

February 16, 2012

Mr. David Czufin, Chairman  
Exelon Generation  
Chairman, BWR Vessel and Internals Project  
Electric Power Research Institute  
3420 Hillview Avenue  
Palo Alto, CA 94304-1395

SUBJECT: APPROVAL LETTER FOR "BWRVIP-62-A: BWR [BOILING WATER REACTOR] VESSEL AND INTERNALS PROJECT, TECHNICAL BASIS FOR INSPECTION RELIEF FOR BWR INTERNAL COMPONENTS WITH HYDROGEN INJECTION" (TAC NO. ME6327)

Dear Mr. Czufin:

The U.S. Nuclear Regulatory Commission (NRC) staff has completed its review of the revisions that were incorporated in the "BWRVIP-62-A: BWR Vessel and Internals Project, Technical Basis for Inspection Relief for BWR Internal Components with Hydrogen Injection" report. This report was re-submitted for NRC staff review and approval by letter dated May 13, 2011 (Agencywide Documents Access and Management System (ADAMS) Accession No. ML11137A192). This report contains a discussion of the technical basis for relief from current inspection requirements for BWR reactor vessel internal components that are protected from intergranular stress corrosion cracking (IGSCC) by the injection of hydrogen into the reactor coolant.

Background:

By letter dated December 31, 1998 (ADAMS Legacy Accession No. 9901050050), the Electric Power Research Institute (EPRI) submitted for NRC staff review and approval BWRVIP report TR-108705, "BWR Vessel and Internals Project, Technical Basis for Inspection Relief for BWR Internal Components with Hydrogen Injection (BWRVIP-62)." A non-proprietary version of BWRVIP-62 was also submitted on March 7, 2000 (ADAMS Accession No. ML003691748).

On January 30, 2001, the NRC staff issued an initial safety evaluation (SE) (ADAMS Accession No. ML010370141) for BWRVIP-62. This initial SE contained open items which are described in more detail in Section 3.0 of the SE. In response to the open items contained in the NRC staff's SE of January 30, 2001, the BWRVIP provided technical information related to the implementation of the BWR Vessel Internals Application (BWRVIA) model in a letter dated August 1, 2001 (ADAMS Accession No. ML012140408) followed by supplemental information in the letters dated May 19, 2003 and December 17, 2004 (ADAMS Accession Nos. ML031430145 and ML043560323). The NRC staff reviewed the responses, comments, and recommendations regarding Section 3.0 of the initial SE. On July 22, 2008, the staff issued a draft version of the final SE for the BWRVIP-62, Revision 0, to the BWRVIP for comment. The staff incorporated the comments, as appropriate, and issued a final SE on April 21, 2010 (ADAMS Accession No. ML100890361). The BWRVIP then submitted the BWRVIP-62-A version for the NRC staff to review and approve by letter dated May 13, 2011 (ADAMS Accession No. ML11137A192).

Review Results:

The NRC staff has reviewed the information in the BWRVIP-62-A report and has found that it accurately incorporates all of the relevant information which was submitted by the BWRVIP in the documents noted above to support NRC staff approval. The staff found that minimal revisions were made to the BWRVIP-62 report in the production of the BWRVIP-62-A report. The staff found that the following revisions are acceptable because:

1. the revisions were made to comply with the staff's requests in the April 21, 2010, SE;
2. the revisions included updated information on references; and
3. the revisions provided clarification of technical issues.

The following paragraphs summarize the specific revisions to the BWRVIP-62 TR:

- The following were added:
  - a report summary and record of revisions,
  - Tables 2-1, 3-7, and 3-8 to the list of tables,
  - Figures 2-9 to 2-15 and 3-15 to 3-19 to the list of figures; and
  - Finetech Inc. to the citation and acknowledgement pages.
- The executive summary was revised to be consistent with the staff's final SE.
- Section 1.4 was revised to include the staff's final SE conclusion related to the effect of flow rate on the IGSCC and a reference to the BWRVIP-64 TR.
- Consistent with the staff's conclusion in the staff's final SE, Section 1.6.1 was revised to include a threshold limit for electrochemical corrosion potential (ECP) that determines the IGSCC susceptibility.
- The threshold limit of oxygen for IGSCC mitigation was included in Section 1.6.2.
- Section 1.8 was revised to include a discussion on the mitigation of deep cracks.
- Guidelines addressed in NEI-03-08, "Guidelines for the Management of Materials Issues," were added to Section 1.9. References 1-23 and 1-24 were added on page 1-23.
- In Section 2.2, BWRVIA V2.0 was added superseding the BWRVIA V1.0 version.
- Section 2.2.4.2 was added to address ECP calculations using the mixed potential model for BWRVIA V2.0. Section 2.2.5 was revised to include:
  - BWRVIA V2.0,
  - total oxidant, and
  - ECP calculations at the local velocity as determined from plant geometry inputs and mass flow rates and ECP calculated at a user-defined low velocity.
- Sections 2.3.2 and 2.3.3 were added to address the validity of the BWRVIA V1.0 and BWRVIA V2.0 versions.

- The BWRVIP revised Section 2.4 to clarify the amount of hydrogen required to mitigate IGSCC in plants that operate on moderate hydrogen water chemistry, and added a new vendor— AEA Technology.
- Section 2.5 was revised to the latest references.
- Per the staff request in Section 3.1.1 of the staff's final SE, Figure 2-9 was added. Consistent with the staff requests that were addressed in Sections 3.2 of the staff's final SE, Table 2-1, and Figures 2-10 through 2-15 were added.
- Section 3.3 was revised to elucidate effective implementation and monitoring of the hydrogen water chemistry (HWC) programs.
- Clarification was provided in Section 3.4 with regards to the monitoring of the secondary parameters related to HWC and noble metal chemical addition (NMCA) programs.
- Sections 3.5 and 3.6 were revised to be consistent with Section 3.3 of the staff's final SE.
- Consistent with Section 3.1 of the staff's final SE, Section 3.8 was revised to include crack growth rates models based on the exposure to different neutron fluences.
- Section 3.9 was revised to include the reference to BWRVIP-59-A report and in Section 3.10 new references were added.
- Consistent with Section 3.3 of the staff's final SE, Tables 3-5, 3-7, and 3-8 and Figures 3-15 through 3-19 were added.
- Consistent with Section 3.1 of the staff's final SE, Section 4.2 was revised to include crack growth rate models based on the exposure to different neutron fluences.
- Section 4.2 was revised to include updated information related to the effect of fluence on the irradiation assisted stress corrosion cracking growth rates which are addressed in the staff approved version of the BWRVIP-99-A report, "BWR Vessel and Internals Project, Crack Growth Rates in Irradiated Stainless Steel in BWR Internals Components."
- Section 4.3 was revised to include updated information regarding the crack growth behavior in Alloy 182/82/600 materials.
- Section 4.6 was added which describes a summary of requirements for inspection relief and the implementation of the BWRVIA radiolysis/ECP model to maintain the most conservative conditions for effective IGSCC mitigation.
- Updated Tables 4-1, 4-2, and 4-4 and references in Section 4.7.
- Appendix A was added which addressed the physical explanation of molar ratio predictions using the BWRVIA model.
- Appendix B was added consisting of the staff's initial SE.

- Appendix C was added consisting of the BWRVIP response to the staff's initial SE.
- Appendix D was added consisting of the supplement to BWRVIP responses, dated May 19, 2003, to the staff's initial SE.
- Appendix E was added consisting of supplementary information dated December 17, 2004, on the implementation of the HWC and HWC/NMCA programs.
- Appendix F was added consisting of the staff's interim SE dated July 22, 2008.
- Appendix G was added consisting of the record of revisions applied to the BWRVIP-62 report.

Based on the discussion above, the NRC staff has determined that the BWRVIP-62-A report is acceptable. Please contact my staff, Andrew Hon at (301) 415-8480, if you have any further questions regarding this subject.

Sincerely,

**/RA/**

Robert A. Nelson, Deputy Director  
Division of Policy and Rulemaking  
Office of Nuclear Reactor Regulation

Project No. 704

cc: See next page

D. Czufin

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- Appendix C was added consisting of the BWRVIP response to the staff's initial SE.
- Appendix D was added consisting of the supplement to BWRVIP responses, dated May 19, 2003, to the staff's initial SE.
- Appendix E was added consisting of supplementary information dated December 17, 2004, on the implementation of the HWC and HWC/NMCA programs.
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Robert A. Nelson, Deputy Director  
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**ADAMS Accession No.: ML120310164**

**NRR-106**

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TECHNICAL BASIS FOR INSPECTION RELIEF FOR BWR INTERNAL COMPONENTS WITH  
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