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SUBJECT: Forwards response to 970528 RAI re core spray weld flaw evaluation.Plant-specific sys & risk assessments,provided.

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June 10, 1997

U.S. Nuclear Regulatory Commission
ATTN: Document Control Desk
Washington, D.C. 20555

Gentlemen:

In the Matter of) Docket No. 50-296
Tennessee Valley Authority)

BROWNS FERRY NUCLEAR PLANT (BFN) - UNIT 3 - RESPONSE TO REQUEST FOR ADDITIONAL INFORMATION REGARDING CORE SPRAY WELD FLAW EVALUATION (TAC NO. M98059)

This letter responds to the NRC's May 28, 1997, request for additional information regarding core spray weld flaw evaluation. NRC requested TVA provide plant-specific system and risk assessments assuming the complete failure of two welds in the core spray piping (welds P8b and P9). These assessments have been completed and are described in the enclosure to this letter.

In summary, TVA re-performed the bounding cases for the Loss of Coolant Accident (LOCA) analysis that assumed this section of core spray piping supplied no flow to the vessel. This analysis showed a nominal increase in the limiting peak clad temperature (PCT) from less than 1591°F to less than 1609°F. These values are well below the maximum acceptable PCT of 2200°F promulgated in 10 CFR 50.46(b)(1).

Similarly, TVA estimated the risk significance assuming this section of core spray piping supplied no flow to the vessel during large and medium break LOCA events. This evaluation resulted in a change in core damage frequency from the current reference value of 9.17×10^{-6} to 1.15×10^{-5}. This increase is considered not risk significant.

D030

There are no commitments in this letter. If you have any questions, please contact me at (205) 729-2636.

Sincerely,

T. E. Abney

T. E. Abney
Manager of Licensing
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ENCLOSURE
BROWNS FERRY NUCLEAR PLANT - UNIT 3
RESPONSE TO REQUEST FOR ADDITIONAL INFORMATION REGARDING
CORE SPRAY WELD FLAW EVALUATION

BACKGROUND

In response to two instances of cracking in core spray spargers, NRC requested in Bulletin 80-13 (Reference 1) that all operating boiling water power reactor facilities perform a visual inspection of the core spray spargers and the segment of piping between the inlet nozzle and the vessel shroud. NRC requested this inspection be performed at the next scheduled outage and at each subsequent refueling outage until further notice. NRC also requested that any identified cracking be evaluated and reported.

In response to this request, on March 7, 1997, TVA submitted a description and structural evaluation of the indications identified during the Unit 3 Cycle 7 examination of the core spray piping (Reference 2). In response to verbal requests for additional information from the NRC, TVA submitted supplemental information on March 9 and 10, 1997 (References 3 and 4).

By NRC letter, dated March 11, 1997 (Reference 5), TVA was informed that no technical issues were identified that should prevent the restart of BFN Unit 3 from the last refueling outage. The results of the staff's detailed evaluation would be provided to TVA at a later date. Any concerns that arose during staff review would be promptly communicated to TVA. TVA was also requested to inform the staff within 30 days if the staff's interpretation of TVA's commitments was incorrect. TVA responded by letter dated April 7, 1997 (Reference 6).

By letter dated May 28, 1997 (Reference 7), the staff requested additional information in order to complete its safety evaluation.

RESPONSE TO REQUESTS FOR ADDITIONAL INFORMATION

The NRC requests for additional information and TVA's responses are provided below.

NRC REQUEST -

1. Provide a plant-specific system assessment assuming complete failure of weld P9 considering that the structural integrity of weld P8 is not assured.

TVA RESPONSE -

With respect to the structural integrity of weld P8b, as discussed in TVA's March 9, 1997 letter (Reference 2), the ultrasonic testing (UT) data show the indications on weld P8b (See Figure 1) to be located in the heat affected zone of the core shroud itself, rather than in the collar. Only for the purposes of conservatively evaluating the capability of the core spray piping for continued operation, was a bounding assumption made that the indications are located in the collar. The projected remaining ligament for weld P8b at the end of the cycle of operations showed a projected remaining ligament of 2.5 inches, which would provide axial load carrying capability. With this amount of ligament remaining, the weld would not have any significant moment carrying capability. However, it is likely axial forces would be resisted up to the capacity of the remaining weld.

Finite element modeling was performed by assuming that the connection of the line to the shroud had no moment carrying capability. For the most limiting load cases, the safety factor was found to be greater than five as defined by load capacity/axial load.

With respect to weld P9, this weld is expected to have an IGSCC susceptibility similar to other girth butt welds in the core spray piping, which were inspected either ultrasonically or visually during the outage and showed no indications (with the exception of the minor indications noted on weld P4d). Since the overall population of girth butt welds in BFN Unit 3 internal core spray piping do not show incidence of cracking, there is a strong basis for concluding that the currently uninspectable weld P9 has not experienced significant Intergranular Stress Corrosion Cracking (IGSCC) Even if some amount of IGSCC had occurred in weld P9, this location could tolerate an existing through wall crack of greater than 9.8 inches in length. With the collar weld disengaged from the shroud, (i.e. loss of moment restraint) the allowable flaw size at weld P9 will still be bounded by that calculated with the collar weld intact. This is typical in a piping system near a moment restraint (i.e. an anchor). If the restraint is released, bending moments in the piping near the restraint actually decrease as the load redistributes through other load paths. In this vicinity, the reduced bending increases the flaw tolerance of weld P9 (i.e., increases the allowable flaw size).

Without prejudice to the above positions, and in order to be responsive to the NRC's request for additional information, TVA re-performed the bounding cases for the Loss of Coolant Accident (LOCA) analysis assuming this section of core spray piping supplied no flow to the vessel. This analysis assumes several conservatisms:

- The piping at the subject weld joint is assumed to totally separate from the sparger nozzle; whereas it is more likely to crack and leak.
- No credit was taken for core cooling from the failed or cracked core spray loop. Realistically, some flow from that loop would contribute to flooding the reactor vessel (Figure 2) even with both welds P8b and P9 in a fully degraded condition.
- The recirculation discharge line break is assumed on Division II to match the core spray loop failure in Division II, which maximizes the effects of single failures in Division I.
- A worst case single failure occurs.

This analysis showed, with no credit taken for Core Spray Loop II and assuming the worst case single failure, a nominal increase in the limiting peak clad temperature (PCT) from less than 1591°F to less than 1609°F. These values are well below the maximum acceptable PCT of 2200°F promulgated in 10 CFR 50.46(b)(1).

NRC REQUEST -

2. Discuss the implications from risk perspective, including effect on core melt frequency, if weld P9 is assumed to fail considering that the structural integrity of weld P8 is not assured.

TVA RESPONSE -

Without prejudice to TVA's positions regarding the structural integrity of welds P8b and P9, and in order to be responsive to the NRC's request for additional information, TVA performed a probabilistic safety assessment. The scenario modeled was the failure of welds P8b and P9, which results in the loss of structural integrity between core spray Loop II and the shroud. This scenario could result in some bypassing of core spray flow into the vessel annulus area, rather than contributing to the spray pattern inside the core shroud.

The failure to provide a sufficient spray pattern inside the core shroud is only important during rapid depressurization events (e.g., large and medium break LOCA events), when spray through the spargers is important to core cooling. TVA estimated risk significance by conservatively assuming this

section of core spray piping supplied no flow to the vessel. This evaluation resulted in a core damage frequency of 1.15×10^{-5}, which represents a 25.8 percent increase from the current reference value of 9.17×10^{-6}. This increase is considered not risk significant when evaluated in accordance with the Electric Power Research Institute (EPRI) Probabilistic Safety Assessment (PSA) Applications Guide (Reference 8).

ADDITIONAL TECHNICAL CONSIDERATIONS

In order to provide the staff with complete information with regard to the assumed failure of the P9 weld, a structural review was also performed to establish the maximum displacements and key stress points to ensure stability of this loop of core spray piping. With the P9 weld assured to fail and the P8b weld in its degraded condition, the piping could displace towards the vessel wall a maximum of approximately three inches. Using this deflection as input, the resulting critical stresses at the upper elbow joint are well within the ultimate stress of the material. In addition, the effects of piping flow induced vibration and fatigue were considered. In all cases, the core spray loop piping would remain stable and would not become free within the annulus area.

CONCLUSIONS

Without prejudice to TVA's position with respect to the structural integrity of welds P8b and P9, TVA re-performed the bounding cases for the Loss of Coolant Accident (LOCA) analysis that assumed this section of core spray piping supplied no flow to the vessel. This analysis showed a nominal increase in the limiting peak clad temperature (PCT) from less than 1591°F to less than 1609°F. These values are well below the maximum acceptable PCT of 2200°F promulgated in 10 CFR 50.46(b)(1).

Similarly, TVA estimated the risk significance assuming this section of core spray piping supplied no flow to the vessel during large and medium break LOCA events. This evaluation resulted in a change in core damage frequency from the current reference value of 9.17×10^{-6} to 1.15×10^{-5}. This increase is considered not risk significant.

REFERENCES

1) NRC letter, dated May 12, 1980, IE Bulletin No. 80-13, Cracking in Core Spray Spargers

2) TVA letter to NRC, dated March 7, 1997, Reactor Pressure Vessel Internals, Augmented Weld Inspection - Evaluation of Indications at the Core Spray System Piping Collar-to-Shroud Weld

3) TVA letter to NRC, dated March 9, 1997, Reactor Pressure Vessel Internals, Augmented Weld Inspection - Supplemental Information for Evaluation of Indications at the Core Spray System Piping Collar-to-Shroud Weld

4) TVA letter to NRC, dated March 10, 1997, Reactor Pressure Vessel Internals, Augmented Weld Inspection - Supplemental Information for Evaluation of Indications at the Core Spray System Piping Collar-to-Shroud Weld

5) NRC letter to TVA, dated March 11, 1997, Assessment of Core Spray Weld Flaw Evaluation

6) NRC letter to TVA, dated May 28, 1997, Request for Additional Information Regarding Core Spray Weld Flaw Evaluation

7) TVA letter to NRC, dated April 7, 1997, Reactor Pressure Vessel Internals, Augmented Weld Inspection - Evaluation of Indications at the Core Spray System Piping Collar-to-Shroud Weld - 30-Day Response to NRC's Assessment

8) EPRI PSA Applications Guide, TR-105396, dated August 1995

FIGURE 1
DIAGRAM OF ATTACHMENT OF CORE SPRAY PIPE TO SHROUD

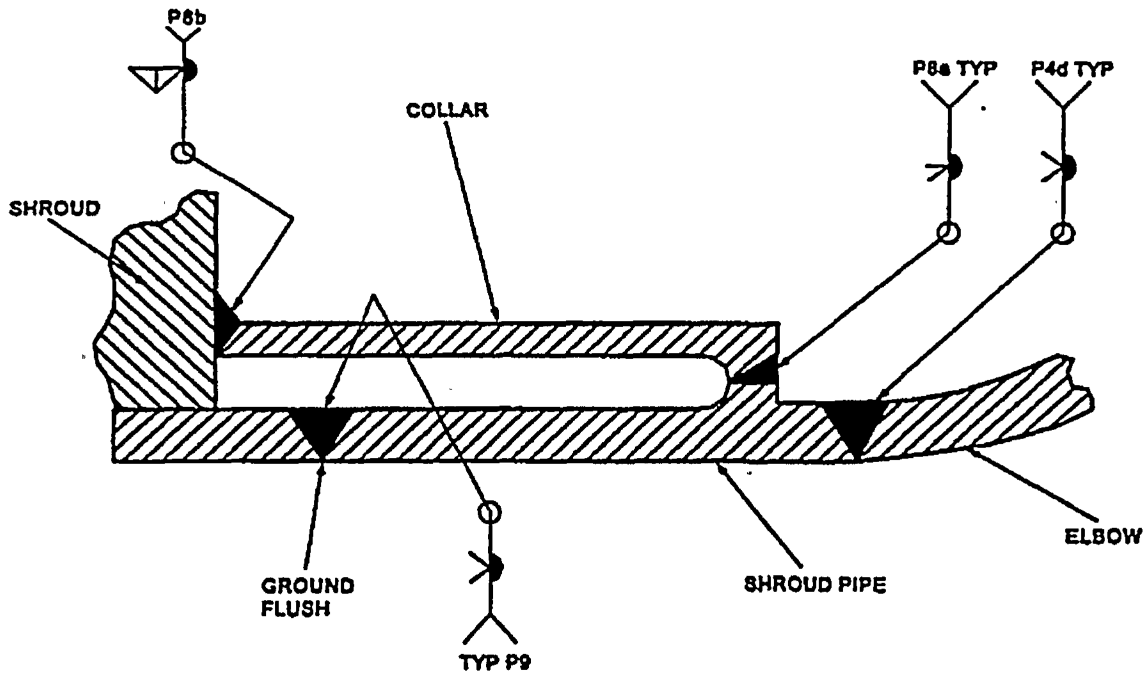

FIGURE 2
SCHEMATIC OF TYPICAL REACTOR VESSEL INTERNAL FLOW