

**SAFETY EVALUATION OF “BWR [BOILING WATER REACTOR] VESSEL AND INTERNALS  
PROJECT, GUIDELINES FOR SELECTION AND USE OF MATERIALS FOR REPAIRS TO  
BWR INTERNALS (BWRVIP-84, REVISION 2)”**

1.0 INTRODUCTION

1.1 History

The initial version of the document "BWR [Boiling Water Reactor] Vessel and Internals Project, Guidelines for Selection and Use of Materials for Repairs to BWR Internals (BWRVIP-84)," was submitted to the U.S. Nuclear Regulatory Commission (NRC) staff for review and approval on November 1, 2000 (Agencywide Document Access and Management System (ADAMS) Accession No. ML003768819). The initial safety evaluation (SE) was issued by the NRC staff on September 6, 2005 (ADAMS Accession No. ML052500529), followed by a final SE on September 23, 2008 (ADAMS Accession No. ML082321084). The final SE and responses to requests for additional information (RAI) were incorporated in BWRVIP-84, Revision 1, dated August 2011.

A second revision was completed in September 2012 and submitted by the Boiling Water Reactor Vessel and Internals Project (BWRVIP) to the NRC on March 13, 2013 (ADAMS Accession No. ML131050057). The new revision includes an additional material-specific appendix (Appendix D) as well as additional minor changes. BWRVIP-84, Revision 2 is applicable to General Electric BWRs/2-6's that are implementing reactor vessel internals component repairs or replacements consistent with the BWRVIP repair design criteria.

1.2 Purpose

The NRC staff reviewed BWRVIP-84, Revision 2 to determine the acceptability of the changes relative to BWRVIP-84, Revision 1-A. The review was limited to the new Appendix D related to the application of Alloy 718 because the other changes to BWRVIP-84, Revision 1-A are editorial in nature and do not need to be reviewed. Because BWRVIP-84, Revision 2.0 is proprietary, this SE does not include proprietary information from the report. The staff does not discuss, in detail, the provisions of the guidelines it finds acceptable. A brief summary of Appendix D is given in Section 2.0 of this SE, with the evaluation presented in Section 3.0. The conclusions are summarized in Section 4.0.

Enclosure

## 2.0 SUMMARY OF APPENDIX D

BWRVIP-84, Revision 2, Appendix D is titled, "Design, Procurement, Fabrication, and Installation of Alloy 718 for BWR Internals," and addresses the following topics:

- Applicable Documents
- Design
- Material Procurement
- Solution and Precipitation Hardening Heat Treatments
- Mechanical Requirements
- Fabrication and Installation
- Material Traceability, Identification, and Marking

## 3.0 STAFF EVALUATION

The NRC staff has reviewed Appendix D of the March 13, 2013, submittal and notes that the majority of the appendix is clearly written and follows the basic outline for other similar materials included in BWRVIP-84, Revision 2. The chemical composition, modified heat treatment, and final hardness are described and the mechanical properties from tensile testing are the same as specified in American Society of Mechanical Engineers Section XI, Code Case N-60-6 for Grade 718 Type 2. The one notable difference between Appendix D for Alloy 718 and Appendix B for Alloy X-750 would be the absence of a requirement to perform a rising load test on each lot of material to demonstrate adequate resistance to stress corrosion cracking (SCC) like that found in Section B.7 of BWRVIP-84, Revision 2.

The use of Alloy 718 with the modified heat treatment as described in Appendix D has already been approved for Nine Mile Point, Unit 2 on April 13, 2011 (ADAMS Accession No. ML120940373). In approving the license amendment request (LAR) for Alloy 718, the staff indicated that the microstructure was a key part of the material's resistance to SCC, and assurance through microstructural characterization of a relatively uniform microstructure (an average grain size of American Society for Testing Materials No. 2 to No. 6) was part of the basis for the staff's approval. In addition to tensile testing and SCC testing to document the resistance to SCC crack initiation, the licensee had performed a microstructural characterization on the lot of material used for all of the mechanical testing and subsequent jet pump beam replacement. The staff was concerned that without verification of grain size, the final microstructure of the component fabricated from Alloy 718 may not be as resistant to SCC initiation as the original lot of material approved for Nine Mile Point, Unit 2 on April 13, 2011. Therefore, the staff requested in RAI-1 that the licensee provide a technical justification for why a microstructural characterization is not included as a quality control check on each lot of heat treated components.

By letter dated February 17, 2015 (ADAMS Accession No. ML15142A755), the BWRVIP noted that a microstructural characterization is appropriate to verify for each lot of heat treated material. Therefore, a paragraph describing an examination of the heat treated microstructure to be performed on each lot of material was proposed to be included as Section D.5.4 in the approved version of BWRVIP-84, Revision 2.

The staff has reviewed the RAI response and finds the proposed addition acceptable as the microstructural examination will verify that the grain structure for each heat treated lot of material is consistent with that found in the material originally used in the approval for the use of Alloy 718 with the modified heat treatment. Therefore, with the addition of Section D.5.4, the staff's concern expressed in the RAI is resolved and the staff finds the BWRVIP-84, Revision 2 report acceptable.

#### 4.0 CONCLUSION

The NRC staff has reviewed the BWRVIP-84, Revision 2 report and the February 17, 2015, RAI response and found that the report, modified as described in the RAI response, provides adequate guidance for the selection and use of materials for repair and/or replacement of any BWR internal component. The modification addressed in the RAI response should be incorporated in a "-A" version of the document.

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