

AUDIT REPORT SUMMARY FOR THE REVIEW OF
TOPICAL REPORT PWROG-18068-NP, REVISION 1, “USE OF DIRECT FRACTURE
TOUGHNESS FOR EVALUATION OF REACTOR PRESSURE VESSEL INTEGRITY”

DOCKET NO. 99902037; (EPID L-2021-TOP-0027)

1.0 BACKGROUND

By letter dated July 17, 2021 (Agencywide Documents Access and Management System (ADAMS) Accession No. ML21209A933), the Pressurized Water Reactor Owners Group (PWROG) submitted Topical Report (TR) PWROG-18068-NP, Revision 1, “Use of Direct Fracture Toughness for Evaluation of Reactor Pressure Vessel Integrity” (PWROG TR) for U.S. Nuclear Regulatory Commission (NRC) review and approval. The PWROG TR provides an alternative methodology to the reactor pressure vessel (RPV) material integrity requirements which are available in NRC’s Title 10 of the *Code of Federal Regulations*, Appendix G to Part 50, “Fracture Toughness Requirements,” Section 50.60, “Acceptance Criteria for Fracture Prevention Measures for Light water Nuclear Power Reactors for Normal Operation,” and Section 50.61, “Fracture Toughness Requirements for Protection Against Pressurized Thermal Shock Events.” NRC’s approval of the PWROG TR will provide NRC licensees the opportunity to use the PWROG TR as a technical basis to support their regulatory actions per the NRC TR program.

During the technical review phase of the PWROG TR, the NRC staff identified that additional clarification for draft responses to NRC’s requests for additional information (RAIs) dated March 30, 2022 (ADAMS Accession No. ML22084A246) was necessary to develop the safety evaluation. Therefore, the NRC staff conducted a virtual regulatory audit from January 17, 2024, (8:00AM to 4:30PM), through January 18, 2024 (8:00AM to 11:00AM) to increase efficiency in the review, facilitate discussion, and closeout items under draft review. This audit was held in accordance with the U.S. NRC Office of Nuclear Reactor Regulation procedure as described in LIC-111, “Regulatory Audits,” and under the guidance provided in LIC-500, “Topical Report Process.” The NRC Regulatory Audit Plan is publicly available (ML24008A051).

2.0 REGULATORY AUDIT OBJECTIVES

The objective of the audit was to improve review process efficiency through direct interaction with PWROG’s technical experts. More specifically, the audit allowed the NRC staff to obtain clarification on RAI responses, have extended discussions about differences in technical opinion, examine supportive documentation, and identify those areas of the review that need additional focus.

The NRC staff and industry representatives who participated in the audit are listed below:

Name	Affiliation
Leslie Fields	US Nuclear Regulatory Commission (NRC)
David Dijamco	NRC
John Tsao	NRC
Robert Tregoning	NRC
David Rudland	NRC
Angela Buford	NRC
Gerond George	NRC
James Andrachek	PWR Owners Group (PWROG)
Brian Hall	PWROG
James Molkenthin	PWROG
David Barton	PWROG
Kemper Young	PWROG

3.0 REGULATORY AUDIT BASES

The purpose of the PWROG TR is to provide an alternative methodology to the RPV material integrity requirements and the following regulations apply to the proposed alternative.

The regulation in 10 CFR 50.61, “Fracture Toughness Requirements for Protection Against Pressurized Thermal Shock,” requires reference temperature of the reactor vessel materials be within specific values to prevent pressurized thermal shock on the reactor vessel materials.

The regulation in 10 CFR Part 50, Appendix G, “Fracture Toughness Requirements,” specifies fracture toughness requirements for RPV materials and pressure-temperature limits.

The regulation in 10 CFR Part 50, Appendix H, “Reactor Vessel Material Surveillance Requirements,” requires surveillance capsules containing RPV material specimens be installed inside the RPV to monitor the embrittlement of the RPV material.

4.0 DISCUSSION

Prior to the audit, the NRC staff grouped together questions where there appeared to be fundamental differences in technical opinion between the NRC staff and PWROG. At the end of the October 11, 2023, public meeting the following list of discussion items from PWROG’s draft responses to the RAIs (ML23180A161) were identified as needing further clarification. The PWROG provided a newly revised draft markup of the PWROG TR (ML23180A190) with the associated draft responses for the audit.

The list of discussion items was divided into two parts. The first part was focused on items that may need significant discussion. The second part were items that, based on the discussions during the public meetings, were expected to have a general discussion. Seeking understanding and alignment on these topics was important to achieve the goals of the audit.

(1) Items That May Need Significant Discussion

Draft Responses to RAI-07a, RAI-21a, RAI-24

(2) Items That Need General Discussion

Draft Responses to RAI-01, RAI 02a & b, RAI-09, RAI-11d, RAI-11f, RAI-13a & b, RAI 19b, RAI-20a, RAI-20d, RAI-23, RAI-25b

The audit allowed for the discussion of topics referred to as (1) items that may need significant discussion and (2) items that needed minimal discussion. The NRC staff was able to obtain enough information and to identify a path to resolution of the concerns (pending additional internal discussion). The NRC staff also obtained a clearer understanding of PWROG's technical position, and PWROG obtained a clearer understanding of the NRC staff's concerns. The audit also allowed for the NRC staff and PWROG representatives to re-examine any final issues and wrap-up discussions in preparation for the review of the final RAI responses from the PWROG.

The discussion during the audit provided multiple instances of clarification, and the NRC examined several calculation notes (provided below in the list of examined audit documents) in support of parameter values used in the estimation of RPV fracture toughness including material variability and uncertainty.

4.1 Future Actions

The next step in the technical review phase is for the PWROG to transmit final responses to the RAIs. After this transmittal, the NRC will start development of the safety evaluation and it may become necessary for NRC staff to introduce limitations and conditions in the safety evaluation for the approval and use of a methodology. The NRC staff plans to inform PWROG of any new developments on this topic, as applicable.

4.2 Examined Electronic Audit Documents (Microsoft Word Version)

1. *Flowchart of data from Material Test Reactor* [dated January 20, 2024]
2. *PWROG-18068-NP Rev 1-DRAFT Revisions_August 2023.docx*
3. *Draft RAI responses to PWROG-18068-NP Revision 1 - August 2023.docx*
4. *An Examination of Margins Needed to Ensure Conservative Application of T 0 to RPV Fracture Toughness [PVP2024 paper-RPV margins_final draft.pdf]*
5. List of RAI responses to discuss based on *significance.docx*.

5.0 CONCLUSION

The audit accomplished the objectives and goals listed in Section 3.0 of the audit plan by allowing direct interaction with PWROG's technical experts. The NRC staff were able to obtain clarification on multiple RAI responses, examine calculation notes supporting the RAI responses, and discuss differences in technical opinion. The clarifications and examination of calculation notes will allow the NRC staff to assess the RAI responses more efficiently. The discussions on differences in technical opinion will allow the NRC staff and PWROG representatives to obtain alignment on the final safety evaluation.