April 11, 2006

10 CFR 50.54(f)

U. S. Nuclear Regulatory Commission
ATTN: Document Control Desk
Washington, D.C. 20555-0001

Gentlemen:

In the Matter of	)	Docket Nos. 50-327
Tennessee Valley Authority	)	50-328

SEQUOYAH NUCLEAR PLANT (SQN) UNITS 1 AND 2 - GENERIC LETTER 2004-02 - POTENTIAL IMPACT OF DEBRIS BLOCKAGE ON EMERGENCY RECIRCULATION DURING DESIGN-BASIS ACCIDENTS AT PRESSURIZED WATER REACTORS - RESPONSE TO REQUEST FOR ADDITIONAL INFORMATION (TAC NOS. MC4717 AND MC4718)

The purpose of this letter is to provide TVA responses to NRC's request for additional information (RAI) for SQN dated February 10, 2006. The responses to this RAI supplements TVA letters dated March 7, July 21, and September 1, 2005, concerning NRC's generic letter.

The enclosure provides the TVA responses for SQN. Please direct questions concerning this issue to J. D. Smith at (423) 843-6672.

I declare under penalty of perjury that the foregoing is true and correct. Executed on this 11th day of April 2006.

Sincerely,

Original signed by James D. Smith for:

P. L. Pace
Manager, Site Licensing and
Industry Affairs

Enclosure
cc: See Page 2

cc (Enclosure):

Mr. Edgar D. Hux
94 Ridgetree Lane
Marietta, Georgia 30068

Mr. Douglas V. Pickett, Senior Project Manager
U.S. Nuclear Regulatory Commission
Mail Stop 08G-9a
One White Flint North
11555 Rockville Pike
Rockville, Maryland 20852-2739

Mr. William T. Russell
400 Plantation Lane
Stevensville, Maryland 21666

ENCLOSURE

SEQUOYAH NUCLEAR PLANT (SQN)
UNITS 1 AND 2
GENERIC LETTER 2004-02
RESPONSE TO REQUEST FOR ADDITIONAL INFORMATION

The following provides TVA's response to NRC's request for additional information letter dated February 10, 2006 concerning Generic Letter 2004-02.

Plant Materials

1. (Not applicable).

2. Identify the amounts (i.e., surface area) of the following materials that are:

   (a) submerged in the containment pool following a loss-of-coolant accident (LOCA),

   (b) in the containment spray zone following a LOCA:

   - aluminum
   - zinc (from galvanized steel and from inorganic zinc coatings)
   - copper
   - carbon steel not coated
   - uncoated concrete

   Compare the amounts of these materials in the submerged and spray zones at your plant relative to the scaled amounts of these materials used in the Nuclear Regulatory Commission (NRC) nuclear industry jointly-sponsored Integrated Chemical Effects Tests (ICET) (e.g., 5x the amount of uncoated carbon steel assumed for the ICETs).

TVA Response 2

The following quantities of materials are present in the SQN containment

Aluminum - 887 ft^2	Submerged - 200 ft^2
Zinc - 957,893 ft^2	Submerged - 71,592 ft^2
Copper - 26,000 ft^2	Submerged - 26,000 ft^2
Carbon Steel - 373,120 ft^2	Submerged - 74,624 ft^2
Uncoated Concrete - 78,586 ft^2	Submerged - 7,859 ft^2

The ICET totals for aluminum and copper were 45 and 7.4 times the SQN amount respectively. SQN has 1.3 times the zinc of the ICET tests. The ICET test used an exposed concrete area of 12,630 ft^2 all submerged. The ICET value is 0.2 times the SQN value. The ICET value for carbon steel is small compared to SQN. The actual surface area used for scaling was not provided in the test plan, or the Test 1 or 5 test report. The surface to volume ratio at SQN is 60 times the ICET value although much of that number is above the sump and not subject to containment spray. Examples of this are all of the steam generator shells, the pressurizer, and the upper parts of the reactor vessel. These quantities are representative of the entire containment, not just the quantities either in the sump or subject to spray. As an example, the zinc values include ice baskets and inorganic zinc paint on the containment shell. Neither of these is in the sump pool or subjected to containment spray.

3. Identify the amount (surface area) and material (e.g., aluminum) for any scaffolding stored in containment. Indicate the amount, if any, that would be submerged in the containment pool following a LOCA. Clarify if scaffolding material was included in the response to Question 2.

TVA Response 3

There is a provision to store some scaffolding in containment that is either submerged in the sump or subject to containment spray. The total light-metal inventory associated with the stored scaffolding is approximately 615 ft^2 of zinc. This inventory is included in the total zinc inventory discussed in the response to Question 2. All other scaffold type structures present in the lower compartment are considered to be permanent plant features and are also included in the response to Question 2.

4. Provide the type and amount of any metallic paints or non-stainless steel insulation jacketing (not included in the response to Question 2) that would be either submerged or subjected to containment spray.

TVA Response 4

There are no paints or non-stainless steel insulation jackets not included in the response to Question 2.

Containment Pool Chemistry

5. Provide the expected containment pool pH during the emergency core cooling system (ECCS) recirculation mission time following a LOCA at the beginning of the fuel cycle and at the end of the fuel cycle. Identify any key assumptions.

TVA Response 5

The expected sump pH is between 8.0 and 8.4 for a LOCA at any time during the fuel cycle. The sump pH range includes conditions for the beginning and end of core life, the minimum and maximum quantities of boron and buffering agent in the reactor coolant system (RCS), the accumulators, the refueling water storage tank, and the ice condenser. The range also includes the maximum and minimum water and ice volumes. The temperature variation of the RWST and accumulators was included in developing this range.

6. For the ICET environment that is the most similar to your plant conditions, compare the expected containment pool conditions to the ICET conditions for the following items: boron concentration, buffering agent concentration, and pH. Identify any other significant differences between the ICET environment and the expected plant-specific environment.

TVA Response 6

ICET 5 is the test most representative of the SQN environment. The boron concentration in the test is 2800 parts per million (ppm) versus a plant concentration of 2500 to 2700 ppm. The buffer is sodium tetraborate with a weight range of 11,070 to 13,284 pounds. The weight range is based on the amount of ice assumed to be in the ice condenser (2,225,880 to 2,671,056 pounds). The test pH ranged from 8.0 to 8.5 and the plant pH (8.0 to 8.40) is essentially identical. The amount of aluminum is much higher in ICET 5 than is present in the plant. Since this is the predominant precipitant, this is significant. The other significant difference is that the ICET temperature is much higher than the SQN post-LOCA temperature. ICET 5 showed concentrations of dissolved aluminum of 55 milligrams per liter (mg/l) and calcium of 35 mg/l. A correlation developed by Westinghouse from separate effects precipitation test data (WCAP-16530) showed a total of 9.6 mg/l for the precipitants at SQN based on the total weight of the precipitants. The precipitants predicted by the Westinghouse correlations were composed mainly of $NaAlSi_3O_8$ with a small amount of AlOOH.

7. For a large-break LOCA (LBLOCA), provide the time until ECCS external recirculation initiation and the associated pool temperature and pool volume. Provide estimated pool temperature and pool volume 24 hours after a LBLOCA. Identify the assumptions used for these estimates.

TVA Response 7

The minimum time for the start of residual heat removal (RHR) recirculation from the sump is approximately 485 seconds or 8.1 minutes. This is the time assuming both emergency core cooling system (ECCS) and containment spray trains are running. The pool volume is 59,487 ft^3 with a temperature of 177.5°F. The pool volume at 24 hours is 72,425 ft^3 with a pool temperature of 132.3°F. The sump temperature is based on single train operation with the maximum ultimate heat sink temperature and highest refueling water storage tank temperature. The minimum refueling water storage tank (RWST) injected volume was used.

Plant-Specific Chemical Effects

8. Discuss your overall strategy to evaluate potential chemical effects including demonstrating that, with chemical effects considered, there is sufficient net positive suction head margin available during the ECCS mission time. Provide an estimated date with milestones for the completion of all chemical effects evaluations.

TVA Response 8

TVA included concentrations of chemical precipitants in head loss testing performed for the advanced design containment sump strainers that significantly bound the concentrations present in the SQN post-LOCA sump inventory. For the purpose of the test, TVA used quantities of aluminum oxides and calcium carbonate corresponding to 90 mg/l. Both of these materials are insoluble in water at the temperature of the test loop. The advanced sump strainer design included a 10 percent (%) increase in required strainer area to accommodate anticipated chemical effects. The testing confirmed that the strainer area is sufficiently large that a fiber bed cannot form. Chemical precipitants are not a head loss contributor when there is not a fiber bed. Further, the quantity of chemical precipitants is very small compared to the total quantity of particulate debris evaluated and tested based on the debris generation calculations. Thus the head loss is not sensitive to the quantity of chemical precipitants present. Based on these considerations, the 10% increase in advanced design strainer flow area to accommodate the chemical effects of the post-LOCA sump recirculation inventory is considered to be adequate. TVA has completed all actions associated with chemical effects evaluations accordingly.

9. Identify, if applicable, any plans to remove certain materials from the containment building and/or to make a change from the existing chemicals that buffer containment pool pH following a LOCA.

TVA Response 9

TVA already uses a buffer (sodium tetraborate) that is one of the alternative buffering materials being considered by the industry. There is no need to remove any materials from the containment to deal with chemical effects at SQN.

10. If bench-top testing is being used to inform plant specific head loss testing, indicate how the bench-top test parameters (e.g., buffering agent concentrations, pH, materials, etc.) compare to your plant conditions. Describe your plans for addressing uncertainties related to head loss from chemical effects including, but not limited to, use of chemical surrogates, scaling of sample size and test durations. Discuss how it will be determined that allowances made for chemical effects are conservative.

TVA Response 10

See the response to Question 8.

Plant Environment Specific

11. Provide a detailed description of any testing that has been or will be performed as part of a plant-specific chemical effects assessment. Identify the vendor, if applicable, that will be performing the testing. Identify the environment (e.g., borated water at pH 9, deionized water, tap water) and test temperature for any plant-specific head loss or transport tests. Discuss how any differences between these test environments and your plant containment pool conditions could affect the behavior of chemical surrogates. Discuss the criteria that will be used to demonstrate that chemical surrogates produced for testing (e.g., head loss, flume) behave in a similar manner physically and chemically as in the ICET environment and plant containment pool environment.

TVA Response 11

TVA has not performed and does not anticipate performing plant specific chemical effects tests. TVA has performed plant specific head loss tests for the advanced design containment sump strainer design. These tests were performed by AREVA and did include consideration of chemical precipitants in the recirculation inventory as discussed in the response to Question 8. The test environment was a flume test using tap water at cold temperatures. The chemicals included in the test inventory were chemically inert at the test temperatures and behaved similar to other particulate debris in the inventory. Because no fiber bed can form on the SQN sump screen as the result of the amount of screen area available compared with the available fiber, chemical precipitants do not impact head loss in a manner any different than other particulate debris. As indicated in the response to Question 8, testing confirmed that the advanced design strainer head loss is not sensitive to the quantity of chemical precipitants present for the SQN post-LOCA sump recirculation inventory.

12. For your plant-specific environment, provide the maximum projected head loss resulting from chemical effects (a) within the first day following a LOCA, and (b) during the entire ECCS recirculation mission time. If the response to this question will be based on testing that is either planned or in progress, provide an estimated date for providing this information to the NRC.

TVA Response 12

The testing done for SQN did not provide a separate effect evaluation of the head loss due to chemical effects. The total head loss was minimal for all debris. Given the low quantities of chemical precipitants and that no fiber bed is present to act as a filter it is judged that the maximum head loss due to chemical effects at the end of the first day is zero. Similarly, the maximum head loss due to chemical effects at any time during the 30 days following a LOCA is judged to be zero.

ICET 1 and ICET 5 Plants

13. Results from the ICET #1 environment and the ICET #5 environment showed chemical products appeared to form as the test solution cooled from the constant 140°F test temperature. Discuss how these results are being considered in your evaluation of chemical effects and downstream effects.

TVA Response 13

The quantities of materials used in the SQN tests were based on the amounts of dissolved material present in ICET 5. The ICET 5 test report did not provide quantities of precipitants formed. Using data from the Westinghouse Owner's Group (WOG) Chemical Effects Tests, a quantification of the precipitants generated when the sump cooled to approximately 70°F was made. The quantities of chemical precipitant surrogates used in the flume tests were 9 times greater than would be seen in the plant. These quantities then contributed to the head loss measured and in the quantities of material that was carried through the strainer and would impact a downstream effects evaluation.

Trisodium Phosphate Plants

14. (Not applicable).

15. (Not applicable).

Additional Chemical Effects Questions

16. (Not applicable).

17. (Not applicable).

18. (Not applicable).

19. (Not applicable).

20. (Not applicable).

21. (Not applicable).

22. (Not applicable).

23. (Not applicable).

24. (Not applicable).

Coatings

Generic - All Plants

25. Describe how your coatings assessment was used to identify degraded qualified/acceptable coatings and determine the amount of debris that will result from these coatings. This should include how the assessment technique(s) demonstrates that qualified/acceptable coatings remain in compliance with plant licensing requirements for design basis accident (DBA) performance. If current examination techniques cannot demonstrate the coatings' ability to meet plant licensing requirements for DBA performance, licensees should describe an augmented testing and inspection program that provides assurance that the qualified/acceptable coatings continue to meet DBA performance requirements. Alternately, assume all containment coatings fail and describe the potential for this debris to transport to the sump.

TVA Response 25

TVA performed head loss testing assuming all coatings failed whether qualified or not. The head loss from the strainer for this test condition was similar to the head loss based on a 10 diameter (D) ZOI for qualified coatings and is a small fraction of the net positive suction head (NSPH) available. Thus, no further assessment of the condition of coatings in the plant is needed.

Plant Specific

26. (Not applicable).

27. (Not applicable).

28. (Not applicable).

29. (Not applicable).

30. The NRC staff's safety evaluation (SE) addresses two distinct scenarios for formation of a fiber bed on the sump screen surface. For a thin bed case, the SE states that all coatings debris should be treated as particulate and assumes 100% transport to the sump screen. For the case in which no thin bed is formed, the staff's SE states that the coatings debris should be sized based on plant-specific analyses for debris generated from within the zone of influence (ZOI) and from outside the ZOI, or that a default chip size equivalent to the area of the sump screen openings should be used (Section 3.4.3.6). Describe how your coatings debris characteristics are modeled to account for your plant-specific fiber bed (i.e. thin bed or no thin bed). If your analysis considers both a thin bed and a non-thin bed case, discuss the coatings debris characteristics assumed for each case. If your analysis deviates from the coatings debris characteristics described in the staff-approved methodology above, provide justification to support your assumptions.

TVA Response 30

The SQN advanced design containment sump strainer has been designed to preclude the formation of a fiber bed (thin or thick) for post accident sump recirculation operation. To confirm this design objective, a series of flow transport/blockage tests were performed. The design basis test case was performed with all failed coatings simulated as 10 micron particles. This test was intended to maximize small particulate transport to the sump screen and serve as a limiting case for thin bed blockage effects. Upon confirmation that the strainer design will preclude thin bed formation, additional tests were performed to evaluate other sump blockage mechanisms. These tests included 1) the limiting failed coating size for maximum strainer blockage (i.e., the size of the failed coatings in this case were approximately 1/8” square and 5 mils thick and were considered small enough to maximize transport and large enough to maximize strainer blockage); 2) the maximum coating inventory (i.e., the coating quantities for phenolic and inorganic zinc coatings were increased to reflect the total amount of qualified and unqualified coatings inside containment); and 3) the maximum latent debris inventory (i.e., the quantity of assumed latent dust and dirt was increased by an order of magnitude to bound latent debris effects). There was very little change in measured head loss in all cases. The head loss difference between the particulate cases and the chip cases was less than 0.05 feet.

31. Your submittal indicated that you had taken samples for latent debris in your containment, but did not provide any details regarding the number, type, and location of samples. Please provide these details.

TVA Response 31

A quantitative latent debris walkdown was performed at SQN. This walkdown was an as found at the start of the refueling outage. There had been no special containment cleaning. The walkdown involved the collection of debris samples from 31 locations inside the reactor containment building selected to provide a representative sample of the latent debris preset in the containment building. The sample collection area for each location varied in size from 1 ft^2 to 70 ft^2. The samples collected were analyzed for both quantity and type of debris. The latent debris from the sampled areas was then projected for the entire containment building based on the total amount of surfaces similar to those surveyed. The walkdown found small quantities of particulate debris such as rust, paint, and dust. The quantity found would scale to a total containment quantity of 24.5 pounds. Only a few latent fibers were found. The latent particulate quantities are insignificant compared to the paint debris. TVA used the NEI latent debris recommendation of 200 pounds total and 12.5 ft^3 of fiber to design and test the SQN advanced containment sump strainers. This assumption is extremely conservative compared to the results of the SQN walkdown.

32. How will your containment cleanliness and foreign material exclusion (FME) programs assure that latent debris in containment will be controlled and monitored to be maintained below the amounts and characterization assumed in the ECCS strainer design? In particular, what is planned for areas/components that are normally inaccessible or not normally cleaned (containment crane rails, cable trays, main steam/feedwater piping, tops of steam generators, etc.)?

TVA Response 32

Procedures are in place to inspect and clean the containment. These were the procedures in place when the latent debris walkdown was performed. Given that the quantities of material found were either insignificant (fibers) or overwhelmed by break generated debris (particulates), no special inspections are planned or can be warranted given the extra dose to personnel and that there is no safety benefit.

33. Will latent debris sampling become an ongoing program?

TVA Response 33

Latent debris sampling will not be an ongoing program. See the response to Question 31 for more details.

34. Based on the low amount of fibrous debris from other sources, has the potential for the "thin bed effect" from Latent fiber only been evaluated? If so, what were the results?

TVA Response 34

Yes. The strainer is sized such that a thin bed cannot form. A latent fiber quantity of 12.5 ft^3 is too small to form a thin bed on a flat screen the size of the SQN strainer much less for an advanced screen design.

35. You indicated that you would be evaluating downstream effects in accordance with WCAP-16406-P. The NRC is currently involved in discussions with the WOG to address questions/concerns regarding this WCAP on a generic basis, and some of these discussions may resolve issues related to your particular station. The following issues have the potential for generic resolution; however, if a generic resolution cannot be obtained, plant-specific resolution will be required. As such, formal RAIs will not be issued on these topics at this time, but may be needed in the

future. It is expected that your final evaluation response will specifically address those portions of the WCAP used, their applicability, and exceptions taken to the WCAP. For your information, topics under ongoing discussion include:

a. Wear rates of pump-wetted materials and the effect of wear on component operation
b. Settling of debris in low flow areas downstream of the strainer or credit for filtering leading to a change in fluid composition
c. Volume of debris injected into the reactor vessel and core region
d. Debris types and properties
e. Contribution of in-vessel velocity profile to the formation of a debris bed or clog
f. Fluid and metal component temperature impact
g. Gravitational and temperature gradients
h. Debris and boron precipitation effects
i. ECCS injection paths
j. Core bypass design features
k. Radiation and chemical considerations
l. Debris adhesion to solid surfaces
m. Thermodynamic properties of coolant

TVA Response 35

No response is required at this time.

36. Your response to GL 2004-02 question (d) (viii) indicated that an active strainer design will not be used, but does not mention any consideration of any other active approaches (i.e., backflushing). Was an active approach considered as a potential strategy or backup for addressing any issues?

TVA Response 36

The SQN strainer showed a head loss of approximately 0.03 feet for a case where all coatings were assumed to fail and all debris fell directly on the strainer. This compares to an available NPSH of about 17 feet. No additional active features were needed.

37. The NRC staff's SE discusses a "systematic approach" to the break selection process where an initial break location is selected at a convenient location (such as the terminal end of the piping) and break locations would be evaluated at 5-foot intervals in order to evaluate all break locations. For each break location, all phases of the accident scenario are evaluated. It is not clear that you have applied such an approach. Please discuss the limiting break locations evaluated and how they were selected.

TVA Response 37

The inside diameters of the primary RCS pipes are 29 inches for the hot legs, 27.5 inches for the cold legs, and 31 inches for the crossover legs. A break in one of the 31-inch crossover legs would create the largest ZOI. However, depending on the exact location of various types of insulation, a break in the smaller hot or cold legs could result in the generation of a larger quantity of debris. Therefore, to analyze this scenario, the worst case break location and corresponding debris generation was considered for all 4 loops. Iterations were performed which showed the limiting break location to be the 31-inch crossover leg pipe. Then, a 28.6D ZOI was used for all materials except qualified coatings. A 26D zone of influence was used for all materials except paint. A 10D zone of influence was used for paint in the base case. Subsequently, TVA assumed all coatings failed, thus the minimum zone of influence is 26D. The volume of the lower compartment is 280,000 ft^3. The volume of the sphere for a 26D zone is 1,690,000 ft^3. The limiting break was a crossover leg double ended rupture. This pipe has an inside diameter of 31 inches. This results in a sphere diameter of almost 68 feet. The distance from the outside of the biological shield wall around the reactor vessel to the crane wall is approximately 31 feet. Moving a break at 5-foot intervals along the pipe does not result in a different ZOI. Thus, where the break is located on the pipe has absolutely no impact on how much debris is generated.

38. Were secondary side breaks (e.g., main steam, feedwater) considered in the break selection analyses? Would these breaks rely on ECCS sump recirculation?

TVA Response 38

No secondary side breaks require sump recirculation for mitigation. Thus, they did not need to be considered in the evaluation.

39. The staff SE refers to Regulatory Guide 1.82 which lists considerations for determining the limiting break location (staff position 1.3.2.3). Please discuss how these considerations were evaluated as part of the Sequoyah break selection analyses.

TVA Response 39

TVA used the following criteria to determine limiting break locations.

Break 1: Largest Potential for Debris Generation

The largest quantity of insulation in containment is located in the RCS loops near each of the steam generators (SG) and reactor coolant pumps (RCPs). Due to the size of the primary RCS loop piping and the quantity of insulation in close proximity to these pipes, a double-ended guillotine break of one of the primary loop pipes presents the limiting case for SBLOCAs and LBLOCAs at SQN. The inside diameters of the primary RCS pipes are 29 inches for the hot legs, 27.5 inches for the cold legs, and 31 inches for the crossover legs. Clearly, a break in one of the 31-inch crossover legs would create the largest ZOI. However, depending on the exact location of various types of insulation, a break in the smaller hot or cold legs could result in the generation of a larger quantity of debris. Therefore, to analyze this scenario, the worst case break location and corresponding debris generation was considered for all 4 loops.

Break 2: Two or More Types of Debris

All of the breaks discussed above encompass this break scenario since reflective metallic insulation (RMI) and coatings are the only debris present in the lower compartment.

Break 3: Most Direct Path to the Sump

Given the sump location, all breaks in the lower compartment proper have a direct path to the sump. Since the ECCS recirculation sump is in close proximity to the RCS piping in Loop 4, a break in this loop would have the most direct path to the sump.

Break 4: Largest Particulate to Insulation Ratio

RMI, latent particles, and coatings are the only debris present inside the crane wall in the lower compartment. RMI does not transport as easily as particulates and is not a major factor in developing head loss. The latent particulate source is independent of break location. The limiting break is the one that produces the most coatings debris. A thorough analysis has shown that a break in each of the crossover legs near the SG nozzle yields the most coating debris. Small break LOCAs do not produce a large quantity of debris.

Break 5: Potential Formation of the Thin-Bed Effect

SQN has no fibrous material in containment that is a potential debris source for the sump. The sump strainer area is large enough that there is not enough fiber in containment to form a thin bed on a flat screen of this size, much less an advances strainer design. As such, this criteria does not affect the break selection process.

40. The licensee did not provide information on the details of the debris characteristics (debris size distribution) assumptions other than to state that the Nuclear Energy Institute (NEI) and SE methodologies were applied. Please provide a description of the assumptions applied in these evaluations and include a discussion of the technical justification for deviations from the SE-approved methodology.

TVA Response 40

TVA did not deviate from the SE-approved methodology. Stainless steel RMI was assumed to fail as 75% small pieces and 25% large pieces. Particulate debris was assumed to be 10 micron particles. No large particulate debris was postulated. Coatings which were assumed to fail as "chips" were assumed to be 1/8 inch in diameter and 5 mils thick. The latent fiber debris was assumed to all be individual fibers.

41. Has debris settling upstream of the sump strainer (i.e., the near-field effect) been credited or will it be credited in testing used to support the sizing or analytical design basis of the proposed replacement strainers? In the case that settling was credited for either of these purposes, estimate the fraction of debris that settled and describe the analyses that were performed to correlate the scaled flow conditions and any surrogate debris in the test flume with the actual flow conditions and debris types in the plant's containment pool.

TVA Response 41

No.

42. Are there any vents or other penetrations through the strainer control surfaces which connect the volume internal to the strainer to the containment atmosphere above the containment minimum water level? In this case, dependent upon the containment pool height and strainer and sump geometries, the presence of the vent line or penetration

could prevent a water seal over the entire strainer surface from ever forming; or else this seal could be lost once the head loss across the debris bed exceeds a certain criterion, such as the submergence depth of the vent line or penetration. According to Appendix A to Regulatory Guide 1.82, Revision 3, without a water seal across the entire strainer surface, the strainer should not be considered to be "fully submerged." Therefore, if applicable, explain what sump strainer failure criteria are being applied for the "vented sump" scenario described above.

TVA Response 42

There are no vents between the sump and the containment atmosphere when recirculation from the sump is initiated after a design basis accident.

43. What is the minimum strainer submergence during the postulated LOCA? At the time that the re-circulation starts, most of the strainer surface is expected to be clean, and the strainer surface close to the pump suction line may experience higher fluid flow than the rest of the strainer. Has any analysis been done to evaluate the possibility of vortex formation close to the pump suction line and possible air ingestion into the ECCS pumps? In addition, has any analysis or test been performed to evaluate the possible accumulation of buoyant debris on top of the strainer, which may cause the formation of an air flow path directly through the strainer surface and reduce the effectiveness of the strainer?

TVA Response 43

The minimum strainer submergence for the limiting LOCA is 9.06 feet at initiation of ECCS switchover to sump recirculation. This rapidly increases to 13.22 feet minimum pool height at containment spray (CS) switchover and remains at this height for long-term operation in the recirculation mode. The potential for vortex formation at the SQN sump was extensively reviewed by the NRC as part of initial plant licensing. TVA performed a number of tests to support initial plant licensing that conclusively demonstrated that no vortex would form. Specifically, the sump design at SQN showed no air drawing vortex with a pool level of 2.5 feet above the floor for ECCS operation and 5 feet above the floor for CS operation. No intermittent surface swirls from supports were demonstrated to exist with a pool level greater than 8 feet. The water level in the lower compartment was raised to 13 feet to provide a quiescent pool surface even with flow rates several times the maximum ECCS rate. Notwithstanding that, the center line of the cross over leg where it is close to the sump strainer is over 8 feet below the pool surface. There is no possible way for a break at this location to entrain air into the sump.

The only potentially buoyant debris present in the sump pool post-LOCA is the latent fiber. The top of the sump strainer is over 5 feet below the pool surface and there is very limited fiber. It is physically impossible for these fibers to form an air flow path to the sump.

44. The September 2005 GL response noted that the licensee analyzed the debris transport based on the methodology described in the NEI guidance report "Pressurized Water Reactor Sump Performance Evaluation Methodology," NEI 04-07, for refined analyses as supplemented by the NRC's safety evaluation, as well as the refined methodologies suggested by the SE in Appendices III, IV, and VI. Please identify and justify if any exception to either the NEI 04-07 or SE method was taken, or confirm that no exception was taken.

TVA Response 44

TVA did not calculate a thin bed head loss as the screens were designed with sufficient surface area to preclude the formation of a thin bed given the amount of fiber assumed in the analysis. Walkdown data showed that there is not enough fiber present to form a thin bed on the current screen.