EPRI

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BWRVIP-329-A-NP: BWR Vessel and Internals Program

Updated Probabilistic Fracture Mechanics Analyses for BWR RPV Welds to Address Extended Operations

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

YES (NO)

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NOTE

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PRODUCT DESCRIPTION

In this current work, the BWRVIP objective is to provide an alternative probabilistic fracture mechanics (PFM) evaluation of boiling water reactor (BWR) reactor pressure vessel (RPV) welds that supports a technical basis for continued relief from the ASME Section XI examination requirements. The BWRVIP conducted bounding PFM analyses to identify the combinations of beltline material conditions that ensure regulatory safety goals are satisfied for a postulated low temperature isothermal pressure transient. This analysis can be used to assess compliance with the safety goals for axial and circumferential welds at the end of any specified operating interval.

Background

In September 1995, the BWRVIP published report BWRVIP-05, "BWR Reactor Pressure Vessel Shell Weld Inspection Recommendation". The purpose of this report was to provide a technical basis to justify a reduction in the required number of ASME Section XI examinations of axial and circumferential welds in the RPV. The results from PFM analyses were used to provide justification for the reduced examination scope. The PFM evaluation was performed for a postulated, low temperature isothermal over-pressure transient event, which had been determined to dominate the BWR RPV failure frequency.

Subsequent Safety Evaluation Reports (SERs) for BWRVIP-05 published by the Nuclear Regulatory Commission (NRC) staff defined the material and irradiation conditions, and the associated failure frequencies necessary to provide relief from examination of circumferential welds and to assess axial weld integrity. These requirements have been incorporated into BWRVIP-74-A, "BWR Vessel and Internals Project BWR Reactor Pressure Vessel Inspection and Flaw Evaluation Guidelines for License Renewal" and NUREG-1800, Revision 2, "Standard Review Plan for Review of License Renewal Applications for Nuclear Power Plants".

The purpose of the work described in this report is to use NRC safety goals and PFM analysis procedures that have been developed since the publication of BWRVIP-05 to update the evaluation procedure and acceptance criteria specified in BWRVIP-74-A for providing relief from examination of circumferential welds and assessing axial weld integrity.

Objectives

- To evaluate the safety significance of a postulated, low temperature isothermal pressure transient in BWR reactor pressure vessels.
- To identify the combinations of beltline material conditions that will ensure regulatory safety goals are satisfied for the postulated transient.

Approach

The BWR Vessel and Internals Program (BWRVIP) conducted PFM analyses to identify the combinations of RPV beltline material conditions that will ensure regulatory safety goals are satisfied for RPVs for a postulated, low temperature isothermal pressure transient. The approach for these analyses is consistent with previous industry and regulatory evaluations for the postulated BWR low temperature pressure transient, and with more recent analysis procedures employed by NRC staff in the development of the Alternate PTS Rule, 10CFR50.61a.

Results

The results identify the combinations of beltline material conditions for the BWR fleet that will ensure regulatory safety goals are satisfied for the postulated transient. The results from this work are used to demonstrate that reactor pressure vessels in the BWR fleet have margins against failure that satisfy regulatory criteria through at least an 80-year operating interval for the postulated, low temperature isothermal pressure transient.

Applications, Value, and Use

Results of this work provide the capability for BWR owners to demonstrate that reactor pressure vessels have margins against failure that satisfy regulatory safety goals for the postulated, low temperature isothermal pressure transient. Application of these results provide BWR owners with a continuing basis to justify relief from examination of circumferential welds, and the capability to demonstrate acceptable integrity for axial welds for RPVs.

Keywords

BWR reactor pressure vessels
Low temperature pressure transients
Probabilistic fracture mechanics
Examination requirements