UNITED STATES
NUCLEAR REGULATORY COMMISSION
OFFICE OF NUCLEAR REACTOR REGULATION
WASHINGTON, DC 20555-0001

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INFORMATION NOTICE 2021-01: LESSONS LEARNED FROM U.S. NUCLEAR REGULATORY COMMISSION INSPECTIONS OF DESIGN-BASIS CAPABILITY OF POWER-OPERATED VALVES AT NUCLEAR POWER PLANTS

ADDRESSEES

All holders of operating licenses, construction permits, or combined licenses for nuclear power reactors, except those that have permanently ceased operations and have certified that fuel has been permanently removed from the reactor vessel.

PURPOSE

The U.S. Nuclear Regulatory Commission (NRC) is issuing this information notice (IN) to alert addressees to recent information related to lessons learned from NRC inspections of the design-basis capability of power-operated valves (POVs) at nuclear power plants. The NRC expects that addressees will review the information for applicability to their facilities and consider actions, as appropriate, to identify and address similar issues. Suggestions contained in this IN are not NRC requirements. Therefore, no specific action or written response is required.

DESCRIPTION OF CIRCUMSTANCES

Recently, the NRC staff initiated an update to the Reactor Oversight Process engineering inspections in furtherance of the NRC safety mission. One of the new inspection programs relates to POVs as described in Attachment 21N.02, “Design-Basis Capability of Power-Operated Valves Under 10 CFR 50.55a Requirements,” to NRC Inspection Procedure (IP) 71111, “Reactor Safety—Initiating Events, Mitigating Systems, Barrier Integrity.” In particular, the NRC issued IP 71111.21N.02 to assess the reliability, functional capability, and design-basis capability of risk-important POVs to determine whether licensees are maintaining the POV capability to perform as intended under design-basis conditions. During public meetings in late 2019 and early 2020 (for example, see Agencywide Documents Access and Management System (ADAMS) Accession Nos. ML19351E131 and ML20038A207), the NRC staff described the intent of the IP 71111.21N.02 inspections, and indicated that lessons learned from those inspections would be made available to the stakeholders. During a public meeting on December 8, 2020 (ADAMS Accession No. ML2104AA409), participants requested that the lessons learned from the recent POV inspections be documented and made available as soon as possible.

ML21061A265

DISCUSSION

The NRC staff conducted inspections using IP 71111.21N.02 to assess the reliability, functional capability, and design-basis capability of risk-important POVs to determine whether licensees are maintaining the POV capability to perform as intended under design-basis conditions. The enclosure to this IN provides background information related to design-basis capability of POVs at nuclear power plants. Initial NRC inspections using IP 71111.21N.02 identified numerous lessons learned related to the design-basis capability of POVs at the sampled nuclear power plants.

The following is a summary of the major lessons learned from the initial NRC inspections using IP 71111.21N.02:

1. The NRC inspections found that the Inservice Testing (IST) Program Plans at some nuclear power plants were not fully consistent with the American Society of Mechanical Engineers (ASME) *Operation and Maintenance of Nuclear Power Plants*, Division 1, OM Code: Section IST (OM Code) as incorporated by reference in Title 10 of the *Code of Federal Regulations* (10 CFR) Part 50, "Domestic licensing of production and utilization facilities," Section 55a, "Codes and standards" (10 CFR 50.55a), for POVs within the scope of the ASME OM Code. For example, some IST Program Plans for specific nuclear power plants did not address all POV safety functions. In meeting 10 CFR 50.55a(b)(3)(ii), nuclear power plant licensees may pursue risk-informed approaches based on the licensing basis including authorizations contained in the applicable ASME OM Code as incorporated by reference in 10 CFR 50.55a, and consistent with the NRC's acceptance of the implementation of the industry's Joint Owners Group (JOG) Program on Motor-Operated Valve (MOV) Periodic Verification for the specific nuclear power plant. NRC inspections at some nuclear power plants found that some licensees were not periodically updating their POV risk rankings.

2. The NRC inspections found that some licensees did not address the requirement in ASME OM Code, Appendix III, "Preservice and Inservice Testing of Active Electric Motor-Operated Valve Assemblies in Light-Water Reactor Power Plants," to apply a mix of static and dynamic testing. For MOVs within the scope of the JOG Program, a licensee may rely on the dynamic testing conducted as part of that program to satisfy the requirement in Appendix III for a mix of static and dynamic testing. The NRC inspections found that some licensees are installing new valves and not performing dynamic testing in accordance with ASME OM Code, Appendix III, or otherwise justifying the valve performance assumptions. The JOG Program provides guidance for re-establishing the qualifying basis for a new valve or determining the current operating valve friction coefficient for the new valve to compare to the JOG threshold value.

3. The NRC inspections found that one licensee did not follow its NRC-accepted commitment modification process to modify the JOG test intervals or notify the NRC in accordance with that process. For example, the JOG Program does not include grace periods for the specified JOG test intervals. A licensee applied MOV test intervals that differed from the JOG test intervals that were relied upon by the NRC staff to close Generic Letter (GL) 96-05, "Periodic Verification of Design Basis Capability of Safety Related Motor Operated Valves," for that nuclear power plant.

4. The NRC inspections found that some licensees were not properly determining the operating requirements and actuator capability for POVs to perform their safety

functions. For example, some licensees did not adequately address all appropriate parameters (such as valve friction coefficients, maximum differential pressure conditions, motor torque temperature derating factors, stem friction coefficients, and butterfly valve bearing friction coefficients) when calculating valve operating requirements or actuator capability. The NRC inspections found some licensees were using improper values for various parameters in their POV calculations (such as incorrect stem pitch and lead assumptions, valve factors and stem friction coefficients that were less than values obtained from valve tests, and incorrect uncertainty values). In some cases, licensees did not justify the use of valve friction coefficients from outside sources. The JOG Program specifies guidance for determining appropriate valve friction coefficients. In some cases, licensees did not address the potential for increased thrust and torque requirements (referred to as side loading) to operate globe valves under high-flow dynamic conditions. In some cases, licensees did not consider the presence of radiation hot spots and ambient temperature conditions that can impact the service life of environmental qualification of a valve actuator. The NRC inspections found one licensee had not updated its POV program to incorporate new computer software used in its POV calculations. The NRC inspections found that the capability of individual POV subparts was not determined to be able to withstand the maximum thrust and torque that the POV actuator can produce (sometimes referred to as a weak link evaluation). For example, structural limits specified in the ASME *Boiler and Pressure Vessel Code* are not applicable to POV internal parts that involve operating motion of the valve and actuator. With respect to previous POV capability issues, GL 79-46, "Containment Purging and Venting During Normal Operation--Guidelines for Valve Operability," dated September 27, 1979 (ADAMS Accession No. ML031320191), provides recommendations to demonstrate that containment purge valves can close and seal under design-basis conditions, including seismic loads.

5. The NRC inspections found that some licensees incorrectly assumed that the valve friction coefficients determined for MOVs as part of the JOG Program represented a database of friction coefficients that can be applied in general to calculate the thrust and torque required to operate various MOVs under design-basis conditions. The JOG Program determined whether there was the potential for degradation of valve friction coefficients for various valve types and applications, rather than determining specific values of friction coefficients. The NRC provided information on various approaches for obtaining valve performance data in IN 2012-14, "Motor-Operated Valve Inoperable Due to Stem-Disc Separation," dated July 24, 2012 (ADAMS Accession No. ML12150A046).

6. The NRC inspections found that contrary to the industry topical report MPR-2524-A on the JOG Program on MOV Periodic Verification, some licensees who committed to the JOG Program to satisfy GL 96-05 and are implementing the JOG Program as part of their compliance with 10 CFR 50.55a(b)(3)(ii) had not established methods to periodically demonstrate the design-basis capability of their MOVs that are JOG Class D valves (defined by JOG as outside the scope of the JOG Program). In addition, the NRC inspections found that some licensees had modified the JOG classification of their MOVs from a JOG Class D valve to a JOG Class A valve (defined by JOG as not susceptible to degradation). The basis for reclassifying a valve that is outside the scope of the JOG Program (JOG Class D valve) to a valve not susceptible to degradation (JOG Class A valve) was not apparent. The NRC inspections also found that some licensees were applying guidance developed by the Electric Power Research Institute (EPRI) for evaluating MOV diagnostic test data

obtained under static conditions (i.e., without differential pressure or flow) beyond the capability of that testing to predict MOV performance under dynamic conditions (i.e., differential pressure and flow).

7. The NRC inspections found that some licensees that evaluated MOVs using the EPRI MOV Performance Prediction Methodology (PPM) were not addressing all of the applicable provisions when implementing the EPRI MOV PPM to determine valve operating requirements. In accepting the EPRI MOV PPM, the NRC staff noted that EPRI assumed that each valve is maintained in good condition for the EPRI MOV PPM to remain valid for that valve. The NRC inspections found that some licensees were incorrectly assuming that a valve is JOG Class A or JOG Class B (defined by JOG as not susceptible to degradation by extension) because the EPRI PPM was applied without ensuring that the valve is maintained with good internal condition. The NRC provides more information on the EPRI MOV PPM in NUREG-1482, "Guidelines for Inservice Testing at Nuclear Power Plants," Revision 3, issued July 2020 (ADAMS Accession No. ML20202A473).

8. The NRC inspections identified an instance of improper justification for increasing the thrust ratings for certain Limitorque motor actuators beyond their qualified design limits. Limitorque Technical Update 92-01, "Thrust Rating Increase SMB-000, SMB-00, SMB-0 & SMB-1 Actuators" (which is available from Limitorque), evaluated Kalsi Engineering Document #1707C (which is a proprietary report by Kalsi Engineering) and approved its use to increase the maximum allowable thrust for Limitorque actuator models SMB-000, SMB-00, SMB-0, and SMB-1 up to 140 percent of the original ratings, with certain conditions.[1] The 140-percent maximum thrust that Limitorque allows in Technical Update 92-01 is less than the 162-percent maximum thrust limit discussed in Kalsi Engineering Document #1707C. Despite the limitations of the Limitorque analyses, NRC inspections found some licensees had applied Kalsi Engineering Document #1707C to increase the allowable maximum thrust for Limitorque actuators to 162 percent of the original ratings. Previously, licensees had to have specific permission from Limitorque to increase the allowable maximum thrust for Limitorque actuators to 162 percent of the original ratings. Limitorque has since indicated that licensees that participated in the Kalsi study or have possession of the proprietary Kalsi Engineering Document #1707C report may apply the 162-percent maximum thrust rating described in the Kalsi report where the specific conditions are implemented without an individual letter from Limitorque.

9. The NRC inspections at some nuclear power plants identified that POV testing was not conducted properly, and the results were not adequately evaluated to demonstrate that the POVs could perform their safety functions. For example, POV test acceptance criteria were not properly translated from POV design calculations to test procedures. Diagnostic equipment was not verified to be installed and operating properly as part of the POV testing and evaluation of results. Operating requirements for valves were not evaluated throughout the full valve stroke. POV test data evaluations were not fully completed to ensure that the required parameters (such as valve friction coefficient, stem factor, and rate of loading) were being calculated and that they were within the acceptable range. Valve friction values from testing were not compared to the JOG

[1] NRC IN 92-83, "Thrust Limits for Limitorque Actuators and Potential Overstressing of Motor-Operated Valves," dated December 17, 1992, discussed Limitorque Technical Update 92-01 and the applicable study by Kalsi Engineering.

threshold values for valve friction when implementing the JOG Program. Overthrust events when testing POVs were not addressed. The potential variation of valve performance was not addressed when relying on a single test to establish POV operating requirements. Licensees relying on the use of POV static testing associated with containment leakage testing in accordance with 10 CFR Part 50, Appendix J, "Primary Reactor Containment Leakage Testing for Water-Cooled Power Reactors," are responsible for justifying when using such testing to demonstrate that the requirements of 10 CFR 50.55a(b)(3)(ii) for periodic verification of MOV design-basis capability are satisfied. The NRC inspections found that the performance of thermal overload devices that can impact the safety function of MOVs was not evaluated periodically. The NRC inspections also found that monitoring reports were not prepared in accordance with plant procedures to identify any adverse performance indications of POVs.

10. The NRC inspections found that some licensees, with MOVs that had a safety function to close, had set the motor control switch trip circuit to be controlled by the limit switch gear train, instead of the torque switch. For example, some licensees were relying on static testing of limit switch-controlled MOVs performed as part of containment leakage testing in accordance with 10 CFR Part 50, Appendix J, in their effort to meet the 10 CFR 50.55a(b)(3)(ii) requirement for periodic verification of MOV design-basis capability. Although the MOVs are required to close and seal under dynamic conditions, some licensees set those MOVs using the limit switch during a periodic static test. The NRC inspections identified that some licensees did not have a valid test or analysis demonstrating that the limit switch control setting of the MOV under static conditions will achieve the required leak-tight performance when the MOV is closed under dynamic conditions.

11. The NRC inspections identified that some licensees did not provide adequate justification to extend the qualified life of POVs installed in their nuclear power plants. Limitorque qualified its safety-related MOV actuators for 40 years or 2,000 cycles, whichever comes first. Licensees are permitted to extend the qualified life of their Limitorque actuators if they have adequate justification. The justification for the extension of the qualified life of the actuator, including attention to radiation levels and ambient temperature conditions where MOVs are located, should provide assurance that the environmental qualification requirements are not exceeded, and that appropriate replacement frequencies for POVs or their individual parts are established. EPRI has developed guidance for extending the qualified life of Limitorque actuators that includes provisions for a valve assembly that is considered to be functional beyond its qualified life. Licensees may follow this guidance or choose their own method where justified.

12. The NRC inspections found that some licensees were not properly implementing the Boiling Water Reactor Owners Group (BWROG) guidance (such as evaluating the weak link of the wedge pin under motor stall conditions) in assessing the susceptibility for separation of the stem-disk connection in Anchor/Darling double-disk gate valves. This guidance was established by the BWROG to address the issue of potential failure of the stem-disk connection in Anchor/Darling double-disk gate valves, which is discussed in IN 2017-03, "Anchor/Darling Double Disc Gate Valve Wedge Pin and Stem-Disc Separation Failures," dated June 15, 2017 (ADAMS Accession No. ML17153A053).

13. The NRC inspections found that some licensees were not meeting the requirement in 10 CFR 50.55a(b)(3)(xi), to supplement the valve position indication testing required in paragraph ISTC-3700, "Position Verification Testing," in Subsection ISTC, "Inservice Testing of Valves in Water-Cooled Reactor Nuclear Power Plants," of the 2012 Edition and later editions of the ASME OM Code. Paragraph ISTC-3700 requires, as conditioned by 10 CFR 50.55a(b)(3)(xi), that valves with remote position indicators be observed locally at least once every 2 years to verify that valve operation is accurately indicated. The NRC regulations in 10 CFR 50.55a(b)(3)(xi) state that when implementing ASME OM Code, 2012 Edition (or later editions), paragraph ISTC-3700, licensees shall verify that valve operation is accurately indicated by supplementing valve position indicating lights with other indications, such as flow meters or other suitable instrumentation, to provide assurance of proper obturator position. In the July 18, 2017 *Federal Register* notice (82 FR 32934) for the final rule, the NRC emphasizes the provisions in the ASME OM Code, 2012 Edition, paragraph ISTC-3700, requiring verification that valve obturator position is accurately indicated, and does not state or indicate that the condition in 10 CFR 50.55a(b)(3)(xi) represents a new test. In particular, paragraph ISTC-3700 requires licensees to test valves every 2 years to verify their remote position indicating lights. The NRC responses to public comments on the proposed rule (ADAMS Accession No. ML16130A531) included a response to a specific public comment requesting an additional 24 months to implement 10 CFR 50.55a(b)(3)(xi) for licensees nearing their IST Program update deadline. The NRC response stated that licensees would not be allowed additional time to comply with this condition as part of the rulemaking, and that licensees determining that they will need additional time to implement the 2012 Edition of the ASME OM Code (including the condition on valve position indication in 10 CFR 50.55a(b)(3)(xi)) may submit a request for an alternative in accordance with 10 CFR 50.55a(z) for NRC staff review. Additional information on this topic is found in two monthly Reactor Oversight Process meeting summaries (ADAMS Accession Nos. ML21041A409 andML21047A290).

14. With respect to POV preventive maintenance and walkdowns, the NRC inspections found that some licensees were not justifying the lubrication interval for the MOV stem where brittle or degraded lubrication grease was identified that could have impacted the operation of the MOV. The NRC inspections found MOVs installed in non-normal positions that can cause MOV maintenance issues (such as potential grease leakage into the limit switch compartment that might lead to grease interfering with the actuator wiring, or abnormal performance of a gate valve with the disk in the horizontal plane resulting in increased wear over time).

The NRC staff discussed the above issues with the applicable licensees in detail during the POV inspections. The licensees took action to address the immediate concerns related to these issues identified by the NRC inspectors. In some cases, longer term action will be needed as part of the corrective action programs at the applicable nuclear power plants. The NRC inspection reports discuss those findings that were determined to be Green, or of very low safety significance, with no findings to date. The NRC staff suggests that licensees review this information for applicability to their facilities and consider actions, as appropriate, to identify and address similar issues. Review and consideration of the information in this IN will support POV inspections at licensee facilities.

CONTACTS

This IN requires no specific action or written response. Please direct any questions about this matter to the technical contacts listed below or to the appropriate Office of Nuclear Reactor Regulation (NRR) project manager.

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Note: NRC generic communications may be found on the NRC public Web site, http://www.nrc.gov, under Electronic Reading Room/Document Collections.

Enclosure: Background Information related to Design-Basis Capability of Power-Operated Valves at Nuclear Power Plants

NRC INFORMATION NOTICE 2021-01, "LESSONS LEARNED FROM NRC INSPECTIONS OF DESIGN-BASIS CAPABILITY OF POWER-OPERATED VALVES AT NUCLEAR POWER PLANTS" DATE: May 6, 2021

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Background Information related to Design-Basis Capability
of Power-Operated Valves at Nuclear Power Plants

The U.S. Nuclear Regulatory Commission (NRC) regulations in Appendix A, "General Design Criteria for Nuclear Power Plants," to Title 10 of the *Code of Federal Regulations* (10 CFR) Part 50, "Domestic licensing of production and utilization facilities," require that structures, systems, and components (SSCs) important to safety be designed, fabricated, erected, and tested to quality standards commensurate with the importance of the safety functions to be performed. Appendix B, "Quality Assurance Criteria for Nuclear Power Plants and Fuel Reprocessing Plants," to 10 CFR Part 50 specifies criteria for the quality assurance program to provide adequate confidence in the capability of safety-related SSCs to perform their design-basis functions. The NRC regulations in 10 CFR 50.55a, "Codes and standards," require, in part, that licensees conduct inservice tests to verify the operational readiness of valves whose function is required for safety. These regulations address valves with safety functions, such as power-operated valves (POVs), including motor-operated valves (MOVs), air-operated valves (AOVs), hydraulic-operated valves, solenoid-operated valves, 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 (OM Code) for implementation of preservice testing and inservice testing (IST) activities for pumps, valves, and dynamic restraints used in nuclear power plants. At the time of the issuance of this information notice (IN), the NRC regulations incorporate by reference up to the 2017 Edition of the ASME OM Code with conditions. 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 establish a program to ensure that MOVs continue to be capable of performing their design-basis safety functions.

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 the GL 89-10 programs at nuclear power plants.

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." The EPRI MOV PPM was developed as a response to the NRC request in GL 89-10 that nuclear power plant licensees verify the design-basis capability of MOVs at that time. On March 15, 1996, the NRC staff issued a safety evaluation report (SER) (Agencywide Documents Access and Management System (ADAMS) Accession No. ML15142A761) accepting the EPRI MOV PPM topical report with certain conditions and limitations. The NRC staff issued supplemental SERs on subsequent addenda to the EPRI MOV PPM topical report. NRC Information Notice (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 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 an SER dated September 25, 2006 (ADAMS Accession No. ML061280315) and its supplement dated September 18, 2008 (ADAMS Accession No. ML082480638). JOG Report MPR-2524-A (November 2006), "Joint Owners Group (JOG) Motor Operated Valve Periodic Verification Program Summary," (ADAMS Accession No. ML063490194) updated the JOG Program topical report to reflect the NRC final SER, and included the JOG response to NRC staff requests for additional information and the final SER as appendices to the report. In response to GL 96-05, many licensees submitted written descriptions of their plans to implement the JOG Program to provide for periodic verification of the design-basis capability of their safety-related MOVs. The NRC staff prepared safety evaluations that accepted those licensees' responses to GL 96-05 based on each licensee's individual written description. As stated in the plant-specific safety evaluation, if a licensee commits to implement the JOG Program in response to GL 96-05 and then proposes to implement an approach different from the JOG Program, the NRC staff will evaluate the proposed approach.

The JOG Program determined whether specific valves within the scope of the program would experience an increase in their valve friction coefficient over time. The JOG Program found that certain valves with a friction coefficient demonstrated by testing that was below a specific threshold value can have their control switches set using that threshold value with confidence that the friction coefficient would not increase above the threshold value over time. Individual licensees collected the data obtained as part of the JOG Program using their own diagnostic evaluation methods to determine the trend of the valve coefficient of friction values for three dynamic tests of each valve over the 5-year test program. Therefore, the specific values of the friction coefficients calculated by licensees for individual valves cannot be compared to each other because of the different approaches used by licensees in evaluating their individual MOV diagnostic traces. Further, the amount of test data collected as part of the JOG Program was not sufficient to establish a database that addressed the variation in performance for a large population of valves. As stated in the NRC staff's SER dated September 25, 2006, the JOG Program does not include actuator output capability as part of its MOV program, so each licensee should address this aspect of MOV periodic verification on a plant-specific basis.

The JOG Program established four classes of MOVs in evaluating the potential degradation of the valve performance over time. JOG Report MPR-2524-A specifies that Class A valves are not susceptible to degradation, as verified by testing performed in the JOG Program or other suitable basis (e.g., EPRI MOV PPM). JOG Report MPR-2524-A specifies that Class B valves are not susceptible to degradation based on the test results in the JOG Program, extended by analysis and engineering judgment to configurations and conditions beyond those tested. JOG Report MPR-2524-A specifies that Class C valves are susceptible to changes in required thrust or torque, as shown by test results in the JOG Program. JOG Report MPR-2524-A specifies that Class D valves are outside the scope of the JOG Program. In Regulatory Issue Summary (RIS) 2011-13 dated January 6, 2012 (ADAMS Accession No. ML113050259), "Follow up 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.

Although the EPRI MOV PPM was not originally developed for that purpose, the JOG Program encompassed the EPRI MOV PPM into its MOV periodic verification methodology. It is important to note that the NRC staff indicated in its SER for the EPRI MOV PPM that when implementing the gate valve computer model, the user must verify the applicability of the valve and fluid conditions, establish a proper piping configuration for the System Flow Model, and obtain detailed internal gate valve information by inspection or from the valve vendor. The EPRI MOV PPM topical report states that the model is applicable to only valves which are properly fabricated and maintained. In addition, the EPRI topical report "Application Guide for Motor-Operated Valves in Nuclear Power Plants Volume 1 Revision 1: Gate and Globe Valves" states that of particular note is the provision that the long-term reliability of the PPM predictions depends on implementation of an appropriate preventative maintenance program for valves.

To assist licensees in applying the EPRI MOV PPM, EPRI prepared EPRI MOV Performance Prediction Program Performance Prediction Methodology (PPM) Version 3.0 User Manual and Implementation Guide-NP, dated May 2004 (ADAMS Accession No. ML041700265, nonproprietary version), which includes directions for verifying the internal valve dimensions of the applicable valves. As indicated in the NRC SER on the EPRI MOV PPM, EPRI assumes that each valve is maintained in good condition for the EPRI MOV PPM to remain valid for that valve. Licensees consider several factors to determine acceptable valve internal conditions such as:

(1) consideration of valve susceptibility to internal component degradation due to system operation and conditions,
(2) performance of diagnostic dynamic testing that monitors and trends valve operating parameters (such as thrust, torque, running loads, motor current, and motor power),
(3) periodic valve internal inspection activities, and
(4) verification of internal dimensions during valve inspection activities, where vendor drawings were used to capture the internal dimensions in performing the EPRI MOV PPM calculation.

For valves that have an EPRI MOV PPM calculation without a JOG classification evaluation (or similar evaluation) that applies all valve aspects (such as disk-to-seat materials, disk-to-guide materials, system, temperature, and flow), the NRC SER for the EPRI MOV PPM noted that periodic valve internal inspections need to be performed to justify that the valve remains in good condition as part of implementing the EPRI MOV PPM. For valves that are susceptible to degradation (Class C), an EPRI MOV PPM evaluation is an acceptable engineering analysis to justify that the valve will perform its safety function and may be classified as JOG Class A or Class B. However, the EPRI MOV PPM does not justify that the valve is not susceptible to further inservice degradation. Valves in raw water applications (such as the service water system), and valves for which the JOG Program is not applicable, might be susceptible to internal degradation over time (such as resulting in the need for periodic internal inspection of a sample of valves). The EPRI MOV PPM also provides guidance on potential adverse performance of valves in high-temperature applications or with unfavorable internal dimensions. For example, the EPRI MOV PPM states there is a potential for galling of stainless steel on stainless steel internal parts of MOVs in high-temperature applications.

In addition to its other valve activities, EPRI developed guidance describing the various insights of MOV performance that static testing (i.e., diagnostic testing without differential pressure or flow) can provide to the licensee. The NRC staff has not been requested to formally review the EPRI guidance on static testing. However, static diagnostic testing does not provide information on the operating requirements related to differential pressure and flow (i.e., dynamic conditions).

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," (ADAMS Accession No. ML003686003) 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 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 for providing reasonable assurance of POV capability, 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.

Beginning with the 2009 Edition, the ASME OM Code replaced 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 Water-Cooled Reactor Nuclear Power Plants," to periodically verify that MOVs are capable of performing their design-basis safety functions. ASME OM Code, Appendix III, specifies, in part, that the MOV testing program includes a one-time design-basis verification of each MOV and also implements a mix of static testing (i.e., testing with no fluid differential pressure or flow) and dynamic testing (i.e., testing with fluid differential pressure and flow) of active MOVs. 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 for all AOVs within the scope of the IST Program, and periodic performance assessment testing for AOVs with high safety significance up to a maximum interval of 10 years based on their capability margin. In accordance with 10 CFR 50.55a, the NRC requires licensees to update their IST Programs every 120 months to the most recent edition of the ASME OM Code incorporated by reference in 10 CFR 50.55a within 18 months of the update requirement.

The NRC inspections using Attachment 21N.02, "Design-Basis Capability of Power-Operated Valves Under 10 CFR 50.55a Requirements," to NRC Inspection Procedure (IP) 71111, "Reactor Safety—Initiating Events, Mitigating Systems, Barrier Integrity," (referred to IP 71111.21N.02) are intended to verify that licensee activities provide reasonable assurance of the design-basis capability of POVs at the sampled nuclear power plants. During recent

inspections, the NRC identified several issues related to the capability of POVs to perform their safety functions at operating nuclear power plants. These issues involved: (1) the use of valve data information that was developed by JOG and EPRI, (2) the determination of POV operating requirements, actuator capability, and appropriate performance parameters, (3) the performance of POV testing, (4) the evaluation of the POV test results, (5) the evaluation of the potential for stem-disk separation in Anchor/Darling double-disk gate valves, (6) the implementation of an NRC regulatory condition for supplementing the ASME OM Code requirements for valve position indication testing, and (7) the conduct of preventive maintenance for POVs. This IN summarizes the major lessons learned from the initial NRC inspections using IP 71111.21N.02 at the sampled nuclear power plants.