



**ATTACHMENT**

**RESPONSES TO NRC'S REQUEST FOR ADDITIONAL INFORMATION**

## RESPONSES TO NRC'S REQUEST FOR ADDITIONAL INFORMATION

### Question 1:

You indicated that you had performed a plant-specific analysis for horizontal weld H7. You stated that, based on the results of the analysis, inspection of weld H7 during the upcoming RFO7 is not required. Please provide a detailed description of the analysis for the methodology used. In addition, provide the justification for the methodology used in your analysis which deviates from the guidelines provided in BWRVIP-07 and discuss its conservatism.

### Response 1:

The methodology applied to determine the required inspection interval for the H7 weld satisfies BWRVIP-07 as follows:

- a. The cracking of the core shroud horizontal weld H7 exceeds 30 percent of inspected length. Per Table 1 of BWRVIP-07, as approved by the NRC, a plant specific analysis is required to determine the reinspection interval. The plant specific analyses are defined based on guidance provided in BWRVIP-01.
- b. BWRVIP-01 requires a Linear Elastic Fracture Mechanics (LEFM) analysis only for shroud welds with fluence greater than  $3 \times 10^{20}$  neutrons/cm<sup>2</sup> (n/cm<sup>2</sup>). The fluence at the H7 weld location will remain well below the  $3 \times 10^{20}$  n/cm<sup>2</sup> threshold through the end of cycle 8 (H7 is a below core plate weld). Due to the low fluence at the H7 weld location, only a Limit Load analysis is required. The Limit Load analysis for weld H7 is documented in GE Report GENE-B13-01920-63, Revision 2, which evaluated the refueling outage number 6 (RFO6) shroud inspection results. The additional evaluation for weld H7 uses the same methodology with the following input and assumption changes:
  1. The methodology used in the analysis is consistent with the BWRVIP-01 Limit Load methodology. Accordingly, the BWRVIP-20 Core Shroud Distributed Ligament Length (DLL) flaw evaluation program was used. The loads used in the analysis were determined using a Square Root of Sum of Squares (SRSS) approach. Normal and Upset stresses were found to be limiting. The stresses were calculated to be 562 psi (membrane) and 2610 psi (bending) for weld H7. This method of combining loads satisfies the Nine Mile Point Unit 2 (NMP2) design basis and is consistent with BWRVIP-01 guidelines.

**RESPONSES TO NRC'S REQUEST FOR ADDITIONAL INFORMATION (Cont'd)**

2. The fuel cycle length for crack growth purposes is defined as 16,000 hours, based on a 24 month cycle and 95 % availability factor.

The H7 limit load evaluation considered a remaining ligament that resulted in a Limit Load safety factor for weld H7 of 4.67 compared to the Normal & Upset allowable of 2.77. With the assumed remaining ligament, the required end of interval (EOI) is greater than 6 years assuming  $2.2E-5$  inch/hour (in/hr) crack growth rate (BWRVIP-14 criterion) and 4 years assuming  $5E-5$  in/hr crack growth rate. Both BWRVIP-76 and BWRVIP-07 cap the EOI at 6 years for welds with cracking exceeding 30 percent.

**Question 2:**

You stated that inspection of vertical welds V24 and V25 is not required during RFO7 because the cracking in the intersecting horizontal welds H7 and H8 satisfies the criteria provided in 3.1.1.b and 3.1.1.a of BWRVIP-63, respectively. Provide details regarding how the cracking in weld H7 meets the criteria stated in 3.1.1.b.

**Response 2:**

Vertical welds V24 and V25 intersect horizontal welds H7 and H8, which are non-beltline welds with fluence less than  $3 \times 10^{20}$  n/cm<sup>2</sup>. Inspection of the vertical welds V24 and V25 is not required in refueling outage number 7 (RFO7) provided the intersecting horizontal welds H7 and H8 satisfy either 3.1.1.a or 3.1.1.b of BWRVIP-63. Weld H7 satisfies 3.1.1.b criteria as follows:

The average crack depth in horizontal weld H7 is 29.4% when calculated to the end of cycle 8, considering 2 cycles of operation (16000 hours/cycle). A crack growth rate of  $2.2E-5$  in/hr was used for depth sizing based on BWRVIP-63, Section 3, and BWRVIP-14 criteria. The average crack depth of 29.4%, which was computed using BWRVIP-63, Appendix C criteria, met the BWRVIP-63, Section 3.1.1.b requirement to maintain average crack depth below 30 percent at the end of the evaluation period. To compute the average crack depth per BWRVIP-63, Appendix C, proximity criteria per BWRVIP-01, Appendix B, were used to adjust ligament lengths. Also, a crack growth rate of  $5E-5$  in/hr for change in length was used.

In addition, the maximum flaw depth for the portion of horizontal weld H7 located at the intersection of vertical welds V24 and V25 has been determined to be 55 percent after two cycles of operation. This meets the 60 percent criterion of BWRVIP-63, Section 3.1.1.b.

Based on the above, the intersecting horizontal weld H7 meets the criteria stated in section 3.1.1.b of BWRVIP-63. Therefore, inspection of vertical welds V24 and V25 is not required up to refueling outage number 8 (RF08), based on a crack growth rate of  $2.2E-5$  in/hr. Per BWRVIP-62, the inspection interval for weld H7 can be increased to 6 years (assuming 8000 hot operating hours per year) if credit is taken for NobleChem/Hydrogen Water Chemistry protection and the resulting "factor of improvement" (FOI) for this weld. Noble Chem/Hydrogen Water Chemistry protection is expected to be available starting in the Fall of 2000.

**RESPONSES TO NRC'S REQUEST FOR ADDITIONAL INFORMATION (Cont'd)****Question 3:**

Provide the reinspection schedule for the welds which will not be inspected during RFO7 and discuss consistency with the guidance provided in BWRVIP-07 and BWRVIP-63.

**Response 3:**

Only horizontal welds H4 and H5 will be inspected during RFO7. The reinspection schedule for the remaining welds, as determined from the baseline inspections performed in April 1998, during RFO6, and assuming 24-month long fuel cycles, is as follows:

**Horizontal Welds**

- a. There is minimal cracking in horizontal welds H1, H2, H3, H6 and H8 (cracking 0 to 10 percent of inspected length). Per BWRVIP-07, the reinspection interval for these welds is 10 years. The reinspection of these welds will be scheduled for refueling outage number 11 (RFO11).
- b. Due to significant cracking (greater than 30 percent of inspected length), plant specific evaluation for weld H7 is required per BWRVIP-07 to establish reinspection requirements. The plant specific analysis for weld H7 indicates that an EOI greater than 6 years is justified based on application of the BWRVIP-14 crack growth rate of  $2.2E-5$  in/hr. With the addition of NobleChem, an EOI of 10 years can be justified for this weld. However, based on BWRVIP-76 and BWRVIP-07, the EOI is capped at 6 years. Therefore, the reinspection of weld H7 will be scheduled for refueling outage number 9 (RFO9).

**Vertical Welds**

- a. Due to insignificant cracking of welds H1 and H2 (less than 10 percent of inspected length), inspection of vertical welds V4 and V5 is not required during RFO7. The inspection interval for these vertical welds is equal to that for the horizontal welds, i.e., 10 years, per BWRVIP-63, Section 3.1.1. Therefore, the reinspection of welds V4 and V5 will be scheduled for refueling outage number 11 (RFO11).
- b. All accessible areas of vertical welds V12 through V17, which intersect welds H4 and H5, were inspected during RFO6. No evidence of cracking of these welds was noted. Per BWRVIP-63, Sections 3.1.2 and 3.1.3, inspection of these welds during RFO7 is not required. Reinspection is required after 10 years. Therefore, the reinspection of welds V12 through V17 will be scheduled for RFO11.
- c. Inspection of vertical welds V24 and V25 was discussed above in Response 2. The planned inspection interval for these welds is 6 years, i.e., in RFO9, based on the H7 inspection interval. The evaluation of this 6-year interval credits NobleChem protection and a resulting FOI for the H7 weld, per BWRVIP-62. Without taking credit for NobleChem protection, inspection will be required in RFO8. Based on the above, reinspection of welds V24 and V25 will be scheduled for either RFO8 or RFO9.

**RESPONSES TO NRC'S REQUEST FOR ADDITIONAL INFORMATION (Cont'd)****Vertical Welds (Cont'd)**

- d. Inspection of radial ring welds (V1 through V3, V6 through V11, V18 through V23) is not required, since for unrepaired shrouds, radial ring welds are exempted from inspection per BWRVIP-63, Section 3.3.