

August 20, 2004

Bill Eaton, BWRVIP Chairman  
Entergy Operations, Inc.  
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SUBJECT: SUPPLEMENT TO SAFETY EVALUATION OF THE "BWRVIP VESSEL AND INTERNALS PROJECT, SHROUD SUPPORT AND VESSEL BRACKET REPAIR DESIGN CRITERIA (BWRVIP-52)," EPRI REPORT TR-108720, JUNE 1998 (TAC NO. MC0653)

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 the Electric Power Research Institute (EPRI) proprietary report TR-108720, "BWR Vessel and Internals Project, Shroud Support and Vessel Bracket Repair Design Criteria (BWRVIP-52)," dated June 1998. Both proprietary and non-proprietary versions of the BWRVIP-52 report were submitted to the U. S. NRC for staff review by letter dated June 26, 1998, as supplemented by letters dated December 6, 1999, and May 19, 2000. The letter dated December 6, 1999, was in response to the NRC staff's request for additional information (RAI), dated August 13, 1999. By letter dated May 19, 2000, an expanded non-proprietary version of the BWRVIP-52 report was submitted. The staff's initial SE is documented in a letter to C. Terry, BWRVIP Chairman, dated November 2, 2000.

The BWRVIP-52 report provides general design acceptance criteria for the permanent and temporary repair of the shroud support structure and vessel internal attachments. These guidelines are intended to maintain the structural integrity and system functionality of the shroud support structure and vessel internal attachments during normal operation and under postulated transient and design basis accident conditions. The BWRVIP provided the BWRVIP-52 report to support generic regulatory efforts related to the repair of the BWR shroud support structure and vessel internal attachments.

The NRC staff has reviewed the BWRVIP-52 report and the BWRVIP's associated RAI responses and finds, as documented in the enclosed SE supplement, that the BWRVIP-52 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-52 report will provide an acceptable repair design criteria for the safety-related components addressed. In addition, inspections of the repaired components should be consistent with the intent of the inspections defined in BWRVIP-38 and BWRVIP-48. The BWRVIP-52 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

B. Eaton

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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. 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-52 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, Branch Chief  
Materials and Chemical Engineering Branch  
Division of Engineering  
Office of Nuclear Reactor Regulation

Enclosure: As stated

cc: BWRVIP Service List

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. 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-52 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,

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

Enclosure: As stated

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U.S. NUCLEAR REGULATORY COMMISSION  
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SUPPLEMENT TO SAFETY EVALUATION OF THE "BWRVIP VESSEL AND INTERNALS  
PROJECT, SHROUD SUPPORT AND VESSEL BRACKET REPAIR DESIGN CRITERIA  
(BWRVIP-52)," EPRI REPORT TR-108720

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 the Electric Power Research Institute (EPRI) proprietary report TR-108720, "BWR Vessel and Internals Project, Shroud Support and Vessel Bracket Repair Design Criteria (BWRVIP-52)," dated June 1998. The BWRVIP-52 report was submitted to the U. S. NRC for staff review by letter dated June 26, 1998, as supplemented by letters dated December 6, 1999, and May 19, 2000. The BWRVIP-52 report was supplemented by letter dated December 6, 1999, which was in response to the NRC staff's request for additional information (RAI), dated August 13, 1999. An expanded non-proprietary version of the BWRVIP-52 report was submitted by letter dated May 19, 2000. The staff's initial SE is documented in a letter to C. Terry, BWRVIP Chairman, dated November 2, 2000.

The BWRVIP-52 report provides general design acceptance criteria for the permanent and temporary repair of the shroud support structure and reactor vessel (RV) internal attachments. These guidelines are intended to maintain the structural integrity and system functionality of the shroud support structure and RV internal attachments during normal operation and under postulated transient and design basis accident conditions. The BWRVIP provided the BWRVIP-52 report to support generic regulatory efforts related to the repair of the BWR shroud support structure and RV internal attachments.

1.2 Purpose

The staff reviewed the BWRVIP-52 report, as supplemented, to determine whether its proposed revised guidance adequately addressed the open items in the staff's SE, and if it will provide an acceptable repair design criteria of the subject safety-related RV 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.

ENCLOSURE

### 1.3 Organization of this Report

Because the BWRVIP report is proprietary, this SE was written not to repeat 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-52 report is given in Section 2 of this SE, with the evaluation presented in Section 3. The conclusions are summarized in Section 4. The presentation of the evaluation is structured according to the organization of the BWRVIP-52 report.

### 2.0 SUMMARY OF BWRVIP-52 REPORT

The BWRVIP-52 report addresses the following topics in the following order:

- Configuration and Safety Function - The shroud support structure and RV internal attachment configurations are described in detail with brief descriptions of each configuration's function and characteristics. Differences among the various models of BWRs and plants are identified. The safety design bases for the shroud support structure and RV internal attachments are given.
- Scope of Repairs - The scope of the proposed repairs is given, including mechanical repairs, welded repairs and flaw removal.
- Design Objectives - The following design objectives are presented and briefly discussed: design life, safety design bases, safety analysis events, structural integrity, retained flaw(s), loose parts considerations, physical interfaces with other RV internals, and design verification. Installation to minimize the critical path in-vessel time and shroud support structure leakage are considered.
- General Design Criteria - The design criteria of the shroud support structure and RV internal attachments are presented. In summary, all repair designs should meet the individual plant safety analysis report (SAR) as well as NRC and American Society of Mechanical Engineers (ASME) Code established methodology for RV internals mechanical design. RV pressure boundary involvement in the repairs is also discussed.
- Structural and Design Evaluation - Terms (e.g., deadweight, hydraulic loads, fuel lift loads, etc.) associated with applied loads on the reactor internals are briefly discussed. Various events and operational service level conditions are also considered to ensure that the repairs do not inhibit safety and operational functions of the internal components. Other structural and design topics addressed are: load combinations, functional evaluation criteria, allowable stresses, consideration of repair or cracking of other internals, flow-induced vibration and hydraulic loads, repair impact on existing internal components, thermal and radiation effects on repair design, analysis codes, thermal cycles, and corrosion allowance.
- System Evaluation - The following system evaluations are discussed: leakage impact and acceptance criteria for normal operation and accident conditions, leakage evaluation methodology for accident conditions, impact to core flow distribution, 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 welding and fabrication guidelines are also discussed. Pre-installation as-built inspection, installation cleanliness, ALARA considerations, and qualification of critical design parameters are presented.
- Inspection - Inspection of the reactor internal components is addressed in the following topics: inspection access, pre- and post-installation inspection, inservice inspection requirements and vessel inspections.

### 3.0 STAFF EVALUATION

The BWRVIP-52 report provides the proposed general design acceptance criteria for permanent and temporary repairs of the shroud support structure and vessel internal attachments. While it does not present specific designs to effect repairs of the subject safety-related BWR internal components, it does present a methodology for BWR licensees to follow in designing repairs which maintain the structural integrity and system functionality of the shroud support structure and vessel internal attachments during normal operation and under postulated transient and design basis accident conditions for the specified service life of the components.

The core shroud support structure consists of the shroud support plate and shroud support cylinder, including the design-dependent gussets or legs. The vessel internal attachments include: core spray bracket, jet pump riser brace, guide rod bracket, steam dryer support bracket, steam dryer holddown bracket, feedwater sparger bracket, and surveillance sample holder bracket. According to the BWRVIP-52 report, the only safety-related attachments are the core spray piping bracket and jet pump riser brace attachments, along with the shroud support structure. The shroud support also supports the weight of the peripheral fuel bundles and provides lateral restraint during seismic or other dynamic events. The staff notes that the core shroud support structure forms part of the core coolant envelope, which is required to provide two-thirds core cooling in BWR/3s through BWR/6s, in the event of a recirculation line loss of coolant accident (LOCA).

#### 3.1 BWRVIP Response to Staff's Open Items

The staff's November 2, 2000, letter identified one open item. The BWRVIP, in its letter of July 18, 2003, addressed this item, which is discussed below.

Open Item discussed in Section 3.4 of Safety Evaluation: General Comment

In order to be consistent with the other BWRVIP repair procedures, the staff requested that three items should be added or changed in Section 9.1, "Materials," of the BWRVIP-52 report:

1. The rising load test, as described in NP-7032, will be retained in order to provide verification by physical testing that the specified heat treatment was properly performed.

2. The allowable cobalt level for individual heats of Alloy X-750 will 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 will 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 reactor coolant.
3. The following statement should be included in the BWRVIP-52 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 [ASME Code] 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 on a case-by-case basis to the regulatory authorities for approval, on a plant-specific basis."

BWRVIP Response to Items 1 through 3: The discussion of material requirements will be removed from the final version of the BWRVIP-52 report. All material-related considerations for repair are now contained in BWRVIP-84. Item 3 is addressed in BWRVIP-84, which is currently under review by the staff. (Note: The essential elements of Item 3, above, have been included in paragraph 3.2 of the BWRVIP-84 report, and Items 1 and 2 have been retained in the BWRVIP-84 report).

Staff's Evaluation of BWRVIP's Response to Items 1 through 3: The staff has confirmed that the information requested to be included in Items 1 and 2 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-84 report as part of its review. The staff finds the BWRVIP's response acceptable because the material requirements will be removed from the BWRVIP-52 report and the remaining issue will be resolved in the staff's review of the BWRVIP-84 report.

Section 3.2 of the BWRVIP-84 report states, "materials must meet the requirements of ASME Section II specifications, ASME Code Cases, ASTM specifications, 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 ASME Code Section II requirements, 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 3 is resolved. 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.

Additional Item discussed in the July 18, 2003, letter:

In Section 3.0 of the safety evaluation, the staff states, "Inspections of the repaired components should be in accordance with the BWRVIP-38 guidance, as approved by the staff."

BWRVIP Response to this statement: As previously discussed with the staff in relation to other repair design criteria, the specific inspection requirements in the inspection and evaluation guidelines (e.g., BWRVIP-38) may not be appropriate for a repaired component. Locations specified for inspection in inspection and evaluation (I&E) guidelines may be, for example, structurally replaced by a repair and will not require further inspection. However, it is appropriate that the intent of the I&E guidelines be met in future inspections of the repaired component. Therefore, Section 10.3 will be revised to state:

"Inservice inspection requirements for vessel internal attachment or shroud support structure repairs shall be specified by the designer. Such inspections shall be consistent with the intent of the inspections defined in BWRVIP-38 and BWRVIP-48."

Staff's Evaluation of BWRVIP's Response: Since the additional statement in Section 10.3 of BWRVIP-52 will include a statement that the inspections of repairs shall be consistent with the intent of the inspections defined in BWRVIP-38 and BWRVIP-48, the staff accepts the addition proposed by the BWRVIP.

#### 4.0 CONCLUSION

The NRC staff has reviewed the BWRVIP-52 report, the associated RAI responses and the responses to the staff's initial SE. The staff finds that the BWRVIP-52 report, as modified and clarified to incorporate the staff's comments above, is acceptable for providing guidance for permanent or temporary repairs of the shroud support and vessel bracket. Therefore, the staff has concluded that implementation of the guidelines in the BWRVIP-52 report, as modified, will provide an acceptable repair design criteria for the safety-related components addressed. In addition, inspections of the repaired components should be consistent with the intent of the inspections defined in BWRVIP-38 and BWRVIP-48. The BWRVIP-52 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-52 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, Shroud Support and Vessel Bracket Repair Design Criteria (BWRVIP-52)," EPRI Report TR-108720, dated June 1998.
2. C. E. Carpenter, USNRC, to Carl Terry, BWRVIP, "Propriety Request for Additional Information - Review of EPRI Topical Reports TR-108720, TR108719, and TR-108721," dated August 13, 1999.

3. Carl Terry, BWRVIP, to USNRC, "BWRVIP Response to NRC Request for Additional Information on BWRVIP-52," December 6, 1999.
4. EPRI Document NP-7032, "Material Specification for Alloy X-750 for Use in LWR Internal Components," Revision 1, November 1990.
5. Carl Terry, BWRVIP to USNRC, "Project 704 - BWRVIP Response to NRC Safety Evaluation of BWRVIP Repair Design Criteria (BWRVIP-16, BWRVIP-19, BWRVIP-50, BWRVIP-51, BWRVIP-52, BWRVIP-55, BWRVIP-56, and BWRVIP-57)," July 18, 2003.
6. Letter from Carl Terry, BWRVIP, to USNRC, "BWR Vessel and Internals Project, Vessel [Inner Diameter] ID Attachment Weld Inspection and Flaw Evaluation Guidelines (BWRVIP-48)," EPRI Report TR-108724, dated March 6, 1998.
7. Letter from Carl Terry, BWRVIP, to USNRC, "BWR Vessel and Internals Project, "BWR Shroud Support Inspection and Flaw Evaluation Guidelines EPRI Report TR-106823, dated September 15, 1997.