

# **NRC Operating Plant RAIs on BWRVIP-25, Rev. 1**

## ***Core Plate Inspection and Evaluation Guideline***

**Robert Carter**  
Technical Executive

**BWRVIP-NRC Meeting**  
September 7, 2017



# Outline – Operating Plants RAIs

- MVIB RAIs on BWRVIP-25, Rev. 1
- ESEB RAIs on BWRVIP-25, Rev. 1

# MVIB Related RAIs on BWRVIP-25, Rev. 1

# MVIB Operating Plants RAI-1(1)

- Request Synopsis:
  - Some BWR licensees have committed to performing the VT-3 exams as an aging management activity
    1. Discuss whether any in-vessel visual inspections would be conducted to provide reasonable assurance that the bolts and their locking devices are remaining in place during PEOs
- BWRVIP Position:
  - A VT-3 (or other visual exam method) performed from the core plate upper surface provides very little information regarding the structural integrity of the bolted connection
  - If the plant satisfies the requirements stated in Section 9.7 and Figure 9-9, then no future targeted inspections will be required

# MVIB Operating Plants RAI-1(2)

- Request Synopsis:
  - Some BWR licensees have committed to performing the VT-3 exams as an aging management activity
  - 2. Please address how the plant-specific CP bolt inspection criteria will be determined based on the results of this plant-specific analysis.
- BWRVIP Position:
  - Utilities can use their plant-specific loads to reduce conservatisms contained in the BWRVIP-25, Rev. 1 generic evaluation,
  - Utilities could apply the plant-specific approach in Appendix A, or another plant-specific approach with appropriate justification

# MVIB Operating Plants RAI-1(3)

## ■ Request Synopsis:

- Some BWR licensees have committed to performing the VT-3 exams as an aging management activity

3. For those plants that do not satisfy the Appendix I evaluation criteria, and for which a plant-specific stress analysis does not demonstrate acceptable margins, per the example provided in Appendix A, please identify whether these plants would be required to perform UT and/or EVT-1 examinations of bolts in accordance with the original BWRVIP-25 guidelines.

## ■ BWRVIP Position:

- Utilities could apply an approach other than BWRVIP-25, Rev. 1
- Generally speaking, a resolution regarding licensing commitments would be between the utility and the NRC

# MVIB Operating Plants RAI-2 (1)

- Request Synopsis:
  - The NRC staff has identified some inconsistencies
    - [[

Content Deleted  
EPRI Proprietary Information

]]
    - 1. Reconcile contradictory statements regarding the accessibility of the CP bolts for VT-3 visual examination
- BWRVIP Position:
  - BWRVIP-25, Rev. 1 supersedes SIL 588, Rev. 1
    - The basis for the VT-3 examination in SIL-588 relates to the potential for loosening of the bolt by rotation if a locking device fails. Substantial inspections have been performed in the BWR fleet to demonstrate that the locking device remains in place and no rotation has been observed. Thus, the BWRVIP believes that any additional visual exam from the top side of the bolt will provide little to no value in assuring integrity of the bolt.
    - Furthermore, access to interrogate the structural integrity of the bolt from the top side is not possible because the keeper configurations prevent UT and the only part of the bolt that is visible is the head of the bolt.

# MVIB Operating Plants RAI-2 (2)

- Request Synopsis:
  - The NRC staff has identified some inconsistencies
    - [[

Content Deleted  
EPRI Proprietary Information

]]

2. Address whether plants proposing to implement the BWRVIP-25, Rev. 1 methodology will ensure compliance with either (i) the ASME Code, Section XI, Examination Category B-N-2 requirement for VT-3 examination of accessible surfaces of the core plate during refueling and/or maintenance activities; or (ii) plant-specific alternatives authorized by the NRC staff pursuant to 10 CFR 50.55a(z)(1) for implementation of BWRVIP-25 guidelines in lieu of the ASME Code, Section XI, Examination Category B-N-2 VT-3 examinations

- BWRVIP Position:
  - Category B-N-2 is for “welded” core support structures and interior attachments. The core plate assembly does not meet the criteria for Category B-N-2 welded core support structure because it is not directly welded to the RPV and thus there are no Code requirements for examination of core plate assembly and associated core plate bolts.
  - Again, if a plant can satisfy the requirements of BWRVIP-25, Rev. 1 Appendix I, then no additional inspections are recommended by BWRVIP-25, Rev. 1



# MVIB and ESEB Operating Plants RAI-3 (1)

- Request Synopsis:

- Address how the loss of CP bolt functionality as a result of IGSCC and fatigue cracking is evaluated for determining a bounding number and distribution (i.e., clustering) of failed bolts for the BWRVIP-25, Rev. 1, Appendix I structural analysis.

1. This technical justification should specifically address how the following attributes are incorporated into the Appendix I structural analysis to determine the minimum number and bounding distribution of intact (crack free) bolts that are necessary to satisfy the structural acceptance criteria: (1) the extent of IGSCC in the bolts; (2) the distribution of IGSCC in the bolts (i.e., randomness or clustering of cracking in various locations); (3) the effects of fatigue cracking on the bolts; and (4) the effects of potential clustering of cracked and non-functional bolts on the stress analysis and worst-bolt determination used in the parametric study, including a consideration of moments and stress conditions generated by asymmetrical or eccentric clustering of non-functional bolts.

- BWRVIP Position:

- (1) The basis for the possibility of IGSCC is provided in Section 4 of Appendix I.

- [[

- 

- 

Content Deleted  
EPRI Proprietary Information

]]

# MVIB and ESEB Operating Plants RAI-3 (2)

- Request Synopsis:
  - Address how the loss of CP bolt functionality as a result of IGSCC and fatigue cracking is evaluated for determining a bounding number and distribution (i.e., clustering) of failed bolts for the BWRVIP-25, Rev. 1, Appendix I structural analysis.
  - 2. For plants with normal water chemistry (no credit for HWC and NMCA/OLNC), if the effects of IGSCC and fatigue were not already considered for the Appendix I structural analysis, please revise and/supplement BWRVIP-25, Rev. 1, Appendix I to address how applicable plants using the Appendix I, Section 9 evaluation process will specifically determine whether they have an acceptable number and distribution of intact bolts to satisfy the structural-acceptance criteria, based on a conservative plant-specific calculation of a certain number of non-functional bolts due to IGSCC and fatigue cracking
- BWRVIP Position:
  - All U.S. plants are considered protected via HWC and/or NMCA/OLNC.
  - Section 10 of Appendix I states the following
    - If a plant meets the requirements in Appendix I and the plant can demonstrate the acceptability of at least one (1) missing bolt, then sufficient justification (considering the other conservatisms in the analysis) exists for the elimination of core plate bolt inspections.

# MVIB Operating Plants RAI-4

- Request Synopsis:
  - Appendix A does not specify how reduction in bolt preload due to stress relaxation (per the mechanisms identified in Appendix I) and the potential for bolt cracking would be accounted for in a plant-specific analysis. NRC requests a revision and/or supplement BWRVIP-25, Rev. 1, Appendix A to address the effects of stress relaxation and cracking for the core plate bolts.
- BWRVIP Position:
  - BWRVIP understands the RAI and will provide a response

# MVIB Operating Plants RAI-5 (1)

- Request Synopsis:

- For all plants listed in Table 3-1 of BWRVIP-25, Rev. 1, Appendix I, please identify whether the original bolt procurement specification specifically required the Type 304 bolt material to be solution heat treated following the cold roll threading process.

- BWRVIP Position:

- [[

Content Deleted  
EPRI Proprietary Information

]]

# MVIB Operating Plants RAI-5 (2)

- Request Synopsis:

- For all plants listed in Table 3-1 of Appendix I, please identify whether the original bolt procurement specification also limited the as-fabricated material surface hardness to be below a certain value in order to limit the amount of localized cold work introduced as part of the thread machining process

- BWRVIP Position:

- Although this is not stated in the report, [[

Content Deleted  
EPRI Proprietary Information

]]

# MVIB Operating Plants RAI-6

- Request Synopsis:

- Section 6.2 identifies that small amounts of plastic deformation due to mechanisms associated with thermal creep would result in a Content Deleted  
EPRI Proprietary Information **[[ ]]** reduction in bolt preload. The basis for this value is References 11 and 12 of the BWRVIP-25, Rev. 1. Please discuss how this value was calculated and address how it is bounding for all Appendix I, Table 3-1 BWR plants.

- BWRVIP Position:

- BWRVIP understands the RAI and will provide a response

# MVIB Operating Plants RAI-7 (1)

- Request Synopsis:

- The detailed calculations regarding the amount of projected stress relaxation due to neutron irradiation for 60 years of operation are not provided to demonstrate that they are bounding for all BWR plants listed in Table 3-1. Nor does it address how the neutron fluence values that were used to calculate the projected stress relaxation due to irradiation were determined to be bounding for all BWR plants listed in Table 3-1.

1. Discuss how the projected stress relaxation values due to neutron irradiation were calculated and address how they are bounding for all Appendix I, Table 3-1 BWR plants, taking into consideration the differences in plant-specific CP bolt configuration and geometry.

- BWRVIP Position:

- The BWRVIP understands the RAI and will develop a response but it should be pointed out that the fluence limits are specified in the report and that utilities will be required to demonstrate that those limits are satisfied.

# MVIB Operating Plants RAI-7 (2)

- Request Synopsis:
  - The detailed calculations regarding the amount of projected stress relaxation due to neutron irradiation for 60 years of operation are not provided to demonstrate that they are bounding for all BWR plants listed in Table 3-1. Nor does it address how the neutron fluence values that were used to calculate the projected stress relaxation due to irradiation were determined to be bounding for all BWR plants listed in Table 3-1.
  - 2. Address how the Appendix I, Section 6.3 neutron fluence values that were used as the basis for determining projected decrease in CP bolt preload due to irradiation-enhanced stress relaxation were determined to be bounding for the BWR plants in Appendix I, Table 3-1, taking into consideration variation in neutron flux as a function of bolt azimuthal location around the periphery of the core plate and differences in plant-specific neutron fluence for the bolts.
- BWRVIP Position:
  - BWRVIP understands the RAI and will provide a response



# MVIB Operating Plants RAI-8

- Request Synopsis:

- [[

Content Deleted  
EPRI Proprietary Information

]]

- The NRC staff identified that these neutron fluence methodologies were approved by the NRC staff only for the specific applications identified therein – specifically, reactor-pressure vessel (RPV) integrity evaluations
    - Address how these methodologies were validated for calculating the specific neutron fluence values identified in Section 6.3, taking into consideration any benchmarking of the calculations (based on measured neutron activation of material samples) for application to core plate bolting.

- BWRVIP Position:

- BWRVIP understands the RAI and will provide a response

# ESEB Related RAIs on BWRVIP-25, Rev. 1

# ESEB Operating Plants RAI 1

- Request Synopsis:

- BWRVIP-25, Rev. 1, Appendix I, Section 8.3 states that [[

Content Deleted  
EPRI Proprietary Information

]] Sufficient technical justification is not provided to justify the use of a weld quality factor of [[  
Content Deleted  
EPRI Proprietary Information]], as the strength of unmodeled welds cannot be credited or exchanged for an increase in weld quality factor.

- BWRVIP Position:

- BWRVIP understands the RAI and will provide a response