UNITED STATES
NUCLEAR REGULATORY COMMISSION
WASHINGTON, D.C. 20555-0001

FINAL SAFETY EVALUATION

BY THE OFFICE OF NUCLEAR REACTOR REGULATION

TECHNICAL REPORT 3002023774,

MOTOR-OPERATED VALVE PERFORMANCE PREDICTION METHODOLOGY, VERSION 4.1

ELECTRIC POWER RESEARCH INSTITUTE

DOCKET NO. 99902021

EPID: L-2023-NTR-0006

1. INTRODUCTION AND BACKGROUND

1.1. Introduction

As accepted by the U.S. Nuclear Regulatory Commission (NRC), Electric Power Research Institute (EPRI) Topical Report (TR)-103237, "EPRI MOV [Motor-Operated Valve] Performance Prediction Program," may be used by nuclear power plant applicants and licensees to determine the thrust and torque required to operate certain power-operated valves under dynamic flow conditions. The EPRI MOV Performance Prediction Methodology (PPM) includes methods for prediction or evaluation of system flow parameters; gate, globe, and butterfly valve performance; and motor-actuator load sensitive behavior or rate-of-loading effects. The EPRI MOV PPM includes computer models, software, and hand-calculation models to implement individual valve and system models and methods. The EPRI MOV PPM is not limited to MOVs but can also be used to determine the operating requirements for other power-operated valves, such as air-operated valves (AOVs) and hydraulic-operated valves (HOVs).

By letter dated June 14, 2023 (Ref. 1), EPRI submitted EPRI MOV Performance Prediction Program, Addendum 11 to TR-103237-R2 – Changes to Performance Prediction Methodology Software, Version 4.1, 2023 Technical Report 3002026131 (March 2023) to the NRC for review and acceptance. This safety evaluation (SE) describes the NRC staff review of EPRI MOV PPM, Version 4.1. The NRC staff relies on the review described in this SE and previously issued SEs for overall acceptability of the EPRI MOV PPM.

1.2. Background

In February 1994, the Nuclear Energy Institute (NEI) submitted EPRI TR-103237, Revision 0 (Ref. 2) for NRC review. On November 30, 1995, the NEI submitted EPRI TR-103237, Revision 1 (Ref. 3) for NRC review. On March 15, 1996, the NRC staff issued an SE (Ref. 4) documenting the NRC staff's acceptance of the EPRI MOV PPM described in TR-103237, with certain conditions and limitations. The SE addressed the EPRI computer model for globe and

butterfly valves and various gate valves, and EPRI hand-calculation models for Anchor/Darling double disk gate valves and Westinghouse Electric Company flexible wedge gate valves.

On February 20, 1997, the NRC staff issued Supplement 1 to the SE (Ref. 5) on the EPRI MOV PPM. This supplemental SE discussed two additional gate valve (WKM parallel expanding and Aloyco split wedge) hand-calculation methods and highlighted other aspects of the TR.

On September 8, 1999, the NEI submitted for NRC staff review Addendum 1, "PPM Version 2.0," and Addendum 2, "Thrust Uncertainty Method" (Ref. 6) to EPRI TR-103237, Revision 2. Version 2.0 of the EPRI MOV PPM described in Addendum 1 to TR-103237 resolved several previous modeling errors and incorporated other improvements to the modeling software. In Addendum 2 to EPRI TR-103237, Revision 2, EPRI described the development of its Thrust Uncertainty Method that considers conservatism in the EPRI MOV PPM to predict a more realistic thrust requirement for closing gate valves.

On April 20, 2001, the NRC staff issued Supplement 2 to the SE (Ref. 7) dated March 15, 1996, concluding that the changes made to the PPM in Addendum 1 to EPRI TR-103237, Revision 2, improve the ability of the EPRI model to predict the applicable thrust or torque required to operate gate, globe, and butterfly valves.

On January 5, 2001 (Ref. 8), December 6, 2001 (Ref. 9), and June 10, 2002 (Ref. 10), the NEI submitted for NRC staff review revisions to Addendum 2 to EPRI TR-103237, Revision 2. These revisions involved the establishment of additional criteria for application of the Thrust Uncertainty Method for gate valves under cold water applications within the scope of the Thrust Uncertainty Method. By letter dated September 30, 2002 (Ref. 11), the NRC staff issued Supplement 3 to the SE on the EPRI MOV 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 gate valves under cold water applications within the scope of the Thrust Uncertainty Method and subject to the applicable limitations and conditions specified in the Thrust Uncertainty Method.

On June 8, 2004 (Ref. 12), the NEI submitted Addendum 5, "PPM Version 3.1 Software Changes," Addendum 6, "PPM Version 3.2 Software Changes," and several PPM error and information notices to EPRI TR-103237, Revision 2, for NRC staff review. Addendum 5 provided PPM Software Version 3.1; updated the PPM to a Microsoft Windows-based application; automated certain manual calculations; adjusted the software to allow more ready use for AOV and HOV applications; and incorporated software and documentation improvements. Addendum 6 provided PPM Software Version 3.2; corrected potential non-conservative effects from upstream disturbances; and prevented incorrect use of "best estimate" butterfly valve torque predictions.

On January 6, 2006 (Ref. 13), the NEI submitted Addendum 3, "An Improved and Validated Method for Predicting Gate Valve Unwedging Thrust Requirements," Addendum 4, "Use of Static Closure Data for Determining Stem Stem-Nut Coefficients of Friction at Unwedging," and Addendum 7, "PPM Version 3.3 Software Changes," to EPRI TR-103237, Revision 2, for NRC staff review. Addenda 3, 4, and 7 document changes made to the EPRI PPM computer code between Versions 3.2 and 3.3, and also provide improved methods for evaluating gate valve unwedging thrust requirements. On April 23, 2007 (Ref. 14), and June 3, 2008 (Ref. 15), the NRC staff requested NEI to provide additional information to support its request. NEI submitted the requested information in letters dated September 27, 2007 (Ref. 16) and August 7, 2008 (Ref. 17).

On February 24, 2009, the NRC staff provided Supplement 4 to the SE to NEI on Addenda 3, 4, 5, 6, and 7 to EPRI MOV PPM (Ref. 18). Based on the review of Addenda 3, 4, 5, 6, and 7 to EPRI TR-103237-R2, the NRC staff concluded that the improved gate valve unwedging methodology, the improved stem to stem-nut coefficient of friction methodology, and the changes made to Versions 3.1, 3.2, and 3.3 of the EPRI MOV PPM, improve the ability of licensees to predict the thrust and torque required to operate gate, globe, and butterfly valves and are acceptable for referencing by licensees as delineated in Addenda 3, 4, 5, 6, and 7 to EPRI TR-103237-R2. Based on its review, the NRC staff found that Addenda 3, 4, 5, 6, and 7 to EPRI TR-103237, Revision 2, are acceptable for referencing in licensing applications as discussed in the SE.

By letters dated March 10, 2014 (Ref. 19) and June 17, 2014 (Ref. 20), the NEI submitted EPRI PPM Software Versions 3.4 and 3.5. On April 2, 2015, the NRC sent an SE (Ref. 21) to NEI describing the NRC staff review of the update of EPRI TR-103237, Revision 2, Versions 3.4 and 3.5. The NRC staff concluded that the changes made were minor in nature in that they corrected coding errors, improved functionality of user interface, improved the overall accuracy, and incorporated fixes to known program inadequacies. The NRC staff also concluded that the changes made in Versions 3.4 and 3.5 do not alter the methodology or introduce new methods. Therefore, the NRC staff found that Versions 3.4 and 3.5 of EPRI TR-103237, Revision 2, were acceptable for referencing in licensing applications and that an updated SE was not required.

By letters dated August 30, 2018 (Ref. 22) and November 8, 2018 (Ref. 23), the NEI submitted to the NRC staff for review the EPRI TR, “EPRI MOV Performance Prediction Program: Addendum 10 to EPRI 103237-R2: PPM Version 4.0 Software Changes.” The NRC staff reviewed the update of EPRI TR-103237, Revision 2, Version 3.5 to Version 4.0. The NRC staff determined that the changes made in Version 4.0 do not alter the methodology or introduce new methods. On January 25, 2019, the NRC staff sent its SE (Ref. 24) on Version 4.0 to NEI concluding that EPRI MOV PPM, Version 4.0, was acceptable for referencing by nuclear power plant applicants and licensees.

2. REGULATORY EVALUATION

The NRC regulations require that MOVs important to safety be treated in a manner that provides assurance of their intended performance. General Design Criterion (GDC) 1, “Quality standards and records,” to Appendix A, “General Design Criteria for Nuclear Power Plants,” to Part 50 of Title 10 of the *Code of Federal Regulations* (10 CFR) states, in part, that “structures, systems, and components important to safety shall be designed, fabricated, erected, and tested to quality standards commensurate with the importance of the safety functions to be performed.” The quality assurance program to be applied to safety-related components is described in Appendix B, “Quality Assurance Criteria for Nuclear Power Plants and Fuel Reprocessing Plants,” to 10 CFR Part 50. In Section 55a, “Codes and standards,” of 10 CFR Part 50, the NRC requires nuclear power plant licensees to establish inservice testing (IST) programs in accordance 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 10 CFR 50.55a.

In response to operating experience concerns regarding MOV performance in nuclear power plants, the NRC staff issued Generic Letter (GL) 89-10, “Safety-Related Motor-Operated Valve Testing and Surveillance” (Ref. 25) on June 28, 1989. It requested nuclear power plant licensees and construction permit holders to ensure the capability of MOVs in safety-related systems will perform their intended functions. The licensees would accomplish this by reviewing

MOV design bases, verifying MOV switch settings, frequently testing MOVs under design-basis conditions, improving evaluations and corrective actions of MOV failures, and trending MOV problems. In GL 89-10, the NRC staff requested that licensees complete the verification of the design-basis capability of safety-related MOVs within approximately three refueling outages or 5 years from the date of issuance of GL 89-10. Permit holders were requested to complete the GL 89-10 program before plant startup or in accordance with the above schedule, whichever was later.

On September 18, 1996 (Ref. 26), the NRC staff issued GL 96-05, “Periodic Verification of Design-Basis Capability of Safety-Related Motor-Operated Valves,” requesting each nuclear power plant licensee to establish a program, or ensure the effectiveness of its current program, to verify on a periodic basis that safety-related MOVs continue to be capable of performing their safety functions within the current licensing bases of the facility. In GL 96-05, the NRC staff summarized several industry and regulatory activities and programs related to maintaining long-term capability of safety-related MOVs. For example, the NRC staff discussed the use of the EPRI MOV PPM in establishing an effective MOV program. Many licensees are applying the EPRI MOV PPM as part of their programs to provide assurance of the capability of MOVs to perform their safety functions in response to GL 89-10 and GL 96-05.

Based on the results of GL 89-10 and GL 96-05 programs, the NRC determined that the stroke-time testing requirements in the ASME OM Code were insufficient to demonstrate the operational readiness of MOVs to be able to perform their design-basis safety functions. As a result, the NRC revised 10 CFR 50.55a(b)(3)(ii), “OM Condition: Motor-Operated Valve (MOV) testing,” to require that nuclear power plant licensees supplement the provisions of the ASME OM Code to establish a program to ensure that MOVs continue to be capable of performing their design-basis safety functions. Since then, many nuclear power plant licensees have been applying the EPRI MOV PPM as part of their programs to meet the regulatory requirements in 10 CFR 50.55a(b)(3)(ii) to 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. The NRC has incorporated by reference in 10 CFR 50.55a the editions of the ASME OM Code that include Appendix III for MOV testing and Appendix IV for AOV testing.

The EPRI MOV PPM as accepted by the NRC staff with conditions as specified in the above identified SEs and this SE may be applied by nuclear power plant applicants and licensees as part of activities to provide reasonable assurance that power-operated valves are capable of their design-basis safety functions in accordance with the NRC regulations in 10 CFR 50.55a(b)(3)(ii). Based on its review, the NRC staff has determined that the EPRI MOV PPM has been verified and validated by valve diagnostic test data and analysis to determine the

thrust and torque required to operate certain power-operated valves under dynamic flow conditions, as required by the NRC regulations. Based on the continued use of the EPRI MOV PPM by nuclear power plant applicants and licensees to meet the NRC regulations, the NRC staff concludes that the review of EPRI MOV PPM, Version 4.1, is necessary to provide reasonable assurance of the capability of MOVs to perform their design-basis safety functions.

3. TECHNICAL EVALUATION

3.1. Summary of Updates in EPRI MOV PPM, Version 4.1

EPRI provides several enhancements for evaluating MOV operating requirements in Version 4.1 of the EPRI MOV PPM. In particular, EPRI incorporated its Thrust Uncertainty Method into EPRI MOV PPM, Version 4.1. EPRI added the ability to use a refined unwedging equation to calculate the highest allowed measured static unwedging load when static test data are unavailable to the user. EPRI included the automatic application of the 1.05 multiplier for required thrust predictions for Borg-Warner valves in accordance with the NRC SE on the EPRI MOV PPM. EPRI incorporated guidance in the User Manual/Implementation Guide for the EPRI MOV PPM on addressing unwedging effects in globe valve evaluations. EPRI implemented multiple changes to MOV PPM parametric prediction report to address EPRI notice 2020-01 and assist with the method for using packing parametric runs as design standard outputs. EPRI discussed the User Manual/Implementation Guide, which allows a packing parametric prediction to be used as the design basis for the MOV, provided that the user performs a full prediction. EPRI made multiple other changes to resolve issues and enhancements in the software for the EPRI MOV PPM, Version 4.1.

Descriptions of the updates that EPRI included in the MOV PPM, Version 4.1, are as follows:

EPRI MOV PPM, Version 4.1, includes software functionality and usability improvements. There are no changes to underlying technical modules, such as the gate valve, globe valve, butterfly valve, or system flow modules. EPRI did not change the engineering equations and methods used in these modules for modeling valves.

EPRI MOV PPM, Version 4.1, incorporates the Thrust Uncertainty Method, which had to be hand-performed in previous versions of the EPRI MOV PPM. Addendum 2 to EPRI TR-103237-R2 describes the Thrust Uncertainty Method.

EPRI MOV PPM, Version 4.1, expands the usability of the EPRI Refined Gate Valve Unwedging Methodology. Addendum 3 to the EPRI MOV PPM describes the Refined Gate Valve Unwedging Methodology. Version 4.1 to the EPRI MOV PPM does not include any changes to the methodology. The Refined Gate Valve Unwedging Methodology requires valve static setup and actuator capability information that might be available to the user when performing a PPM evaluation, such as replacing valves. If this information is not available, the software provides partial results. If the static unwedging thrust is not entered into the PPM, the static unwedging thrust must be combined with the dynamic component of unwedging to calculate total unwedging thrust for the gate valve.

EPRI MOV PPM, Version 4.1, incorporates an automatic application of the 1.05 multiplier for the thrust required to operate Borg-Warner gate valves. This multiplier is applied to all required thrust values and outputs in the PPM prediction reports for Borg-Warner gate valves as described in EPRI MOV PPM TR-103237.

EPRI MOV PPM, Version 4.1, provides guidance for addressing the unwedging effects for globe valves. Operating and research experience has shown that some globe valve designs are susceptible to unwedging effects contrary to previous assumptions.

EPRI MOV PPM, Version 4.1, has expanded the parametric output report to allow parametric evaluations to be used as the design standard with a full prediction report. These new features include (a) flagging of unpredictable gate valve results, (b) providing only the higher of positive and negative offset values for gate valves, (c) adding a reminder that parametric results do not include error or warning messages, (d) providing the maximum required torque and maximum transmitted torque for each parametric run for butterfly valves, and (e) providing the larger of static versus dynamic required thrust for self-actuating or near-self-actuating globe valves.

EPRI MOV PPM, Version 4.1, includes several improvements to provide more clarity in the selection of inputs and readability of PPM results. These improvements include (a) modification of the inputs interface to provide visual indicators for editable cells, (b) allowing the user to select a printer, (c) updating the software to perform checks of inputs prior to performing the evaluation, (d) updating the software to provide a description in drop-down selections for gate valve guide materials (such as grades of Stellite and stainless steel), (e) updating the software to perform an evaluation with current inputs before viewing calculation results, and (f) updating the software to adjust how torque results are displayed in the butterfly valve output report for clarity.

EPRI MOV PPM, Version 4.1, includes resolution of several software issues and error corrections. Most issues and error corrections were resolved through modifications to the Microsoft Windows-based user interface module and did not involve changes to technical modules with two exceptions. To resolve Problem Report 2022-01, EPRI revised the software to address an issue where the final wedged stroke position for gate valves might be repeated in the detailed stroke-versus-position tables with minor differences. To resolve Problem Report 2022-03, EPRI revised the software to address errors for supplemental outputs in globe valve reports when a static stroke bounds dynamic stroke for self-actuating or near-self-actuating globe valves. EPRI did not change the engineering equations and methods used in these modules.

Other improvements by EPRI to the MOV PPM to resolve software issues and implement error corrections included (a) a software revision to correct minor run time errors, (b) a software revision to correct non-standard screen issues, (c) correction of a discrepancy in the display of “stroke position-specific” warning messages, (d) a software revision to address errors related to modeling of butterfly valve closing strokes where the maximum required torque occurs at the open position, (e) a software revision to address stem lead and pitch display issues, (f) a software revision to resolve a cosmetic issue where a new globe valve evaluation could show Steam/Mixture Mass Ratio input box as active prior to selecting System Method and Fluid Medium, (g) a software revision to address an issue where software windows would not close, (h) a software revision to address an issue where the final wedged stroke position for gate valves could be repeated in tables with minor differences in results without altering engineering equations or methods, (i) a software revision to correct issues in globe valve reports for references and in gate and globe valve reports by removing the equivalent valve factor, and (j) a software revision to address a legacy error where balanced globe valves were evaluated in SI units.

3.2. NRC Staff Evaluation of EPRI MOV PPM, Version 4.1

On June 14, 2023 (Ref. 1), EPRI provided EPRI MOV Performance Prediction Program, Addendum 11 to TR-103237-R2 – Changes to Performance Prediction Methodology Software, Version 4.1, 2023 Technical Report 3002026131 (March 2023) to the NRC for review. The enhancements to the EPRI MOV PPM in Version 4.1 are described in Section 3.1 above. By e-mail dated August 16, 2023 (Ref. 27), the NRC staff accepted the EPRI MOV PPM, Version 4.1, for review. The NRC staff relies on the review described in this SE and previously issued SEs for overall acceptability of the EPRI MOV PPM.

During its initial review of the EPRI MOV PPM, Version 4.1, the NRC staff identified the need to conduct a regulatory audit to better understand the EPRI MOV PPM, Version 4.1, by reviewing the supporting documentation for the PPM software, and discussing this documentation with EPRI staff. In a letter dated September 26, 2023 (Ref. 28), the NRC staff provided the audit plan to EPRI describing the scope of the audit and information requested to be made available in an EPRI-established electronic portal. The staff performed the audit of the EPRI MOV PPM, Version 4.1, in accordance with Office of Nuclear Reactor Regulation (NRR) Office Instruction LIC-111, “Regulatory Audits,” Revision 1, dated October 2019 (Ref. 29).

On November 16, 2023 (Ref. 30), the NRC staff issued its report of the regulatory audit of EPRI MOV PPM, Version 4.1. In the audit report, the staff summarized the performance of the audit and its results. In the conclusion of the audit report, the staff stated the regulatory audit had allowed the NRC staff to gain an understanding of the EPRI MOV PPM, Version 4.1; to verify information described in Addendum 11 to EPRI MOV PPM TR-103237-R2; and to identify any information that would require docketing to support the basis for the regulatory decision by the NRC staff in its evaluation of the EPRI MOV PPM, Version 4.1.

As part of its review of the EPRI MOV PPM, Version 4.1, the NRC staff verified that documentation made available by EPRI and its contractor described activities to perform software verification and validation (V&V) of the modifications to the software in the EPRI MOV PPM, Version 4.1. The NRC staff also reviewed documentation made available by EPRI and its contractor that provided the results of the V&V evaluation for each change in the EPRI MOV PPM, Version 4.1. The NRC staff verified that these reports specify that the V&V activities were implemented in accordance with the quality assurance (QA) requirements of 10 CFR Part 50, Appendix B, including independent verification of the evaluation results.

In Supplement 3 to the SE dated September 30, 2002 (Ref. 11) on Addendum 2 to EPRI TR-103237-R2, the NRC staff accepted the hand-calculation method for the Thrust Uncertainty Method that allows the user of the EPRI MOV PPM to calculate a less conservative prediction of the thrust required to operate gate valves under dynamic flow from the standard EPRI MOV PPM calculation, with specific conditions. In the EPRI MOV PPM, Version 4.1, EPRI incorporated the hand-calculation method for applying the Thrust Uncertainty Method. As part of its audit review, the NRC staff verified examples of EPRI MOV PPM prediction output reports that demonstrated the incorporation and performance of the Thrust Uncertainty Method as part of the EPRI MOV PPM, Version 4.1. The NRC staff reviewed the changes from PPM prediction output reports provided from Version 4.0 to Version 4.1 related to the calculations of the predicted MOV thrust requirements using the Thrust Uncertainty Method. In addition, the NRC staff reviewed the automatic software notifications where parameters were input that exceeded the limitations for application of the Thrust Uncertainty Method. The NRC staff found that the EPRI MOV PPM, Version 4.1, referred users to the applicable EPRI document for guidance to incorporate the Thrust Uncertainty Method results (including the Thrust Uncertainty Method

uncertainty values) into the MOV thrust prediction calculation. The NRC staff verified that the updated Addendum 2 to EPRI TR-103237-R2 incorporated the NRC SE at the beginning of the report. Further, the staff verified that the incorporation of the Thrust Uncertainty Method into the EPRI MOV PPM, Version 4.1, included V&V activities described in the applicable EPRI reports.

The NRC staff reviewed examples of the EPRI MOV PPM prediction output reports that demonstrated the incorporation and performance of the Refined Gate Valve Unwedging Equation as part of the EPRI MOV PPM, Version 4.1. The modification to the EPRI MOV PPM in Version 4.1 included the ability to use the Refined Gate Valve Unwedging Equation to calculate the highest allowed measured static unwedging load. In Supplement 4 (Ref. 18) to the NRC SE on the EPRI MOV PPM, the NRC staff described its review and acceptance of Addendum 3 to EPRI TR-103237, Revision 2, which provides a description of the Refined Gate Valve Unwedging Methodology. During its review of the EPRI MOV PPM, Version 4.1, the staff verified that the incorporation of the Refined Gate Valve Unwedging Equation included V&V activities described in the applicable EPRI reports.

The NRC staff reviewed examples of the EPRI MOV PPM prediction output reports and parametric reports that demonstrated the incorporation and performance of the multiplier for the thrust prediction for Borg-Warner gate valves as part of the EPRI MOV PPM, Version 4.1. The automatic application of the multiplier for Borg-Warner gate valves is consistent with the initial NRC SE dated March 15, 1996 (Ref. 4) on the EPRI MOV PPM. The staff reviewed a sample of the EPRI MOV PPM prediction output reports and parametric reports for accurate thrust predictions with the Borg-Warner gate valve multiplier, with minor deviations from rounding numbers. The NRC staff verified that the incorporation of the automatic application of the Borg-Warner gate valve multiplier into the EPRI MOV PPM, Version 4.1, included V&V activities described in the applicable EPRI reports.

The NRC staff reviewed the new guidance prepared by EPRI for addressing potential unwedging effects of globe valves as part of the EPRI MOV PPM. This new guidance reflects operating and test experience that globe valves might experience unwedging effects, as a result of the disk angle for some globe valves that allows the disk to enter the seat more fully than typically assumed for globe valves. The new guidance specifies that globe valve unwedging effects are not modeled by the EPRI MOV PPM and are the responsibility of the user to address when identified. The new guidance indicates how to use the PPM results with the identified globe valve unwedging effect, and how an unwedging effect can be conservatively applied to PPM inputs. EPRI did not adjust the PPM software and engineering methods for the globe valve unwedging effect. The NRC staff verified that this new guidance is included in the user manual for the EPRI MOV PPM, Version 4.1.

The NRC staff reviewed examples of the PPM parametric reports for the EPRI MOV PPM, Version 4.1, based on the changes to the software that allow parametric evaluations to be used as a design standard for packing loads, and demonstrating the incorporation and performance of the method using packing parametric runs. In the EPRI MOV PPM, Version 4.1, EPRI made the PPM prediction output reports more detailed to allow parametric predictions of packing load to be used as design-basis outputs. The updated parametric reports specify that the parametric results for gate valves, butterfly valves, and globe valves cannot be used as design-basis output, with the exception of packing evaluations.

The NRC staff reviewed the description of each EPRI MOV PPM problem report and other notifications that resulted in changes to the EPRI MOV PPM in Version 4.1. For example, the staff reviewed Addendum 11 to TR-103237-R2, which describes the changes in the EPRI MOV

PPM, Version 4.1, and the basis for each change. During the audit described above, the NRC staff also reviewed MPR Document 0140-0415-RPT-001, which discussed the changes in the EPRI MOV PPM, Version 4.1, and the results of the V&V activities for each change.

Based on its review, the NRC staff finds that EPRI has adequately described and justified the changes incorporated into EPRI MOV PPM, Version 4.1, for determining the thrust and torque required to operate valves under dynamic flow conditions. The NRC staff also finds that EPRI has developed those changes in accordance with an acceptable QA program and V&V activities. All previously reviewed provisions of the EPRI MOV PPM described in the applicable SEs prepared by the NRC staff continue to apply when implementing EPRI MOV PPM, Version 4.1.

4. CONCLUSION

As described above, the NRC staff determined that EPRI has justified the changes made in the EPRI MOV PPM, Version 4.1, for determining the thrust and torque required to operate valves under dynamic flow conditions. Therefore, the NRC staff concludes that the EPRI MOV PPM, Version 4.1, is acceptable for use by nuclear power plant applicants and licensees where implemented in accordance with the provisions of the EPRI MOV PPM and the previous SEs prepared by the NRC staff on the EPRI MOV PPM. In reaching this conclusion, the NRC staff relies on the review described in this SE and previously issued SEs for overall acceptability of the EPRI MOV PPM.

5. REFERENCES

1. Letter from Nick Camilli, EPRI, to U.S. NRC, EPRI MOV Performance Prediction Methodology (PPM) Version 4.1, 3002023774, June 14, 2023 (ADAMS Accession No. ML23180A012).

2. EPRI TR-103237-P, Revision 0, “EPRI MOV Performance Prediction Program,” February 1994 (Accession No. 9411160332 non-public).

3. EPRI TR-103237-NP, Revision 1, “EPRI MOV Performance Prediction Program,” November 30, 1995 (Accession No. 9604030085 microfiche).

4. U.S. NRC Safety Evaluation on Electric Power Research Institute Topical Report TR-103237-R1, EPRI Motor-Operated Valve Performance Prediction Program, March 15, 1996 (Accession No. 9608070288 microfiche).

5. Supplement 1 to USNRC Safety Evaluation on Electric Power Research Institute Topical Report TR-103237-R1, EPRI Motor-Operated Valve Performance Prediction Program, February 20,1997 (Accession No. 9704300116 microfiche).

6. Addendum 1, “PPM Version 2.0,” and Addendum 2, “Thrust Uncertainty Method,” to EPRI TR-103237, Revision 2, September 8, 1999 (not available).

7. Supplement 2 to U.S. NRC Safety Evaluation on Electric Power Research Institute Topical Report TR-103237-R2, “EPRI Motor-Operated Valve Performance Prediction Program,” April 20, 2001 (Accession No. ML011100121).

8. Letter from David Modeen, NEI, to U.S. NRC, “Response to Questions on Addendum 2 to EPRI Performance Prediction Methodology Software, Version 2.0 to EPRI TR-103237,” January 5, 2001 (Accession No. ML012950349).

9. Letter from Alexander Marion, NEI, to U.S. NRC, “Addendum to Responses to Questions on Addendum 2 to EPRI Performance Prediction Program Topical Report TR-103237-R2 Thrust Uncertainty Method,” December 6, 2001 (Accession No. ML020160518).

10. Letter from Alexander Marion, NEI, to U.S. NRC, “Additional Responses to Questions on EPRI Report 110779 "Addendum 2 to EPRI TR-103237-R2 Thrust Uncertainty Method," June 10, 2002 (Accession No. ML021830330).

11. Letter from William H. Ruland, U.S. NRC, to Gary L. Vine, NEI, “Supplement 3 to Safety Evaluation on Electric Power Research Institute Topical Report TR-103237-R2, EPRI Motor-Operated Valve Performance Prediction Program, Addendum 2,” September 30, 2002 (Accession No. ML022410364).

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Date: April 11, 2024