

July 12, 2004

Bill Eaton, BWRVIP Chairman
Entergy Operations, Inc.
Echelon One
1340 Echelon Parkway
Jackson, MS 39213-8202

SUBJECT: SUPPLEMENT TO SAFETY EVALUATION OF THE "BWRVIP VESSEL AND INTERNALS PROJECT, INTERNAL CORE SPRAY PIPING AND SPARGER REPLACEMENT DESIGN CRITERIA (BWRVIP-16)" AND OF THE "BWRVIP VESSEL AND INTERNALS PROJECT, INTERNAL CORE SPRAY PIPING AND SPARGER REPAIR DESIGN CRITERIA (BWRVIP-19)" (TAC NOS. MC0649 AND MC0650)

Dear Mr. Eaton:

In a letter dated July 18, 2003, the BWR Vessels and Internals Project (BWRVIP) provided responses to the Nuclear Regulatory Commission (NRC) Safety Evaluations (SEs) for the Electric Power Research Institute (EPRI) proprietary reports TR-106708, "BWR Vessel and Internals Project, Internal Core Spray Piping and Sparger Replacement Design Criteria (BWRVIP-16)," dated March 18, 1997; and TR-106893, "BWR Vessel and Internals Project, Internal Core Spray Piping and Sparger Repair Design Criteria (BWRVIP-19)," dated September 16, 1996. The BWRVIP provided additional information concerning BWRVIP-16 by letters dated March 27, 1998, and December 6, 1999. The BWRVIP provided additional information concerning BWRVIP-19 by letters dated February 24, 1997, and December 6, 1999.

By letter dated November 17, 1998, the NRC staff issued its initial SE of the BWRVIP-16 and BWRVIP-19 reports, which found the guidance of the BWRVIP-16 and BWRVIP-19 reports to be acceptable for replacement and/or repair, as applicable, of the subject safety-related RPV internal components, with some exceptions as noted in the SE. On August 10, 2000, the NRC staff issued a revised SE, which identified additional open issues. The BWRVIP was requested to resolve the open issues raised in the staff's August 10, 2000, SE.

The NRC staff has reviewed the BWRVIP's responses and has found, in the enclosed supplement to the staff's August 10, 2000 SE, that the BWRVIP-16 and BWRVIP-19 reports, as revised, are acceptable for replacement and/or repair, as applicable, of the subject safety-related reactor vessel internal components. The BWRVIP-16 and BWRVIP-19 reports are 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.

In accordance with the procedures established in NUREG-0390, "Topical Report Review Status," the staff requests that the BWRVIP publish the accepted versions of the BWRVIP-16 and BWRVIP-19 reports within 90 days after receiving this letter. In addition, the published versions shall incorporate this letter and the enclosed SE supplement between the title page and the abstract. This SE supplement has also identified issues that must be resolved in the BWRVIP-84 and BWRVIP-97 reports.

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

Sincerely,

/RA by Matthew Mitchell Acting For/

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

Enclosure: As stated

cc: BWRVIP Service List

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 versions of the BWRVIP-16 and BWRVIP-19 reports within 90 days after receiving this letter. In addition, the published versions shall incorporate this letter and the enclosed SE supplement between the title page and the abstract. This SE supplement has also identified issues that must be resolved in the BWRVIP-84 and BWRVIP-97 reports.

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

Enclosure: As stated

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U.S. NUCLEAR REGULATORY COMMISSION
OFFICE OF NUCLEAR REACTOR REGULATION SUPPLEMENT TO SAFETY EVALUATION
OF "BWRVIP VESSEL AND INTERNALS PROJECT, INTERNAL CORE SPRAY PIPING
AND SPARGER REPLACEMENT DESIGN CRITERIA (BWRVIP-16)"
EPRI REPORT TR-106708, MARCH 1997, AND
"BWRVIP VESSEL AND INTERNALS PROJECT, INTERNAL CORE SPRAY PIPING
AND SPARGER REPAIR DESIGN CRITERIA (BWRVIP-19)"
EPRI REPORT TR-106893, SEPTEMBER 1996

1.0 INTRODUCTION

1.1 Background

By letter dated March 18, 1997, as supplemented by letters dated March 27, 1998, and December 6, 1999, the Boiling Water Reactor Vessel and Internals Project (BWRVIP) submitted the Electric Power Research Institute (EPRI) proprietary report, TR-106708, "BWR Vessel and Internals Project, Internal Core Spray Piping and Sparger Replacement Design Criteria (BWRVIP-16)." The BWRVIP-16 report provides general design acceptance criteria for full and/or partial replacement of 300 series stainless steel internal core spray piping, spargers and supports, and is intended to assist licensees in designing replacements which will maintain the structural integrity of the core spray system under normal operation, as well as under postulated transient and design basis accident conditions. In response to the staff's request for additional information (RAI), dated December 15, 1997, the BWRVIP provided supplemental information in a letter dated March 27, 1998, and responded to the staff's November 17, 1998, initial safety evaluation report (SER) by letter dated December 6, 1999. A non-proprietary version of this report was provided by letter dated March 7, 2000.

By letter dated September 16, 1996, as supplemented by letters dated February 24, 1997, and December 6, 1999, the BWRVIP submitted the EPRI proprietary report, TR-106893, "BWR Vessel and Internals Project, Internal Core Spray Piping and Sparger Repair Design Criteria (BWRVIP-19)." The BWRVIP-19 report provides general design acceptance criteria for temporary and permanent repair of 300 series stainless steel internal core spray piping and spargers. In response to the staff's RAI, dated January 22, 1997, the BWRVIP provided supplemental information in a letter dated February 24, 1997, and responded to the staff's November 17, 1998, initial SER by letter dated December 6, 1999. A non-proprietary version of this report was provided by letter dated March 7, 2000.

On November 17, 1998, the NRC staff issued its initial SER of the BWRVIP-16 and BWRVIP-19 reports, which found the guidance of the BWRVIP-16 and BWRVIP-19 reports acceptable for replacement and/or repair, as applicable, of the subject safety-related reactor vessel internal components, with some exceptions as noted in the SER. The BWRVIP was requested to resolve the open issues raised in the staff's initial SER. By letter dated December 6, 1999, BWRVIP provided a response which proposed to resolve these open issues. On August 10, 2000, the NRC staff issued a safety evaluation, which identified additional open issues. By letter dated July 18, 2003, the BWRVIP provided a response to the August 10, 2000, safety evaluation.

ENCLOSURE

1.2 Purpose

The staff reviewed the BWRVIP-16 and BWRVIP-19 reports, as supplemented, to determine whether the revised guidance addressed the open items in the staff's final SER, and if the revised reports would provide acceptable levels of quality for replacement and/or repair of the safety-related internal core spray piping and spargers.

1.3 Organization of this Report

Because the BWRVIP-16 and BWRVIP-19 reports are proprietary, this SER was written not to repeat proprietary information contained in the reports. The staff does not discuss, in any detail, the provisions of the guidelines nor the parts of the guidelines it finds acceptable. Since the two reports were virtually identical, except for one being for replacement and the other for repair, the staff has combined its review into a single SER which addresses both reports.

2.0 SUMMARY OF BWRVIP-16 AND BWRVIP-19 REPORTS

The BWRVIP-16 and BWRVIP-19 reports address the following topics in the following order:

- Internal Core Spray Piping and Sparger Characteristics and Safety Function: provides a generic physical description of the subject safety-related components, the safety design bases, and event analyses for normal operation, anticipated operational occurrences (upset conditions), design basis accidents (emergency/faulted conditions), and various loading combinations.
- Replacement/Repair Scope and Design Objectives: provides the scope of the proposed replacement/repair, and the design objectives, including replacement/repair design life, safety design bases, safety analysis events, structural integrity, retained flaw(s), loose parts considerations, physical interfaces with other reactor internals, and replacement/repair installation.
- General Design Criteria and Structural and Design Evaluation: describes the significant service load conditions and load combinations for the core spray piping and supports and core spray spargers and supports, allowable stresses, consideration of shroud repair or cracking, flow-induced vibration, repair impact on existing internal components, radiation effects on replacement/repair design, analysis codes, thermal cycles, and corrosion allowance.
- System Evaluation: (a) describes the leakage evaluation requirements for normal operation and accident conditions for internal core spray piping and core spray spargers; and (b) describes analyses to determine the impact of internal core spray piping on internal pressure drop, flow distribution, emergency operating procedure (EOP) calculations, power uprate conditions, internal core spray piping high point venting, and sparger spray distribution.
- Materials, Fabrication and Installation: describes materials to be used, crevice elimination criteria, welding and fabrication, pre-installation as-built inspection, installation cleanliness criteria, ALARA considerations, and qualification of critical design parameters.

- Inspection: describes inspection access, pre- and post-installation inspection, quality assurance program and design-basis documentation.

3.0 STAFF EVALUATION

The staff's August 10, 2000, SER identified three open items. The BWRVIP, by letter dated July 18, 2003, addressed these items, which are discussed below.

Item 3.4: The materials requirements, specified in Section 9.1, are acceptable with the exception of Items 4-1 through 4-3, below.

Item 4-1: In Section 9.1.2, it is stated that "Materials shall be manufactured in accordance with ASTM or ASME specifications using" The words "ASTM specification" referenced in this section should be deleted since only the materials covered by the scope of ASME Section II, Material Requirements, are acceptable and, furthermore, not all ASTM materials specifications are covered by equivalent ASME Material Specifications. However, it is acceptable if the referenced sentence is revised as "Materials shall be manufactured in accordance with ASME or equivalent ASTM specifications using"

Item 4-2: In the third sentence of Section 9.1.2, regarding the use of alternative materials not covered by the scope of ASME Material Requirements, the staff recommends that the words "and approved by the governing regulatory authority" should be added to the end of the sentence, so that it would be consistent with the requirements specified in Section 9.1.8.

Item 4-3: The note of Section 9.1 discussed the acceptance by the plant owner of specific exceptions to the documents of EPRI NP-7032, "Material Specification for Alloy X-750 for Use in LWR Internal Components, Rev. 1," and EPRI #84-MG-18, "Nuclear Grade Stainless Steel, Procurement, Manufacturing and Fabrication Guidelines." The staff recommends that the words "and the governing regulatory authority" should be added to the end of the note to indicate that any exceptions to these documents require the acceptance by NRC as well as the plant owner.

BWRVIP Response to Item 3.4: All material-related discussion, including that of Sections 9.1 and 9.1.2, will be deleted from the final versions of BWRVIP-16 and BWRVIP-19. All material-related considerations for repair are now contained in BWRVIP-84. Items 4-1, 4-2 and 4-3 are addressed in BWRVIP-84 which is currently under review by the staff. (Note: the relevant information is found in Section 3.1 of BWRVIP-84 and is, we believe, in accordance with current regulatory guidance.)

Staff's Evaluation of BWRVIP's Response to Item 3.4: 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 materials 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 (Item 4-1). Therefore, Item 4-1 is resolved. This statement does indicate that materials not meeting ASME Section II specifications will be submitted to the governing regulatory authority for approval. Therefore Item 4-2 is resolved. There is no discussion of EPRI NP-7032 and EPRI #84-MG-18 in BWRVIP-84. Therefore, the staff will request the BWRVIP to discuss Item 4.3, above, in its review of BWRVIP-84. The staff finds the BWRVIP's response acceptable because the materials requirements will be removed from BWRVIP-16 and BWRVIP-19 and the remaining issues will be resolved in the staff's review of BWRVIP-84.

Item 3.5: Until the staff's confirmatory research on the weldability of highly-irradiated materials is completed, the staff's recommendation is that the weldability of such materials should be demonstrated on a mock-up, made of materials with similar levels of radiation damage and helium content. Further, this recommendation, and any other available guidelines, should be added into Section 9.3.7 of the BWRVIP reports.

BWRVIP Response to Item 3.5: All material-related discussions, including that involving welding, will be removed from the final versions of BWRVIP-16 and BWRVIP-19. Material-related considerations are now contained in BWRVIP-84. Item 3.5 is addressed in BWRVIP-84, which is currently under review by the staff. For information, subsequent to the issuance of this safety evaluation, the BWRVIP has published a report entitled, "BWRVIP-97, BWR Vessel and Internals Project, Guidelines for Performing Weld Repairs to Irradiated BWR Internals." This report describes issues that must be considered when welding irradiated material and prescribes guidelines for determining if a successful weld repair can be made. A new paragraph will be added to Section 5 of the BWRVIP-84 report, as follows:

Weld repair to irradiated materials requires special considerations. The guidance contained in BWRVIP-97, "BWR Vessel and Internals Project, Guidelines for Performing Weld Repairs to Irradiated BWR Internals," shall be implemented in conjunction with welded repairs.

Staff's Evaluation of BWRVIP's Response to Item 3.5: In a letter dated March 24, 2004, which contained the BWRVIP response to the staff's request for additional information concerning BWRVIP-84, the BWRVIP indicated that the weld repairs to irradiated materials will be implemented in accordance with the guidance in BWRVIP-97. In addition, the BWRVIP indicated, "Code Cases must be approved by the NRC in RG 1.147 or RG 1.84 or individually approved as a relief request on the utility's docket prior to use." RG 1.147 approved Code Case N-516-2, "Underwater Welding, Section XI, Division 1," with the condition that techniques to be used in underwater weld repair or replacement of irradiated material be approved by the NRC. The staff finds the BWRVIP's response acceptable because the weld repair requirements will be removed from the BWRVIP-16 and BWRVIP-19 reports; furthermore, the weld repair requirements are included in the BWRVIP-84 and BWRVIP-97 reports, and the techniques for weld repairs of irradiated materials will be reviewed by the staff in accordance with the condition specified in RG 1.147 for Code Case N-516-2.

Item 3.6: Section 10 of BWRVIP-16 report contains inspection guidelines for repair of internal core spray piping and spargers. Section 10 of BWRVIP-19 report contains inspection guidelines for replacement of internal core spray piping and spargers. In the staff's safety evaluation of these BWRVIP reports, the staff requested that the BWRVIP-18 report, "BWR Core Spray Internals Inspection and Flaw Evaluation Guidelines," be cited, as applicable, for

those inspection requirements which are consistent with the guidance of the BWRVIP-18 report. In cases where the inspection recommendations of the BWRVIP-18 report are not applicable for a modified repair or replacement procedure, the BWRVIP shall develop a revised inspection scope, consistent with the guidance of the BWRVIP-18 guidelines.

BWRVIP Response to Item 3.6: The BWRVIP agrees that the inspections of repairs to BWR internals should be consistent with the intent and scope of the BWRVIP Inspection and Evaluation Guidelines. However, the BWRVIP is not in a position to develop inspection requirements for every repair that is designed and implemented by utilities. The BWRVIP will revise Sections 10.2.3 and 10.2.4, to indicate that the inspections specified by the designer shall be "consistent with the requirements and scope of BWRVIP-18." This is consistent with prior agreements between the BWRVIP and the NRC regarding inspection of repaired components.

Staff's Evaluation of BWRVIP's Response to Item 3.6: The staff finds the BWRVIP's response acceptable, because the report will direct licensees to be consistent with the requirements and scope of BWRVIP-18.

4.0 CONCLUSIONS

The NRC staff has reviewed the BWRVIP-16 and BWRVIP-19 reports, the associated RAI responses, and the responses to the staff's SER. The staff has found that the guidance of the reports, as modified and clarified to incorporate the staff's comments above, is acceptable for replacement and/or repair of the subject safety-related core spray internal components. Therefore, the staff has concluded that licensee implementation of the guidelines in the BWRVIP-16 and BWRVIP-19 reports, as modified, will provide an acceptable repair design criteria of the safety-related components, as discussed above. The modifications stated in the RAI and SER, and as addressed above, should be incorporated in the A-version of the BWRVIP-16 and BWRVIP-19 reports, as well as the BWRVIP-84 and BWRVIP-97 reports.

5.0 REFERENCES

1. Carl Terry, BWRVIP, to USNRC, "BWR Vessel and Internals Project, Internal Core Spray Piping and Sparger Replacement Design Criteria (BWRVIP-16)," EPRI Report TR-106708, March 18, 1997.
2. Bruce McLeod, BWRVIP, to C. E. Carpenter, USNRC, "BWRVIP Response to NRC Request for Additional Information on BWRVIP-19," February 24, 1997.
3. C. E. Carpenter, USNRC, to Carl Terry, BWRVIP, "Proprietary Request for Additional Information - Review of BWR Vessel and Internals Project Reports, 'BWR Core Spray Inspection and Flaw Evaluation Guidelines (BWRVIP-18),' and 'Core Spray Piping and Sparger Repair Design Criteria (BWRVIP-19),' (TAC NOS. M96219 and M96539)," January 22, 1997.
4. J. T. Beckham, Jr., BWRVIP to USNRC, "BWR Vessel and Internals Project, Internal Core Spray Piping and Sparger Repair Design Criteria (BWRVIP-19)," EPRI Report TR-106893, September 16, 1996.

5. 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.
6. BWRVIP response to staff's November 17, 1998, initial SER, dated December 6, 1999.
7. 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.
8. Carl Terry, BWRVIP, to USNRC, "BWR Vessel and Internals Project, Guidelines for Performing Weld Repairs to Irradiated BWR Internals (BWRVIP-97)," EPRI Report TR-10030208, March 18, 1997.