August 31, 1999

MEMORANDUM TO: Sheri R. Peterson, Chief, Section 2
Project Directorate II
Division of Licensing Project Management - NRR

FROM: William O. Long, Senior Project Manager, Section 2 /Original signed by:
Project Directorate II
Division of Licensing Project Management - NRR

SUBJECT: FORTHCOMING MEETING WITH TENNESSEE VALLEY AUTHORITY BROWNS FERRY NUCLEAR PLANT UNIT 3 - DISCUSSIONS RELATING TO PROPOSED RISK-INFORMED INSERVICE INSPECTION PROGRAM (TAC NO. MA5355)

DATE & TIME: September 20, 1999
9:00 a.m. - 11:30 a.m.

LOCATION: U.S. Nuclear Regulatory Commission Headquarters Building
One White Flint North
11555 Rockville Pike, Room O-3-B-4
Rockville, Maryland 20852

PURPOSE: To discuss staff questions (attached) relating to licensee's proposed risk-informed Inservice Inspection program.

PARTICIPANTS*: Participants from the NRC include members of the Office of Nuclear Reactor Regulation (NRR).

NRR	UTILITY
W. Long	T. Abney
S. Dinsmore	R. Graybill
S. Ali	J. Victory
E. Sullivan	

Docket Nos. 50-296

Attachment: As stated

cc w/att: See next page

CONTACT: W. Long, NRR
301-415-3026

*Meetings between NRC technical staff and applicants or licensees are open for interested members of the public, petitioners, intervenors, or other parties to attend as observers pursuant to "Commission Policy Statement on Staff Meetings Open to the Public" 59 Federal Register 48340, 9/20/94.

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WASHINGTON, D.C. 20555-0001

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William O. Long

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DRAFT QUESTIONS FOR FUTURE REQUEST
FOR ADDITIONAL INFORMATION AND/OR MEETING

Probabilistic Safety Assessment Branch Questions on Browns Ferry Unit 3 (BFN3) Risk-Informed Inservice Inspection (RI-ISI)

1. The "Westinghouse Owners' Group Application of Risk-Informed Methods to Piping Inservice Inspection Topical Report WCAP-14572" (WCAP) methodology estimates a segment failure probability by estimating the failure probability of a single weld, in which all the degradation mechanisms found in the segment are simultaneously assumed to exist at the single weld, e.g., an aggregate worst-case weld. This technique was agreed upon because the staff did not consider simply selecting the "highest" weld probability in a segment to be sufficiently representative of the segment's failure probability, and the Westinghouse Owners Group (WOG) did not believe that the calculation and addition of the failure probability of all welds in the segment is necessary. Your submittal states that the weld failure probabilities were calculated for all the welds in the segment, yet only the highest probability was selected and used to represent the failure probability of the segments. Your methodology is questionable because it appears to violate the calculus of probabilities which states that the segment failure probability is the sum of the weld probabilities, and does not provide reasonable confidence that all the degradation mechanisms in the segment are represented in the segment failure probability. Please provide an analysis where the sum of the welds failure frequencies in each segment is used as the segment failure frequency.

2. The approved WOG methodology and your methodology both calculate segment and total risk without inspections, that is, a no-inspection base case. The results of this base case are used to identify the high safety significance segments which should be inspected. The WOG methodology is aimed at improving the selection process for American Society of Mechanical Engineers Boiler and Pressure Vessel Code (ASME) Section XI and thus excludes augmented inspection from consideration. It includes the impact of augmented inspections in the base case without inspection failure probability. That is, the failure probability of welds currently inspected in the augmented programs credits the augmented inspection in the base case (without inspection) resulting in a lower segment failure probability than when no inspection is credited. Your methodology, however, appears to calculate the no-inspection base case by not crediting the Intergranular Stress Corrosion Cracking (IGSCC) inspections. That is, in your base case, the weld's failure frequency estimate assumes the weld is never tested, even under the IGSCC program. Is this true?

   If it is true, then the total dominance of the IGSCC and flow accelerated corrosion (FAC) segments in your high-risk category is a direct result of the assumption built into your computer model that IGSCC and FAC have much higher failure probabilities than other welds. The risk reduction worth (RRW) values are relative values and if a small number of segments dominate the risk, all other segments will necessarily have very small RRWs. Therefore, your use of the RRW cutoff is inconsistent with that approved for the WOG and with the staff's current position on the Electric Power Research Institute methodology. The staff does not believe that the purpose of RI-ISI is to eliminate Section XI inspections and retain only augmented inspections. The one nonaugmented program weld inspection in your submittal does not, "provide a substantive ongoing assessment of piping condition." Please develop a base line without inspection but including the IGSCC and FAC inspections in your base case without inspection

Attachment

calculations, perform a sensitivity study for IGSCC similar to the study you performed for FAC as described on page E-15, or develop some other systematic proposal such that your RI-ISI program will provide confidence that potential degradation mechanisms other than just FAC and IGSCC will not threaten the integrity of your piping system.

3. Section 2.2 of the proposed alternative inspection program indicates the program contains alternate inspection requirements for the augmented Generic Letter 88-01 IGSCC Category "A" welds only, but Table 5-1 in the submittal indicates some C, E and G welds are also being included as part of the RI-ISI program. Please clarify.

4. In Section 3.4, Failure Assessment, of the submittal, sensitivity studies are performed to bound failure rates due to FAC. Were any similar sensitivity studies performed to bound failure rates due to IGSCC to ensure that no other segment failure mechanisms were masked by the IGSCC contribution?

5. What is the frequency of the IGSCC categories B through G examinationss under your proposed program?

6. Page E-11 of your submittal states that, "Normal operator actions were considered in the Operational Interface Review in determining the appropriate resulting initiating events and impacts. Results both with and without operator action were identified where applicable. Operator recovery (i.e., isolation of failed pipe segments, etc.) was considered and the most likely action was used as the applicable case."

   The treatment of operator actions approved during the WOG review had two parts.

   A) Recovery actions credited in the base line probabilistic risk assessment (PRA) such as starting pumps and remotely-opening valves following signal failure werre reviewed. For example, the baseline PRA might include the probability that an operator starts a pump following failure of an actuation signal but, if the pump is underwater, it is no longer possible to start the pump. Actions no longer recoverable when the component failure is caused by the spatial effects of pipe rupture were removed from the baseline PRA before quantification.

   B) Some specific recovery actions were identified. For example, following a rupture, it may be possible for an operator to remotely close a valve, cutting off the water to the ruptured pipe which may both allow more water to flow where it should, and stop the environmental effects of the ruptured pipe. These actions were evaluated both with and without operator action calculations in the WOG methodology.

   It is not clear from the description in your submittal how operator actions are considered. Please clarify how you included operator action with reference to A) and B) above.

7. When an operator does a "walkaround," what types of failures can he detect. If the pipe is under static pressure, such as attached to a storage tank, the results of a pipe rupture should be quickly observable even without a walkaround. If the pipe is under no pressure, such as between a closed motor-operated valve and a check valve, a

walkdown would not reveal the flaw. How was and how much credit was given to operators discovering flaws on walkarounds?

8. Your discussion of shutdown cooling on page E-14 is unclear. From your submittal, it appears that the loss of shutdown cooling (SDC) represented by top event SDC represents the loss of cooling capability following some transient which involves, among other events, a rector trip from full power. If this is so, does this mean that you use a one-week mission time for the SDC analysis as opposed to the customary 24 hours?

9. Generally when we refer to risk during shutdown, we mean the risk during the different plant configurations that occur during a refueling outage. In these shutdown configurations, substantially more equipment is inoperable than during normal operation, but which might be operable for a post trip shutdown condition. Also, there are a number of configurations particular to shutdown which result in initiators unique to shutdown configurations and which place dependance on a limited set of equipment. Unless your PRA models the plant configuration during shutdown and which only credits equipment which is expected to be available during shutdown, risk informed applications have required that the expert panel explicitly and systematically evaluate the shutdown configurations and available equipment to determine if the plant depends heavily on this equipment. Please provide your position.

10. Staff and industry PRA's of shutdown tend to indicate that shutdown risks are comparable with operating risks when averaged over the operating cycle. That is, the risk during a 3-week shutdown, when expressed on a per-year basis, is comparable to the risk from an operating plant also expressed on a per-year basis. These results are obtained also for an 18-month operating cycle. Please reconcile your use of the exposure time factors of 1.28E-02 to apparently claim that the core damage frequency (CDF) due to loss of shutdown cooling is actually about [(1.117E-05)(1.28E-02)] or 1.4E-7/yr.

11. In your submittal you refer to the "High Energy Pipe Rupture Evaluation." In your reference section there are several pipe rupture evaluation reports. Please identify the reports referenced, why the evaluations were done, and provide some indication on the methodology (e.g., were walkdowns performed?). What is the relationship between flooding analysis and these high energy line break studies?

12. In Section 3.3, Consequence Evaluation, there is no mention of a plant walkdown being accomplished to evaluate the direct and indirect effects of the postulated pipe segment failures. Where are effects of High Energy Pipe Rupture Evaluations and flooding initiators described?

13. There were no segments selected due to large early release frequency (LERF) considerations However, failure of a valve to close for a number of segments would result in a loss-of-coolant accident outside containment. Failure of some valves to close is on the order of 1E-2 per demand. Please discuss how failure of isolation valves to close was evaluated in your methodology.

14. In Table 3.10-2, on operator actions, your CDF decreased by 2.2E-6/yr and your LERF decreased by 1.8E-6/yr. Since you are only adding one inspection not previously being

done, please explain where the decreases in CDF and LERF are coming from.

15. Page E-9 discusses "portions of a system" to be included. Which systems had portions excluded? What is the basis for excluding portions? Are any inspections currently performed in the excluded portions and, if so, what happens to these inspections?

16. Table 3.10-2 provides a comparison of CDF/LERF detected by current programs and that of the risk-informed program. It is not clear from this table why, in the current Section XI program, significantly more of the CDF and LERF are addressed by the operators taking no action to isolate the break than the cases where operator action is assumed to be successful, but the reverse is true when augmented inspections are considered.

17. From the PRA, the Raw Cooling Water (RCW) system importance is 11% of total core damage frequency. In reviewing the top accident sequences, Loss of RCW as an initiator constitutes the 4th and 6th highest contributors to overall core damage. Therefore, given an active degradation mechanism such as microbiologically-induced corrosion, why are there no high safety significant segments for the RCW? Of the 20 RCW segments, are there no failures that can result in total loss of RCW? A similar question could be raised for the Residual Heat Removal Service Water system.

18. In Section 3, Structural Element Selection, what is meant by the statement that for some elements in Region 2 of the matrix, the calculated failure rate was zero? Does this mean that the calculated value was less than some truncation level? An earlier statement indicated that failure rates were quantified for each individual element in a segment, and the highest individual rate was used for segment risk; does this mean all of the elements in that segment were not quantifiable? Which system segments and elements comprise the two segments that fell into Region 2? How many elements were selected using existing Section XI criteria? For segments in Region 2 that are not amenable to statistical evaluation, the WOG methodology requires that a determination of any potential secondary degradation mechanisms be made and if of concern, then examination of at least one location in the segment for that mechanism be included in the RI-ISI program. To what extent were secondary mechanisms evaluated?

19. In section 3.2, Segment Definition, clarify what is meant by piping segments defined as a run of piping whose failure would result in the same loss of function, as determined from the plant probabilistic safety assessment (PSA) or other considerations (functions which do not impact CDF).

20. Are there any systems modeled in PSA that were not included in the scope of the RI-ISI program and if so, what was the rationale for exclusion?

21. In Section 3.4, Failure Assessment, the report indicates pipe failure frequency was performed using the WinPRAISE program; if not applicable, deterministic methods were used. Describe these deterministic methods and how many segments were subject to these? Please describe why WinPraise was considered to be not applicable for those segments, e.g., due to material properties?

22. To what extent were degradation mechanisms considered other than known augmented

inspections?

23. In Table 3.5-1, please explain what is meant by the "Applicable CDF" in relation to with or without operator error, and why a given case is chosen, especially when it is not the highest CDF of the two cases.

24. Comparing Table 3.7-3 to 3.7.2, for the recirculation system, it would appear that there should be four medium and three low risk segments categorized based on RRW values rather than the three medium and four low shown in Table 3.7-2.

25. In Section 3.8 of the submittal, it is noted that the Code Case N-577 allows that when a postulated failure mode for an element is being addressed by a program already in place, that program may be used to satisfy the requirements of Table 1, subject to certain conditions. Except for one High Pressure Coolant Injection system element that was in the current Section XI program, you are proposing use of existing FAC and IGSCC inspection programs to satisfy all of the examination requirements under the new RI-ISI program. Please confirm that the proposed program meets the criteria specified in paragraph I.6.1(a), (b), and (c).

26. Table D-1 in Appendix D of the Unit 3 PSA indicates a total CDF of 9.19E-06 with an unaccounted frequency of 9.18E-04. Does this imply that there are a great number of low frequency sequences that when summed would be two orders of magnitude greater than the baseline CDF? Since the PSA CDF results are being used to evaluate various aspects of the RI-ISI program, and accident scenarios involving pipe failure initiators are also low probability events, please describe the potential impact on the results of the evaluation by ignoring these nontrivial contributions.

27. Section 3.9 of the submittal indicates some limitations for exams to provide greater than 90% coverage will not be known since some locations will be examined for the first time by the specified techniques. The licensee should clarify the reason for this statement since all locations to be examined are already examined under an existing program.

28. Although TVA states that WinPRAISE is a Microsoft Windows-based version of the PRAISE code, and that the PRAISE code was used as the benchmark for SRRA in WCAP-14572, Supplement 1, evaluation of these codes for failure probability determinations is beyond the scope of this evaluation. It is recommended that the licensee provide further analyses to demonstrate similar results would be obtained from application of the WinPRAISE and SRRA codes, as used in support of an RI-ISI program.

<u>Materials and Chemical Engineering Branch Questions on BFN3 RI-ISI</u>

1. Section 2.2 states that augmented program inspections, with the exception of IGSCC Category "A" welds, remain unchanged. Please describe if the augmented inspection program inspections are credited toward the samples required using the RI-ISI sample selection criteria. If so, please specify the percentage of inspections in the RI-ISI program that are included in the current augmented inspection programs. Also, Section 3.8 states that all locations identified for examination are locations already identified under existing programs, either Section XI, IGSCC, or FAC. The staff has a concern that

the following issues should be addressed:

- The inspection samples should include a reasonable representation of material conditions (e.g., stainless steel and carbon steel).

- Each degradation mechanism type existing in high safety significance (HSS) locations should be inspected.

- Typically no more than one half of the N-577 inspections should be taken from the augmented inspection program.

2. In the WOG methodology process, the failure probability of a segment is characterized by the failure potential of the worst-case situation in each segment. This was calculated by inputting the most limiting or bounding conditions for the entire piping segment. This was the justification for using a single bounding value of failure probability rather than combining failure probabilities of various welds in the segment. The BFN3 submittal states (Section 3, "Determination of Failure Rate for a Segment") that failure rates were quantified for each segment by using the calculated worst result when failure rates were determined for more than one point. Please provide the justification for ignoring the number of welds or not combining the failure rates for various welds in the segment.

3. The structural element selection criteria described in Section 3 needs clarification. Specifically, the following items should be clarified:

   - The submittal states that for those elements with a quantified failure rate, that failure rate was used to select elements. Please describe how this criterion is implemented.

   - The alternative selection criterion described is the one used in ASME XI, i.e., 25% for Class 1 and 7.5% for Class 2. What criteria are used for non-ASME piping systems?

   - What structural element criteria are used for segments in Region 1(B)?

4. The segment definition in Section 3.2 is based on a combination of consequence and failure probability. Although acceptable, this is a deviation from the WOG methodology and should be listed as such.

5. Section 3.4 describes sensitivity studies performed to bound failure rates due to FAC. Please describe sensitivity studies performed to bound failure rates due to other failure mechanisms.

6. Section 3.6 states that the expert panel included members of the expert panel that had been established to implement the Maintenance Rule. However, in the Westinghouse Owners' Group (WOG) methodology, the panel should also include members that have expertise in related areas, such as inservice inspection, nondestructive examination, and stress and material considerations, as specified in Section 3.6.3 of the WCAP 14572. Please specify if the expert panel that reviewed and approved the RI-ISI program at the BFN3 included members with these qualifications.

7. Section 3.7 states that segments with RRW greater than 1.001 are considered for examination. Please clarify if these segments are classified as HSS.

8. The effort to benchmark piping failure probabilities for the WOG methodology was accomplished for pressurized-water reactors and therefore did not include IGSCC. Since BFN3 is a boiling-water reactor, what efforts were made to benchmark and validate failure probabilities due to IGSCC?

9. Section 3.8 provides structural element and nondestructive examination selection details. The current ASME XI requires volumetric examination of a sample of 25% of Categories B-J welds. Please provide the percentage of welds that are to be examined under the BFN3 RI-ISI program. Please provide a justification of this sample size if this percentage is smaller than 10%, as permitted by ASME Code Case N-560.

10. Section 3.8 states that there are 35 segments in Region 1. Please describe how many of these are in Region 1A and in Region 1B. Also, please provide the methodology for selecting elements from Regions 1B and Region 2. These are the regions for which the WOG methodology uses Purdue-Abramson method.

11. Section 5 states that the current ASME XI selects 222 locations while the proposed RI-ISI program selects 70 locations. How many of these 70 locations are already included in the current augmented programs, such as FAC and/or IGSCC? The staff has a concern that if major portions of these 70 locations are already covered by the current augmented programs, such as FAC and/or IGSCC, then the implication is that the current ASME program is being entirely eliminated under the RI-ISI program.

    Section 5 also states that the IGSCC locations are being reduced from 164 to 137. Please verify that this reduction is only applicable to IGSCC Category A welds.

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