Tennessee Valley Authority, Post Office Box 2000, Spring City, Tennessee 37381-2000

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

Gentlemen:

In the Matter of	)	Docket No.50-390
Tennessee Valley Authority	)	

WATTS BAR NUCLEAR PLANT (WBN) UNIT 1 - BULLETIN 2003-01 - POTENTIAL IMPACT OF DEBRIS BLOCKAGE ON EMERGENCY SUMP RECIRCULATION AT PRESSURIZED WATER REACTORS - REQUEST FOR ADDITIONAL INFORMATION (TAC NO. MB 9872)

The purpose of this letter is to respond to NRC's request for additional information concerning the subject bulletin response dated August 8, 2003. TVA received the request from the NRC WBN Project Manager on September 21, 2004 by electronic mail concerning TVA's 60-day response dated August 8, 2004. The Enclosure provides the response to those concerns.

There are no regulatory commitments associated with this submittal. If you have any questions about this proposed change, please contact me at (423) 365-1824.

I declare under penalty of perjury that the foregoing is true and correct. Executed on this 19th day of November 2004.

Sincerely,

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

Enclosure
cc: See page 2

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Enclosure
cc (Enclosure):

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ENCLOSURE

WATTS BAR NUCLEAR PLANT (WBN) UNIT 1
BULLETIN 2003-01 CONTAINMENT SUMP BLOCKAGE
REQUEST FOR ADDITIONAL INFORMATION (RAI)

ENCLOSURE

WATTS BAR NUCLEAR PLANT (WBN) UNIT 1
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By letter dated August 8, 2003, TVA provided the 60-day response to Bulletin 2003-01 for the WBN Unit 1. The Bulletin requested TVA to either (1) state that the emergency core cooling system (ECCS) and containment spray system recirculation functions have been analyzed with respect to the potentially adverse post-accident debris blockage effects identified in the Bulletin and are in compliance with all existing applicable regulatory requirements, or (2) describe any interim compensatory measures that have been implemented or that will be implemented to reduce the interim risk associated with potentially degraded or nonconforming ECCS and containment spray system recirculation functions until an evaluation to determine compliance is complete. NRC requested by electronic mail (e-mail) on September 21, 2004, the following information in order to complete the review:

QUESTION 1

On page E1-4 and page E1-5 of Enclosure 1 of your Bulletin 2003-01 response, you discussed a number of training efforts related to the sump clogging issue: a shift order revision; licensed operator training for a revised emergency operating procedure to include information on mechanisms for sump clogging; available indications [e.g., pump flow/pump current]; actions in response to sump blockage; sump clogging scenarios run in the Watts Bar reactor simulator, and training for technical support center (TSC) and CECC personnel on revised Technical Instruction TI-128. However, your response does not completely discuss the operator and technical assistance personnel training to be implemented. Please provide a detailed discussion of the operating and technical assistance procedures to be implemented, the indications of sump clogging that the operators are instructed to monitor, and the response actions the operators are instructed to take in the event of sump clogging and loss of ECCS recirculation capability.

RESPONSE

TVA's Emergency Operating Procedure ES-1.3, "Transfer to Containment Sump," Appendix D, "Monitoring for Containment Sump Blockage," is initiated after the ECCS and containment spray system have been realigned for sump recirculation. ES-1.3, Appendix D, requires operators to record the following initial baseline readings after cold leg recirculation is established to aid in monitoring for sump blockage:

- Residual heat removal (RHR) pump flows, motor currents, and discharge pressures
- Safety injection (SI) pump flows, motor currents, and discharge pressures
- Containment spray pump flows and motor currents
- Centrifugal charging pump (CCP) flow, motor currents, header pressure and boron injection tank 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)
- RHR spray flow, motor current and discharge pressure (if placed in service)

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, ES-1.3 Appendix D, 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)
- Containment spray 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 leakage or 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 containment spray and ECCS (if both trains are running) and initiate makeup to the RWST. The procedure contains a note which reminds operators of the basis for stopping one train of containment spray 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 ES-1.3, Appendix D on monitoring for indications of the onset of sump blockage, the ES-1.3 step (which initiates Appendix D) directs monitoring for indications of cavitation on running ECCS and containment spray 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 containment spray pumps, then stop containment spray pumps and place handswitches in PULL TO LOCK
- If ECCS or containment spray flow is lost due to sump blockage, then transition to ECA-1.1, "Loss of RHR Sump Recirculation."

Licensed operators received training on ES-1.3 and Appendix D, 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, licensed operators have had simulator training on ES-1.3, Appendix D.

The TSC technical assessment team procedure has the following guidance if indications of sump clogging are observed:

- Evaluate reducing containment spray flow and ECCS flow by stopping one train. This is expected to slow the rate of debris buildup and will reduce the differential pressure across the sump screens. If containment pressure is not excessive, reducing containment spray flow to single train is preferred over reducing ECCS flow. Caution should be

exercised since deliberately stopping one train of ECCS or containment spray may violate accident analysis assumptions.

- Evaluate the need for RWST refill to allow realigning pump suction to RWST. Caution should be exercised prior to pumping an additional large water volume into containment due to the potential for containment flooding resulting in loss of instrumentation and eventual loss of containment integrity.
- If sump clogging results in severely degraded flow, then evaluate the need for entry into Emergency Operating Instruction ECA-1.1, "Loss of RHR Sump Recirculation." This ECA initiates actions to refill the RWST, allows reducing or stopping containment spray flow, initiates RCS cooldown/depressurization, and initiates RCS makeup from alternate source (normal charging).
- Briefly stopping and then restarting all flow across sump screens (by stopping all ECCS and containment spray) may allow debris to fall. This action should NOT be recommended without carefully considering the impact on core temperatures and containment pressure.

Training has been provided to the technical assessment team to familiarize the team with the concerns for sump blockage and cover the procedural steps as committed in the August 8, 2003, letter concerning the bulletin.

QUESTION 2

On page E1-6 of Enclosure 1 of your Bulletin 2003-01 response you state that "TVA will perform a licensing evaluation to consider preemptive actions that delay or reduce ECCS and CSS flow during a LOCA. A licensing evaluation will be completed by December 15, 2003." Please provide a detailed discussion of the results of this licensing evaluation, including planned or completed procedural changes, design changes and/or licensing changes, as well as any associated training efforts. For the training efforts, as above, please provide a detailed discussion of the operating and technical assistance procedures to be implemented, the indications of sump clogging that the operators are instructed to monitor, and the response actions the operators are instructed to take in the event of sump clogging and loss of ECCS recirculation capability.

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WATTS BAR NUCLEAR PLANT (WBN) UNIT 1
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REQUEST FOR ADDITIONAL INFORMATION (RAI)

Response

The adequacy of the ECCS in mitigating a Loss of Coolant Accident (LOCA) is based on minimum safeguards. That is, one-of-two trains of ECCS in operation. If only one train of ECCS were in operation at a reduced flowrate, significant reanalysis would be required to determine the reduction in margin to the peak cladding temperature (PCT) acceptance criteria for this fission product barrier.

In a LOCA, PCT occurs when the ECCS pumps are taking suction from the RWST. However, the flow rate from the ECCS pumps is not designed to be adjusted during a design basis accident (DBA). Therefore, the ECCS pump flow rate cannot be reduced when taking suction from the containment sump without also reducing the flow rate when taking suction from the RWST. As discussed above, the adequacy of the ECCS in mitigating a LOCA-DBA is based on one-of-two trains of ECCS in operation. When both trains of ECCS are in operation, flow from the containment sump could be reduced by shutting down the redundant train. However, when both trains are in operation, a single failure has not occurred. Should a single failure which disables the operating train of engineered safety features (ESF) occur after the redundant train has been shutdown, operators would need to identify the loss of the operating train of ECCS and restart the standby train. Implementing this change would require significant analyses be performed to determine the amount of time available to restart a standby train of ECCS and still meet fission product barrier acceptance criteria.

WBN is an ice condenser plant. The ice is used to provide containment pressure control early in the event. The containment spray 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 containment spray heat exchangers. WBN does not have fan coolers that can be used for containment pressure control and heat removal that are typically found in many dry containment designs. As such, completely shutting off containment spray is not an option for WBN. It is important that switchover to sump recirculation occur prior to ice bed melt-out. If the spray trains have to be shutdown to perform the switchover at the same time 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 to ensure that a single failure would not result in the loss of all containment

spray flow. 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 design pressure.

It is TVA's position that preemptive actions that delay or reduce ECCS or containment spray during a LOCA, are beyond what would be expected to be implemented in response to the bulletin. It is also TVA's position that the design decisions that TVA made to use only stainless steel reflective insulation on the RCS and limit the use of fibrous material in the containment to preclude sump blockage, should receive at least equal credit as any interim measures which might have limited affect on sump blockage and which could challenge the containment design or core cooling.

QUESTION 3

On page E1-1 of Enclosure 1 of your Bulletin 2003-01 response you state that "TVA has been a participant in the Nuclear Energy Institute (NEI) Sump Task Force since its inception." The Westinghouse Owners Group (WOG), in an effort closely related to the NEI Sump Task Force efforts, 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.

RESPONSE

The Westinghouse Owners Group (WOG) developed eleven candidate actions to reduce the potential for sump blockage. Of these eleven, ten 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 percent capacity spray

trains and two 50 percent capacity fan coolers for post-LOCA heat removal. The TVA ice condenser plants have two 100 percent 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 containment spray setpoint due to the operation of the fan coolers. Very small RCS breaks initiate containment spray at an ice condenser plant.

A1a - Operator Action to Secure One Spray Pump

This action proposes turning off one containment spray prior to initiating sump recirculation. WBN has two containment spray trains. Each pump provides a minimum flow rate of 4,000 gallons per minute (gpm). The spray system also includes two containment spray heat exchangers for removing energy from the containment after sump recirculation. The design basis LOCA presented in the Final Safety Analysis Report (FSAR) 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 containment spray pump. It is important that the containment spray 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 containment spray pump.

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

- According to the Westinghouse evaluation in WCAP-16204, *Engineering Evaluation and Analyses Report - Evaluation of Potential ERG and EPG Changes to Address NRC Bulletin 2003-01 Recommendations (PA-SEE-0085)*, 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 WBN 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 containment spray train in operation at the minimum calculated injection mode flow (4,300 gpm) ECCS sump recirculation will be initiated no later than approximately 58 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 with two trains of containment spray in operations, will be no more than approximately 29 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 design value. WBN 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 WBN. 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 plant, even very small breaks (1,000 gpm) result in actuation of the containment spray system within about three minutes of the event. Most dry containments would not even actuate sprays for a 1,000 gpm break. Thus the timing is not favorable. It should be noted that small breaks do not generate much debris. Since WBN has RMI for insulation on the RCS, the likelihood of sump blockage for events which this could be considered, are unlikely to result in blockage.

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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 WBN and it would require a license amendment to implement due to single failure considerations. An additional factor that reduces the value of this action, is that the containment spray flow rate is higher than the ECCS flow rate. For WBN, recirculation alignment of the ECCS could occur as early as ten minutes. A single failure on the operating ECCS train would result in loss of all core cooling; TVA is not aware of analyses that support loss of 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 the recommendation for the next proposed action that it was not recommended due to the rapid operator recognition and reaction needed. Because of the short time to start recirculation, TVA had similar concerns and, as such, this action is not considered justifiable.

Action A4 - Early Termination of One LPSI/RHR Pump Prior to Recirculation Alignment

This proposed change will extend the injection time and reduce the flow rate through the sump. This change is less beneficial for WBN than for 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 to support an 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 the fact there is limited debris sources available for transport to the sump and there is the high available net positive suction head (NPSH), 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

WBN has procedures in place to refill the RWST and steps in ES-1.3 to notify the TSC technical assessment team to evaluate the need for RWST refill if containment sump level is dropping.

Action A6 - Inject more than One RWST Volume

After the RWST is injected into the containment, the water level inside the containment is approximately at the mid-plane of the RCS piping. Water is present on the outside of the reactor vessel up to 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 WBN emergency procedures. Procedure ES-1.2, *Post LOCA Cooldown and Depressurization,* provides the guidance to cool the RCS at a rate up to 100 degrees Fahrenheit (F) per hour. TVA does not consider 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 generator. Even for very small breaks, the RCS cools down at a rate in excess of 100 degrees F per hour. By the end of the first hour, WBN will already be on sump recirculation because of containment spray actuation. Therefore, cooling down at the limit does not change the likelihood of sump blockage as the spray flow rate dominates the sump flow for small breaks. The fact that WBN uses RMI as the RCS insulation, 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 Appendix D to Emergency Procedures ES-1.3. 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, 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 into the emergency operating procedures. TVA's current schedule for

developing this procedure is being tracked in the TVA's Corrective Action Program and should be completed in 2005.

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 for Sequoyah in 1990 assuming LOCA blowdowns ranging from 120 to 2,000 gpm to determine the time to containment spray actuation. These analyses are also applicable to WBN. 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 containment spray initiation setpoint would be required to prevent automatic containment spray 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 2,000 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 containment spray. 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 smaller breaks (<500 gpm) would be very small. A one-inch pipe would produce about 2,000 gpm. Sump blockage is not considered to 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 considered to be 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 implementation.

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REQUEST FOR ADDITIONAL INFORMATION (RAI)

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.

RESPONSE

As a participant in the WOG program, TVA proposed the action of raising the containment spray setpoint that was evaluated in the WOG program. TVA also considered having the operators stop all spray pumps for very small LOCAs prior to the WOG effort. This action was not implemented as described in TVA's response to Questions 2 and 3 above. TVA has not identified other compensatory actions that would reduce the risk of sump blockage. TVA considers the actions that were 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 containment spray 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.