review

### 02.01 Scope

#### Detailed Guidance:

- a. The inspector should determine, based on the POV sample, that the licensee is maintaining POVs consistent with their risk significance and NRC regulations.
- b. The inspector should review POV program changes that removed safety-related valves from ASME Code required testing programs since the completion of previous NRC reviews or inspections to verify the change(s) were acceptable.
- c. The inspector should determine whether the licensee is applying the proper criteria when establishing the scope of its POV activities. Where a licensee has modified the scope of its POV activities since a previous review or inspection, the inspector should determine whether the licensee has adequately justified the removal of any POVs from ASME Code required testing programs. The inspector should also review plant modifications and determine whether new or modified POVs were properly incorporated into the licensee's valve testing programs, as appropriate.
- d. Since specific MOV and AOV provisions are provided in different editions of the ASME OM Code, the inspector should determine the ASME OM Code of record for the PST and IST program at the nuclear power plant to be inspected, and the status of the incorporation by reference of the latest edition of the ASME OM Code into 10 CFR 50.55a.

#### Supporting Information:

With respect to MOVs, Appendix A, "Considerations in Reviewing the Scope of Licensee MOV Program," to [IP 62708](#), "Motor-Operated Valve Capability," provides additional guidance for the inspector regarding the scope of the licensee's MOV program. The inspector should also be aware that Mandatory Appendix III, "Preservice and Inservice Testing of Active Electric Motor Operated Valve Assemblies in Light-Water Reactor Power Plants," in the ASME OM Code includes all active MOVs within the scope of the IST program.

## 02.02 Design

### Detailed Guidance:

- a. The inspector should review licensee design bases documentation demonstrating that the sampled POVs are capable of performing their design-basis functions and meet applicable codes and commitments, including design documents and calculations for POV functional requirements under normal, abnormal, and accident conditions. This includes MOV motor and actuator sizing; AOV actuator sizing; methods for selecting, setting, and adjusting POVs, as applicable; and modifications to the system or valves that could affect the POV capability in the as-modified configuration.
- b. As a follow-up to the GL 89-10 program review, the inspector should review the methods used by the licensee for determining the design-basis functional requirements for as-modified POVs within the scope of the program under the applicable system and environmental parameters for normal, abnormal, and accident conditions that are used in selecting, setting, and adjusting switches (including torque, limit, bypass, and thermal overload).
- c. The inspector should review the output capability calculations for the MOV actuators. The inspector should evaluate the electrical calculations for the impact on MOV output capability based on degraded voltage and temperature effects.
- d. The inspector should review the methods used for determining the design-basis functional requirements for the sample AOVs under the applicable system and environmental parameters for normal, abnormal, and accident conditions. The inspector should review the design calculations for the **AOV** samples.
- e. For all sampled POVs, the inspector should determine whether the licensee has addressed the potential for pressure locking or thermal binding of POVs.

### Supporting Information:

Following the initial verification of POV capability under design-basis conditions, the POV capability will need to be re-verified 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 POV in its modified configuration. For example, replacement of the valve or its internal disc would require complete demonstration of the design-basis capability. Because of the interrelationship of various operating parameters, the performance of the POV can be affected by routine maintenance work, such as valve packing adjustments.

Motor sizing calculations need to consider degraded voltage and elevated ambient temperature conditions. Use of appropriate actuator efficiency and the proper application factor needs to be justified. Adequate bases need to exist for stem factors, valve factors, load sensitive behavior, and other assumed parameters that are used in calculations to size the MOV actuators. As part of the functional design verification, the licensee may apply the Electric Power Research Institute (EPRI) MOV Performance Prediction Methodology (PPM) where implemented in accordance with NRC acceptance. EPRI provides guidance for AOV design calculations in EPRI Technical Report TR-107321, "Application Guide for Evaluation of Actuator Output



Capability for Air-Operated Valves in Nuclear Power Plants,” and TR-107322, “AOV Evaluation Guide.”

EPRI provides guidance for MOV design calculations in Technical Report TR-106563, “Application Guide for Motor-Operated Valves in Nuclear Power Plants,” Volume 1: Gate and Globe Valves, and Volume 2: Butterfly Valves. The explanation of various MOV terms can be found in EPRI guidance and other documents. For example, valve factor may be used as part of the calculation of the thrust required to operate a gate or globe valve due to the differential pressure across the valve seat area. Stem factor is the ratio of the rotational torque of the actuator and the output thrust applied to a rising-stem valve, which depends on the stem dimensions and stem friction coefficient. Stem friction coefficient is the coefficient of friction between the threads of valve stem and the stem nut in the actuator. Load sensitive behavior (or the rate-of-loading effect) is a phenomenon related to the reduced actuator output that can occur when the valve is operated under dynamic conditions relative to static conditions.

The following references will assist inspectors in their output capability calculations for MOV actuators. For example, the NRC staff discussed **alternating current (AC)** powered MOV actuator capability in IN 96-48, Supplement 1 (July 24, 1998), “Motor-Operated Valve Performance Issues,” which references Limitorque Technical Update 98-01 (updated by its Supplement 1). The NRC staff discussed direct current (**DC**) powered MOV actuator capability in Regulatory Issue Summary (RIS) 2001-15 (August 1, 2001), “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 pressurized water reactor nuclear power plants.

As discussed in [IN 2012-14](#), “Motor-Operated Valve Inoperable Due To Stem-Disc Separation,” the NRC staff indicated four acceptable methods a licensee could use to demonstrate the design-basis capability of safety-related MOVs during GL 89-10 program inspections. The four methods, in descending order of acceptability, were:

- a. 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 provides assurance that the valve performance is predictable. The licensee should consider adjusting the valve factors when evaluating valve design bases performance during its design-basis evaluation and setup based on test data obtained from the actual valve or from similarly constructed valves.
- b. Application of the EPRI MOV PPM. This method was initially developed for those valves that could not be dynamically tested. The PPM requires internal valve measurements to provide assurance that the valve performance is predictable. The NRC staff accepted the use of the PPM where dynamic testing for an MOV was not practicable. If the licensee is implementing another test-based methodology, the inspector should contact the NRC headquarters staff to determine the most efficient method to obtain generic review and acceptance of the methodology.
- c. Where valve-specific dynamic testing was not performed and the PPM was not used, the NRC 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 be aware of the valve performance and maintenance history, and helped provide confidence that the valve performance is predictable.

- d. The least preferred approach (with the most margin necessary) 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. (If a licensee is applying this least preferred approach, the inspector should contact the NRC headquarters staff for technical assistance in determining a reasonable margin for the MOV capability.)

With respect to MOVs, IP 62708, "Motor-Operated Valve Capability," provides a list of issues to be assessed and assumptions to be justified as applicable in the MOV design calculations. The inspector should also be aware that Mandatory Appendix III, "Preservice and Inservice Testing of Active Electric Motor Operated Valve Assemblies in Light-Water Reactor Power Plants," in the ASME OM Code includes all active MOVs within the scope of the IST program.

During the implementation of GL 89-10, the NRC staff focused on the design-basis capability of gate, globe, and butterfly valves with motor operators. Therefore, a licensee implementing Mandatory Appendix III will need to have information that supports the design-basis capability of other valve types (such as ball and plug valves) that might not have been tested as part of the GL 89-10 program. The licensee might be able to obtain this information from the specific valve vendor.

Licensees implemented activities in response to GL 95-07 to evaluate potential pressure locking and thermal binding of safety-related power-operated gate valves. The inspector may obtain the GL 95-07 evaluation for the specific nuclear power plant to be inspected. Additional inspection guidance for this activity is provided in IP 62710, "Power-Operated Gate Valve Pressure Locking and Thermal Binding." Operating experience has revealed that globe valves might also be subject to thermal binding in certain situations.

### 02.03 Testing

#### Detailed Guidance:

- a. The inspector should review evaluation and test documents for verification of POV design-basis capability, PST and IST procedures, test equipment, training of evaluation and test personnel, acceptance criteria, and evaluation and test results. The inspector should evaluate ongoing POV verification and testing activities and consider selecting systems with activities scheduled during the inspection period. When observing POV testing, the inspector should:
  1. Confirm that the licensee has appropriately extrapolated test data to design-basis conditions in determining the capability of the tested POVs.
  2. Determine whether licensee activities prior to testing might result in unacceptable preconditioning of the performance of the POV.
  3. Determine whether test equipment is setup and calibrated in accordance with vendor recommendations.
  4. Determine whether test personnel are properly qualified.

5. Verify that engineering and quality control personnel are appropriately involved in the testing activity.
  6. Determine test equipment inaccuracies and test data accuracy and performance assumptions are appropriately included in the test data evaluation.
  7. Determine whether the licensee is evaluating test results and initiating corrective actions in a timely manner.
- b. The inspector should evaluate the test results for the sampled POVs as follows:
1. Review a sufficient population of test data for the sampled POVs (such as stroke time, leak rate testing, diagnostic, position indication, as applicable) over the last two test intervals, as appropriate.
  2. Determine whether applicable technical specification ACTION statements and applicable reporting requirements are satisfied when POVs are declared inoperable as a result of testing activities.
  3. Review the method of test data comparison to previous test activities and actions taken on POVs indicating a degrading condition or a repetitive problem.
  4. Review the documented results of engineering evaluations performed over the previous 5 years, where possible, for POVs that did not satisfy the test acceptance criteria at any time during that interval, verify the licensee has taken corrective action(s) and has a reasonable bases for returning the POVs to an operable status.
- c. With respect to post-maintenance testing, the inspector should review a sample of POV maintenance packages and determine whether the post-maintenance tests and results demonstrated that the POVs were capable of performing their design-basis functions.
1. The inspector should determine whether the licensee's procedures require that POVs be tested prior to return to service following maintenance.
  2. The licensee should follow the vendor recommendations for post-maintenance testing consistent with the NRC regulations or should justify its alternate approach.
  3. The inspector should review selected POV maintenance packages and determine whether the post-maintenance tests demonstrated the POV was capable of performing its design function.
  4. The inspector should determine whether the licensee had an adequate basis for not testing a POV following packing adjustment
- d. The inspector should determine whether the licensee has demonstrated the functional design-basis capability of POVs to perform their safety functions. The design-basis verification provides the foundation for the PST and IST programs to demonstrate the operational readiness of POVs prior to and during reliance on those POVs to perform their safety functions. The inspector should determine whether the licensee meets the PST and IST provisions specified in the ASME OM Code as incorporated by reference in 10 CFR 50.55a (or acceptable ASME OM Code Cases). For example, Appendix III to the ASME OM Code specifies PST and IST requirements for active MOVs within the scope of the ASME OM Code for nuclear power plants.
- e. The inspector should ensure that the licensee is conducting appropriate leak rate testing of Category A valves of the ASME OM Code.
- f. The inspector should verify the licensee's justification for implementation of the conditions specified in RG 1.192 where Code Case OMN-12 will be applied at the nuclear power plant.

- g. When the licensee is implementing ASME OM Code, Mandatory Appendix III, or Code Case OMN-1, the inspector should review the licensee's consideration of the extension of the exercising of MOVs from a quarterly frequency to every refueling outage.
- h. The inspector should determine the applicability of the most recent edition of the ASME OM Code to the nuclear power plant being inspected, and the implementation of the conditions specified directly in 10 CFR 50.55a or through RG 1.192 as incorporated by reference in 10 CFR 50.55a.
- i. The inspector should determine whether the licensee has justified the accuracy of POV and AOV diagnostic equipment. The inspector should also verify personnel operating POV and AOV diagnostic equipment and analyzing the information have been trained in accordance with the licensee training and qualification program. As part of that training, the licensee should ensure that plant personnel understand the inherent sensitivities and limitations of the diagnostic equipment.
- j. The inspector should verify the following AOV information regarding the licensee's AOV program and note any areas that the program does not adequately cover:
  1. The licensee is responsible for justifying the AOV test data used in sizing and setting its AOVs.
  2. The licensee has justification for its assumptions for each parameter in its AOV calculations.
  3. The licensee assumes a reasonable value based on industry test data for a parameter where it does not have plant-specific justification for the parameter.
  4. The licensee takes action where the calculation predicts AOV capability problems.
  5. The licensee undertakes prompt evaluation of test results to determine capability under design-bases conditions prior to declaring the AOV operable and returning it to service.
  6. The licensee has justification for the accuracy of its AOV diagnostic equipment.
  7. The licensee monitors test data to affirm its assumptions.
  8. The licensee has justification for applying test data to valve groups.
  9. The licensee can determine the capability margin for its AOVs and validate its AOV assumptions and validate its MOV assumptions, including valve and stem friction coefficients, and load sensitive behavior, for gate and globe valves; and bearing friction coefficients for butterfly valves.
  10. As part of training, the licensee ensures that plant personnel understand the inherent sensitivities and limitations of the diagnostic equipment.

Supporting Information:

Testing activities need to satisfy the ASME OM Code edition or addendum that is applicable to the nuclear power plant to be inspected as incorporated by reference in 10 CFR 50.55a, OM Code Cases as accepted in RG 1.192 or authorized alternatives or granted relief requests. Instruments used for POV testing activities need to meet the accuracy and range requirements and be within calibration. Portions of this inspection procedure might be accomplished during plant operations or refueling outages because POV testing might be accomplished during outages.

For MOVs, the inspector may rely on the demonstration provided by the licensee for specific MOVs in response to GL 89-10 where that demonstration is justified and continues to apply.

One acceptable method of demonstrating the functional design-basis capability of POVs to perform their safety functions is to apply the provisions in ASME QME-1-2007, "Qualification of Active Mechanical Equipment Used in Nuclear Power Plants," as accepted in RG 1.100 (Revision 3), "Seismic Qualification of Electrical and Active Mechanical Equipment and Functional Qualification of Active Mechanical Equipment for Nuclear Power Plants." **Another acceptable method is to apply the provisions of ASME QME-1-2017, "Qualification of Active Mechanical Equipment Used in Nuclear Facilities," as accepted in RG 1.100 (Revision 4).**

The licensee will need to have obtained acceptance from the NRC for relief from or alternatives to the applicable ASME OM Code provisions. **On May 4, 2020, the NRC revised 10 CFR 50.55a to incorporate by reference the 2015 and 2017 Editions of the ASME OM Code.** The 2017 Edition of the ASME OM Code includes Mandatory Appendix IV, "Preservice and Inservice Testing of Active Pneumatically Operated Valve Assemblies in Nuclear Reactor Power Plants," with updated PST and IST provisions for AOVs.

RG 1.192 as incorporated in 10 CFR 50.55a accepts the use of ASME OM Code Cases with conditions (where appropriate) as alternatives to specific requirements in the ASME OM Code. RG 1.192 also accepts the use of ASME OM Code Case OMN-3, "Requirements for Safety Significance Categorization of Components Using Risk Insights for Inservice Testing of LWR Power Plants," with conditions for the risk ranking of MOVs for use in implementing Code Cases OMN-1 and 11. In addition, RG 1.192 accepts the use of ASME OM Code Case OMN-12, "Alternative Requirements for Inservice Testing Using Risk Insights for Pneumatically and Hydraulically Operated Valve Assemblies in Light-Water Reactor Power Plants," with conditions as an alternative to the quarterly stroke-time testing provisions for AOVs in the ASME OM Code.

ASME incorporated OM Code Cases OMN-1 and OMN-11 into the 2009 Edition of the ASME OM Code as Mandatory Appendix III to replace the requirements for quarterly stroke-time testing of MOVs. As of **June 2020**, the NRC incorporates by reference into 10 CFR 50.55a the ASME OM Code up through the 2017 Edition with conditions on Appendix III similar to those imposed in RG 1.192 on OM Code Cases OMN-1 and OMN-11. In addition, the NRC imposed a condition requiring that when applying Paragraph III-3600, "MOV Exercising Requirements," of Appendix III to the ASME OM Code, licensees shall verify that the stroke time of MOVs specified in plant technical specifications satisfies the assumptions in the plant's safety analyses.

As discussed in *Federal Register* Notice 64 FR 51370 (dated September 22, 1999) on page 51386 and *Federal Register* Notice 82 FR 32934 (dated July 18, 2017) on page 32946, the licensee should 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. Where degradation in the performance of a high-risk MOV is identified when exercised or tested at an extended interval, the licensee needs to reapply the quarterly frequency for the exercise test interval for all high-risk MOVs and implement diagnostic testing of those MOVs at an interval that provides assurance of their design-basis capability throughout the test interval. The licensee should also evaluate the performance results for MOVs to determine whether the risk ranking of MOVs must be raised to a higher level based on those results. Section 2.4.5, "Deferring Valve Testing to Cold Shutdown or Refueling Outages," in NUREG-1482 provides

additional guidance for justification of extending test intervals beyond quarterly based on safety concerns.

RG 1.106 (Revision 2), "Thermal Overload Protection for Electric Motors on Motor-Operated Valves," describes acceptable methods for the application of thermal overload protection devices that are integral with the motor starter for MOV motors. The licensee should have justification for its use of MOV thermal overload protection devices.

[RIS 2000-03](#) provides elements for a successful AOV periodic verification program such as:

- Setpoints for AOVs will be defined based on current vendor information or valve qualification diagnostic testing, such that the valve is capable of performing its design-basis functions.
- Periodic static testing will be performed to identify potential degradation, unless those valves are periodically cycled during normal plant operation under conditions that meet or exceed the worst case operating conditions within the licensing basis of the plant for the valve, which would provide adequate periodic demonstration of AOV capability.
- Sufficient diagnostics will be used to collect relevant data (e.g., valve stem thrust and torque, fluid pressure and temperature, stroke time, operating and/or control air pressure, etc.) to verify the valve meets the functional requirements of the qualification specification.
- Test frequency will be specified and evaluated each refueling outage based on data trends as a result of testing and in accordance with the JOG AOV Program.
- Post-maintenance procedures include appropriate instructions and criteria to ensure baseline testing is re-performed as necessary when maintenance on the valve, repair or replacement, have the potential to affect valve functional performance.
- Guidance is included to address lessons learned from other valve programs specific to the AOV program.

The NRC has provided guidance related to preconditioning in several documents, including Inspection Manual Part 9900, "Technical Guidance on Maintenance – Preconditioning," IP 61726, "Surveillance Observations," IP 71111.22, "Surveillance Testing," and NUREG-1482, "Guidelines for Inservice Testing at Nuclear Power Plants." The NRC staff also alerted licensees to preconditioning issues in IN 97-16, "Preconditioning of Plant Structures, Systems, and Components before ASME Code Inservice Testing or Technical Specification Surveillance Testing."

POVs should be sized and set to deliver their output capability based on design-basis conditions. Stroking a valve following maintenance that could have adversely affected the capability of the POV to provide the required output does not demonstrate that the POV is capable of operating during design-basis conditions. Since post-maintenance testing under design-basis conditions is not always feasible, the licensee might need to use other methods to ensure the maintenance performed has not rendered the POV incapable of performing its intended function.

If the licensee chooses not to test a POV following maintenance, the licensee needs to be able to justify that a test was not necessary to demonstrate the capability of the POV to perform its safety function. For example, valve packing adjustment can affect POV operation since the adjustment of packing could increase the thrust required to open or close the POV. In some

instances, it might be difficult to test a POV following the adjustment of packing during plant operation because plant conditions prohibit the cycling of the POV. In this example, test data previously obtained could be used to demonstrate that the POV's capability was not adversely affected by the specific packing adjustment. This might include justification based on diagnostic test data that re-torquing the packing to the previously tested value does not adversely impact running load.

#### 02.04 Maintenance

##### Detailed Guidance:

- a. The inspector should evaluate the implementation of the licensee's activities at the nuclear power plant to periodically verify POV and AOV design-basis capability.
- b. The inspector should evaluate development and implementation of the periodic verification of MOV design-basis capability consistent with the NRC regulations in 10 CFR 50.55a(b)(3)(ii), including review of MOV periodic verification test results, both static and dynamic tests. The inspector should determine whether information from these tests was incorporated into the design, sizing, and setup calculations for the sampled POVs, as applicable. The inspector should determine whether the licensee has justified the extension of the fatigue life of its POV actuators, if applicable.
- c. The inspector should determine whether the licensee plans to implement the JOG MOV program as part of satisfying the regulatory requirements to periodically verify the design basis capability of MOVs.
  1. Where a licensee does not plan to implement the JOG MOV program as accepted by the NRC, the licensee will be responsible for justifying its program in response to 10 CFR 50.55a to demonstrate the periodic verification of MOVs to perform their design basis safety functions.
  2. Where the licensee has committed to implement the JOG MOV program, the inspector should determine whether 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.
- d. The inspector should determine whether the licensee has procedures to periodically review POV data as part of a monitoring and feedback effort for POV performance.
- e. The inspector should determine whether the licensee has implemented periodic POV preventive maintenance based on POV frequency of operation, working environment and operational experience. The inspector should verify licensee personnel performing POV maintenance are trained in accordance with the applicable site specific training program. The inspector should evaluate preventive maintenance activities during a walkdown of POVs installed in the plant, and through a review of the POV treatment in the licensee's Maintenance Rule Program.
- f. The licensee should implement vendor recommendations for preventive maintenance or have justification for an alternate approach.
- g. The inspector should determine whether the licensee is periodically reviewing information related to POV failures and the effectiveness of the corrective actions.
  1. The inspector should determine whether the licensee's administrative procedures



- require that POV failures, malfunctions, and deficiencies be promptly identified and corrected.
2. The inspector should determine whether the licensee's procedures for analysis of POV failures, justification of corrective actions, and monitoring of failures and corrective actions for the selected POVs are adequate.
  3. The inspector should review any recent POV failures and the resulting corrective actions.
  4. The inspector should determine whether the licensee performed the appropriate level of cause analysis based on the significance of POV failures, malfunctions, and deficiencies.
    - i. The licensee's failure analysis should include the results and history of each as-found deteriorated condition, malfunction, test, inspection, analysis, repair, or alteration.
    - ii. For example, an MOV torque switch adjustment might overcome an increased actuator load, but does not identify and correct the cause of the increased actuator load. The application of a greater actuator torque might allow the MOV to be returned to service, but could lead to a repetitive or more serious failure.
- h. The inspector should verify that POV operating experience information and vendor notifications are being incorporated into the licensee's POV program in accordance with site procedures. The inspector should evaluate the consideration of POV operating experience at the nuclear power plant being inspected and from other nuclear power plants.
- i. The inspector should review the specific attributes of the JOG program including, for example, proper classification of the valves, documentation of the valve material construction, service conditions, qualifying basis, and verification of proper valve factor being applied. The provisions in ASME OM Code Cases OMN-1 and OMN-3 as accepted with conditions in RG 1.192 also satisfy the NRC regulatory requirements for MOV periodic verification. An example of the performance of an inspection of an MOV periodic verification program can be found in NRC IP 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).
- j. The inspector should evaluate the licensee's design activities related to the operational readiness of the sampled POVs such as the following:
1. Review the licensee's procedures for test data evaluation, any available evaluation activities, and actions taken for POVs found to be degraded or that require frequent corrective maintenance.
    - i. For these POVs, the inspector should determine if an engineering evaluation was performed that adequately addressed the cause.
    - ii. The inspector should assess the licensee's actions if the mode of degradation is likely to affect other POVs.
    - iii. The inspector should review any engineering evaluations which were performed to return a POV to operable status in lieu of other corrective actions.
  2. Review at least one example (if available) of test equipment that was found to be out-of-calibration during testing activities.

- i. The inspector should evaluate the acceptability of the licensee's corrective actions for this deficiency.
    - ii. The inspector should review the engineering evaluations that were performed to address the impact of the use of an out-of-calibration instrument on the operability of affected POVs.
  - 3. Determine whether the licensee is implementing vendor recommendations regarding testing, preventive maintenance, and post-maintenance testing for applicable POVs. If not, what engineering justifications does the licensee have regarding testing, preventive maintenance, and post-maintenance testing to ensure the POV will operate for the expected life under the plant conditions.
  - 4. Determine whether appropriate post-maintenance testing is conducted following the modification or replacement process.
  - 5. Determine whether the licensee's review of test documents adequately assess operational readiness of the POVs.
- k. The inspector should review significant changes made in activities affecting the sampled POVs since previous NRC reviews or inspections. The inspector should discuss any POV activity changes with the licensee, and evaluate the justification of those changes consistent with the guidance in this inspection procedure.

Supporting Information:

Periodic Monitoring:

Reference Appendix III and Appendix IV of the ASME OM Code for monitoring and feedback provisions for MOVs and AOVs, respectively.

- 1. Examples of MOV parameters that may be monitored 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.
- 2. Examples of AOV parameters that may be monitored include stroke time, packing/running loads, setpoint pressure, preload or bench set range, seating/unseating loads, and valve friction factors. In addition to plant specific data, the monitoring and feedback effort should include industry-wide POV data.

Preventive Maintenance:

- 1. Examples of MOV preventive maintenance activities include the following items:
  - i. Checking for indications of grease or oil leakage from the various sealed joints and shaft protrusions.
  - ii. Checking the mounting flange and valve yoke for cracks or damage. Checking fasteners for tightness.
  - iii. Lubrication of valve stem, main gear case, and limit switches.
  - iv. Checking valve stem and stem nut threads for damage by direct visual inspection or validated diagnostic methods. With regard to stem nut wear, operating experience has revealed that checking for bronze shavings below an MOV during a plant walkdown is not sufficient to identify significant thread wear of the stem nut prior to failure of the MOV to operate electrically or manually.
  - v. Checking that the ball in the grease relief valve, if installed, is free to move.
  - vi. Sampling and analysis of the grease in main gear case.
  - vii. Checking spring pack for hardened grease.

- viii. Checking that T-drains are installed, where appropriate, and are clear of paint and debris.
  - ix. Check limit switch compartment for cleanliness and general integrity of gears and wire terminals.
  - x. Verify EQ seals on the valve and wiring conduits are intact.
2. Examples of AOV preventive maintenance activities include the following items:
- i. Conducting visual external inspections. Inspecting and adjusting valve packing.
  - ii. Calibrating AOV accessories, such as pressure regulators or switches. Performing diagnostic testing to measure AOV parameters, such as valve travel, friction, air pressure, spring rate, and seat load.
  - iii. Checking for internal leakages.
  - iv. Performing periodic actuator and valve overhaul.

Operating Experience:

Examples of NRC information notices and industry bulletins that have alerted licensees to operating experience issues with POVs are listed in the "References" section (02.04) of this procedure, but also include the following:

1. IN 2006-26, "Failure of Magnesium Rotors in Motor-Operated Valve Actuators," discussed degradation of magnesium rotors in MOV motors at several nuclear power plants.
2. IN 2017-03, "Anchor/Darling Double Disc Gate Valve Wedge Pin and Stem-Disc Separation Failures," alerted licensees to operating experience involving Anchor/Darling double-disc gate valves that failed at their stem-disc connection. The inspector should verify that the licensee has justified the structural integrity of the stem-disc connections for its Anchor/Darling double-disc gate valves with threaded connections. If needed, inspectors should request assistance from the NRC headquarters staff in evaluating the structural integrity of the stem-disc connections of Anchor/Darling double-disc gate valves.
3. 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.
4. Where the licensee is not implementing vendor recommendations, the licensee should provide justification for its approach. See IN 2012-06, "Ineffective Use of Vendor Technical Recommendations," April 24, 2012 for additional guidance.

For implementation of the JOG MOV program, the inspector should determine whether the licensee has completed the MOV classification process and has justified the results. 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.

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.

1. The inspector should determine whether MOVs in JOG Class A or Class B are periodically tested to demonstrate their output capability to satisfy the valve operating requirements.
2. The inspector should determine whether MOVs in JOG Class C are periodically tested to demonstrate their design-basis capability.
3. For those MOVs in JOG Class D or where the licensee has not committed to implement the JOG program, the inspector should determine whether 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 provided 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 MOVs outside the scope of the JOG program. 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.

In addition to valve operating requirements, the inspector should determine whether the licensee addresses actuator output capability as part of its MOV periodic verification program. The inspector should review the documentation regarding the periodic verification of MOV design-basis capability and determine whether those commitments have been implemented.

The JOG MOV 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 the purpose of justifying valve design-basis capability. If a valve in service has a disallowing modification, the inspector should determine whether the licensee has obtained a new qualifying basis.

Limitorque (now Flowserve) qualifies its motor actuators to be capable of performing their design functions for 2000 strokes over a plant life of 40 years. The nuclear industry has conducted testing programs to evaluate the structural limits for Limitorque actuators. For example, IN 92-83, "Thrust Limits for Limitorque Actuators and Potential Overstressing of Motor-Operated Valves," describes the NRC review of industry test programs to justify increased limits on Limitorque actuators, including testing for 4000 strokes. More recently, EPRI has developed a methodology to extend the fatigue life of Limitorque actuators from 2000 strokes (40 years) to 4000 strokes (60 or more years). EPRI describes this methodology in Technical Report 1016701 (December 2008), "Limitorque Actuator Fatigue Life Extension." The details of the EPRI methodology are proprietary; however, NRC inspectors may view the EPRI report in NRC's Agencywide Documents Access and Management System (ADAMS) at accession number [ML14136A072](#) (non-public ADAMS link). If a licensee intends to apply the EPRI methodology, the licensee should address the scope, limitations, and provisions for use of

the EPRI methodology specified in the EPRI report to justify the extension of the fatigue life of its Limitorque actuators.

The ASME OM Code in the 2017 Edition includes periodic verification testing provisions for AOVs in the IST program in nuclear power plants. In addition, the NRC regulations in 10 CFR 50.55a requires post-2000 reactors to implement periodic verification programs for the design-basis capability of POVs to perform their safety functions.

The inspector should contact the applicable NRC headquarters staff for assistance in evaluating the periodic verification of POV design-basis capability.

## Appendix C, “Power-Operated Valve Inspection Capability Information ”

### 71111.21N.02C-01 Introduction

This appendix to IP 71111.21N, Attachment 2, “Design-Basis Capability of Power-Operated Valves under 10 CFR 50.55a Requirements,” provides examples of the type of information to be used by NRC inspectors in evaluating the capability of power-operated valves (POVs) to perform their design-basis functions. NRC inspectors may apply other information to evaluate POV capability as available from the nuclear power plant licensee. This appendix includes information for motor-operated valves (MOVs) and air-operated valves (AOVs). The inspector may apply this information in the evaluation of other types of POVs, as applicable.

### 71111.21N.02C-02 General Information Requested

General information about the licensee’s specific POV program should be made available for review, and may be requested for review by the NRC inspectors as part of the initial request for information for the inspections. This information may include, but is not limited to:

- List of POVs important to safety at the licensee. The list should include (a) component identification number; (b) applicable plant system; (c) ASME *Boiler and Pressure Vessel Code* (BPV Code) Class; (d) safety-related or nonsafety-related classification; (e) valve type, size and manufacturer; and (f) actuator type, size, and manufacturer. If the NRC has granted a license amendment to categorize structures, systems, and component in accordance with 10 CFR 50.69, please provide the risk-informed safety category of the component.
- Listing of the POVs sorted by risk importance, including external risk considerations.
- Licensee’s word-searchable updated final safety analysis report (UFSAR), License Conditions, Technical Specifications, and most recent Inservice Testing (IST) program plan. Specifically identify which UFSAR sections address environmental, seismic, and functional qualification of POVs.
- NRC Safety Evaluation Report(s) associated with the licensee IST program and relief and alternative requests submitted in accordance with 10 CFR 50.55a for POVs, as well as any standards to which the licensee has committed with respect to POV capability and testing.
- List of systems, system numbers/designators and corresponding names.
- List of site contacts that will be associated with the inspection.
- A description of the POV program including valve performance assumptions, testing methodologies, and maintenance approach.

During the inspection, the NRC inspectors will also request to interview a licensee representative to discuss following areas:

- Site POV capability analyses, including plant drawings and assumptions and analysis for accident conditions.
- POV maintenance elements as integrated into plant programs and procedures.
- Maintaining the design-basis capability of POVs if they have entered a period of extended operation, if applicable.

Once the NRC lead inspector has selected their 8-10 valve samples, the following may be requested:

- Documentation files, including test reports, for the electrical and mechanical components associated with the POVs selected.
- References associated with the electrical and mechanical components document files.
- Vendor manuals and technical sheets associated with the selected POVs.
- Tours of the rooms in which the selected POVs are installed.

## 71111.21N.02C-03 Motor-Operated Valves

### 03.01. MOV Information List

The following is a list of the information that should be made available by the licensee for review by the NRC inspector for the MOVs sampled to evaluate their design-basis capability.

#### Valve:

- Safety function
- Manufacturer, type, and size
- Pressure rating
- Stem-disc connection
- Disc area used in calculations
- Stem diameter, pitch, and lead
- Assumed Valve Factor (VF) for Rising-Stem Valve
- Assumed Stem Friction Coefficient (SFC)
- Assumed Quarter-Turn Valve parameters for calculating bearing, seating, packing, hydrostatic, and hydrodynamic torque
- Assumed packing load

#### Actuator:

- Manufacturer, type, and size
- Overall gear ratio
- Pullout and stall efficiencies
- Application factor
- Degraded voltage factor
- Temperature degradation factor
- Butterfly valve gearbox information (such as HBC gear ratio and efficiency)



Control Switch Trip (CST) application for torque and limit switches  
Motor actuator stall output

Motor:

Manufacturer  
Power (AC/DC)  
Nominal torque  
Speed  
Rated voltage

Design-basis conditions:

Differential pressure  
System pressure  
Motor voltage  
Fluid and ambient temperature  
Fluid flow

Diagnostic equipment:

Manufacturer  
Type  
Accuracy

Uncertainty assumptions:

Diagnostic equipment  
Torque switch repeatability  
Limit switch repeatability  
Load sensitive behavior (LSB)  
Spring pack relaxation  
Stem lubrication degradation

Structural thrust/torque justification:

Valve weak-link analysis  
Actuator structural limitation  
Stem-disc connection capability  
Actuator spring pack rating

Design-basis capability and testing for close/open strokes as applicable to valve type:

Calculated required thrust and torque  
Least available actuator output (e.g., actuator capability, CST setting, actuator limit, spring pack capability, and valve weak link limitation)  
Test conditions (e.g., fluid differential pressure (DP), system pressure, flow, and temperature; ambient temperature; and motor voltage)  
Thrust and torque at CST for static and dynamic tests  
Thrust and torque required to overcome dynamic conditions  
Average running load for static and dynamic tests  
Rising-Stem Valve: Measured VF  
Rising-Stem Valve: Available VF  
Measured SFC and LSB  
Quarter-Turn Valve: Measured bearing torque coefficient  
Determined Margin (%)

Design-basis capability basis:

Design-basis dynamic test

Extrapolated dynamic test

Justification from normal operation at or above design-basis conditions

Industry dynamic test methodology

Grouping with dynamic tested valves at plant

Grouping with dynamic tested valves at other plants

Valve qualification testing (such as ASME Standard QME-1-2007 or QME-1-2017)

Other basis (such as large calculated margin)

Guidance applied in determining design-basis capability, such as:

Electric Power Research Institute (EPRI) MOV Application Guide

EPRI MOV Performance Prediction Methodology (PPM)

Limatorque Technical Bulletins

Commonwealth Edison (ComEd) White Paper 125, Motor Output

Boiling Water Reactor Owners Group (BWROG) DC MOV Motor Methodology

Joint Owners Group (JOG) MOV Periodic Verification Program

NRC generic communications and regulatory guides

### 03.02. MOV Example Table

The following is one example of an information table to help provide a snapshot evaluation of the capability of MOVs to perform their design-basis functions:

MOV Identification	MOV-XX-123
Safety Function	
Valve manufacturer, type, and size	
Actuator manufacturer, type, and size	
Motor manufacturer, type (AC/DC), and size	
Valve ASME Class	
Risk Significance	
Control Switch Trip (CST) Application (Close/Open)	
Design-Basis Differential Pressure (DBDP) and Flow (Close/Open)	
Rising-Stem Valve: Assumed Valve Factor (VF)	
Quarter-Turn Valve: Assumed bearing torque coefficient	
Assumed Stem Friction Coefficient (SFC)	
Assumed Load Sensitive Behavior (LSB) (%)	
% Uncertainties (e.g., diagnostic equipment, CST repeatability, etc.)	
Calculated Required Thrust/Torque (Close/Open)	
Least Available Output (e.g., actuator, CST, rating, spring pack, weak link)	
Test Conditions (e.g., fluid differential pressure (DP), system pressure, flow, and temperature; ambient temperature; and motor voltage) (Close/Open)	
Thrust and torque required to overcome dynamic conditions (Close/Open)	
Rising-Stem Valve: Measured VF (Close/Open)	
Rising-Stem Valve: Available VF (Close/Open)	
Measured SFC (Close/Open)	
Measured LSB (%)	
Quarter-Turn Valve: Measured bearing torque coefficient (Close/Open)	
Determined % Margin (Close/Open)	
Basis for Design-Basis Capability:	
1. Dynamic test performed at design-basis DP/flow conditions	
2. Extrapolation of dynamic test data	
3. Justification from normal operation at or above design-basis conditions	
4. Industry dynamic test methodology (such as EPRI MOV PPM)	
5. Grouped with similar valves dynamically tested at plant	
6. Grouped with similar valves dynamically tested at other plants	
7. Valve qualification testing (such as ASME QME-1-2007 or QME-1-2017)	
8. Other (such as large calculated margin)	
*Specify Not Applicable (NA) as appropriate	

71111.21N.02C-04 Air-Operated Valves

04.01. AOV Information List

The following is a list of the information that should be made available by the licensee for review by the NRC inspector for the AOVs sampled to evaluate their design-basis capability.

Valve:

- Safety function
- Fail safe position (Close/Open)
- Manufacturer, type, and size
- Pressure rating
- Stem-disc connection
- Disc area used in calculations
- Stem diameter
- Assumed Valve Factor (VF) for Rising-Stem Valve
- Assumed Quarter-Turn Valve parameters for calculating required torque
- Assumed packing load

Actuator:

- Manufacturer, type, and size
- Setup parameters (such as minimum and maximum allowable air pressure and minimum and maximum allowable spring preload, as applicable)
- Maximum actuator output

Design-basis conditions:

- Differential pressure
- System pressure
- Fluid and ambient temperature
- Fluid flow

Diagnostic equipment:

- Manufacturer
- Type
- Accuracy

Uncertainty assumptions:

- Diagnostic equipment
- Actuator air stroke capability
- Actuator spring stroke capability
- Actuator structural capability
- Spring structural capability

Structural thrust/torque justification:

- Valve weak-link analysis
- Actuator structural limitation
- Stem-disc connection capability

Design-basis capability and testing for close/open strokes as applicable to valve type:

- Calculated required thrust and torque
- Minimum allowable air pressure (Beginning/End Stroke)
- Maximum allowable air pressure (Beginning/End Stroke)
- Minimum allowable spring preload (Beginning/End Stroke)
- Maximum allowable spring preload (Beginning/End Stroke)
- Least available actuator output (e.g., actuator capability, actuator limit, and valve weak link limitation)
- Test conditions (e.g., fluid differential pressure (DP), system pressure, flow and temperature; and ambient temperature)
- Thrust and torque required to overcome dynamic conditions
- Determined Margin (%) (Least margin for air stroke operation, spring stroke operation, maximum spring load, and structural capability)

Design-basis capability basis:

- Design-basis dynamic test
- Extrapolated dynamic test
- Justification from normal operation at or above design-basis conditions
- Industry dynamic test methodology
- Grouping with dynamic tested valves at plant
- Grouping with dynamic tested valves at other plants
- Valve qualification testing (such as ASME QME-1-2007 or QME-1-2017)
- Other basis (such as large calculated margin)

Guidance applied in determining design-basis capability, such as:

- EPRI AOV Guides
- EPRI MOV PPM (valve operating requirements)
- JOG AOV Program
- NRC generic communications and regulatory guides

#### 04.02. AOV Example Table

The following is one example of an information table to help provide a snapshot evaluation of the capability of AOVs to perform their design-basis functions:

AOV Identification	AOV-XX-123
Safety Function	
Fail safe position (Close/Open)	
Valve manufacturer, type, and size	
Actuator manufacturer, type, and size	
Valve ASME Class	
Risk Significance	
Design-Basis Differential Pressure (DBDP) and Flow (Close/Open)	
Rising-Stem Valve: Assumed Valve Factor (VF)	
Quarter-Turn Valve: Assumed bearing torque coefficient	
% Uncertainties (e.g., diagnostic equipment, and actuator and structural capability, etc.)	
Calculated Required Thrust/Torque (Close/Open)	
Minimum allowable air pressure (Beginning/End Stroke)	
Maximum allowable air pressure (Beginning/End Stroke)	
Minimum allowable spring preload (Beginning/End Stroke)	
Maximum allowable spring preload (Beginning/End Stroke)	
Least available actuator output (e.g., actuator capability, actuator limit, and valve weak link limitation)	
Test Conditions (e.g., fluid differential pressure (DP), system pressure, flow and temperature; and ambient temperature) (Close/Open)	
Thrust and torque required to overcome dynamic conditions (Close/Open)	
Rising-Stem Valve: Measured VF (Close/Open)	
Quarter-Turn Valve: Measured bearing torque coefficient (Close/Open)	
Determined Margin (%) (Least margin for air stroke operation, spring stroke operation, maximum spring load, and structural capability)	
Basis for Design-Basis Capability:	
1. Dynamic test performed at design-basis DP/flow conditions	
2. Extrapolation of dynamic test data	
3. Justification from normal operation at or above design-basis conditions	
4. Industry dynamic test methodology	
5. Grouped with similar valves dynamically tested at plant	
6. Grouped with similar valves dynamically tested at other plants	
7. Valve qualification testing (such as ASME QME-1-2007 or QME-1-2017)	
8. Other (such as large calculated margin)	
*Specify Not Applicable (NA) as appropriate	

Attachment 1  
Revision History for IP 71111.21N.02

Commitment Tracking Number	Accession Number Issue Date Change Notice	Description of Change	Description of Training Required and Completion Date	Comment Resolution and Closed Feedback Form Accession Number (Pre-Decisional, Non-Public Information)
	ML19067A240 07/26/19 CN 19-024	<p>First issuance. Completed 4 year search for commitments and found none.</p> <p>This IP is one of the Focused Engineering Inspections recommended by staff in SECY 18-0113. In the SECY, staff recommended a quadrennial engineering inspection cycle to begin in 2020 and take the place of Design Basis Assurance Inspection (Teams) and Design Basis Assurance Inspection (Programs). Awaiting Commission approval.</p>	<ol style="list-style-type: none"> <li>1. 2-day Instructor-led training on POV concepts. Completed 4/12/2019</li> <li>2. 4-hour Training on procedure implementation. Completed</li> </ol>	ML19071A236
	ML20220A667 10/09/20 CN 20-050	<p>Additional guidance for when to send request for information on valves and bagman trip. Additional guidance for a valve sample to follow 50.69 testing requirements if applicable. Additional guidance included in Appendix C for what is expected in the requests for information. Updated references to 10 CFR 50.55a and RG 1.100.</p>	None	ML20225A046