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

APR 1 1 2006

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

Gentlemen:

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

WATTS BAR NUCLEAR PLANT (WBN) UNIT 1 - 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 NO. MC4730)

The purpose of this letter is to provide TVA's response to the subject RAI dated February 10, 2006. The responses to this RAI supplements TVA's letters dated March 7, July 21, and September 1, 2005, concerning NRC's generic letter.

The Enclosure provides TVA's responses to NRC's concerns. There are no new Regulatory Commitments identified in this letter. If you have any questions concerning this matter, please call P. L. Pace at (423) 365-1824.

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

Sincerely,

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

Enclosure
cc: See Page 2

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Enclosure
cc (Enclosure):

NRC Resident Inspector
Watts Bar Nuclear Plant
1260 Nuclear Plant Road
Spring City, Tennessee 37381

Mr. D. V. Pickett, Senior Project Manager
U.S. Nuclear Regulatory Commission
MS 08G9a
One White Flint North
11555 Rockville Pike
Rockville, Maryland 20852-2738

U.S. Nuclear Regulatory Commission
Region II
Sam Nunn Atlanta Federal Center
61 Forsyth St., SW, Suite 23T85
Atlanta, Georgia 30303

ENCLOSURE

WATTS BAR NUCLEAR PLANT (WBN) UNIT 1
GENERIC LETTER 2004-02 CONTAINMENT SUMP RECIRCULATION
RESPONSE TO REQUEST FOR ADDITIONAL INFORMATION

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

PLANT MATERIALS

NRC QUESTION 1

(Not Applicable).

NRC QUESTION 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).

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RESPONSE TO REQUEST FOR ADDITIONAL INFORMATION

RESPONSE

The following quantities in square feet (ft^2) of materials are present in WBN's containment:

Material in Containment

	Total (ft^2)	Submerged (ft^2)	Spray zone (ft^2)
Aluminum	843	257	586
Zinc:			
Coatings	821,000	351,000	347,000
Galvanized	477,000	135,000	136,000
Total Zinc	1,298,000	486,000	483,000
Copper *	29,700	29,700	0
Carbon Steel **	286,000	57,000	229,000
Uncoated Concrete**	37,000	3,700	33,300

* The copper existing in the Lower Containment Cooler Coils is not tabulated, as it is not submerged and does not exist in the spray zone.

** Conservatively considered to be 100 percent affected by either submergence or spray.

A comparison of the plant specific materials and the materials used in the NRC's nuclear industry jointly-sponsored ICET, Test 5 specifically is provided below:

Submerged Material (ft^2)

Material	ICET 5	WBN	WBN/ICET ratio
Zinc in Galvanized Steel	19,600	135,000	6.9
Inorganic Zinc Primer Coating (non-topcoated)	9,000	351,000*	39
Inorganic Zinc Primer Coating (topcoated)	0	*	
Aluminum	8,500	257	0.03

Copper	73,500	29,700	0.4
Carbon Steel	2,500	57,000	23
Concrete (surface)	750	3,700	4.9

Material in Spray Zone (ft^2)

Material	ICET 5	WBN	WBN/ICET ratio
Zinc in Galvanized Steel	372,400	136,000	0.37
Inorganic Zinc Primer Coating (non-topcoated)	216,400	347,000*	1.6
Inorganic Zinc Primer Coating (topcoated)	0	*	
Aluminum	162,900	586	.0036
Copper	220,500	0	--
Carbon Steel	4,850	229,000	47
Concrete (surface)	1,450	33,300	23

*The non-topcoated zinc primer value includes the topcoated quantities.

NRC QUESTION 3

Identify the amount (surface area) and materials (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.

RESPONSE

WBN can have up to 150 ft^2 aluminum scaffolding stored in containment. However, none of the scaffolding stored in containment is inside the crane wall and thus, is not in the submerged area of the active sump. The total amount of scaffolding was included in the quantity of aluminum in the spray zone.

NRC QUESTION 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.

RESPONSE

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

CONTAINMENT POOL CHEMISTRY

NRC QUESTION 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.

RESPONSE

The expected sump pH is 7.8 to 8.2 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 (RWST), and in 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.

NRC QUESTION 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.

RESPONSE

ICET 5 is the test most representative of the WBN environment. The boron concentration in the test is 2800 parts per million (ppm) versus a maximum WBN concentration of 3300 ppm. The buffer is sodium tetraborate contained in the ice of the ice condenser. A concentration for the sodium tetraborate is not calculated. The solution used to form the ice is sampled and has to have a boron concentration of 1800 to 2000 ppm and the pH is required to be between 9.0 and 9.5. The test pH range is 8.0 to 8.5 and the WBN sump pH is between 7.8 and 8.2 as discussed in the response to Question 5. The amount of aluminum is much higher in ICET 5 than is present in the plant. Since aluminum is the predominant precipitant, this difference is significant. The other significant difference is the ICET temperature is much higher than is present in the plant. 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-NP, *Evaluation of Post-Accident Chemical Effects in Containment Sump Fluids to Support GSI-191*) showed a total of 10 mg/l for the precipitants based on the total weight of the precipitants. The concentrations based on the elemental values were lower. The precipitants predicted by the Westinghouse correlations were composed mainly of $NaAlSi_3O_8$ with a small amount of AlOOH.

NRC QUESTION 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.

RESPONSE

The minimum time for the start of residual heat removal (RHR) recirculation from the sump is 14 minutes. This is the time assuming both ECCS and containment spray trains are running. The active pool volume is 32,430 cubic feet (ft^3) with a temperature of 168 degrees Fahrenheit (F). The active pool volume at 24 hours is 49,000 ft^3 with a pool temperature of 125 degrees F. The sump temperature is based on single train operation with the maximum ultimate heat sink temperature and highest RWST temperature. The minimum RWST injected volume was used.

PLANT-SPECIFIC CHEMICAL EFFECTS

NRC QUESTION 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.

RESPONSE

Sump screen tests were conducted for TVA by Framatome ANP (subcontracted to Alden Research Laboratory, Inc.) during the week of November 27-30, 2005. TVA included concentrations of chemical precipitants in the sump screen tests that significantly bound the concentrations that would be present in the WBN sump during post-LOCA operation. The new sump strainers include a 50 percent increase in required area to accommodate chemical effects that were unknown at the time of the initial strainer selection. Also the screen area is sufficiently large that a fiber bed cannot form on the advanced strainer design. That is, the total amount of estimated fiber load getting to the strainer is lower than the amount necessary to form a uniform thin bed. Chemical precipitants are not a head loss contributor when a fiber bed does not exist. Therefore, the net positive suction head (NPSH) available is not impacted due to chemical effects. TVA has completed all actions associated with chemical effects evaluations.

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NRC QUESTION 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.

RESPONSE

TVA already uses a sodium tetraborate buffer, which 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 WBN.

NRC QUESTION 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.

RESPONSE

TVA included concentrations of chemical precipitants in the sump screen tests that significantly bound the concentrations that would be present in the WBN sump post-LOCA. The new sump strainer design includes a 50 percent increase in required area to accommodate chemical effects that were unknown at the time of initial strainer selection. Also the screen 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. In addition, WBN specific testing was performed assuming a chemical concentration of 89 mg/l, composed of 55 mg/l of aluminum hydroxide and 34 mg/l of calcium carbonate. The WBN plant specific evaluation showed that the concentrations would be 10 mg/l. Finally, the total weight of expected chemical precipitants at WBN from the Westinghouse methodology is approximately 37 pounds. This compares with an actual design basis case particulate weight of over 1900 pounds. The total amount of chemical precipitant is negligible compared to the other debris. The numbers provided above are based on the 10D zone of influence (ZOI) for qualified coatings. The definition of 'D' is the diameter of the high energy source. For the case where all coatings fail the particulate load is over 50,500 pounds. This makes the chemical constituents even less a concern.

PLANT ENVIRONMENT SPECIFIC

NRC QUESTION 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 test. 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.

RESPONSE

TVA has not performed and does not anticipate performing plant specific chemical effects tests. TVA has performed plant specific head loss tests. These tests were performed by Framatome ANP as discussed in the response to Question 8. The test environment was a flume test using tap water at cold temperatures (51 degrees F nominal). Since no fiber bed can form on the WBN sump screen because of the amount of screen area available compared with the available fiber, chemical precipitants would not impact head loss in a manner different than any other particulate debris. Therefore, the behavior of chemical surrogates due to differences between the test environment and containment pool conditions is not a factor at WBN.

NRC QUESTION 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 a providing this information to the NRC.

RESPONSE

The testing done for WBN 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

NRC QUESTION 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.

RESPONSE

The quantities of materials used in the WBN 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 Owners Group (WOG) Chemical Effects Tests, a quantification of the precipitants generated when the sump cooled to approximately 70 degrees F was made. The scaled quantities of chemical precipitant surrogates used in the flume tests were approximately 5.5 times greater than would be seen in the plant. These quantities then contributed to any head loss measured. The quantities are also reflected in the material carried through the strainer and would impact a downstream effects evaluation.

TRISODIUM PHOSPHATE PLANTS

NRC QUESTION 14

(Not applicable).

NRC QUESTION 15

(Not applicable).

NRC QUESTION 16

(Not applicable).

ADDITIONAL CHEMICAL EFFECTS QUESTIONS

NRC QUESTION 17

(Not applicable).

NRC QUESTION 18

(Not applicable).

NRC QUESTION 19

(Not applicable).

NRC QUESTION 20

(Not applicable).

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RESPONSE TO REQUEST FOR ADDITIONAL INFORMATION

NRC QUESTION 21

(Not applicable).

NRC QUESTION 22

(Not applicable).

NRC QUESTION 23

The Watts Bar GL 2004-02 response indicates that the critical parameters in the ICET #5 bound the plant parameters. This response also indicates the post-accident pH in the Watts Bar sump ranges from 7.5-10 pH, but will generally be less than the value used in testing. Given the ICET #5 pH ranged between 8 and 8.5, discuss how your plant-specific chemical effects evaluation accounts for potential pH levels greater than those tested in ICET #5.

RESPONSE

While a range was given, the actual WBN sump pH will be 7.8 to 8.2. The quantity of precipitants in ICET 5 is considerably higher than that predicted by the Westinghouse methodology. There are two principal reasons for this. The amount of submerged aluminum used in ICET 5 was 33 times greater than that present in WBN and the WBN sump temperature is lower. The aluminum oxidizes at a higher rate with higher temperatures. WBN specific testing was done using very conservative quantities of precipitant material.

NRC QUESTION 24

(Not applicable).

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COATINGS

Generic - All Plants

NRC QUESTION 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.

RESPONSE

The WBN strainers were tested assuming all coatings failed whether qualified or not. The resulting head loss from the strainer is a small fraction of the pump NSPH available. Thus, no further assessment of the condition of coatings in the plant is needed.

NRC QUESTION 26

(Not applicable).

NRC QUESTION 27

(Not applicable).

NRC QUESTION 28

(Not applicable).

NRC QUESTION 29

(Not applicable).

NRC QUESTION 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 a 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 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, provide justification to support your assumptions.

RESPONSE

The WBN sump strainer is designed so that no fiber bed, thin or thick, can form. The base case testing was done assuming all paint debris was 10 micron particulates. Additional testing was performed using paint chips. A range of chip sizes were tested and virtually none transported whether small (less than 1/32 inch) or large (greater than 1/2 inch). The paint chip size distribution used in the WBN specific testing is such that greater than 95 percent of the paint chips were greater than the sump screen opening of 0.085 inches nominal and thus is conservative. There was very little change in measured head loss whether chips or particulates were used. It is also noteworthy that there was only a small increase in head loss when all coatings were assumed to fail when compared to the base case. The head loss difference between the particulate cases and the chip cases was less than 0.05 feet.

NRC QUESTION 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.

RESPONSE

TVA did not take samples for latent debris in containment. The WBN generic letter response dated September 1, 2005, stated that a quantitative latent debris walkdown had not been performed. TVA committed in that response to perform a quantitative latent debris walkdown during the Unit 1 Cycle 7 refueling outage.

A quantitative latent debris walkdown was performed at TVA's Sequoyah Nuclear Plant (SQN). That walkdown was an "as found" evaluation performed at the start of the refueling outage. There had been no special containment cleaning. The walkdown found small quantities of particulate debris such as rust, paint, and dust. Only a few latent fibers were found. Based on the results of the SQN walkdown and the fact that the WBN containment cleanliness procedures are almost identical to SQN cleanliness procedures, it is expected that the WBN results for latent debris quantities would be similar to those at SQN. However, WBN used the quantities recommended in Nuclear Energy Institute (NEI) Guidance Report 04-07, *Pressurized Water Reactor Sump Performance Evaluation Methodology*, for latent material including 12.5 ft^3 for latent fiber. The latent particulate quantities are insignificant compared to the paint debris, 170 pounds of latent particulate compared to 1900 pounds of paint debris. The use of 12.5 ft^3 is extremely conservative compared to the results of the SQN walkdown. The WBN latent debris results from the Cycle 7 refueling outage scheduled walkdown are not expected to exceed the quantities recommended in NEI 04-07. If quantities are exceeded, reevaluation of the head loss, including testing, maybe required.

NRC QUESTION 32

You indicated that you would be evaluating downstream effects in accordance with WCAP 16406-P. The NRC is currently involved in discussions with the Westinghouse Owner's Group

(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.

RESPONSE

No response required until the generic resolution between WOG and NRC is complete.

NRC QUESTION 33

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?

RESPONSE

The WBN 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 head loss will have a negligible effect on the pump NPSH available. No additional active features were needed.

NRC QUESTION 34

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.

RESPONSE

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 10D ZOI was used for qualified coatings in the base case. All four loops were evaluated. The volume of the lower compartment is approximately 248,000 ft^3. The volume of the sphere for a 28.6D zone is 1,690,000 ft^3. Eighty to ninety percent of the lower compartment is within the ZOI for any break location. Moving the break location five feet or ten feet or any value would not significantly change the amount of debris generated. Thus, the break location on the pipe, has minimal impact on how much debris is generated.

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NRC QUESTION 35

The staff's 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 Watts Bar break selection analyses.

RESPONSE

WBN is not a Regulatory Guide 1.82, "*Water Sources for Long-Term Recirculation Cooling Following a Loss-of-Coolant Accident,*" Revision 3, plant nor did TVA commit to conform to this revision of the Regulatory Guide. However, the following factors as described in Section 1.3.2.3 of Regulatory Guide 1.82, Revision 3 were considered in determining 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 small break LOCAs (SBLOCAs) and LBLOCAs at WBN. 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 four loops.

Break 2: Two or More Types of Debris

All of the breaks discussed above encompass this break scenario since multiple types of debris are present in each loop.

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 Loops 3 and 4, a break in both of these cases would have the most direct path to the sump.

Break 4: Largest Particulate to Insulation Ratio

The WBN debris spreadsheet identified Min-K, 3M-M20C, and reflective metallic insulation (RMI) within containment. Of these three types of insulation, RMI is the least problematic. RMI does not transport as easily as particulate and is not a major factor in developing head loss. Min-K is predominantly a particulate insulation material. This insulation is in various locations close to the main steam lines and steam generators. A LBLOCA at any of the RCS pipes in any of the four loops would destroy most of the Min-K in the vicinity of its loop and also the loop adjacent to it (i.e. a break in Loop 1 would destroy the Min-K in Loops 1 and 4). There is a small amount of the 3M-M20C insulation that would be destroyed in a Loop 1 or 2 break with no 3M-M20C insulation destroyed in a Loop 3 or 4 break. Therefore, as the quantity of RMI is not significant and the quantity of Min-K would be relatively the same for each break, the bounding case for each loop is which RCS break would destroy the most coatings. In addition, the debris transport calculation applies the largest quantity of Min-K and 3M-M20C destroyed for any loop to the bounding case for coating debris. A thorough analysis has shown that a break in each of the crossover legs near the steam generator nozzle yields the most coating debris. SBLOCAs do not produce as much debris as the LBLOCAs, nor would a SBLOCA destroy as much total Min-K or 3M-M20C as a LBLOCA due to the large percentage of lower containment that a LBLOCA (28.6D ZOI) envelopes.

Break 5: Potential Formation of the Thin-Bed Effect

With the exception of a small amount of the 3M-M20C insulation, Min-K insulation and latent fibers, WBN has no fibrous debris in containment. The sump strainer area is large enough that there is not enough fiber in containment to form a thin bed on the advanced strainer design. That is, the total amount of estimated fiber load getting to the strainer is lower than the amount necessary to form a uniform this bed of 1/8 inch to 1/4 inch in thickness on the strainer surface area of approximately 4600 square feet. A bounding debris generation case was used that included the largest amount of 3M-M20C debris.

NRC QUESTION 36

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 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.

RESPONSE

TVA did not deviate from the SE-approved methodology. Stainless steel RMI was assumed to fail as 75 percent small pieces and 25 percent as large pieces. Particulate debris was assumed to be 10 micron particles. No large particulate was postulated. The 3M-M20C fire wrap insulation and the latent fiber debris was assumed to all be individual fibers. Min-K insulation was treated as 100 percent fines. Min-K was assumed to fail as 20 micron SiO_2 agglomerate, 2.5 micron TiO_2 particulate, and 6 micron individual fibers. The composition of Min-K is 20 percent fiber, 65 percent SiO_2, and 15 percent TiO_2. No large pieces were assumed to be present.

NRC QUESTION 37

Watts Bar operates with a tritium producing core which requires much higher boron concentration levels in the refueling water storage tank. Please discuss how this might influence a new screen design, particularly from a chemical effects perspective?

RESPONSE

The current maximum boron concentration in the RWST is 3300 ppm. Raising the boron concentration in the RWST reduces the long term sump pH. Reducing the pH reduces the quantity of precipitants that can form in the sump as aluminum corrosion increases as sump pH increases. An evaluation of initial sump pH as low as 4.1 did not result in different precipitants and, as described above, resulted in less precipitants than when a pH of 4.4 was used as the initial value. The Westinghouse chemical testing evaluations included this pH range. The results were well within the bounds of the precipitants that formed in ICET 5. Thus, the strainer design is unaffected.

NRC QUESTION 38

Has debris setting 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.

RESPONSE

No, settling of debris upstream of the sump strainer will not be used to support sizing of the replacement strainers.

NRC QUESTION 39

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.

ENCLOSURE

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RESPONSE TO REQUEST FOR ADDITIONAL INFORMATION

RESPONSE

There are no vents between the sump and the containment atmosphere when recirculation from the sump is initiated after a design basis accident. The sump strainers are designed such that the strainers remain submerged for a SBLOCA and LBLOCA.