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August 30, 2018

NRC Document Control Desk
U.S. Nuclear Regulatory Commission
Washington, DC 20555-0001
Attention: Joseph Holonich Jr.

Subject: Transmittal of EPRI Report 3002013039 "EPRI MOV Performance Prediction Program: Addendum 10 to EPRI 103237-R2: PPM Version 4.0 Software Changes"

Project Number: 689

Dear Mr. Holonich:

Enclosed are five (5) paper copies of the report "EPRI MOV Performance Prediction Program: Addendum 10 to EPRI 103237-R2: PPM Version 4.0 Software Changes," EPRI Technical Report 3002013039.

The purpose of this letter is to request NRC review to facilitate an NRC Staff Evaluation leading to a determination that the PPM version 4.0 software is acceptable for referencing in licensing applications and that an updated Safety Evaluation is not required.

The EPRI motor operated valve (MOV) Performance Prediction Methodology (PPM) software was developed to enhance industry's ability to size MOVs and predict their performance. Versions 1.0 - 3.3 were approved by the NRC through a Safety Evaluation and four (4) supplements. The most recent versions of the software (versions 3.4 and 3.5) submitted to the staff were reviewed and approved by NRC by letter on April 2, 2015. Since that time, Version 4.0 has been completed. The attached report documents the changes made to the EPRI PPM software between version 3.5 and version 4.0. For reference, Table 1 provides a summary of all EPRI MOV Performance Prediction Program submittals and NRC approvals to date.

The primary changes to the PPM software between version 3.5 and version 4.0 were 1) to make it compatible with 64-bit operating systems and 2) to correct coding errors without changing functionality. In addition, the "Improved Gate Valve Un-Wedging Method" documented in EPRI report 1020350 "EPRI MOV Performance Prediction Program - Addendum 3 to TR-103237-R2: An Improved and Validated Gate Valve Un-wedging Methodology-A," dated March 2010, was incorporated into the PPM version 4.0 software. This hand calculational methodology was previously approved by NRC in Supplement 4 to the NRC SE on TR-103237-R1, "EPRI MOV Performance Prediction Program Topical Report" dated February 24, 2009.

Please note that the enclosed report contains proprietary information. All proprietary information is

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Joseph Holonich Jr
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highlighted with yellow shading indicating that information is considered trade secrets in accordance with 10CFR2.390. A letter requesting that the report be withheld from public disclosure and an affidavit describing the basis for withholding this information are provided as Attachment 1.

Two paper copies of the non-proprietary report "EPRI MOV Performance Prediction Program: Addendum 10 to EPRI 103237-R2: PPM Version 4.0 Software Changes NP," Technical Report 3002013039NP, are also enclosed. This non-proprietary report is identical to the enclosed proprietary report except that the proprietary information has been deleted and the letters "NP" appear in the BWRVIP report title and report number.

All NRC fees will be paid directly by EPRI and all bills should be sent to the following address:

EPRI
Attention: Accounts Payable Dept.
3420 Hillview Avenue
PO Box 10412
Palo Alto, CA 94304

If there are any questions on these matters, please contact me (202-739-8037), txr@nei.org or Mr. John Hosler (704-252-0780), JHOSLER@epri.com.

Sincerely,



Timothy Riti

Attachment

c: Mr. Joseph Holonich Jr., NRR/DPR/PLPB, NRC
Mr. Michael Farnan, NRR/DF/EPNB, NRC (w/o enclosures)
Mr. John Hosler, EPRI (w/o enclosures)
Mr. James Heishman EPRI (w/o enclosures)
Mr. Thomas Walker, EPRI (w/o enclosures)

Table 1
Summary of EPRI MOV Performance Prediction Program Submittals and NRC Approvals

EPRI/NEI Submittal	EPRI Report #	EPRI Product(s) Description	NRC SE/SE Supplement/Evaluation
EPRI MOV Performance Prediction Program Topical Report Revision 1, dated November 1995.	TR-103237-R1	PPM version 1.0 software and Westinghouse, Anchor/Darling Double disk gate valve hand calculation methods	NRC SE on TR-103238-R1 March 15, 1996
NRC approved EPRI MOV Performance Prediction Program Topical Report Revision 2, dated April 1997.	TR-103237-R2	PPM version 1.0 software and Westinghouse, Anchor/Darling Double disk gate valve, Aloyco and WKM valve hand calculation methods	NRC SE on TR-103237-R1, Supplement 1, February 20, 1997
NRC approved Addendum 1 to TR103237-R2, dated December 1998.	AD-110778	PPM version 2.0 software changes	NRC SE on TR-103237-R1, Supplement 2, April 20, 2001
NRC approved Addendum 2 to TR-103237-R2, dated October 2002.	1003279	Thrust Uncertainty Method (Hand calculation)	NRC SE on TR-103237-R1, Supplement 3, September 30, 2001
NRC approved Addendum 3 to TR-103237-R2-A, dated March 2010.	1020350	Improved Gate Valve Un-wedging Method (Hand calculation)	NRC SE on TR-103237-R1, Supplement 4, February 24, 2009
NRC approved Addendum 4 to TR-103237-R2-A, dated March 2010.	1020357	Use of Static Closure Data for Un-Wedging Calculations (Hand calculation)	
NRC approved Addendum 5 to TR- 103237-R2-A, dated March 2010.	1020358	PPM version 3.1 software changes	
NRC approved Addendum 6 to TR-103237-R2-A, dated March 2010.	1020359	PPM version 3.2 software changes	
NRC approved Addendum 7 to TR-103237-R2-A, dated March 2010.	1020360	PPM version 3.3 software changes	
NRC approved Addendum 8 to TR-103237-R2-A, dated March 2016.	3002007058	PPM version 3.4 software changes	NRC Staff Evaluation of PPM v 3.4 and 3.5, April 2, 2015
NRC approved Addendum 9 to TR-103237-R2-A, dated March 2016.	3002007059	PPM version 3.5 software changes	
Addendum 10 to TR-103237-R2, dated April 2018.	3002013039	PPM version 4.0 software changes	

NEIL WILMSHURST
Vice President and
Chief Nuclear Officer

Ref. EPRI Docket No. 689

Date *August 8, 2018*

Attention: Joseph Holonich Jr.
Document Control Desk
Office of Nuclear Reactor Regulation
U.S. Nuclear Regulatory Commission
Washington, DC 20555-0001

Subject: Request for Withholding of the following Proprietary information included in:

EPRI MOV Performance Prediction Program, Addendum 10 to EPRI TR-103237-R2: PPM Version 4.0
Software Changes, EPRI Technical Report 3002013039

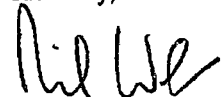
To Whom It May Concern:

This is a request under 10 C.F.R. §2.390(a)(4) that the U.S. Nuclear Regulatory Commission ("NRC") withhold from public disclosure the information identified in the enclosed Affidavit consisting of the proprietary information owned by Electric Power Research Institute, Inc. ("EPRI") identified above (the "Report"). Proprietary and non-proprietary versions of the Report and the Affidavit in support of this request are enclosed.

EPRI desires to disclose the Report in confidence as a means of exchanging technical information with the NRC. The Report is not to be divulged to anyone outside of the NRC or to any of its contractors, nor shall any copies be made of the Report provided herein. EPRI welcomes any discussions and/or questions relating to the information enclosed.

If you have any questions about the legal aspects of this request for withholding, please do not hesitate to contact me at (704) 595-2732. Questions on the content of the Report should be directed to Jim Heishman of EPRI at (704) 595-2768.

Sincerely,



Attachment(s)

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AFFIDAVIT

RE: Request for Withholding of the Following Proprietary Document:

EPRI MOV Performance Prediction Program, Addendum 10 to EPRI TR-103237-R2: PPM Version 4.0
Software Changes, EPRI Technical Report 3002013039

I, Neil Wilmschurst, being duly sworn, depose and state as follows:

I am the Vice President and Chief Nuclear Officer at Electric Power Research Institute, Inc. whose principal office is located at 3420 Hillview Avenue, Palo Alto, California ("EPRI") and I have been specifically delegated responsibility for the above-listed Report that is sought under this Affidavit to be withheld (the "Report"). I am authorized to apply to the U.S. Nuclear Regulatory Commission ("NRC") for the withholding of the Report on behalf of EPRI.

EPRI Proprietary Information is identified in the above referenced report with highlighted yellow shading. The pages with the proprietary information are also marked with the letters "TS" indicating that information is considered trade secrets in accordance with 10 CFR 2.390.

EPRI requests that the Report be withheld from the public on the following bases:

Withholding Based Upon Privileged And Confidential Trade Secrets Or Commercial Or Financial Information (see e.g. 10 C.F.R. §2.390(a)(4)):

a. The Report is owned by EPRI and has been held in confidence by EPRI. All entities accepting copies of the Report do so subject to written agreements imposing an obligation upon the recipient to maintain the confidentiality of the Report. The Report is disclosed only to parties who agree, in writing, to preserve the confidentiality thereof.

b. EPRI considers the Report and the proprietary information contained therein (the "Proprietary Information") to constitute trade secrets of EPRI. As such, EPRI holds the Report in confidence and disclosure thereof is strictly limited to individuals and entities who have agreed, in writing, to maintain the confidentiality of the Report. EPRI made a substantial economic investment to develop the Report, and, by prohibiting public disclosure, EPRI derives an economic benefit in the form of licensing royalties and other additional fees from the confidential nature of the Report. If the Report and the Proprietary Information were publicly available to consultants and/or other businesses providing services in the electric and/or nuclear power industry, they would be able to use the Report for their own commercial benefit and profit and without expending the substantial economic resources required of EPRI to develop the Report.

c. EPRI's classification of the Report and the Proprietary Information as trade secrets is justified by the Uniform Trade Secrets Act which California adopted in 1984 and a version of which has been adopted by over forty states. The California Uniform Trade Secrets Act, California Civil Code §§3426 – 3426.11, defines a "trade secret" as follows:

"Trade secret" means information, including a formula, pattern, compilation, program device, method, technique, or process, that:

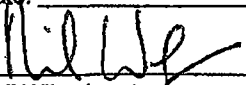
- (1) Derives independent economic value, actual or potential, from not being generally known to the public or to other persons who can obtain economic value from its disclosure or use; and
- (2) Is the subject of efforts that are reasonable under the circumstances to maintain its secrecy."

d. The Report and the Proprietary Information contained therein are not generally known or available to the public. EPRI developed the Report only after making a determination that the Proprietary Information was not available from public sources. EPRI made a substantial investment of both money and employee hours in the development of the Report. EPRI was required to devote these resources and effort to derive the Proprietary Information and the Report. As a result of such effort and cost, both in terms of dollars spent and dedicated employee time, the Report is highly valuable to EPRI.

e. A public disclosure of the Proprietary Information would be highly likely to cause substantial harm to EPRI's competitive position and the ability of EPRI to license the Proprietary Information both domestically and internationally. The Proprietary Information and Report can only be acquired and/or duplicated by others using an equivalent investment of time and effort.

I have read the foregoing and the matters stated herein are true and correct to the best of my knowledge, information and belief. I make this affidavit under penalty of perjury under the laws of the United States of America and under the laws of the State of California.

Executed at 1300 W WT Harris Blvd, Charlotte, NC being the premises and place of business of Electric Power Research Institute, Inc.

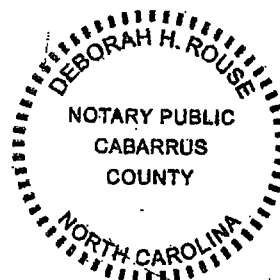
Date: 8-8-2018

Neil Wilmshurst

(State of North Carolina)
(County of Mecklenburg)

Subscribed and sworn to (or affirmed) before me on this 8th day of August, 2018, by Neil Wilmshurst, proved to me on the basis of satisfactory evidence to be the person(s) who appeared before me.

Signature Deborah H. Rouse (Seal)

My Commission Expires 2nd day of April, 2021



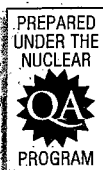


ELECTRIC POWER
RESEARCH INSTITUTE

EPRI MOV Performance Prediction Program

Addendum 10 to EPRI TR-103237-R2: PPM Version 4.0 Software Changes NP

2018 TECHNICAL REPORT



NOTICE: THIS REPORT CONTAINS THE NON-PROPRIETARY INFORMATION THAT IS INCLUDED IN THE PROPRIETARY VERSION OF THE REPORT. THE PROPRIETARY VERSION CONTAINS PROPRIETARY INFORMATION THAT IS THE INTELLECTUAL PROPERTY OF BWRVIP UTILITY MEMBERS AND EPRI. ACCORDINGLY, IT IS AVAILABLE ONLY UNDER LICENSE FROM EPRI AND MAY NOT BE REPRODUCED OR DISCLOSED, WHOLLY OR IN PART, BY ANY LICENSEE TO ANY OTHER PERSON OR ORGANIZATION WITHOUT EPRI'S PRIOR WRITTEN CONSENT, EXCEPT AS MAY BE ALLOWED UNDER THE TERMS AND CONDITIONS OF THE APPLICABLE LICENSE AGREEMENT WITH EPRI.

EPRI MOV Performance Prediction Program

Addendum 10 to EPRI TR-103237-R2: PPM
Version 4.0 Software ChangesNP
3002013039NP

Final Report, April 2018

EPRI Project Manager
J. Hosler

All or a portion of the requirements of the EPRI Nuclear
Quality Assurance Program apply to this product.



NO

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THE FOLLOWING ORGANIZATION, UNDER CONTRACT TO EPRI, PREPARED THIS REPORT:

MPR Associates, Inc.

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NOTE

For further information about EPRI, call the EPRI Customer Assistance Center at 800.313.3774 or e-mail askepri@epri.com.

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ACKNOWLEDGMENTS

The following organizations, under contract to the Electric Power Research Institute (EPRI), prepared this report:

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Alexandria, VA 22314

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J. Simons
T. Shaw
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This report describes research sponsored by EPRI.

This publication is a corporate document that should be cited in the literature in the following manner:

EPRI MOV Performance Prediction Program: Addendum 10 to EPRI TR-103237-R2—PPM Version 4.0 Software Changes. EPRI, Palo Alto, CA: 2018. 3002013039.

ABSTRACT

This addendum to EPRI report TR-103237-R2, *EPRI MOV Performance Prediction Program Topical Report*, documents changes made to the EPRI Motor-Operated Valve (MOV) Performance Prediction Methodology (PPM) computer code between Version 3.5 and Version 4.0.

The EPRI MOV PPM is a validated computer code for determining the required thrust or torque to stroke gate, globe, and butterfly valves under design basis conditions. Version 1.0 of the PPM computer code was issued in 1995. *EPRI MOV Performance Prediction Program Topical Report, Revision 1* (TR-103237-R1) documents a technical description of Version 1.0, including model data comparisons justifying the method. The Nuclear Regulatory Commission (NRC) issued a safety evaluation on Version 1.0 in March 1996 and issued a supplemental safety evaluation covering specific hand calculation methods in February 1997. *EPRI MOV Performance Prediction Program Topical Report, Revision 2* (TR-103237-R2) was issued in April 1997 and includes the hand calculation methods as well as the initial NRC safety evaluation and supplemental safety evaluations.

Version 2.0 of the PPM computer code was issued in August 1998 to correct minor software errors and incorporate features to facilitate implementation. *Addendum 1 to EPRI TR-103237-R2* (AD-110778) describes the changes between Version 1.0 and Version 2.0 and demonstrates that the changes did not affect the code's ability to make bounding predictions of required thrust and torque. The NRC issued a safety evaluation covering Version 2.0 in May 2000.

Version 3.0 was issued in August 2001. It incorporated a Windows-based user interface model (WUIM) and automated many of the hand calculations that had previously been required. Version 3.0 was recalled shortly thereafter, due to the discovery of a coding error. Version 3.1 corrected the error and was issued in November 2001. *Addendum 5 to EPRI TR-103237-R2* (1020358) describes the changes from Version 2.0 to Version 3.1. This addendum includes the NRC Safety Evaluation for Version 3.1.

Version 3.2 was issued in December 2003 to correct minor errors in the software and incorporate a design change related to butterfly valve torque predictions. *Addendum 6 to EPRI TR-103237-R2* (1020359) describes the changes from Version 3.1 to Version 3.2. This addendum includes the NRC Safety Evaluation for Version 3.2.

Version 3.3 of the PPM was issued in August 2005 to incorporate changes to the WUIM that addressed several errors and added new features and functionality to the user interface.

Addendum 7 to EPRI TR-103237-R2 (1020360) describes the changes from Version 3.2 to Version 3.3. This addendum includes the NRC Safety Evaluation for Version 3.3.

Version 3.4 addressed several software error and information notices, improved the accuracy of PPM predictions (differential pressures), and provided new functionality in the user interface.

Addendum 8 to EPRI TR-103237-R2 (3002007058) describes the changes from Version 3.3 to Version 3.4. This addendum includes a letter from the NRC accepting Version 3.4.

Version 3.5 addressed several problem reports and error notices and incorporated SI Units.

Addendum 9 to EPRI TR-103237-R2 (3002007059) describes the changes from Version 3.4 to Version 3.5. This addendum includes a letter from the NRC accepting Version 3.5.

Keywords

Motor-operated valves

Performance

Software tools

Valves

Deliverable Number: 3002013039NP

Product Type: Technical Report

Product Title: EPRI MOV Performance Prediction Program: Addendum 10 to EPRI TR-103237-R2: PPM Version 4.0 Software ChangesNP

PRIMARY AUDIENCE: Plant staff responsible for engineering evaluation of valve thrust and torque requirements

SECONDARY AUDIENCE: Plant engineering staff

KEY RESEARCH QUESTION

There is a need for validated analytical methods for predicting thrust and torque requirements for nuclear plant gate, globe, and butterfly valves.

RESEARCH OVERVIEW

As part of the EPRI MOV Performance Prediction Program (PPP), improved methodologies for analyzing gate, globe, and butterfly valves were developed and implemented in the form of a computer program called the Performance Prediction Methodology (PPM). In Versions 1.0 and 2.0 of the PPM, valve type-specific technical modules were combined with a DOS-based user interface module (UIM). The UIM provided an interface with the user and ensured that the various technical modules were run properly. In Version 3 of the PPM (PPM for Windows), a Windows-based user interface module (WUIM) was developed to interface with the user and execute the technical modules. This updated version of the software also performed many of the calculations that users were previously required to perform by hand. Although Versions 1.0 and 2.0 of the PPM were only applicable to MOVs, Version 3 was adapted to also cover air operated valves (AOVs) and hydraulically operated valves (HOVs). The latest version of the PPM software, Version 4.0, was developed to provide compatibility with 64-bit operating systems, add the EPRI Refined Gate Valve Unwedging Methodology, and correct several issues identified in problem reports and information or error notices.

KEY FINDINGS

- Key changes incorporated in Version 4.0 of the PPM are summarized below:
- Recode and recompile the four (4) PPM technical modules (SFM, GLBM, GATM, and BFM) in ANSI C, to provide compatibility with 64-bit operating systems (and maintain compatibility with 32-bit operating systems)
- Update the gate valve applicability table in the WUIM to address Information Notice 2014-01
- Revise the globe valve prediction report to address missing reference numbers as detailed in Problem Report 2014-02
- Revise the software to address errors experienced when modeling restrictors, as described in Error Notice 2015-01
- Add the Refined EPRI Unwedging Method as detailed in Addendum 3 to TR-103237-R2
- Revise the software to address an error in the SFM module related to modeling two-phase flow scenarios to address Error Notice 2017-01

- Revise the software to correct gate valve model dimensional checks as described in Problem Report 2017-02
- Revise the software to correct the globe valve model orientation check (pitch and roll angles) as described in Problem Report 2017-03
- Revise the User Manual to clarify use of the Equivalent Resistance Method and Full System Flow Method in the gate valve model as described in Problem Report 2017-04
- Revise the software to correctly display the piping labels in the Gate Valve user interface (Pipe Data Tab) as described in Problem Report 2017-05, Rev. 1
- Revise the software to correct the modal/non-modal window error as described in Problem Report 2018-01
- Revise the software and User Manual to change "English Units" to "US Customary Units"

WHY THIS MATTERS

This software development project has produced a version of the PPM software that is compatible with 64-bit operating systems. Accordingly, the software will remain a viable tool for use in defining operational load (thrust/torque) requirements for gate, globe, and butterfly valves well into the future.

HOW TO APPLY RESULTS

The PPM version 4.0 software may be used to predict thrust and torque requirements for gate, globe, and butterfly valves.

LEARNING AND ENGAGEMENT OPPORTUNITIES

- EPRI MOV PPM User Group

EPRI CONTACTS: John Hosler (jhosler@epri.com) and Thomas Walker (twalker@epri.com)

PROGRAM: Nuclear Maintenance Applications Center, P41.05.01

IMPLEMENTATION CATEGORY: Category 1

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BACKGROUND/PURPOSE

Background

The EPRI MOV Performance Prediction Methodology (PPM) is a validated computer code for determining the required thrust or torque to stroke gate, globe, and butterfly valves under design basis conditions. Version 1.0 of the PPM computer code was issued in 1995. *EPRI MOV Performance Prediction Program Topical Report, Revision 1* (TR-103237-R1) documents a technical description of Version 1.0, including model data comparisons justifying the method. The Nuclear Regulatory Commission (NRC) issued a safety evaluation on Version 1.0 in March 1996 and issued a supplemental safety evaluation covering specific hand calculation methods in February 1997. *EPRI MOV Performance Prediction Program Topical Report, Revision 2* (TR-103237-R2) was issued in April 1997 and includes the hand calculation methods as well as the initial NRC safety evaluation and supplemental safety evaluations.

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Version 3.3 of the PPM was issued in August 2005 to incorporate changes to the WUIM that addressed several errors and added new features and functionality to the user interface. *Addendum 7 to EPRI TR-103237-R2* (1020360) describes the changes from Version 3.2 to Version 3.3. This addendum includes the NRC Safety Evaluation for Version 3.3.

Version 3.4 addressed several software error and information notices, improved the accuracy of PPM predictions (differential pressures), and provided new functionality in the user interface. *Addendum 8 to EPRI TR-103237-R2* (3002007058) describes the changes from Version 3.3 to Version 3.4. This addendum includes a letter from the NRC accepting Version 3.4.

Version 3.5 addressed several problem reports and error notices and incorporated SI Units. *Addendum 9 to EPRI TR-103237-R2* (3002007059) describes the changes from Version 3.4 to Version 3.5. This addendum includes a letter from the NRC accepting Version 3.5.

Purpose

The purpose of this report is to describe the changes made from Version 3.5 to Version 4.0 of the PPM and justify that these changes do not affect the code's ability to appropriately bound expected thrust/torque requirements for gate, globe, and butterfly valves.

The changes incorporated in Version 4.0 of the PPM are summarized below:

- Recode and recompile the four (4) PPM technical modules (SFM, GLBM, GATM, and BFM) in ANSI C, to provide compatibility with both 32 and 64-bit operating systems
- Add the EPRI Refined Gate Valve Unwedging Methodology as detailed in Addendum 3 to TR-103237-R2 (Reference 1)
- Update the gate valve applicability table in the WUIM to address Information Notice 2014-01 (Reference 2)
- Revise the globe valve prediction report to address missing reference numbers as detailed in Problem Report 2014-02 (Reference 2)
- Revise the software to address errors experienced when modeling restrictors, as described in Error Notice 2015-01 (Reference 2)
- Revise the software to address an error in the SFM module related to modeling two-phase flow scenarios to address Error Notice 2017-01 (Reference 2)
- Revise the software to correct gate valve model dimensional checks as described in Problem Report 2017-02 (Reference 2)
- Revise the software to correct the globe valve model orientation check (pitch and roll angles) as described in Problem Report 2017-03 (Reference 2)
- Revise the User Manual to clarify use of the Equivalent Resistance Method and Full System Flow Method in the gate valve model as described in Problem Report 2017-04 (Reference 2)

- Revise the software to correctly display the piping labels in the Gate Valve user interface (Pipe Data Tab) as described in Problem Report 2017-05, Rev. 1 (Reference 2)
- Revise the software to correct the modal/non-modal window error as described in Problem Report 2018-01 (Reference 2)
- Revise the software and User Manual to change "English Units" to "US Customary Units"

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SUMMARY OF CHANGES IN VERSION 4.0

This section describes the changes between PPM Version 3.5 and Version 4.0. These code revisions were performed to improve the usability of the PPM software and correct issues and/or errors identified since development of Version 3.5.

Software Usability Improvements

Re-code Technical Modules for Compatibility with 64-bit Operating Systems

The initial PPM Software (Version 1.0) was developed in 1994. The software consisted of four DOS-based technical modules and a DOS user-interface module as listed below.

- System Flow Module (SFM)
- Globe Valve Module (GLBM)
- Butterfly Valve Module (BFM)
- Gate Valve Module (GATM)
- User Interface Module (UIM)

In 2001, EPRI developed a Windows-based UIM for the PPM. Versions 3.1 through 3.5 of PPM included this Windows-based UIM but retained the four DOS-based technical modules (SFM, GLBM, BFM, and GATM).

The four DOS-based technical modules were originally programmed and compiled into executable files using Microsoft QuickBasic 4.5. These executable files are compatible with Microsoft Operating Systems up to 32-bit but are not compatible with the latest Microsoft 64-bit environments. (Note: The Windows user interface module, developed in 2001, is compatible with Microsoft 64-bit environments.)

For PPM Version 4.0, the four DOS-based technical modules (SFM, BFM, GLBM, and GATM) were recoded from Microsoft QuickBasic to ANSI C. These modules were then recompiled into executable files that are compatible with both 32-bit and 64-bit Microsoft operating systems. No changes were made to the engineering models within these four technical modules.

Note: To ensure no changes were made to the engineering modules during this recoding effort, verification and validation activities included the following:

- Complete line-by-line code review of each new ANSI C module; comparing it to its original QuickBasic module code (code reviewer was independent of code developer)
- Individual unit testing of each new ANSI C module using validation test cases designed to exercise all potential input options for that module; comparing the results from each test case to results from that same test case performed with its original QuickBasic module (the scope of the validation test cases for each module matched or exceeded those performed during the original development of the PPM methodology in the 1990's).

Incorporate EPRI Refined Gate Valve Unwedging Methodology

For Version 4.0, the PPM software was revised to include an option to use the EPRI Refined Gate Valve Unwedging Methodology as defined in Addendum 3 to EPRI TR-103237-R2 (Reference 1). As documented in Reference 1, the USNRC has reviewed this refined unwedging methodology and issued a Safety Evaluation for this methodology.

Software Issue/Error Corrections

Information Notice 2014-1: Gate Valve Applicability Table

For Version 4.0, the PPM software was revised to include the latest revision of the Gate Valve Applicability Table, as documented in EPRI PPM Information Notice 2014-01 (included in Appendix A).

Problem Report 2014-02: Missing Reference Numbers in Globe Valve Prediction Report

For Version 4.0, the PPM software was revised to address minor errors in the Globe Valve Prediction Output Report, as documented in EPRI PPM Problem Report 2014-02 (included in Appendix A). Specifically, the problem report notes that the PPM software allowed users to identify references for individual design inputs; however, in the PPM prediction output report for a globe valve analysis, the reference numbers were not printed for the following design inputs:

- Actuator Overall Ratio
- Motor Speed
- Stem Thread Type
- Stem Thread Lead
- Stem Thread Pitch

Error Notice 2015-01: Restrictor Modeling

For Version 4.0, the PPM software was revised to address errors related to the modeling of restrictors, as documented in EPRI PPM Error Notice 2015-01 (included in Appendix A). Specifically, these errors in the UIM module did not allow users to execute the PPM software if modeling an orifice or nozzle/venturi in PPM Versions 3.1 through 3.5. In Versions 3.1 through 3.5, the UIM module would issue an error message and halt execution if a user attempted to model an orifice or nozzle/venture.

Note: This Version 4.0 software revision did not alter the engineering equations/methods in the System Flow Module for modeling orifices/nozzles/venturies. This revision only corrected an error in the software which made it impossible to model these restrictor types. These restrictor types were able to be modeled in PPM Versions 1.0 and 2.0, which had a DOS-based user-interface.

Error Notice 2017-01: SFM modeling of Two-Phase Flow Scenarios

For Version 4.0, the PPM software was revised to correct an error in the SFM module related to modeling two-phase flow scenarios, as documented in Error Notice 2017-01 (included in Appendix A). This error was identified in the original SFM software code during re-coding of the SFM for 64-bit compatibility. As detailed in the error notice, this error had the potential to cause non-conservative prediction results for certain two-phase flow scenarios.

Problem Report 2017-02: Gate Valve Model Dimensional Checks

For Version 4.0, the PPM software was revised to address an issue in the GATM module algorithm that checks internal valve dimensions, as described in Problem Report 2017-02 (included in Appendix A). This issue was identified in the original GATM software code during re-coding of the GATM module for 64-bit compatibility. As detailed in the problem report, this issue did not affect the prediction results from the GATM module; this issue only affected potential warning messages provided to a user if the user entered incorrect gate valve internal dimensions. As noted in the problem report, the accuracy of the software inputs is ultimately the responsibility of the user. However, this revision to the PPM code for Version 4.0 improves the capability of the code to detect if a user has entered inconsistent valve internal dimensions.

Problem Report 2017-03: Globe Valve Model Orientation Check

For Version 4.0, the PPM software was revised to address an issue in the GLBM module algorithm that checks valve orientation to determine the effect of disk and stem weight, as described in Problem Report 2017-03 (included in Appendix A). This issue was identified in the original GLBM software code during re-coding of the GLBM module for 64-bit compatibility. As detailed in the problem report, this issue did not affect the prediction results from the GLBM module; this issue only affected potential warning messages provided to the user if the user entered incorrect globe valve orientation angles (pitch and roll). As noted in the problem report, the accuracy of the software inputs is ultimately the responsibility of the user. However, this revision to the code for Version 4.0 improves the capability of the code to detect if a user has entered inconsistent pitch and roll angles.

Problem Report 2017-04: Clarify Use of ERM vs. Full SFM

For Version 4.0, the PPM software user manual was revised to clarify use of the Equivalent Resistance Method (ERM) versus the Full System Flow Method (Full SFM), as described in Problem Report 2017-04 (included in Appendix A). As detailed in the Problem Report, this issue only affected the user manual; no software revisions were required. Specifically, the software user manual was updated to clearly indicate the system configuration that is modeled by the PPM when users select either the ERM or the Full SFM.

Problem Report 2017-05, Rev. 1: WUIM Gate Valve Piping Labels

For Version 4.0, the PPM software was revised to address an issue in the WUIM module with regard to the piping labels displayed in the gate valve user interface (Pipe Data Tab), as described in Problem Report 2017-05, Rev. 1 (included in Appendix A). As detailed in the Problem Report, there is an error in the WUIM module of PPM v3.5; the piping labels on the Gate Valve Pipe Data Tab do not update in accordance with the user-selected system modeling methodology. This issue did not affect the prediction results.

Problem Report 2018-01: Modal / Non-modal Window Error

For Version 4.0, the PPM software was revised to address an error in the WUIM module which may occur when a user has two or more PPM analyses open at the same time. Specifically, under certain circumstances, the software would issue a runtime error message to the user and then shutdown (crash). When this error occurs, no prediction results are provided and no files are saved. Accordingly, this error does not have the potential to affect prediction results. However, the revision to the PPM code for Version 4.0 to address this issue improves the usability of the software.

EPRI Code Revision Request: Change “English Units” to “US Customary Units”

For Version 4.0, the PPM software and user manual were revised to change the terminology “English Units” to “US Customary Units.” There is no error associated with this software revision. This revision was simply a “cosmetic” change requested by EPRI.

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CONCLUSIONS

PPM Version 4.0 was developed in accordance with a Quality Assurance Program that satisfies 10 CFR 50, Appendix B and ASME NQA-1. All software revisions from Version 3.5 to Version 4.0 were documented and independently verified. The modified software was independently validated in accordance with written test plans to verify that the software performed its required functions. A verification and validation report summarizes the requirements, design, and testing of Version 4.0 of the PPM and documents the results of validation testing.

There were no changes to the PPM methodology or its implementation approach. Accordingly, it is concluded that the assessment of previous versions of the PPM is applicable to Version 4.0.

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REFERENCES

1. EPRI 1020350, *Addendum 3 to EPRI TR-103237-R2: An Improved and Validated Gate Valve Unwedging Methodology-A*, March 2010.
2. MPR Document 0140-0271-01, *EPRI PPM Software Error Report Status File*, Revision 9.

A

PPM PROBLEM REPORTS, INFORMATION NOTICES, AND ERROR NOTICES

This appendix contains the following problem reports, information notices, and error notices discussed in this document. This appendix is 38 pages, including this cover page.

- Information Notice 2014-1
- Problem Report 2014-02
- Error Notice 2015-01
- Error Notice 2017-01
- Problem Report 2017-02
- Problem Report 2017-03
- Problem Report 2017-04
- Problem Report 2017-05, Rev. 1
- Problem Report 2018-01

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