

BWRVIP BWR Vessel & Internals Project _____ 2003-249

July 18, 2003

Document Control Desk
U.S. Nuclear Regulatory Commission
11555 Rockville Pike
Rockville, MD 20852

Attention: Meena Khanna

Subject: Project 704 - BWRVIP Response to NRC Safety Evaluations of BWRVIP Repair Design Criteria (BWRVIP-16, -19, -50, -51, -52, -55, -56 and -57)

Enclosed are ten (10) copies of the BWRVIP response to the NRC Safety Evaluations (SE) of the following BWRVIP Repair Design Criteria:

- “BWR Vessel and Internals Project, Internal Core Spray Piping and Sparger Replacement Design Criteria (BWRVIP-16)”, EPRI report TR-106708
- “BWR Vessel and Internals Project, Internal Core Spray Piping and Sparger Repair Design Criteria (BWRVIP-19)”, EPRI Report TR-106893
- “BWR Vessel and Internals Project, Top Guide/Core Plate Repair Design Criteria (BWRVIP-50)”, EPRI Report TR-108722
- “BWR Vessel and Internals Project, Jet Pump Repair Design Criteria (BWRVIP-51)”, EPRI Report TR-108718
- “BWR Vessel and Internals Project, Shroud Support and Vessel Bracket Repair Design Criteria (BWRVIP-52)”, EPRI Report TR-108720
- “BWR Vessel and Internals Project, Lower Plenum Repair Design Criteria (BWRVIP-55)”, EPRI Report TR-108719
- “BWR Vessel and Internals Project, LPCI Coupling Repair Design Criteria (BWRVIP-56)”, EPRI Report TR-108717
- “BWR Vessel and Internals Project, Instrument Penetrations Repair Design Criteria (BWRVIP-57)”, EPRI Report TR-108721

The NRC SEs were transmitted to the BWRVIP via the correspondence listed in the reference section of the enclosed response.

The BWRVIP is also in receipt of the NRC SE of the report “BWR Vessel and Internals Project, Standby Liquid Control Line Repair Design Criteria (BWRVIP-53)”, EPRI Report TR-108716, and will submit a response to this SE at a later date.

Note that subsequent to the original publication of the Repair Design Criteria, the BWRVIP consolidated all material-related information from the Repair Design Criteria into a separate report entitled "BWR Vessel and Internals Project, Guidelines for Selection and Use of Materials for Repairs to BWR Internal Components (BWRVIP-84)", EPRI Technical Report 1000248. BWRVIP-84 is the primary source for material requirements related to repair design and supersedes all material requirements in the Repair Design Criteria. In our response to material-related issues in the attached document, we have noted that these issues are addressed in BWRVIP-84, which is currently under review by the staff. We would expect that any future questions related to material issues would be asked in reference to BWRVIP-84.

The enclosed information concerns reports that the NRC staff has accepted as being proprietary in nature. Therefore, the enclosed information is also proprietary and should be withheld from public disclosure.

If you have any questions on this subject, please contact Denver Atwood (Southern Nuclear), BWRVIP Repair Focus Group Technical Chairman, at 205.992.7461.

Sincerely,



Carl Terry
Chairman, BWR Vessel and Internals Project
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BWRVIP Response to NRC Final SE on BWRVIP-16 and -19 (“Core Spray Replacement Design Criteria” and “Core Spray Repair Design Criteria”)

Open issues from the NRC Final Safety Evaluations (Reference 1) of BWRVIP-16 and BWRVIP-19 are repeated below verbatim followed by the BWRVIP response to the Staff's evaluation. Items from the SE for which the Staff has indicated their concurrence with the BWRVIP position are not repeated here. Open items related to material issues will be addressed in response to the Staff's evaluation of BWRVIP-84 (Material Guideline) as discussed below.

Item 3.4: The materials requirements specified in Section 9.1 are acceptable with the exception of items 4-1 - 4-4 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 III, 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 Section III 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 Items 4-1, 4-2 and 4-3: BWRVIP members recognize that repair and replacement designs for plants with internals which were designed and constructed in accordance with ASME Section III must meet the rules of ASME Section XI. Section XI requires that repairs or replacements meet the applicable requirements of ASME Section III and the Owner's Original Design Specification. This would include the applicable Code materials requirements. If the Code is not met, a relief request to allow a technical alternative to the Code pursuant to 10 CFR 50.55a must be requested.

Section XI rules for repair and replacement also applies to components that were not designed to Section III, but are classified by the Owner as “Welded Core Support

Structures" and are subject to inspection under Section XI Category B-N-1 from Table IWB-2500-1. These components are to be repaired or replaced in accordance with the Owner's original Design Specification and Construction Code. NRC allows later approved versions of Section III to be used. If this requirement is not met, approval of a technical alternative must be sought pursuant to 10CFR50.55a.

Repair and replacement designs for plants which were not designed and constructed in accordance with ASME 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 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 BWRVIP and approved by 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.

Staff's Evaluation of BWRVIP's Response to Item 4-1, 4-2, and 4-3: The staff finds that, for Items 4-1 and 4-2, the statements in the staff's initial SER should be included in the BWRVIP-16 and -19 reports in Sections 9.1 and 9.1.2, respectively. The staff further finds that a statement such as the one in the third paragraph of BWRVIP's response to Items 4-1, 4-2 and 4-3, above, should be included in the BWRVIP-16 and -19 reports in Section 9.1.2.

BWRVIP Response to Staff Evaluation of Items 4-1, 4-2 and 4-3: 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.)

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 level 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: BWRVIP agrees that welded repairs on highly irradiated components require additional considerations. To provide additional guidance in this area, the BWRVIP Repair Committee is developing a "white paper" for use by utilities until the staff's (and BWRVIP's) confirmatory research is complete. The white paper will describe a region of the vessel inside of which irradiation effects may be important. Before performing a welded repair to a component inside this region, it will be required

that a small material sample be taken and analyzed for helium content. If the helium content is below some threshold (~0.1 appm), conventional welding can be used. If the helium is above the threshold, special welding techniques may be required. Guidelines on the appropriate qualification of the special techniques will be provided in the white paper.

While it would be desirable to demonstrate the weldability of irradiated materials in a mockup of similar configuration and helium content for each repair, it is not feasible to do so.

BWRVIP will submit the white paper to the NRC for review when it is completed.

Staff's Evaluation of BWRVIP's Response to Item 3.5: Staff approval of welded repair procedure on highly irradiated components addressed in Item 3.5 is pending and will be based upon the staff's review of BWRVIP's submittal of the white paper discussing the appropriate qualification of the special welding techniques, and the completion of the staff's review of the BWRVIP-45 report, "Weldability of Irradiated LWR Structural Components," which is presently on hold while additional data is gathered by the Office of Nuclear Regulatory Research (RES). This will be addressed in the staff's SER for BWRVIP-45.

BWRVIP Response to Staff Evaluation of Item 3.5: All material-related discussion, 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 BWRVIP-84 as follows:

- 5.x 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.

Item 3.6: Section 10.2, Pre- and Post- Installation Inspection. The BWRVIP-18 report should be referenced in Section 10.2 to ensure the inspection requirements stated in this section are consistent with those required in the BWRVIP-18 report.

BWRVIP Response to Item 3.6: The inspection recommendations of BWRVIP-18 may not be appropriate for a repaired or replaced component. For example, if a clamp structurally replaces a cracked weld, it will no longer be necessary to inspect the weld as described in BWRVIP-18. Additionally, if a section of piping is replaced, the design would use materials that are superior to the original piping and may eliminate certain welds from the original design. In this case, a revised inspection scope and schedule would be appropriate and the recommendations of BWRVIP-18 would not be applicable.

Clearly, the inspection recommendations of BWRVIP-18 must be adjusted when inspections are defined for the repaired/replaced components.

Staff's Evaluation of BWRVIP's Response to Item 3.6: The BWRVIP-18 report shall 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, BWRVIP shall develop a revised inspection scope consistent with the guidance of the BWRVIP-18 guidelines.

BWRVIP Response to Staff Evaluation of 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.

BWRVIP Response to NRC SE on BWRVIP-50 (“Top Guide/Core Plate Repair Design Criteria”)

Open issues from the NRC Safety Evaluation of BWRVIP-50 (Reference 2) are repeated below verbatim followed by the BWRVIP response to the Staff's evaluation. Items from the SE for which the Staff has indicated their concurrence with the BWRVIP position are not repeated here. Open items related to material issues will be addressed in response to the Staff's evaluation of BWRVIP-84 (Material Guideline) as discussed below.

RAI Item 3: Provide further details for the “CIB” condition for Alloy X-750. Provide the basis for the use of Alloy 750 in the “CIB” condition.

BWRVIP Response to RAI Item 3: Details of the CIB heat treatment condition for alloy X-750 and the basis for its use in the BWR environment are found in EPRI Document NP-7032, “Material Specification for Alloy X-750 for Use in LWR Internal Components (Revision 1),” which has previously been reviewed by NRC in conjunction with review of the Shroud Repair Design Criteria (BWRVIP-02).

Staff's Evaluation to BWRVIP Response to RAI Item 3: In the “BWRVIP Response to NRC Safety Evaluation on BWRVIP-16 and BWRVIP-19,” dated December 6, 1999, the BWRVIP stated, “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.”

In this same response the BWRVIP also stated, “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.”

In order for the BWRVIP to be consistent, both of the requirements stated above should be included in the BWRVIP-50 report. With the inclusion of these two statements, the staff finds that BWRVIP's response adequately addressed this item.

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

RAI Item 5: Clarifications should be made to the BWRVIP-50 report so that individual licensees will make plant-specific submittals for the following instances:

RAI Item 5-1: Licensees with materials not covered by the scope of the ASME Code or in the original design Code of Record should submit a plant-specific alternative to the NRC for review and approval.

BWRVIP Response to RAI Item 5-1: It is recognized by the BWRVIP members that repair and replacement designs for plants with internals which were designed and constructed in accordance with ASME Section III must meet the rules of ASME Section XI. Section XI requires that repairs or replacements meet the applicable requirements of ASME Section III and the Owner's Original Design Specification. This would include the applicable Code materials requirements. If the Code is not met, a relief request to allow a technical alternative to the Code pursuant to 10 CFR 50.55a must be requested.

Section XI rules for repair and replacement also applies to components that were not designed to Section III, but are classified by the Owner as "Welded Core Support Structures" and are subject to inspection under Section XI Category B-N-1 from Table IWB-2500-1. These components are to be repaired or replaced in accordance with the Owner's original Design Specification and Construction Code. NRC allows later approved versions of Section III to be used. If this requirement is not met, approval of a technical alternative must be sought pursuant to 10CFR50.55a.

Repair and replacement designs for plants which were not designed and constructed in accordance with ASME 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 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 BWRVIP and approved by 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.

Staff's Evaluation to BWRVIP Response to RAI Item 5-1: The staff finds the BWRVIP response to be acceptable. However, the staff requests that the third paragraph of the BWRVIP's response to Item 5-1, above, be included in the BWRVIP-50 report in Section 9.1.

BWRVIP Response to Staff Evaluation of Item 5-1: The discussion of material requirements will be removed from the final version of the BWRVIP-50. 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 third paragraph of the BWRVIP response have been included in BWRVIP-84 as paragraph 3.2.)

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, November 16, 1994. Is this the same document as GENE-771-44-0894 Rev. 2, which has the same title and date?

BWRVIP Response to RAI Item 7: The GENE document numbers in 3.2.1 and 3.2.2 are in error. The GENE document numbers in Section 13 (Reference 8) and Appendix A Section 7 (Reference A-4) are also wrong. The correct reference is General Electric document GENE-771-44-0894, "Justification of Allowable Displacements of the Core Plate and Top Guide - Shroud Repair," Rev. 2, November 16, 1994.

Staff's Evaluation to BWRVIP Response to RAI Item 7: The staff finds that BWRVIP's response adequately addressed this item and requests that the BWRVIP-50 report be modified to address the BWRVIP response to item 7.

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

RAI Item 8: Section 8, System Evaluation, does not discuss potential leakage caused by a top guide or core plate repair. If the repair results in a new source of leakage or increases the leakage from known leakage points, this leakage should be evaluated as part of the repair.

BWRVIP Response to RAI Item 8: Section 8.1 requires that the effects of the repair on the reactor coolant flow distribution be minimized. This would include the assessment of the effects on leakage of any new shroud leakage paths, e.g., from any holes EDM'd in the shroud. The section will be clarified to state that evaluation of the coolant flow distribution includes consideration of leakage caused by the repair.

Staff's Evaluation to BWRVIP Response to RAI Item 8: With the inclusion of the above clarification in the BWRVIP-50 report, the staff finds that BWRVIP's response adequately addresses this item.

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

RAI Item 10: Since the frictional coefficient between metallic surfaces often varies significantly from location to location and has a tendency to change over a period of time, discuss how the repair design criteria will assure that unanticipated frictional resistance between the repair parts will not result in excessive loading of the top guide/core plate structures.

BWRVIP Response to Item 10: The wedge designs would have to address differential motion between supported surfaces. Typically, this would be accomplished by minimizing the effects of changes in friction coefficients by providing small clearances or by minimizing the extent of the relative motion.

Staff's Evaluation to BWRVIP Response to RAI Item 10: Since it is difficult to maintain small clearances under operating conditions, the BWRVIP should be aware that it may be prudent to minimize the relative motion between supported surfaces in the event differential motion is completely inhibited due to friction or other unanticipated causes. The structural integrity of the affected subassemblies should be maintained and no loose parts generated. The staff finds that, with the preceding modification to the BWRVIP-50 report, the BWRVIP's response adequately addressed this item.

BWRVIP Response to Staff Evaluation of Item 10: The report will be revised as requested.

RAI Item 11: Distinguish between the repair criteria for temporary and permanent repairs.

BWRVIP Response to RAI Item 11: These Repair Design Criteria are intended to define the requirements for a permanent repair. Situations may occur where due to, for example, material availability, a licensee cannot meet all requirements for a permanent repair, but could install a repair that would be fully functional for a limited time or under limited operating conditions. This type of repair would be considered a temporary repair.

Staff's Evaluation to BWRVIP Response to RAI Item 11: The staff has a concern over the vagueness of the distinction between temporary and permanent repairs. Specifically, the staff requests that the BWRVIP revise its definition of temporary and permanent repairs to acknowledge that repairs may be in accordance with the ASME Code and meet the requirements of 10 CFR Part 50, under which circumstances no regulatory review or action would be needed. Conversely, if the repair, either temporary or permanent, does not meet the Code or the regulatory requirements, staff review and approval would be required. The staff requests that the BWRVIP address this in a revision to the BWRVIP-50 report.

BWRVIP Response to Staff Evaluation of Item 11: Subsequent to the issuance of this Safety Evaluation, 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 provides guidance on the content of such a submittal. The BWRVIP proposes that no change be made to BWRVIP-50 (or the other Repair Design Criteria) since the appropriate guidance is contained in BWRVIP-95.

BWRVIP Response to NRC SE on BWRVIP-51 (“Jet Pump Repair Design Criteria”)

Open issues from the NRC Safety Evaluation of BWRVIP-51 (Reference 3) are repeated below verbatim followed by the BWRVIP response to the Staff's evaluation. Items from the SE for which the Staff has indicated their concurrence with the BWRVIP position are not repeated here. Open items related to material issues will be addressed in response to the Staff's evaluation of BWRVIP-84 (Material Guideline) as discussed below.

RAI Item 2: Existing EPRI guidelines recommend that threaded fasteners not be lock welded. In Section 5.6, the BWRVIP-51 report recommends lock welding [fasteners] or [fitting them] with lock welded retainers. Justify this recommendation.

BWRVIP Response to Item 2: Longstanding industry experience has shown that both mechanical and welded locking devices are reliable, effective means of preventing loose parts. The only consideration here is the reliability of the field installation equipment.

Staff's Evaluation of BWRVIP Response to Item 2: 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. The staff requests that the BWRVIP-51 report be modified to require licensees to determine the weldability of the materials to be welded.

BWRVIP Response to Staff Evaluation: All material issues, including those involving welding, will be removed from the final version of BWRVIP-51. Material considerations are now contained in BWRVIP-84. Item 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 mockup 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."

RAI Item 4: Clarifications should be made to the BWRVIP-51 report, so that individual licensees will make plant-specific submittals for the following instances:

RAI Item 4-1: Licensees with materials not covered by the scope of the ASME Code or in the original design Code of Record should submit a plant-specific alternative to the NRC for review and approval.

BWRVIP Response to Item 4-1: It is recognized by the BWRVIP members that repair and replacement designs for plants with internals which were designed and constructed in accordance with ASME Section III must meet the rules of ASME Section XI. Section XI requires that repairs or replacements meet the applicable requirements of ASME Section III and the Owner's Original Design Specification. This would include the applicable Code materials requirements. If the Code is not met, a relief request to allow a technical alternative to the Code pursuant to 10 CFR 50.55a must be requested.

Section XI rules for repair and replacement also applies to components that were not designed to Section III but are classified by the Owner as "Welded Core Support Structures" and are subject to inspection under Section XI Category B-N-1 from Table IWB-2500-1. These components are to be repaired or replaced in accordance with the Owner's original Design Specification and Construction Code. NRC allows later approved versions of Section III to be used. If this requirement is not met, approval of a technical alternative must be sought pursuant to 10 CFR 50.55a.

Repair and replacement designs for plants which were not designed and constructed in accordance with ASME 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 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 BWRVIP and approved by 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.

Staff's Evaluation of BWRVIP Response to Item 4-1: The staff finds that, with the inclusion of the third paragraph of the BWRVIP's response to Item 4-1, above, into Section 9.1.2 of the BWRVIP-51 report, this response is acceptable.

BWRVIP Response to Staff Evaluation of Item 4-1: The discussion of material requirements will be removed from the final version of the BWRVIP-51. All material-related considerations for repair are now contained in BWRVIP-84. Item 4-1 is addressed in BWRVIP-84 which is currently under review by the staff. (Note: the essential elements of the third paragraph of the BWRVIP response have been included in BWRVIP-84 as paragraph 3.2.)

RAI Item 5: Provide further details for the "CIB " condition for Alloy X-750. Provide the basis for the use of Alloy 750 in the "CIB" condition.

BWRVIP Response to Item 5: Details of the CIB heat treatment condition for alloy X-750 and the basis for its use in the BWR environment are found in ERPI Document NP-7032, "Material Specification for Alloy X-750 for Use in LWR Internal Components (Revision 1)," which has previously been reviewed by NRC as part of the review of the Shroud Repair Design Criteria (BWRVIP-02).

Staff's Evaluation BWRVIP Response to Item 5: In the "BWRVIP Response to NRC Safety Evaluation on BWRVIP-16 and BWRVIP-19," dated December 6, 1999, the BWRVIP stated, "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."

In this same response the BWRVIP also stated, "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."

In order for the BWRVIP to be consistent, both of the requirements stated above shall be included in the BWRVIP-51 report. With the inclusion of these two statements, the staff finds that BWRVIP's response adequately addressed this item.

BWRVIP Response to Staff Evaluation of Item 5: The discussion of material requirements will be removed from the final version of the BWRVIP-51. All material-related considerations for repair are now contained in BWRVIP-84. Item 5 is addressed in BWRVIP-84 which is currently under review by the staff. Note that both paragraphs have been retained in BWRVIP-84.

RAI Item 6: Clarification is needed for the case of a licensee which has been previously granted relief or an alternative to the regulations regarding inspection of reactor vessel welds based either on inaccessibility or the provisions of Generic Letter 98-05. Specifically, if during the course of the repairs, the subject welds are exposed sufficiently to allow for inservice inspection access, there needs to be an adequate technical justification as to why these welds should not be inspected in accordance with the ASME Code or Regulations.

BWRVIP Response to Item 6: It is recognized by BWRVIP members that when access is gained to previously inaccessible components or welds, that as a minimum, a visual inspection should be performed. When this is done, inspection results will be provided to NRC as part of the routine reporting from BWRVIP.

However, visual examinations of reactor vessel welds are of limited benefit and temporary access to a weld in the reactor vessel during a repair will not generally allow for a meaningful volumetric examination. Volumetric examination of reactor vessel welds requires outage time, inspection tooling and qualified examination procedures and personnel.

Having the time required to adequately plan and implement a vessel inspection during the course of an internal repair is a significant logistical problem. Also the amount of weld metal likely to be exposed by a repair is not likely to be sufficient to warrant the cost/effort to perform the examination. This is especially true of reactor vessel welds outside of the beltline region which are exposed to less fluence and thus do not suffer from significant reduction in fracture toughness. (The NRC evaluation of BWRVIP-05 confirms the limited benefit of a small area examined, especially for circumferential welds.) Also, if the repair was unanticipated prior to the outage in which it is performed, it is unlikely that the appropriately qualified personnel and inspection equipment would be available.

Finally, it is not appropriate that an approved relief request regarding inspection of one component (e.g., RPV) become unapproved due to work on another component (e.g., top guide), unless the repaired component's problem has direct bearing on the functionality of the component for which relief was granted.

Staff's Evaluation BWRVIP Response to Item 6: The staff has stated many times in the past that meaningful inspections should be performed if conditions change and accessibility becomes possible. Therefore, the BWRVIP—51 report should be modified to include language stating that licensees should plan on inspecting welds made accessible during the course of repairs performed on the subject safety-related internal components, or develop a technical justification as to why these welds should not be inspected during this accessibility period.

BWRVIP Response to Staff Evaluation of Item 6: The BWRVIP I&E Guidelines define inspection requirements at all locations for which failure has safety consequences. Many locations do not require inspection in order to ensure safety. No locations were eliminated from inspection on the basis of accessibility considerations. Utilities typically elect to perform additional inspections when conditions allow; however, such inspections are not required to ensure the safety of the plant. Therefore, no additional inspections should be mandated by BWRVIP-51. Additionally, NRC has shown that the risk impact of not inspecting reactor pressure vessel circumferential welds is insignificant. Therefore, the cost and dose associated with these inspections is not warranted.

BWRVIP Response to NRC SE on BWRVIP-52 (“Shroud Support and Vessel Bracket Repair Design Criteria”)

Open issues from the NRC Final Safety Evaluation of BWRVIP-52 (Reference 4) are repeated below verbatim followed by the BWRVIP response to the Staff's evaluation. Items from the SE for which the Staff has indicated their concurrence with the BWRVIP position are not repeated here. Open items related to material issues will be addressed in response to the Staff's evaluation of BWRVIP-84 (Material Guideline) as discussed below.

Section 3.4 of Safety Evaluation: General Comment

In order to be consistent with other BWRVIP repair procedures, such as the BWRVIP-16 and BWRVIP-19 reports, the following requirements 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.

BWRVIP Response to Item 1: The discussion of material requirements will be removed from the final version of the BWRVIP-52. All material-related considerations for repair are now contained in BWRVIP-84. Item 1 is addressed in BWRVIP-84 which is currently under review by the staff. Note that this requirement has been retained in BWRVIP-84.

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.

BWRVIP Response to Item 2: The discussion of material requirements will be removed from the final version of the BWRVIP-52. All material-related considerations for repair are now contained in BWRVIP-84. Item 2 is addressed in BWRVIP-84 which is currently under review by the staff. Note that this requirement has been retained in BWRVIP-84.

3. The following statement should be included in the BWRVIP-52 report in this Section. “Repair and replacement designs for plants which were not designed and constructed in accordance with ASME 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 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 BWRVIP and approved by 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 Item 3: The discussion of material requirements will be removed from the final version of the BWRVIP-52. 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 the paragraph above have been included in BWRVIP-84 as paragraph 3.2.)

Additional Item: 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." 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 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 [2] and BWRVIP-48 [3].”

BWRVIP Response to NRC SE on BWRVIP-55 (“Lower Plenum Repair Design Criteria”)

Open issues from the NRC Safety Evaluation of BWRVIP-55 (Reference 5) are repeated below verbatim followed by the BWRVIP response to the Staff's evaluation. Items from the SE for which the Staff has indicated their concurrence with the BWRVIP position are not repeated here. Open items related to material issues will be addressed in response to the Staff's evaluation of BWRVIP-84 (Material Guideline) as discussed below.

Item 2: Section 9.1.3 states that austenitic stainless steel shall meet the requirements of EPRI document No. 84-MG-18, “Nuclear Grade Stainless Steel, Procurement, Manufacturing and Fabrication Guidelines.” This document provides guidance for the use of Types 304 and 316 stainless steels in nuclear applications. Further, other stainless steels (SS), e.g., stabilized SS, could be appropriate for certain repair applications. Has the BWRVIP considered including these materials in the subject guidelines?

BWRVIP Response to Item 2:

A variety of materials have been considered for use in BWR internals applications, such as stabilized types 347 and 321 and nickel-based alloys 625 and 718. The BWRVIP has no plans to address these materials at this time.

Staff's Evaluation:

The staff finds that BWRVIP's response adequately addressed this item; however, austenitic stainless steel or any other materials shall meet the requirements of EPRI document No. 84-MG-18 or the requirements of other materials proven through testing, performance demonstrations, and field experience to be satisfactory for the application.

BWRVIP Response to Staff Evaluation of Item 2:

The discussion of material requirements will be removed from the final version of the BWRVIP-55. All material-related considerations for repair are now contained in BWRVIP-84. Item 2 is addressed in BWRVIP-84 which is currently under review by the staff. While BWRVIP-84 does not require adherence to 84-MG-18, the detailed material requirements specified in BWRVIP-84 are consistent with the staff position that all materials should be proven through testing, performance demonstration and field experience.

Item 5: Section 9.1.7 suggests that re-solution annealing is an acceptable technique for removing stresses. If localized solution annealing is an option for reducing stresses in a stainless steel weld, discuss the potential for sensitizing part of the cross section area in the temperature gradient between the solution annealed and non-annealed material.

BWRVIP Response to Item 5:

In the context of Section 9.1.7, localized solution annealing would only be applied to nuclear grade types 304 and 316 and XM-19, materials which already exhibit excellent resistance to sensitization. The effect of local solution annealing would be to relieve stresses, anneal cold work, and re-solutionize carbides. This would be a concern in high stress concentration regions such as threads, and in the exposed surface of a weld heat affected zone which is unavoidably subjected to significant plastic strain as a result of the welding process. In the unlikely event that sensitization does occur in these materials in the temperature gradient between solution annealed and non-annealed material, it would be in a region remote from significant stress concentrations.

Staff's Evaluation:

The staff finds that BWRVIP's response adequately addressed this item; however, for stress relaxation of weldments, only low carbon (like type 304L and 316L) or carbon stabilized (like type 347 and 321) stainless steels which exhibit excellent resistance to sensitization, can be subjected to re-solution annealing.

BWRVIP Response to Staff Evaluation of Item 5: The discussion of material requirements will be removed from the final version of the BWRVIP-51. All material-related considerations for repair are now contained in BWRVIP-84. Item 5 is addressed in BWRVIP-84 which is currently under review by the staff. Note that Sections A.5 (300 Series) and C.5 (XM-19) allow local solution annealing only on a case-by-case basis.

General Comments:

1. On the page after the title page under the heading, "Results," the BWRVIP-55 report states, "the document provides general design acceptance criteria for the repair of SLC piping." The staff recommends this be reworded to state, "the document provides general design acceptance criteria for the repair of lower plenum components."

BWRVIP Response to Comment 1: The text will be revised as suggested.

2. In order to be consistent with other BWRVIP repair procedures, such as the BWRVIP-16 and BWRVIP-19 reports, the following requirements in Section 9.1.2, Materials, of the BWRVIP-55 report should be modified to read: "Repair and replacement designs for plants which were not designed and constructed in accordance with ASME 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 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 BWRVIP and approved by 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 Comment 2: The discussion of material requirements will be removed from the final version of the BWRVIP-55. All material-related considerations for repair are now contained in BWRVIP-84. Comment 2 is addressed in BWRVIP-84 which is currently under review by the staff. (Note: the essential elements of the comment have been included in BWRVIP-84 as paragraph 3.2.)

3. The staff requests 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, BWRVIP could eliminate all welding on fasteners in this document.

BWRVIP Response to Comment 3: All material issues, including those involving welding, will be removed from the final version of BWRVIP-55. Material considerations are now contained in BWRVIP-84. Comment 3 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 mockup 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."

BWRVIP Response to NRC SE on BWRVIP-56 (“LPCI Coupling Repair Design Criteria”)

Open issues from the NRC Safety Evaluation of BWRVIP-56 (Reference 6) are repeated below verbatim followed by the BWRVIP response to the Staff's evaluation. Items from the SE for which the Staff has indicated their concurrence with the BWRVIP position are not repeated here. Open items related to material issues will be addressed in response to the Staff's evaluation of BWRVIP-84 (Material Guideline) as discussed below.

General Comments:

1. In order to be consistent with other BWRVIP repair procedures, such as the BWRVIP-16 and BWRVIP-19 reports, the following requirements should be added or changed in Section 9.1.2, Materials, of the BWRVIP-56 report: “Repair and replacement designs for plants which were not designed and constructed in accordance with ASME 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 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 BWRVIP and approved by 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-56. 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 BWRVIP-84 as paragraph 3.2.)

2. The staff finds Section 5.6 to be generally acceptable; however, 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 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-56. 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 mockup 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."

BWRVIP Response to NRC SE on BWRVIP-57 (“Instrument Penetration Repair Design Criteria”)

Open issues from the NRC Safety Evaluation of BWRVIP-57 (Reference 7) are repeated below verbatim followed by the BWRVIP response to the Staff's evaluation. Items from the SE for which the Staff has indicated their concurrence with the BWRVIP position are not repeated here. Open items related to material issues will be addressed in response to the Staff's evaluation of BWRVIP-84 (Material Guideline) as discussed below.

General Comments:

1. In order to be consistent with other BWRVIP repair procedures, such as the BWRVIP-16 and BWRVIP-19 reports, 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 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 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 BWRVIP and approved by 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. 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 BWRVIP-84 as paragraph 3.2.)

2. The staff finds Section 5.6 to be generally acceptable; however, 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 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 mockup 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."

References

1. Letter from Jack Strosnider (NRC) to Carl Terry (BWRVIP Chairman) "Final 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. M98266 and M96539)," dated August 10, 2000.
2. Letter from Jack Strosnider (NRC) to Carl Terry (BWRVIP Chairman) "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. MA1926)" dated January 29, 2001.
3. Letter from Jack Strosnider (NRC) to Carl Terry (BWRVIP Chairman) "Safety Evaluation of the "BWRVIP Vessel and Internals Project, Jet Pump Repair Design Criteria (BWRVIP-51)," EPRI Report TR-108718, May, 1998 (TAC NO. MA1927)" dated October 28, 2000.
4. Letter from Jack Strosnider (NRC) to Carl Terry (BWRVIP Chairman) "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. MA2326)" dated November 2, 2000.
5. Letter from William Bateman (NRC) to Carl Terry (BWRVIP Chairman) "Safety Evaluation of the "BWRVIP Vessel and Internals Project, Lower Plenum Repair Design Criteria (BWRVIP-55)," EPRI Report TR-108719, September, 1998 (TAC NO. MA3673)" dated September 21, 2001.
6. Letter from William Bateman (NRC) to Carl Terry (BWRVIP Chairman) "Safety Evaluation of the "BWRVIP Vessel and Internals Project, LPCI Coupling Repair Design Criteria (BWRVIP-56)," EPRI Report TR-108717, November, 1998 (TAC NO. MA4203)" dated February 22, 2002.
7. Letter from William Bateman (NRC) to Carl Terry (BWRVIP Chairman) "Safety Evaluation of the "BWRVIP Vessel and Internals Project, Instrument Penetration Repair Design Criteria (BWRVIP-57)," EPRI Report TR-108721 (TAC NO. MA4464)" dated May 7, 2002.