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December 21, 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 - NUCLEAR REGULATORY COMMISSION (NRC) GENERIC LETTER (GL) 2004-02, POTENTIAL IMPACT OF DEBRIS BLOCKAGE ON EMERGENCY RECIRCULATION DURING DESIGN BASIS ACCIDENTS AT PRESSURIZED-WATER REACTORS (PWR) - SUPPLEMENTAL RESPONSE (TAC NOS. MC4717, MC4718)

Reference: TVA Letter to NRC dated September 1, 2005 "Sequoyah Nuclear Plant (SQN) Units 1 and 2 - Nuclear Regulatory Commission (NRC) Generic Letter (GL) 2004-02, Potential Impact Of Debris Blockage On Emergency Recirculation During Design Basis Accidents At Pressurized-Water Reactors (PWR) - Second Response (TAC NOS. MC4717, MC4718)"

The purpose of this letter is to provide a supplemental response to NRC GL 2004-02 as committed in the referenced letter. The enclosure provides the supplemental response based on the final design of the containment sump strainer for Unit 2. The basis for the Unit 1 design is the same.

There are no new commitments made in this letter. If you have any questions concerning this matter, please contact me at (423) 843-7170.

I declare under penalty of perjury that the foregoing is true and correct. Executed on the 21st day of December 2006.

Sincerely,

Original signed by:

Glenn W. Morris
Manager, Site Licensing and
Industry Affairs

Enclosure
cc (Enclosure):
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ENCLOSURE

SEQUOYAH NUCLEAR PLANT (SQN)
UNITS 1 AND 2

NRC GENERIC LETTER (GL) 2004-02 SUPPLEMENTAL RESPONSE
POTENTIAL IMPACT OF DEBRIS BLOCKAGE ON EMERGENCY RECIRCULATION DURING DESIGN BASIS ACCIDENTS AT PRESSURIZED-WATER REACTORS (PWR)

The following provides TVA's supplemental response to Generic Letter 2004-02, "Potential Impact of Debris Blockage on Emergency Recirculation during Design Basis Accidents," based on the final design of the Unit 2 containment sump strainer. The basis for the Unit 1 design is the same. This supplemental response only addresses the areas that are being supplemented.

NRC Request 2(b)

"A general description of and implementation schedule for all corrective actions, including any plant modifications, that you identified while responding to this generic letter. Efforts to implement the identified actions should be initiated no later than the first refueling outage starting after April 1, 2006. All actions should be completed by December 31, 2007. Provide justification for not implementing the identified actions during the first refueling outage starting after April 1, 2006. If all corrective actions will not be completed by December 31, 2007, describe how the regulatory requirements discussed in the Applicable Regulatory Requirements section will be met until the corrective actions are completed."

TVA Response

Based on the results of the debris generation and transport analyses discussed in this response, TVA identified the need for modifications to the existing sump to meet the GL. Installation of new sump strainers is planned for the Unit 1 refueling outage in the fall of 2007 and the Unit 2 refueling outage in the fall of 2006. If additional corrective actions are identified in the process of designing and installing new strainers, those actions will be described in a supplement to this submittal.

TVA plans to complete all actions prior to December 31, 2007.

TVA Supplemental Response

In completing the engineering for the installation of the advanced design containment sump strainers, no additional corrective actions were required. The final modification involves removal of the original sump intake structure and replacement with advanced design intake strainers. No modifications were required of any other structure, component or system which would affect high energy line break debris generation or transport. No changes to the emergency core cooling and containment spray systems hardware or operating characteristics were required to accommodate the advanced strainer design.

NRC Request 2(d)

"The submittal should include, at a minimum, the following information:"

Item 2(d)i

"The minimum available NPSH margin for the ECCS and CSS pumps with an unblocked sump screen".

TVA Response

The minimum available net positive suction head (NPSH) margin for the ECCS and CSS pumps with an unblocked sump strainer is not available as the selection of a strainer vendor, and final design is in progress. The available NPSH margin will be provided in the supplemental response to this letter. The minimum NPSH margin for SQN is 14.3 ft. Given that the existing screen has an area of 51 ft^2, a new larger screen should maintain an equivalent or improve the margin. Containment overpressure is not considered in establishing the NPSH margins. An additional five feet of margin is available at the time the containment spray pumps are switched to sump recirculation. This occurs due to the increase in sump pool level due to the water injected from the refueling water storage tank by the spray pumps after the ECCS pumps have been realigned to the sump.

TVA Supplemental Response

The minimum available large break loss-of-coolant accident (LOCA) net positive suction heads (NPSH) margin for the emergency core cooling system (ECCS) and containment spray system (CSS) pumps with a clean advanced design containment sump strainer is 6.73 feet (ft) of water. The change in available NPSH from the 14.3 ft of water discussed in the original response to the 6.73 ft of water for the advanced design strainer configuration results from the following.

1. The flow resistance across the original intake structure (i.e., a flat plate screen) in the clean state was nominal (approximately 0.025 ft of water). The total flow resistance across the clean advanced design strainer (including flow perforations, internal disk flow restrictions, flow channels

and flow plenum) has been conservatively established by calculation to be 1.94 ft of water.

2. The balance of the difference in available NPSH results from TVA identified non-conservatisms in 1) the piping flow resistance values, and 2) the assumed sump level used in the previous TVA NPSH calculation. These conditions were identified as part of the design change process for the advanced design containment sump strainers. The conditions have been formally documented and are being dispositioned in accordance with the requirements of the TVA corrective action program.

Item 2(d)ii

"The submerged area of the sump screen at this time and the percent of submergence of the sump screen (i.e., partial or full) at the time of the switchover to sump recirculation."

TVA Response

A preliminary estimate of the submerged area of the new sump strainer is 1,400 ft^2 utilizing a passive design. The strainers will be fully submerged at the minimum containment water level. The submerged area will be provided in the supplemental response to this letter.

TVA Supplemental Response

The total flow area of the advanced design containment sump strainers is approximately 1,609 ft^2. The minimum sump level upon initiation of ECCS and CSS pump operation when aligned to the containment sump for large break LOCA recirculation is approximately 9.06 ft above the containment building floor. The maximum height of the strainers above the containment floor is approximately 7.30 ft. As such, the total 1,609 ft^2 strainer area will be submerged for large break LOCA sump recirculation operation.

***Item* 2(d)iii**

"The maximum head loss postulated from debris accumulation on the submerged sump screen, and a description of the primary constituents of the debris bed that result in this head loss. In addition to debris generated by jet forces from the pipe rupture, debris created by the resulting containment environment (thermal and chemical) and CSS washdown should be considered in the analyses. Examples of this type of debris are disbonded coatings in the form of chips and particulates and chemical precipitants caused by chemical reactions in the pool..."

TVA Response

TVA performed comprehensive evaluations of the ECCS and the containment spray system recirculation function due to debris generation and transport in a post-accident containment environment for SQN.

SQN is an ice condenser plant with a free standing steel containment (refer to SQN FSAR Figures 6.2.1-5 and 6.2.1-63). There are four distinct regions within the containment. The lower compartment contains the reactor coolant system and the LOCA boundary. The perimeter of the lower compartment is the containment floor, the right circular cylinder concrete crane wall, and the divider barrier at the top. The emergency sump is in the lower compartment. The dead ended compartments are outside the crane wall and extend to the containment shell. The divider barrier is the top of the dead ended compartments. The ice condenser is located outside the crane wall and provides a flow path for steam and non-condensable gases between the lower compartment and the upper compartment. The upper compartment is an open volume that serves as a reservoir for non-condensable gases during a high energy line break in the lower compartment. The containment spray system discharges into the upper compartment. The spray flow is returned to the lower compartment through two drains in the floor of the refueling canal. There are no high energy pipes in the upper compartment or the ice condenser. The containment sump is located near reactor coolant system (RCS) loop 4. The sump is a pit in the containment floor. The suction piping is located approximately 10 feet below the floor elevation. The penetrations in the crane wall have been sealed to an elevation of 13 feet above the containment floor.

During a loss of coolant accident, water fills the sump from the refueling water storage tank by injection from the ECCS system and containment spray system and from water due to ice melt. The lower compartment fills first. After the water level reaches just over 13 feet, water begins to flow into the dead ended regions. Once this water enters the dead ended region, it no longer actively communicates with the lower compartment sump. Thus, any debris generated in or carried into the dead ended regions will not contribute to sump screen blockage or downstream effects.

No exposed fibrous material is used in the SQN containment in areas that are subjected to high energy jets, containment spray or ice condenser melt water flow, or submergence in the active sump pool. Stainless steel reflective metallic insulation is used on the RCS and other insulated piping in the lower compartment. Non-metallic tape, tags and labels in the upper, lower, and ice condenser compartment are a post-LOCA debris source. Based on walkdown information, it was conservatively estimated that there are 870 ft^2 of this type of material. All unqualified coatings in the containment were assumed to fail along with qualified coatings within the zone of influence of high energy jets. These debris sources were determined from a review of design documents and a detailed walkdown of both SQN units. A case has been considered assuming all coatings failed. A quantitative latent debris walkdown was performed for Unit 2. A walkdown has not been performed for Unit 1; however, TVA considers the walkdown information for Unit 2 can be applied to Unit 1 based on the following: 1) the same personnel and procedures are used for housekeeping on both containments; and 2) a complete and comprehensive cleaning of the entire containment was performed following the recent completion of the steam generator replacement activities on SQN Unit 1. Based on the comprehensive cleaning of Unit 1, the SQN Unit 2 walkdown was chosen as the bounding case for establishing the latent debris inventory for input to the analysis and licensing basis for the new sump strainer design. Tags, tapes, and labels are assumed to fail regardless of break size and location.

A 3-dimensional (3D) computational fluid dynamics analysis of the SQN containment was performed to determine flow direction, velocity, and turbulence in the sump pool. The analyses were performed using the FLOW 3D computer code. Debris source terms were generated for breaks in the four coolant loops. Assumptions made with respect to unqualified coatings and other non-break generated debris in conjunction with the use of very large zones of influence provide that different break locations within a given RCS loop results in the same debris generation for a given size pipe. The crossover leg is the largest RCS pipe and has an internal diameter of 31 inches. Based on the debris produced and position relative to the sump, two break locations were modeled. One break was taken in the crossover leg on RCS loop 4. Loop 4 is closest to the sump. A break was also taken in loop 2. This is the loop opposite the sump. These double-ended breaks are limiting as they generate the greatest amount of debris. After the RCS piping, the next largest line is the 14-inch pressurizer surge line. This is also a double-ended rupture. Other lines connected to the RCS are single ended only. A spherical zone of influence with a radius of 28.6 times the diameter (D) was used for the reflective metal insulation and 10 times D for the qualified coatings. The definition of D is the diameter of the high energy source. The volume of the reflective metal insulation zone of influence is 1,690,000 ft^3. The entire volume of the lower compartment is approximately 248,000 ft^3. Thus, the reflective zone of influence does not have a physical meaning. The zone of influence volume for the paint is approximately 72,200 ft^3. The amount of debris generated by the large RCS breaks are much more challenging for screen blockage than any attached piping break. Attached piping breaks will not result in a different debris type than the RCS main loop breaks. As such, only the large breaks were numerically evaluated for debris generation and transport. Water levels in the sump at the time of switchover are based on minimum available for any RCS break in the range of 2 inches to 31 inches in diameter. The ECCS and CSS flow rates used in the computational fluid dynamics and transport analyses were based on two train maximum flow. The table below shows the quantities of debris produced by the most limiting break for each type of debris and the quantities transported to the vicinity of the sump.

Debris Types	**Total Quantity**	**Quantity at Sump**
Insulation		
Transco & Mirror SS RMI	177,605 ft^2	60,385 ft^2
Coatings		
Phenolic	131 lb	131 lb
IOZ	2,150 lb	2,150 lb
Alkyds	5 lb	5 lb
Silicone	162 lb	162 lb
Latent Debris		
Latent fiber	12.5 ft^3	12.5 ft^3
Dirt & Dust	170 lb	170 lb
Labels, Placards, etc.	870 ft^2	870 ft^2

Values shown in this table are based on conservative assumptions and calculations of pool turbulence, particularly the treatment of water from the ice condenser drains. Sensitivity studies are ongoing and include a more appropriate treatment of water addition from the ice condenser. These studies may reduce the quantities of material that will be transported to the sump. The latent debris source terms were taken from the guidance document. The actual values from the Unit 2 walkdown were approximately 50 lbs of particulate debris and less than ten small individual fibers. The value used in the analysis for fiber is many orders of magnitude higher than was actually found. There was not sufficient fiber found to form any type of fiber bed on the existing sump screens. The particulate value is a fraction of the paint values determined in the debris generation study. Upon final determination of the debris load, the most limiting case will be evaluated to ensure head loss across the sump strainer meets the requirements. TVA will include the maximum head loss in the supplemental response.

SQN uses sodium tetra borate as a buffering agent for the boric acid in the RCS and from the refueling water storage tank. The pH in the SQN sump post-accident ranges from 8.0 to 8.4. This is considerably below the values used in the integrated chemical effects testing for either sodium hydroxide or sodium tetra borate. In addition, SQN has only latent fiber and that is in a small quantity. Thus, the deposition of precipitants on fiberglass fibers as experienced in the integrated chemical effects tests will not have any effect on the head loss across the SQN screens. The strainer material for SQN is expected to be stainless steel. Stainless steel is also the predominant debris material in the sump pool post LOCA. If any precipitant were to plate out on stainless steel, it would do so on all stainless surfaces not just on the strainer. TVA has concluded that large margins for chemical effects are not warranted as would be the case if a fiber bed could form on the sump strainer surface. TVA will add a 10 percent margin to the strainer area to cover chemical affects unless further testing justifies a different figure.

TVA Supplemental Response

The total head loss across the clean strainers and the associated flow plenum was established by calculation to be 1.94 ft of water. Testing of the strainer assembly for the design basis large break LOCA debris load resulted in a maximum measured increase in head loss across the strainers of 0.03 ft of water. Accordingly, the maximum total head loss across the advanced design strainer with the design basis large break LOCA debris blockage has been conservatively established by calculation and testing to be 1.97 ft of water.

Additionally, the initial TVA response contained a commitment to add 10 percent margin to the containment sump strainer flow area to account for strainer blockage due to chemical effects. This commitment was based on the anticipated sizing and evaluation of the sump strainer flow area by calculation. Subsequent to the initial response, the total strainer surface area was established by maximizing the flow area in the free volume around the sump entrance available for strainer installation. Performance of this maximized strainer flow area design was established by testing. Since only the actual strainer flow area was tested, the performance margin reserved for chemical effects was established in terms of additional pressure loss across the strainer assembly rather than excess flow area. Based on the test results discussed above, an additional strainer head loss margin allocation of 0.20 ft of water was applied to the available pump net positive suction head to account for potential sump inventory chemical effects. The strainer debris laden head loss of 1.97 ft of water, combined with an additional chemical effects head loss margin allocation of 0.20 ft of water, results in an available pump net positive suction head of 6.5 ft of water.