

September 3, 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, INSTRUMENT PENETRATION REPAIR DESIGN CRITERIA (BWRVIP-57)," EPRI REPORT TR-108721 (TAC NO. MC0648)

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-108721, "BWR Vessel and Internals Project, Instrument Penetration Repair Design Criteria (BWRVIP-57)," dated December 1998. Both proprietary and non-proprietary versions of the BWRVIP-57 report were submitted to the U.S. NRC for staff review by letter dated December 16, 1998. The staff's initial SE is documented in a letter to C. Terry, BWRVIP Chairman, dated May 7, 2002.

The BWRVIP-57 report provides general design acceptance criteria for the temporary and permanent repair of BWR instrument penetrations. These guidelines are intended to maintain the structural integrity of the instrument penetrations during normal operation and under postulated transient and design basis accident conditions.

The NRC staff has reviewed the BWRVIP-57 report and the BWRVIP's associated RAI responses and finds, as documented in the enclosed SE supplement, that the BWRVIP-57 report is acceptable for providing guidance for permanent or temporary repairs of the cracked or leaking internal components of the BWR instrument penetrations. The staff has concluded that implementation of the guidelines in the BWRVIP-57 report will provide an acceptable repair design criteria for the safety-related components addressed. The BWRVIP-57 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. A temporary repair may be authorized for one but not more than two operating cycles, until a permanent repair or replacement can be implemented.

B. Eaton

- 2 -

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-57 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 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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Enclosure: As stated

cc: BWRVIP Service List

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U.S. NUCLEAR REGULATORY COMMISSION
OFFICE OF NUCLEAR REACTOR REGULATION
SUPPLEMENT TO SAFETY EVALUATION OF THE "BWRVIP
VESSEL AND INTERNALS PROJECT, INSTRUMENT
PENETRATIONS REPAIR DESIGN CRITERIA
BWRVIP-57, EPRI REPORT TR-108721

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-108721, "BWR Vessel and Internals Project, Instrument Penetration Repair Design Criteria (BWRVIP-57)," dated December 1998. Both proprietary and non-proprietary versions of the BWRVIP-57 report were submitted to the U.S. NRC for staff review by letter dated December 16, 1998. The staff's initial SE is documented in a letter to C. Terry, BWRVIP Chairman, dated May 7, 2002.

1.2 Purpose

The staff reviewed the BWRVIP-57 report to determine whether it will provide an acceptable repair design criteria of 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-57 report is proprietary, this SE was written so as 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 subject 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-57 report.

ENCLOSURE

2.0 SUMMARY OF BWRVIP-57 REPORT

The BWRVIP-57 report addresses the following topics in the following order:

- Component Configurations and Safety Functions - The functions and various configurations of BWR vessel instrument penetrations (or nozzles) and attached piping are described by a series of illustrations and a table that identifies the materials used for specific plants. Existing loads for startup, shutdown, power operation, anticipated operational occurrences, design basis accidents and load combinations are considered. Water level signals are identified as important for several safety functions and are categorized in table format. The identified repairs are not allowed to interfere with any safety functions.
- Scope of Repairs - The repair criteria, applicable to General Electric BWR/2-6 plants which plan to implement repairs to RPV water level instrument penetrations, addresses cracking and/or leaking in penetration nozzles, nozzle-to-vessel shell welds, nozzle safe ends, and, where applicable, the coupling which was manufactured as part of the RPV.
- Design Objectives - Structural integrity for all loading conditions is discussed for the design of the repair. The repair criteria considers the existing flaw, postulated growth of the crack, appropriate alignment across the flawed area, and loose parts for the current operating term and during the extended license period.
- Design Criteria - This section addresses American Society of Mechanical Engineers Boiler and Pressure Vessel Code (ASME Code) requirements for instrument penetrations (or nozzles) and their welds. In addition to individual plant safety analysis reports (SARs) and other RPV piping design requirements, Sections III and XI of the ASME Code are identified as having specific requirements to be considered in the repair design.
- Structural and Design Evaluation - Plant-specific penetration structural requirements are identified from the original RPV ASME Code Design Specification and Stress Report (ASME CDSSR). This typically addresses the load definitions - applied loads, service load conditions, and load combinations. If an applicable ASME CDSSR is not available or does not contain adequate information, this section summarizes the alternative loads and load combinations which may be used for analyzing a repair design (e.g., allowable stresses, radiation effects on repair design, thermal cycles, and analysis codes and corrosion allowances to be utilized).
- System Evaluation - This section evaluates the effects of power uprate for both proposed and prior instrument penetration repairs.
- Materials, Fabrication and Installation - This section discusses material uses that meet the American Society for Testing and Materials (ASTM) and ASME Code requirements, and the use of alternatives for austenitic stainless steels, Ni-based alloys (i.e., Alloy

82/182/600), and weld repairs that are appropriate to each, welding and fabrication tolerances that the repair will accommodate, installation cleanliness, ALARA considerations, and the use of appropriate mockups for design parameter qualifications.

- Inspection and Testing - Inspection access, and pre- and post-installation inspection and system pressure tests are discussed for the instrument penetration repairs.

3.0 STAFF EVALUATION

Instrument penetrations (or nozzles) are located in the BWR RPV cylindrical shell at various elevations, are welded to the RPV, and are used to determine RPV water level in the liquid region of the core shroud annulus. The configurations of instrument penetrations vary with BWR type and RPV vendor. In most designs, the penetrations are connected to the vessel wall with a partial penetration weld made on the inside of the vessel. In a few cases, the instrument lines connect to vessel nozzles which are in turn connected to the vessel with full penetration welds. The BWRVIP-57 report provides several figures showing the typical configurations for the instrument penetrations (or nozzles), and a table giving plant-specific cross-references to these figures and information on the materials used in the instrument penetrations.

The instrument penetration repairs primarily address cracking and or leaking in intergranular stress corrosion cracking (IGSCC) susceptible stainless steel and nickel alloy components. The BWRVIP-57 repair criteria applies to the instrument penetration (or low alloy nozzle forging) to vessel shell weld, the penetration (or nozzle) safe end and the socket weld fittings used to attach to drywell piping. The design life of the repair will normally be for the remaining life of the plant plus life extension beyond the current operating license. Alternatively, the repair may be temporary—that is, designed for one but not more than two operating cycles—until a permanent repair or replacement can be implemented.

3.1 BWRVIP Response to Staff's Open Items

The staff's letter dated May 7, 2002, identified two comments. The BWRVIP, in its letter of July 18, 2002, addressed these comments, which are discussed below.

Comment 1 in General Comments

In order to be consistent with other BWRVIP repair procedures, the following requirements should be added or changed in Section 9.1.2, Materials, of the BWRVIP-57 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 Cases, ASME Section II specifications, 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 Comment 1

The discussion of material requirements will be removed from the final version of the BWRVIP-57 report. All material-related considerations for repair are now contained in BWRVIP-84. Comment 1 is addressed in BWRVIP-84 which is currently under review by the staff. (Note: the essential elements of the comment have been included in paragraph 3.2 of the BWRVIP-84 report).

Staff Evaluation of BWRVIP Response to Comment 1

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 Code Section II specifications will be submitted to the governing regulatory authority for approval. Therefore, Comment 1 is resolved. The staff finds the BWRVIP response acceptable because the material requirements will be removed from the BWRVIP-57 report and the BWRVIP-84 report contains the requested information.

Comment 2 in General Comments

The staff requires licensees to determine the weldability of all materials to be welded since some fasteners may be made of generally unweldable materials or require very special conditions to weld them, such as AISI 4140, 4340 (B7) low alloy materials or 410 (B6) type stainless steel alloys. Alternatively, the BWRVIP could just eliminate all welding on fasteners in this document.

BWRVIP Response to Comment 2

All material issues, including those involving welding, will be removed from the final version of BWRVIP-57. Material considerations are now contained in BWRVIP-84. Comment 2 is addressed in BWRVIP-84, which is currently under review by the staff. For information, the issue is currently addressed in Section 5.4 of BWRVIP-84, which states, "Underwater tack welding applications shall be demonstrated with a mock-up to be capable of withstanding the specified torque or load without breaking prior to use." However, for clarity, the following sentence will be added to Section 5.4 immediately preceding the quoted sentence, "If tack welds are used, fastener material shall be evaluated for weldability."

Staff Evaluation of BWRVIP Response to Comment 2

The staff finds the BWRVIP response acceptable because the material requirements will be removed from the BWRVIP-57 report and the BWRVIP-84 report will contain the requested information.

4.0 CONCLUSION

The NRC staff has reviewed the BWRVIP-57 report, the associated RAI responses and the responses to the staff's initial SE. The staff finds that the BWRVIP-57 report, as modified and clarified to incorporate the staff's comments above, is acceptable for providing guidance for permanent or temporary repairs of the cracked or leaking internal components in the BWR instrument penetrations. Therefore, the staff has concluded that implementation of the guidelines in the BWRVIP-57 report, as modified, will provide an acceptable repair design criteria for the safety-related components addressed. The BWRVIP-57 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-57 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. A temporary repair may be authorized for one but not more than two operating cycles, until a permanent repair or replacement can be implemented.

5.0 REFERENCES

1. Carl Terry, BWRVIP, to USNRC, "BWR Vessel and Internals Project, Instrument Penetrations Repair Design Criteria (BWRVIP-57)," EPRI Report TR-108721, dated December 16, 1998.
2. 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.
3. 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.