Tennessee Valley Authority, Post Office Box 2000, Soddy-Daisy, Tennessee 37384-2000

October 27, 2004

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

Gentlemen:

In the Matter of	)	Docket No. 50-327
Tennessee Valley Authority	)	50-328

SEQUOYAH NUCLEAR PLANT (SQN) UNITS 1 AND 2 - RESPONSE TO REQUEST FOR ADDITIONAL INFORMATION (RAI) FOR NRC BULLETIN 2003-01, "POTENTIAL IMPACT OF DEBRIS BLOCKAGE ON EMERGENCY SUMP RECIRCULATION AT PRESSURIZED WATER REACTORS"

Reference: TVA letter to NRC dated August 8, 2003, Sequoyah Nuclear Plant (SQN) Units 1 and 2, 60-Day Response to NRC Bulletin 2003-01, "Potential Impact of Debris Blockage on Emergency Sump Recirculation at Pressurized Water Reactors"

The purpose of this letter is to respond to NRC's RAI received from the SQN NRC Project Manager by electronic mail (e-mail) on September 29, 2004. The RAI is associated with TVA's 60-day response to the subject bulletin as submitted by the reference letter. The enclosure provides TVA's responses to NRC's questions.

There are no regulatory commitments identified in this letter. Please direct questions concerning this issue to me at (423) 843-7170 or J. D. Smith at (423) 843-6672.

A103

I declare under penalty of perjury that the foregoing is true and correct. Executed on this 27th day of October, 2004.

Sincerely,

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

Enclosure
cc (Enclosure):
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ENCLOSURE

SEQUOYAH NUCLEAR PLANT (SQN)
UNITS 1 AND 2
REQUEST FOR ADDITIONAL INFORMATION (RAI) FOR NRC BULLETIN 2003-01

By letter dated August 8, 2004, TVA provided a 60-day response to NRC Bulletin 2003-01 for SQN Units 1 and 2. The staff has completed preliminary review of TVA's response and has determined it needs the following additional information to complete the review.

NRC Question 1

On page E1-3 and E1-4 of Enclosure 1 of your Bulletin 2003-01 response, you discussed a new plant emergency procedure, EA-63-8, "Monitoring for Containment Sump Blockage," which directs recording of a set of baseline data on ECCS and CSS pump parameters for use in evaluating subsequent changes, which may indicate the onset of sump blockage. However, your response does not completely discuss the operator training to be implemented, specifically the actual pump parameters to be monitored. Please provide a detailed discussion of the indications of sump clogging that the operators are instructed to monitor, the criteria used to determine a "degrading trend" in sump performance, and the response actions the operators are instructed to take in the event of sump clogging and loss of ECCS recirculation capability.

TVA Response

TVA's new Emergency Procedure EA-63-8 is initiated from Emergency Operating Procedure ES-1.3, "Transfer to RHR Containment Sump" after the Emergency Core Cooling System (ECCS) and Containment Spray (CS) systems have been realigned for sump recirculation. EA-63-8 requires operators to record the following initial baseline readings after cold leg recirculation is established:

- Residual Heat Removal (RHR) pump flows, motor currents, and discharge pressures
- Safety Injection (SI) pump flows
- CS pump flows and motor currents
- RHR spray flow (if placed in service)
- Centrifugal Charging Pump (CCP) flow
- Containment Sump Level
- Reactor Coolant System (RCS) pressure (recorded for use in evaluating whether changes in ECCS flow rates are due to changes in RCS pressure)

An additional set of baseline data is also obtained if hot-leg recirculation is subsequently established, since the valve alignment changes for hot leg recirculation may invalidate the initial ECCS parameters recorded.

Using the baseline data, EA-63-8 directs operators to monitor for changes which may indicate the onset of sump blockage. This monitoring is performed in parallel with subsequent emergency operating procedures. The following specific indications of sump blockage are listed:

- ECCS pump flow, motor current or discharge pressure erratic or gradually dropping (unexplained)
- CS flow or motor current erratic or gradually dropping

This procedure directs the following actions:

- If indications of potential sump blockage are observed, then notify the Technical Support Center (TSC) to evaluate the indications.
- If containment sump level is dropping (which could indicate potential clogging of drain paths inside containment), then notify the TSC to evaluate indications and evaluate the need to refill the Refueling Water Storage Tank (RWST).
- If indications of sump blockage continue to worsen, then evaluate stopping one train of CS and ECCS (if both trains are running) and evaluate the need to refill the RWST. The procedure contains a note which reminds operators of the basis for stopping one train of CS and ECCS (to reduce the rate of debris accumulation on the sump screen and to reduce the pressure drop across the screen) and directs the operator to obtain TSC concurrence prior to taking this action unless significant clogging has occurred prior to TSC being staffed.

In addition to the guidance in EA-63-8 on monitoring for indications of the onset of sump blockage, the ES-1.3 step (which initiates EA-63-8) directs monitoring for indications of cavitation on running ECCS and CS pumps. This step addresses actions that should be taken if pump suction is lost (i.e., pump cavitation becomes so severe that pumps must be stopped). This step requires the following actions:

- If sump blockage results in loss of suction to ECCS pumps, then stop CCPs, SI pumps, and RHR pumps and place handswitches in PULL TO LOCK
- If sump blockage results in loss of suction to CS pumps, then stop CS pumps and place handswitches in PULL TO LOCK
- If ECCS or CS flow is lost due to sump blockage, then transition to ECA-1.1, "Loss of RHR Sump Recirculation"

All licensed operators received training on EA-63-8 and the ES-1.3 step, which monitors for pump cavitation when these changes were implemented. This training consisted of a classroom lecture on sump blockage including the blockage mechanism, available indications, and actions. Also, a portion of licensed operators have had simulator training on EA-63-8. Additional training (classroom and simulator) is planned prior to incorporation of the Westinghouse Owners Group (WOG) Sump Blockage Control Room Guideline (discussed in response to Question 3).

NRC Question 2

On page E1-4 of Enclosure 1 of your Bulletin 2003-01 response, you do not discuss any existing, implemented or planned measures which would "delay switchover to containment sump recirculation," as discussed in Bulletin 2003-01. All of the discussion on page E1-4 centers on actions taken after the emergency sump is in operation. Please state explicitly whether TVA has taken or plans to take any measures which would "delay switchover to containment sump recirculation" in response to Bulletin 2003-01.

TVA Response

SQN has revised Emergency Operating Procedure ES-1.3, "Transfer to RHR Containment Sump" to direct operators to shut off one train of CS once RWST level has dropped to the setpoint for initiating ECCS sump recirculation. When CS is switched to the recirculation mode, both spray pumps are placed back in service if available. This change was made primarily to provide more time for the operators to complete the manual realignment of the CCPs and SI pumps for sump recirculation; however, this change also slows the depletion of the remaining RWST inventory and delays the manual sump switchover for the CS system by several minutes (a small benefit). During the time in which one CS train is stopped, manual operator action is relied upon to restart the idle spray pump if the operating pump fails. This manual action was evaluated as acceptable based upon the fact that ice will be available to control containment pressure and considering the fact that there is some time margin prior to ice bed meltout, since both trains had been operating. If the action to stop one spray pump were taken earlier in the event, this would reduce the available time margin prior to ice bed meltout on a large-break loss of coolant accident (LOCA), and would challenge the ability of operators to take manual action to restart a CS pump prior to ice bed meltout.

SQN's ice condenser is used to provide containment pressure control early in the event. The CS system is used to control pressure after the ice has melted. The spray system is also used to remove heat from the containment via the CS heat exchangers. SQN does not have fan coolers that are typically found in many dry containment designs and can be used for containment pressure control and heat removal. Therefore, completely shutting off CS pumps is not an option for SQN.

It is important that switchover to sump recirculation occurs prior to ice bed melt out. If the CS trains have to be shut down to perform the switchover at any time after the ice bed melts out, the containment design pressure will be exceeded for a number of break sizes. Because of the importance of having a spray train running when the ice bed melts out, it was concluded that both trains should be in operation after switchover to recirculation. Any scenario that could result in no spray when the ice bed melts out results in a significant change to the plant design basis as the resulting containment pressure could be much higher than the containment design pressure. TVA has concluded that such actions are beyond what would be expected to be implemented in response to the bulletin.

NRC Question 3

On page E1-5 of Enclosure 1 of your Bulletin 2003-01 response you state that "TVA does not consider additional preemptive actions to be warranted at this time" [August 8, 2003], basing that decision on conflicts with the philosophy used in development of the Sequoyah Emergency Operating Procedures. The Westinghouse Owners Group (WOG) has developed operational guidance in response to Bulletin 2003-01 for Westinghouse and CE type pressurized water reactors (PWRs). Please provide a discussion of your plans to consider implementing this new WOG guidance. Include a discussion of the WOG recommended compensatory measures that have been or will be implemented at your plant, and the evaluations or analyses performed to determine which of the WOG recommended changes are acceptable at your plant. Provide technical justification for those WOG recommended compensatory measures not being implemented by your plant. Also include a detailed discussion of the procedures being modified, the operator training being implemented, and your schedule for implementing these compensatory measures.

TVA Response

The WOG evaluated 11 candidate actions to reduce the potential for sump blockage or to mitigate sump clogging. Of these, 10 were considered to be applicable to dry containment designs. One was considered to be applicable to ice condenser plants. The following provides TVA's evaluation of the candidate actions. It is important to keep in mind that the reference plant for the Westinghouse Emergency Response Guidelines (ERGs) has a large dry containment with two 50% capacity spray trains and two 50% capacity fan coolers for post-LOCA heat removal. The TVA ice condenser plants have two 100% capacity spray trains and no fan coolers for post-LOCA containment heat removal. For a large dry containment, some small break LOCAs will not reach the CS setpoint due to the operation of the fan coolers. Very small RCS breaks initiate CS at an ice condenser plant.

A1a - Operator Action to Secure One Spray Pump

This action proposes turning off one CS prior to initiating sump recirculation. SQN has two CS trains. Each pump provides a guaranteed flow rate of 4750 gallons per minute (gpm). The spray system also includes two CS heat exchangers for removing energy from the containment after sump recirculation. The design basis LOCA presented in the Final Safety Analysis Report assumes only one spray train is in operation. To prevent exceeding the containment design pressure at one hour after the event, flow is diverted from the RCS to the RHR spray system to supplement the operating CS pump. It is imperative that the CS system be in the recirculation mode prior to ice bed melt-out in order to prevent exceeding the containment design pressure. In order for this action to be acceptable, operators must have adequate time to respond to a single failure of the operating CS pump.

TVA has determined that this action is not advisable based upon the following:

- According to the Westinghouse evaluation in WCAP-16204, this action is only recommended for small-break LOCAs. A small break results in ice bed depletion occurring later such that decay heat levels are reduced and adequate time exists to respond to a single failure. However, smaller breaks also result in a smaller amount of debris generation. Considering the fact that SQN uses only reflective metallic insulation (RMI) on the RCS, TVA considers sump blockage to be less likely for the smaller breaks where this change would be applicable.

- Assuming only one CS train in operation (5,000 gpm), ECCS sump recirculation will be initiated no later than approximately 50 minutes after spray actuation. Any ECCS flow due to the RCS break will reduce this time. The change in the time to the start of sump recirculation will be no more than approximately 25 minutes, which is considered only a modest benefit.

The added complexity associated with stopping one spray pump as an early pre-emptive action and the risk associated with a single failure of the operating spray train appear to outweigh the benefits for an ice condenser plant. Additionally, this change would require significant analysis which TVA considers to be beyond what would be expected to be implemented in response to the bulletin.

Action A1b - Operator Action to Secure Both Spray Pumps

This action is contrary to safe operation for an ice condenser plant. The spray system is required to maintain the containment pressure below the containment design value. SQN does not have fan coolers that are designed to operate in a post-LOCA high pressure environment that are typical of dry containment designs. This is not an appropriate action unless there is an alternative safety grade containment heat removal system to fulfill the function of the spray system.

Action A2 - Manually Establish One Train of Containment Sump Recirculation Prior to Automatic Actuation

This action is proposed to prevent both ECCS trains from failing simultaneously due to sump plugging. This action is not considered beneficial at SQN. The RWST volume for an ice condenser plant is about half the volume of a typical dry containment. This is because the ice acts as an independent source of water for ECCS recirculation located inside the containment. Because of this and the relatively high spray pump flow rate, there is insufficient time for this action to be of value. The ECCS pumps operating off of the RWST would have to be switched to the sump within a very few minutes even for a small break. The Westinghouse evaluation states that this action is not effective for large LOCAs. At an ice condenser, even very small breaks (1000 gpm) result in actuation of the CS system within about three minutes of the event. Most dry containments would not even actuate sprays for a 1000 gpm break. Thus, the timing is not favorable. It should be noted that small breaks do not generate large amounts of debris and given that SQN has reflective metallic insulation, the likelihood of sump blockage for small breaks is small.

Action A3 - Terminate One Train of Safety Injection after Recirculation Alignment

This action reduces the flow rate across the sump screens and potentially delays the onset of screen blockage. This action is considered to be of limited value at SQN and it would require a license amendment to implement due to single failure considerations. An additional factor that reduces the value of this course of action is that the CS flow rate is higher than the ECCS flow rate. For SQN, recirculation alignment of the ECCS could occur as early as 15 minutes. A single failure on the operating ECCS train would result in loss of all core cooling; however, TVA is not aware of analyses that support loss of all core cooling this early in the event. Additional ECCS analyses would be required to show that the operators have adequate time to restart the secured train before there are unacceptable consequences. Westinghouse noted in their recommendation for the next proposed action that they did not recommend this course of action due to the rapid operator recognition and reaction needed. Because of the short time to start recirculation, TVA has similar concerns and, as such, this action is not considered justifiable.

Action A4 - Early Termination of One Low Pressure Safety Injection /Residual Heat Removal Pump Prior to Recirculation Alignment

The proposed change will extend the injection time and reduce the flow rate through the sump. This change is less beneficial for SQN than the typical dry containment plant, due to the high spray flow rate. Switchover to recirculation will still occur early in the event. In addition, analyses are not in place that support acceptable core response should a failure of the operating train occur resulting in a loss of all core cooling. This clearly would require a license amendment. Given that there is no known fiber to transport to the sump and there is sufficient net positive suction head (NPSH) available, the risk of a loss of core cooling due to sump blockage is not high enough to justify such radical operator actions.

Action A5 - Refill of Refueling Water Storage Tank

SQN has procedures in place to refill the RWST. However, these procedures currently are not initiated until after the onset of sump clogging. Initiation of RWST refill prior to the start of sump recirculation is considered impractical due to the short time for RWST depletion at an ice condenser plant. However, initiation of RWST refill after ECCS and CS are aligned for sump recirculation appears to be beneficial, provided that post-accident dose rates allow access to the local valves which must be manipulated. TVA intends to incorporate this action at the end of ES-1.3 as a conditional action (if dose rates permit access to local valves). TVA's current schedule for this procedure change is spring 2005, in accordance with the TVA Corrective Action Program.

Action A6 - Inject More Than One RWST Volume

After the RWST is injected into containment, the water level inside containment is approximately at the mid-plane of the RCS piping. Water is present on the outside of the reactor vessel up on the nozzles and well above the core. While an event that results in a core melt is not desirable, this water level is expected to retain the core in the vessel. Injecting a second RWST does not appreciably change the long-term outlook for this event.

Action A7 - Provide More Aggressive Cooldown and Depressurization Following a Small-Break LOCA

This action is addressed in the SQN emergency procedures. Procedure ES-1.2, "Post-LOCA Cooldown and Depressurization," provides the guidance to cool the RCS at a rate up to 100°F/hr. TVA does not believe any additional guidance is warranted. Once the RCS break size is in the range of a 3- to 4-inch pipe, the RCS rapidly depressurizes and the RCS is effectively decoupled from the steam generators. Even for very small breaks, the RCS cools down at a rate in excess of 100°F/hr. By the end of the first hour, SQN will already be on sump recirculation because of CS actuation. Therefore, cooling down at the Technical Specification limit does not change the likelihood of sump blockage as the spray flow rate dominates the sump flow for small breaks. The fact that SQN uses reflective metallic insulation on RCS piping and components makes it unlikely that sump blockage will occur for small breaks.

Action A8 - Provide Guidance on Systems and Identification of Containment Sump Blockage

This action was implemented by the development of a new procedure EA-63-8, "Monitoring for Containment Sump Blockage." See the response to Question 1 for more details concerning this procedure.

Action A9 - Develop Contingency Actions in Response to: Containment Sump Blockage, Loss of Suction, and Cavitation

This action addresses various contingency actions which have been identified in the WOG Sump Blockage Control Room Guideline (SBCRG). Although many of the actions in the SBCRG are similar to ECA-1.1 ("Loss of Sump Recirculation"), the SBCRG is optimized for sump clogging and provides earlier actions (following the onset of clogging but prior to loss of pump suction). TVA intends to incorporate the SBCRG as a new emergency operating procedure. TVA's current schedule for developing this procedure is spring 2005, in accordance with the TVA Corrective Action Program.

Action A10 - This action was only applicable to Combustion Engineering designed plants.

Action A11 - Prevent or Delay Containment Spray for Small-Break LOCAs (<1.0 inch diameter) in Ice Condenser Plants

TVA performed a set of containment analyses in 1990 assuming LOCA blowdowns ranging from 120 to 2000 gpm to determine the time to CS actuation. These analyses showed that only for very small mass releases was there sufficient time for the operator to diagnose and lock out the spray pumps prior to an automatic actuation. It was concluded that a change to the CS initiation setpoint would be required to prevent automatic CS initiation for small breaks with mass release rates of equal to or greater than 500 gpm. Automatic spray actuation will occur for break flow rates of 2000 gpm or greater at any reasonable spray initiation value. It is possible to change the spray actuation setpoint to a higher value. However, this would require extensive evaluations and potentially significant plant modifications. The high-high containment pressure signal actuates multiple functions. These include some containment isolation functions and initiation of the air return fans as well as initiation of CS. The containment isolation functions would need to be retained at the current value. A number of containment analyses would be required to determine if a higher actuation setpoint is technically acceptable and what an appropriate value would be. It is also concluded that changing the setpoint would require a license amendment.

The amount of debris generated by small pipe breaks (<500 gpm) would be very small. A one-inch pipe would produce about 2000 gpm. TVA does not believe that sump blockage would occur for these breaks given that the RCS insulation is RMI and the limited damage that would occur. Plant modifications and the extensive reanalysis that would be required to change the spray setpoint to prevent or significantly delay spray actuation is not warranted for what is believed to be of no benefit and at best a limited benefit.

This action addresses a limited number of scenarios that are not likely to produce sump blockage. It is concluded that this action is not sufficiently beneficial to justify the effort required to implement it.

NRC Question 4

NRC Bulletin 2003-01 provides possible interim compensatory measures licensees could consider to reduce risks associated with sump clogging. In addition to those compensatory measures listed in Bulletin 2003-01, licensees may also consider implementing unique or plant-specific compensatory measures, as applicable. Please discuss any possible unique or plant-specific compensatory measures you considered for implementation at your plant. Include a basis for rejecting any of these additional considered measures.

TVA Response

As a participant in the WOG program, TVA proposed the action of raising the CS setpoint. TVA also considered having the operators stop all spray pumps for very small LOCAs prior to the Owners Group effort. This action was not implemented as described in our response to Questions 2 and 3. TVA has not identified other compensatory actions that would reduce the risk of sump blockage. TVA believes that the actions taken to use stainless steel RMI for insulation, prohibiting the use of fibrous material in areas of the containment where it could be dislodged by pipe break or CS effects, and having a high water level over the ECCS suction piping are of more value in reducing the likelihood of sump blockage than any compensatory actions that have been identified. In addition SQN, before GSI-191 was raised, performed mechanistic debris transport analyses for the ECCS sump and has determined that adequate NPSH is available for screen blockages up to 90 percent.