

December 19, 2003

MEMORANDUM TO: William H. Bateman, Chief
Materials and Chemical Engineering Branch
Division of Engineering

FROM: Meena Khanna, Materials Engineer */RA/*
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SUBJECT: SUMMARY OF NOVEMBER 4, 2003, MEETING WITH THE BOILING
WATER REACTOR VESSEL AND INTERNALS PROJECT (BWRVIP)
TO DISCUSS TECHNICAL ISSUES RELATED TO VARIOUS BWRVIP
TOPICAL REPORTS

On November 4, 2003, representatives of the Boiling Water Reactor Vessel and Internals Project (BWRVIP) met with the NRC staff to discuss various issues including planned steam dryer inspection activities, non-destructive examination uncertainty, cracking in low carbon stainless steel in Japanese BWR internals and piping, and the effectiveness of enhanced visual examinations in detecting intergranular stress corrosion cracking (IGSCC).

The BWRVIP began the meeting with a discussion of the status of the BWRVIP activities. The BWRVIP representative indicated that 9 BWRVIP topical reports had been transmitted to the NRC in 2003. The reports addressed issues such as reactor pressure vessel and internals examination guidelines, evaluation of SCC growth in low alloy steel vessel materials in the BWR environment, and the RAMA fluence methodology. The BWRVIP discussed ongoing 2003 BWRVIP major tasks which included crack growth and fracture toughness in high fluence BWR materials, evaluation of cracking in jet pump beams, and the integrated surveillance program. The BWRVIP also listed the high priority BWRVIP issues for NRC review which included non-destructive examination (NDE) uncertainty, RAMA fluence methodology, crack growth and fracture toughness in irradiated stainless steels, revised GL 88-01 piping inspection schedules, and revised shroud support inspection guidelines.

The NRC staff then presented a discussion of its review of BWRVIP-104, "Evaluation and Recommendations to Address Shroud Support Cracking in BWRs." The NRC staff member provided an overview of the BWRVIP-104 report and areas that need further dialogue with the BWRVIP. The staff indicated that it would provide its questions and recommendations with respect to BWRVIP-104 in a formal request for additional information in the near future.

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A representative of the BWRVIP then presented a discussion regarding the update of the BWR steam dryers. The BWRVIP representative began the discussion by addressing SIL 644 which described the steam dryer failures at Quad Cities and recommended additional monitoring and inspections for all BWR plants operating at power levels greater than the operator licensed thermal power. The BWRVIP then discussed the relative susceptibility of the steam dryers and the various types of General Electric steam dryer hoods. It was emphasized that the steam flow is the forcing function for the pressure loads during normal operation and that the stress on the dryer structures was controlled by the dryer design. The representative of the BWRVIP indicated that the BWRVIP is in the process of developing inspection and flaw evaluation guidelines for the various configurations. NRC management questioned the BWRVIP that when extended power uprates are approved, how can the staff be reassured that no steam dryer failures will occur. The BWRVIP indicated that the BWRVIP Executives are in the process of addressing this issue.

The BWRVIP representative also indicated that the Boiling Water Reactor Owner's Group (BWROG) Steam Dryer Committee was formed to review recent steam dryer failures and develop an action plan. Short and long term plans were developed to address the steam dryer integrity concerns which included: develop BWRVIP inspection and evaluation guidelines, revisit BWRVIP safety assessment (BWRVIP-06), and address broad reliability and performance issues of the steam dryers.

An overview of the results of the recent steam dryer inspections was also provided for various plants. In addition, the results from the BWRVIP/BWROG survey were discussed. The BWRVIP representative indicated that 19 units have uprated power or are planning future power uprates and that most of the units will be monitoring moisture carryover.

The BWRVIP representative indicated that the BWRVIP program and I&E development is intended to address the steam dryer issues such as preventing failures versus monitoring, inspection methods guidance, inspection timing, and fabrication. The BWRVIP's overall recommendation is that the BWRVIP program be used as the regulatory oversight for maintaining the steam dryer integrity. The staff indicated that the steam dryer inspection issue was of great concern to the NRC and that it would continue to assess the BWRVIP/BWROG activities.

Following the discussion of the steam dryer inspections, a BWRVIP representative presented the status of the top guide evaluation for license renewal. The NRC issued a letter dated June 10, 2003, to the BWRVIP, requesting that additional evaluations of top guide beams may be required when the threshold fluence for IASCC is exceeded. In addition, the staff requested that an analysis be provided to demonstrate that failures of multiple beams (that exceed the threshold fluence) will not impact the safe shutdown of the reactor during normal, upset, emergency, and faulted conditions. The BWRVIP representative indicated that analyses would be performed by the BWRVIP to demonstrate that the top guide could tolerate multiple failures of the grid beams. In addition, it was stated that the assumptions used in the original analyses would be refined where possible, including fluence, crack growth, etc. based on research conducted by the BWRVIP. It was also indicated that if necessary, inspection guidelines for the top guide grid beams would be developed and that the work would be documented in a BWRVIP report and submitted to the staff. The BWRVIP representative concluded its

presentation by stating that this work would be deferred until 2005 because of other priorities and that this issue is limited to the license renewal period.

A BWRVIP representative then provided a discussion of the update on the assessment of NDE uncertainty. Some background information was presented to the staff, which included a description of the RAIs that the staff sent to the BWRVIP on this topic. The BWRVIP then presented a discussion of its responses to the staff's RAIs on NDE uncertainty. With respect to the core shroud welds and the recirculation riser pipe, the BWRVIP representative indicated that the comparison of the structural factors with and without the NDE uncertainty show that there is a slight reduction in the structural factor, but it is not significant. The BWRVIP representative indicated that there is sufficient conservatism in the BWRVIP evaluations to support the conclusion that the effect of excluding the NDE flaw sizing uncertainty is not significant in the overall flaw evaluation process. However, with respect to the core spray piping, the BWRVIP representative indicated that the effect of including the length sizing uncertainty on the structural factor is much larger when compared to the recirculation riser piping. The BWRVIP representative concluded its discussion by indicating that the BWRVIP's future activities with respect to NDE uncertainty included: (1) finalizing the inspection and evaluation guidelines to incorporate the BWRVIP proposed position on NDE uncertainty for flaw tolerant components, (2) developing treatment of NDE uncertainty for core spray and other small diameter internal piping, and (3) finalizing its responses to the RAIs on NDE uncertainty, and then submitting them formally to the staff.

The BWRVIP then presented its preliminary responses to the staff's request for additional information for BWRVIP-99, "Crack Growth Rates in Irradiated Stainless Steels in BWR Internal Components." The BWRVIP representative indicated that the responses to the staff's RAIs would be formally submitted to the staff by the end of January 2004.

Immediately following the discussion of BWRVIP-99, technical staff from Argonne National Laboratories (ANL), via telecon, provided its assessment of the BWRVIP's responses to the staff's RAIs for BWRVIP-100, "Updated Assessment of Fracture Toughness of Irradiated Stainless Steel Internal Components." The ANL technical staff were in agreement with the BWRVIP with respect to the RAI responses; however, they emphasized the importance that as more data on the toughness of HAZ materials become available, the BWRVIP should update the proposed fracture toughness curves for irradiated austenitic stainless steels to ensure consistency with additional data. The NRC staff concluded the presentation by indicating that a safety evaluation for this report would be submitted to the BWRVIP in the near future.

The NRC staff presented a discussion of its review of BWRVIP-62, "Technical Basis for Inspection Relief for BWR Internal Components with Hydrogen Injection." The staff presented additional concerns related to the effective availability of hydrogen water chemistry (HWC). These issues included the following: effective availability of HWC on the upper/lower plenum and core shroud under various conditions, and how the electrochemical potential (ECP) model takes into account or addresses the presence of crevice conditions in components and interstitial elements such as boron and nitrogen in the base metal. The staff concluded its presentation by indicating that the staff would meet with the BWRVIP separately to further discuss these issues regarding BWRVIP-62.

The BWRVIP then presented a discussion on the RAMA fluence methodology, which calculates the neutron and gamma flux distributions. The BWRVIP representative provided an overview of

the modeling of RAMA and the results of the benchmarking calculations. In conclusion, the BWRVIP representative indicated that the RAMA calculations are in “very good” agreement with benchmark problems, indicating that the methodology is accurately predicting neutron flux, dosimetry measurements, and component fluence. In addition, the BWRVIP representative stated that several 2004 activities are planned to further benchmark RAMA and address NRC comments.

The next topic that was discussed was IGSCC of low carbon (316NG) stainless steel piping in Japan. The BWRVIP representative described the characteristics of cracking and the suspected causes for crack initiation in the Japanese BWRs of 316NG stainless steel piping. Some of these suspected causes include excessive cold work during fabrication and chemical composition of the piping. The BWRVIP representative concluded his presentation by indicating that the inspection experience in the U.S. demonstrates exceptional performance of 316NG pipe replacements, and that, currently, no changes to the inspection programs have been recommended. However, the BWRVIP indicated that they would continue to monitor Japanese developments and evaluate the applicability to the U.S. plants.

The meeting continued with a discussion of BWRVIP-75, “Basis for Revisions to GL 88-01 Inspection Intervals.” The BWRVIP representative provided background information regarding BWRVIP-75, which included a discussion of the open item on the proposed inspection frequency for Category B welds. In addition, the BWRVIP provided several clarifications to the staff with respect to past examiner qualifications and the basis for why they were acceptable. The BWRVIP representative indicated that BWRVIP-75 states that licensees shall implement the Performance Demonstration Initiative type examination until Appendix VIII is approved. The representative stressed that examinations done under previously approved programs satisfied the definition of qualified procedures in BWRVIP-75. At the end of the discussion, the staff requested that the BWRVIP include a clarification in its BWRVIP-75-A report indicating that Appendix VIII needs to be implemented by the licensees.

A BWRVIP representative then presented an update of noble metal chemical addition (NMCA). It was stated that 70% of US BWRs have implemented NMCA. The BWRVIP representative indicated that the BWRVIP had evaluated its inspection data with respect to NMCA. The BWRVIP representative provided charts and inspection data that displayed the general trends of noble metal durability following NMCA. In addition, the BWRVIP representative provided data related to the NMCA effectiveness. The BWRVIP representative stated that adequate hydrogen availability is essential to ensure NMCA effectiveness with respect to stress corrosion cracking mitigation.

In addition, the BWRVIP representative presented data of crack growth rates calculated from each inspection to the most current inspection. The summary of the results of the BWRVIP’s evaluation indicated the following: (1) for normal water chemistry, the study validated the use of bounding rates of 5×10^{-5} inches/hour for the length direction and 2.2×10^{-5} inches/hour in the depth direction, (2) additional inspection data is needed to confirm crack growth rates for HWC and NMCA plants, and (3) additional information is needed to establish the relationship of fluence to crack growth. The BWRVIP representative concluded its discussion by indicating that the BWRVIP would continue to evaluate the effectiveness of mitigation with NMCA and moderate HWC by the analysis of core shroud reinspection data from various BWR plants, and would provide periodic updates on reinspection results to the staff.

The NRC staff presented a discussion of the EVT-1 effectiveness in detecting IGSCC, which is being reviewed by the Pacific Northwest National Laboratory (PNNL), under contract with the NRC. The NRC staff member addressed IGSCC morphology, limiting factors, which included critical parameters and practical limitations of the human eye, and examinations. The staff member provided a few preliminary conclusions, which included that the demonstrations with wire may not be reliable and that 25% of IGSCC have widths smaller than 0.8 mils. Based on PNNL's preliminary findings, the staff member recommended that the BWRVIP set up round robin type tests to assess equipment and personnel, and develop performance-based reliability criteria.

The NRC staff expressed its appreciation to the BWRVIP for the presentations. An attendance list is provided in the enclosure. The slides used during the meeting are available in ADAMS under accession number ML033530145.

Enclosure: Meeting Attendees

cc w/att: See next page

MEETING ATTENDEES

MEETING WITH THE BOILING WATER REACTOR VESSEL AND INTERNALS PROJECT

NOVEMBER 4, 2003

BWRVIP

Robin Dyle
Tom Mulford
Robert Carter
Raj Pathania
Ron Horn
Dan Pappone
Ken Putnam
Jeffrey Goldstein
Larry Steinert
David Berko
George Inch
Blane Wilton
Kazutiik Kishioka
Ron Gamble

NRC

Gene Imbro
Stephanie Coffin
Kamal Manoly
Meena Khanna
Kris Parczewski
Alan Wang
Thomas Scarbrough
Alex Velazquez
Carol Moyer
Ganesh Cheruvenki
Barry Elliot
Matthew Mitchell
Jit Vora
Andrea Lee
Undine Shoop
George Georgiev
Kenneth Karwoski
Don Naujock
John Wu

ANL (via teleconf)

Bill Shack
Omesh Chopra

Public

Deann Raleigh

ENCLOSURE

cc:

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