

August 20, 2004

Bill Eaton, BWRVIP Chairman
Entergy Operations, Inc.
Echelon One
1340 Echelon Parkway
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SUBJECT: SUPPLEMENT TO SAFETY EVALUATION OF THE "BWRVIP VESSEL AND INTERNALS PROJECT, TOP GUIDE/CORE PLATE REPAIR DESIGN CRITERIA (BWRVIP-50)," EPRI REPORT TR-108722, MAY 1998 (TAC NO. MC0651)

Dear Mr. Eaton:

In a letter dated July 18, 2003, the Boiling Water Reactor Vessels and Internals Project (BWRVIP) provided responses to the Nuclear Regulatory Commission (NRC) Safety Evaluation (SE) for Electric Power Research Institute (EPRI) proprietary report TR-108722, "BWR Vessel and Internals Project, Top Guide/Core Plate Repair Design Criteria (BWRVIP-50)," dated May 1998. The BWRVIP-50 report was submitted to the U. S. NRC for staff review by letter dated May 14, 1998. This report was supplemented by letters dated December 6, 1999, and July 18, 2003, which were in response to the NRC staff's requests for additional information (RAIs) dated April 7, 1999, and May 24, 1999, and the staff's initial SE dated January 29, 2001.

The BWRVIP-50 report provides general design acceptance criteria for the permanent or temporary repair of the BWR top guide and core plate. These guidelines are intended to maintain the structural integrity and system functionality of the top guide and core plate during normal operation and under postulated transient and design-basis accident conditions. The BWRVIP provided the BWRVIP-50 report to support generic regulatory efforts related to the repair of the BWR top guide and core plate.

The NRC staff has reviewed the BWRVIP-50 report and the BWRVIP's associated RAI responses and finds, as documented in the enclosed SE supplement, that the BWRVIP-50 report is acceptable for providing guidance for permanent or temporary repairs of the top guide and core plate. The staff has concluded that implementation of the guidelines in the BWRVIP-50 report will provide an acceptable repair design criteria for the safety-related components addressed. The BWRVIP-50 report is considered by the staff to be applicable for licensee usage at any time during either the current operating term or during an extended license period. Licensees should note that when applying the repair design criteria to components that, according to the licensing basis of the plant, are classified as American Society for Mechanical Engineers (ASME) Code components, a submittal to the NRC, pursuant to 10 CFR 50.55a(a)(3) is required to request authorization of the repair as an acceptable alternative to the ASME Code.

B. Eaton

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In accordance with the procedures established in NUREG-0390, "Topical Report Review Status," the staff requests that the BWRVIP publish the accepted version of the BWRVIP-50 report within 90 days after receiving this letter. In addition, the published version shall incorporate this letter and the enclosed SE supplement, between the title page and the abstract.

Please contact Meena K. Khanna, of my staff, at (301) 415-2150, if you have any further questions regarding this subject.

Sincerely,

/RA/

William H. Bateman, Chief
Materials and Chemical Engineering Branch
Division of Engineering
Office of Nuclear Reactor Regulation

Enclosure: As stated

cc: BWRVIP Service List

B. Eaton

-2-

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cc: BWRVIP Service List

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U.S. NUCLEAR REGULATORY COMMISSION
OFFICE OF NUCLEAR REACTOR REGULATION SAFETY EVALUATION SUPPLEMENT OF
“BWRVIP VESSEL AND INTERNALS PROJECT, TOP GUIDE/CORE PLATE
REPAIR DESIGN CRITERIA (BWRVIP-50)”
EPRI REPORT TR-108722, MAY 1998

1.0 INTRODUCTION

1.1 Background

In a letter dated July 18, 2003, the Boiling Water Reactor Vessels and Internals Project (BWRVIP) provided responses to the Nuclear Regulatory Commission (NRC) Safety Evaluation (SE) for Electric Power Research Institute (EPRI) proprietary report TR-108722, “BWR Vessel and Internals Project, Top Guide/Core Plate Repair Design Criteria (BWRVIP-50),” dated May 1998. The BWRVIP-50 report was submitted to the U. S. NRC for staff review by letter dated May 14, 1998. This report was supplemented by letters dated December 6, 1999, and July 18, 2003, which were in response to the NRC staff’s requests for additional information (RAIs) dated April 7, 1999, and May 24, 1999, and the staff’s initial SE dated January 29, 2001.

The BWRVIP-50 report, as supplemented, provides general design acceptance criteria for the permanent or temporary repair of the BWR top guide and core plate. These guidelines are intended to maintain the structural integrity and system functionality of the top guide and core plate during normal operation and under postulated transient and design basis accident conditions. The BWRVIP provided the BWRVIP-50 report to support generic regulatory efforts related to the repair of the top guide and core plate.

1.2. Purpose

The staff reviewed the BWRVIP-50 report, as supplemented by the BWRVIP response to the staff’s SE, to determine whether its proposed guidance will provide an acceptable repair design criteria for the subject safety-related reactor pressure vessel (RPV) internal components. The review assessed the design objectives, structural evaluation, system evaluation, materials, fabrication and installation considerations, as well as the required inspection and testing requirements.

1.3. Organization of this Report

Because the BWRVIP-50 report is proprietary, this SE supplement was written not to repeat proprietary information contained in the report. The staff does not discuss, in any detail, the provisions of the guidelines nor the parts of the guidelines it finds acceptable. A brief summary of the contents of the BWRVIP-50 report is given in Section 2 of this SE supplement, with the evaluation presented in Section 3. The conclusions are summarized in Section 4. The

ENCLOSURE

presentation of the evaluation is structured according to the organization of the BWRVIP-50 report.

2.0 SUMMARY OF BWRVIP-50 REPORT

The BWRVIP-50 report addresses the following topics in the following order:

- Component Characteristics and Safety Functions - The top guide and core plate are described in detail with brief descriptions of each component's safety related function. Differences among the various models of BWRs (BWR/2 through BWR/6) are identified. An event analysis is also provided for various operational conditions to ensure the component safety functions are maintained.
- Scope of Repairs - The scope of the proposed repairs is addressed, including degradation of the top guide/core plate and addition of structural wedge-type components between the top guide/core plate and shroud.
- Design Objectives - The following design objectives are presented and briefly discussed: repair design life, safety design-bases, safety analysis events, structural integrity, loose parts considerations, physical interfaces with other reactor internals, installation, load path alterations and existing structures.
- Codes and Standards - The design criteria of the top guide and core plate are presented. In summary, all repair designs should meet the individual plant safety analysis report (SAR), as well as NRC and American Society for Mechanical Engineers (ASME) Code established methodology for reactor pressure vessel (RPV) internals mechanical design.
- Structural and Design Evaluation - Terms (e.g., hydraulic loads, fuel lift loads, etc.) associated with applied loads on the reactor vessel internal are briefly discussed. The various events and operational service level conditions are also considered to ensure the repairs do not inhibit safety and operational functions of the internal components. Other structural and design topics addressed include: load combinations, functional evaluation criteria, allowable stresses, consideration of shroud repair or cracking, repair impact on existing internal components, radiation effects on repair design, analysis codes, thermal cycles, and corrosion allowance.
- System Evaluation - The following system evaluations are discussed: reactor coolant flow distribution and pressure drop, emergency operating procedure (EOP) calculations and power uprate.
- Materials, Fabrication and Installation - The materials specifications are given along with the regulatory requirements pertaining to austenitic stainless steel alloys. Crevices and fabrication guidelines are also discussed. Pre-installation as-built inspection, installation

cleanliness, as low as reasonably achievable (ALARA) considerations, and qualification of critical design parameters are presented.

- Inspection and Testing - Inspection and testing of the reactor internal components are addressed in inspection access and pre- and post-installation inspection.

3.0 STAFF EVALUATION

The top guide and core plate are classified as safety-related components in BWR/2 through BWR/6 plants. The structural integrity of the top guide is relied upon for assuring the correct position of the top of the fuel assemblies to ensure that control rod insertion capability is maintained. An additional safety function of the top guide is to provide lateral support for the fuel assemblies during seismic events. The structural integrity of the core plate is relied upon for assuring the correct position of the bottom end of the fuel assemblies, fuel support castings, and top end of the control rod guide tubes to ensure that control rod insertion capability is maintained. The core plate is also relied on for lateral support for the fuel assemblies and the control rod guide tubes during seismic events and vertical support for peripheral fuel assemblies.

3.1 BWRVIP Response to Staff's Open Items

The staff's SE dated January 29, 2001, identified six open items. The BWRVIP, in its letter of July 18, 2003, addressed these items, which are discussed below.

RAI Item 3: The staff requested that the following information be included in the BWRVIP-50 report:

The rising load test, as described in EPRI Document NP-7032, "Material Specification for Alloy X-750 for Use in LWR Internal Components," should be retained in order to provide verification by physical testing that the specified heat treatment was properly performed.

The allowable cobalt level for individual heats of Alloy X-750 should be specified as 0.25 percent maximum. If this limit is exceeded, an alternative evaluation protocol that can be implemented by the licensee will be provided. The alternative criteria should be a maximum allowable weighted average cobalt level of 0.25 percent, taking into account the surface area of all newly installed components wetted by the reactor coolant.

BWRVIP Response to RAI Item 3: The discussion of material requirements will be removed from the final version of the BWRVIP-50 report. All material-related considerations for repair are now contained in the BWRVIP-84 report. Item 3 has been addressed in BWRVIP-84, which is currently under review by the staff. (Note: Both statements above have been retained in the BWRVIP-84 report, as suggested by the staff).

Staff's Evaluation of BWRVIP's Response to RAI Item 3: The staff has confirmed that the information requested to be included in RAI Item 3, has been included in BWRVIP-84, except that EPRI Document NP-7032 has not been included as a reference in the rising load test. Therefore, the staff will request the BWRVIP to revise the BWRVIP report as part of its review of the BWRVIP-84 report. The staff finds the BWRVIP's response acceptable because the material requirements will be removed from the BWRVIP-50 report and the remaining issue will be resolved in the staff's review of the BWRVIP-84 report.

RAI Item 5-1: The staff requested that the following information be included in Section 9.1 of the BWRVIP-50 report:

Repair and replacement designs for plants which were not designed and constructed in accordance with ASME Code Section III (and components not subject to Section XI) must meet the individual plant SAR and other plant commitments for RPV internals mechanical design, as stated in Section 6. In that instance, materials must meet the requirements of ASME Code Section II specifications, ASME Code Cases, ASTM specifications, or other material specifications that have been previously approved by the regulatory authorities. This would include material specifications/criteria submitted by the BWRVIP and approved by the NRC. Otherwise, it is recognized that a repair or replacement design that uses a material, not meeting these criteria, must be submitted to the regulatory authorities for approval, on a plant specific basis.

BWRVIP Response to RAI Item 5-1: The discussion of material requirements will be removed from the final version of the BWRVIP-50 report. All material-related considerations for repair are now contained in BWRVIP-84. Item 5-1 is addressed in BWRVIP-84, which is currently under review by the staff. (Note: the essential elements of the paragraph have been included in paragraph 3.2 of the BWRVIP-84 report).

Staff's Evaluation of BWRVIP's Response to RAI Item 5-1: Section 3.2 of the BWRVIP-84 report states, "materials must meet the requirements of ASME Section II specifications, ASME Code Case, ASTM specification, or other material specifications that have been previously accepted by the regulatory authority. Otherwise, a material that is necessary for a design must be submitted on a case-by-case basis to the governing regulatory authority for approval, either on a plant-specific basis or through a mechanism such as a BWRVIP repair design criteria topical report." The staff interprets this statement to mean that materials will meet ASTM specifications that have been previously accepted for use by the staff and/or ASME Code Cases that have been previously accepted for use by the staff. This statement does indicate that materials not meeting ASME Section II specifications will be submitted to the governing regulatory authority for approval. Therefore, Item 5-1 is resolved. The staff finds the BWRVIP's response acceptable because the material requirements will be removed from the BWRVIP-50 report and the BWRVIP-84 report contains the requested information.

RAI Item 7: Section 3.2, Safety Related Functions of Analyzed Components, refers to a General Electric document GENE-771-44-0482, "Justification of Allowable Displacements of the Core Plate and Top Guide-Shroud Repair," Rev. 2, dated November 16, 1994. In response to a staff RAI, the BWRVIP indicated that the correct reference was General Electric document

GENE-771-44-0894, "Justification of Allowable Displacements of the Core Plate and Top Guide-Shroud Repair," Rev. 2, dated November 16, 1994. The staff requested that the BWRVIP-50 report be modified to include the correct reference.

BWRVIP Response to Staff Evaluation of Item 7: The report will be revised as requested.

Staff's Evaluation of BWRVIP's Response to RAI Item 7: Since the BWRVIP has agreed to revise the report in accordance with staff guidance, the staff finds that the BWRVIP's response adequately addressed this item.

RAI Item 8: The staff was concerned that Section 8.1 did not adequately discuss potential leakage caused by the top guide and the core plate repair. In response to a staff RAI, the BWRVIP indicated Section 8.1 would be clarified to state that the evaluation of the coolant flow distribution includes consideration of leakage caused by the repair. The staff requested that this clarification be included in the BWRVIP-50 report.

BWRVIP Response to Staff Evaluation of Item 8: The report will be revised as requested.

Staff's Evaluation of BWRVIP's Response to RAI Item 8: Since the BWRVIP has agreed to revise the report in accordance with staff guidance, the staff finds that the BWRVIP's response adequately addressed this item.

RAI Item 10: The staff was concerned that Section 7.2 of the report did not adequately discuss the potential effects of changes in frictional resistance on the structural integrity of the repair parts which are subject to relative motion. In its response to a staff RAI, the BWRVIP indicated that effects of changes in frictional coefficients would be minimized by providing small clearances or by minimizing the extent of relative motion. Since it is difficult to maintain small clearances under operating conditions, the staff review indicated that it may be prudent to minimize the relative motion between supported surfaces and that this should be factored into the design such that the structural integrity of the affected subassemblies would be maintained in the event that differential motion is completely inhibited due to friction.

BWRVIP Response to Staff Evaluation of Item 10: The BWRVIP agreed with the staff's approach to manage changes in frictional resistance. The report will be revised as requested.

Staff's Evaluation of BWRVIP's Response to RAI Item 10: Since the BWRVIP has agreed to revise the report in accordance with staff guidance, the staff finds that the BWRVIP's response adequately addressed this item.

RAI Item 11: The staff was concerned over the vagueness of the distinction between temporary and permanent repairs with respect to ASME Code requirements and BWRVIP topical report guidelines. The staff had requested the BWRVIP to revise its definition of

temporary and permanent repairs to describe those circumstances that need staff review and those that do not need staff review.

BWRVIP Response to Staff Evaluation of Item 11: Subsequent to the issuance of the BWRVIP-50 report, the BWRVIP published the report "BWRVIP-95: BWR Vessel and Internals Project, Guidelines for Format and Content of BWRVIP Repair Design Submittals." This report describes the conditions under which a repair design must be submitted to the NRC for approval and guidance on the contents of such a document. The BWRVIP requested that no changes be made to the BWRVIP-50 report and other Repair Design Criteria reports relative to the definition of temporary and permanent repairs, since the appropriate guidance is contained in the BWRVIP-95 report.

Staff's Evaluation of BWRVIP's Response to RAI Item 11: RAI Item 11 requested the BWRVIP to address circumstances that need staff review and those that do not need staff review for temporary and permanent repairs. The staff noted that its review depends upon whether the component meets or does not meet ASME Code requirements. The BWRVIP-95 report was reviewed and approved by the NRC staff by letter dated December 4, 2003, to provide guidance on the format and contents of reports requesting approval of alternatives to Code weld repair requirements, pursuant to 10 CFR 50.55a(a)(3)(i). A table in Section 1.1 of the BWRVIP-95 report identifies the actions required by licensees who perform repairs on Non-Code and Code components. This table directs licensees with Code components to seek NRC review and approval for repairs that do not meet ASME Code requirements and did not use BWRVIP Repair Design Criteria. Since the directions in this table satisfy the staff's concern discussed in RAI Item 11, the staff concludes that the BWRVIP has addressed this concern and the BWRVIP-50 report need not be revised to address this issue.

4.0 CONCLUSION

The NRC staff has reviewed the BWRVIP-50 report, the associated RAI responses and the responses to the staff's initial SE. The staff finds that the BWRVIP-50 report, as modified and clarified to incorporate the staff's comments above, is acceptable for providing guidance for permanent or temporary repairs of the top guide and core plate. The staff has concluded that implementation of the guidelines in the BWRVIP-50 report will provide an acceptable repair design criteria for the safety-related components addressed. The BWRVIP-50 report is considered by the staff to be applicable for licensee usage at any time during either the current operating term or during an extended license period. The modifications stated in the RAI and addressed above should be incorporated in the A-version of the BWRVIP-50 report. Licensees should note that when applying the repair design criteria to components that, according to the licensing basis of the plant, are classified as ASME Code components, a submittal to the NRC, pursuant to 10 CFR 50.55a(a)(3) is required to request authorization of the repair as an acceptable alternative to the ASME Code.

5.0 REFERENCES

1. Carl Terry, BWRVIP, to USNRC, "BWR Vessel and Internals Project, Top Guide/Core Plate Repair Design Criteria (BWRVIP-50)," EPRI Report TR-108722, May 1998.
2. Carl Terry, BWRVIP, to USNRC, BWRVIP Response to NRC Request for Additional Information on BWRVIP-50, December 6, 1999.
3. Carl Terry, BWRVIP to USNRC, "Project 704 - BWRVIP Response to NRC Safety Evaluation of BWRVIP Repair Design Criteria (BWRVIP-16, -19, -50, -51, -52, -55, -56 and -57)," July 18, 2003.
4. Carl Terry, BWRVIP, to USNRC, "BWR Vessel and Internals Project, Guidelines for Selection and Use of Materials for Repairs to BWR Internals (BWRVIP-84)," EPRI Report TR-1000248, October 2000.
5. Carl Terry, BWRVIP, to USNRC, "BWR Vessel and Internals Project, Guidelines for Format and Content of BWRVIP Repair Design Submittals (BWRVIP-95)," EPRI Report TR-1003021, October 2001.
6. EPRI Document NP-7032, "Material Specification for Alloy X-750 for Use in LWR Internal Components," Revision 1, November 1990.
7. GENE 771-44-0482, "Justification of Allowable Displacements of the Core Plate and Top Guide - Shroud Repair," Revision 2, November 16, 1994.