Tennessee Valley Authority, 1101 Market Street, Chattanooga, Tennessee 37402

April 30, 2013

10 CFR 50.4
10 CFR 50.90

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

Watts Bar Nuclear Plant Unit 1
Facility Operating License No. NPF-90
NRC Docket No. 50-390

Subject: **Response to NRC Health Physics and Human Performance Branch Request for Additional Information Related to License Amendment Request for Watts Bar Nuclear Plant (WBN) Unit 1 Updated Final Safety Analysis Report Changes Associated with Hydrologic Analysis (TAC No. ME9130)**

References:
1. TVA Submittal to NRC Document Control Desk, "Application to Revise Watts Bar Nuclear Plant Unit 1 Updated Final Safety Analysis Report Regarding Changes to Hydrologic Analysis, TAC No. ME8200 (WBN-UFSAR-12-01)," dated July 19, 2012 (ADAMS Accession No. ML122360173).

2. Letter from NRC to TVA, "Watts Bar Nuclear Station, Unit 1 - Request for Additional Information Related to License Amendment Request to Updated Final Safety Analysis Report Changes Associated with Hydrologic Analysis (TAC No. ME9130)," dated March 1, 2013 (ADAMS Accession No. ML13046A112).

By letter dated July 19, 2012 (Reference 1), Tennessee Valley Authority (TVA) submitted a request for an amendment to the Facility Operating License No. NPF-90 for the Watts Bar Nuclear Plant (WBN) Unit 1. The license amendment request (LAR) proposed to revise the WBN Unit 1 Updated Final Safety Analysis Report (UFSAR) to reflect the results from new hydrologic analysis. These proposed changes are consistent with the latest approved hydrology calculations.

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NRL

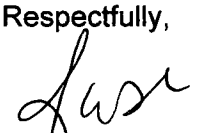
By letter dated March 1, 2013 (Reference 2), the Nuclear Regulatory Commission (NRC) forwarded a request for additional information (RAI) originating from the NRC Health Physics and Human Performance Branch (AHPB). The response to the RAI was due 30 days from its date of issuance, or March 31, 2013. However, as discussed with the NRC staff, TVA received an extension of the due date for the response to April 30, 2013.

Enclosure 1 to this letter provides TVA's response to this RAI. There are no changes required to the LAR as submitted in the Reference 1 letter as a result of this additional information. Consistent with the standards set forth in 10 CFR 50.92(c), TVA has determined that the additional information as provided in this letter does not affect the no significant hazards considerations associated with the proposed amendment previously provided in Reference 1. TVA has further determined that the proposed amendment still qualifies for a categorical exclusion from environmental review pursuant to the provisions of 10 CFR 51.22(c)(9). Additionally, in accordance with 10 CFR 50.91(b)(1), TVA is sending a copy of this letter, the enclosures, and the attachments to the Tennessee Department of Environment and Conservation.

There are no new regulatory commitments included in this submittal. Please address any questions regarding this submittal to Ed Schrull at (423) 751-3850.

I declare under penalty of perjury that the foregoing is true and correct. Executed on this 30th day of April 2013.

Respectfully,



J.W. Shea
Vice President, Nuclear Licensing

Enclosure:

1. Response to NRC Health Physics and Human Performance Branch (AHPB) Request for Additional Information (RAI)

cc (Enclosures):

NRC Regional Administrator - Region II
NRC Senior Resident Inspector – Watts Bar Nuclear Plant, Unit 1
Director, Division of Radiological Health, Tennessee State Department of Environment and Conservation

ENCLOSURE 1

TENNESSEE VALLEY AUTHORITY
WATTS BAR NUCLEAR PLANT
UNIT 1

RESPONSE TO NRC HEALTH PHYSICS AND HUMAN PERFORMANCE BRANCH (AHPB)
REQUEST FOR ADDITIONAL INFORMATION (RAI)

Subject: **Application to Revise Watts Bar Nuclear Plant Unit 1 Updated Final Safety Analysis Report Regarding Changes to Hydrologic Analysis, (WBN-UFSAR-12-01)**

1.0 AHPB RAI Question 1

What, if any, operator actions are being changed, added or deleted?

1.1 TVA Response - AHPB RAI Question 1

As described in the WBN license amendment request (LAR), because the probable maximum flood (PMF) and design basis flood (DBF) levels at various plant locations that would occur by the limiting large rainfall and seismically induced dam failure floods are increased from those currently provided in the WBN Unit 1 UFSAR, there are two distinct changes to the physical flooding protection features of WBN Unit 1 required. These two changes are discussed below.

As described in the WBN LAR, the Intake Pumping Station (IPS) is designed to have the Essential Raw Cooling Water (ERCW) System and the High Pressure Fire Protection (HPFP) System remain fully functional for the DBF. The revised DBF elevation for the critical face of the IPS results in the possibility of flooding of the IPS impacting ERCW equipment required for flood mode operation located on elevation 722 ft. As a result of this increase, a compensatory measure of staged sandbags to be constructed into a berm at any time prior to or during the event of a Stage I flood warning was implemented. Future plans exist for two temporary flood barriers designed to be installed at any time prior to or during the event of a Stage I flood warning instead of the use of sandbags. The temporary flood barriers will prevent floodwater intrusion through the elevation 741 ft Stairwell 1L door W1 and Stairwell 1R door W2 into elevation 722 ft floor, and provide a two foot margin above the DBF elevation which includes wind wave run-up to the IPS. These barriers will protect the electrical equipment associated with the ERCW and HPFP pumps and motors, with permanent mounting locations and storage racks located nearby. Further details are provided in the response to AHPB RAI Questions 8 and 9.

As described in the WBN LAR, the Service, Turbine, Auxiliary, and Control Buildings are permitted to flood as the water exceeds the plant level entrances. No permanent barriers to specifically protect flood sensitive plant equipment exist in any of these structures. However, the revised DBF elevation inside of the Auxiliary Building results in the possibility of flooding of the Thermal Barrier Booster (TBB) Pump Motors. As a result of this increase, a permanent plant modification including permanent engineered

flood barriers has been completed to protect the TBB Pump Motors from a DBF. This plant modification and the required actions for installation of permanent engineered flood barriers are discussed further in the response to AHPB RAI Question 9.

As described in the WBN LAR, the Stage I and Stage II Flood Warning times remain at 10 hours and 17 hours, respectively. The only change as a result of the reevaluation is the revised forecasted plant site water levels where Stage I Flood Warning actions are required to begin. The Stage I threshold levels are addressed in the TVA River Operations instructions that determine when the WBN site should be notified of a Stage I Flood Warning. These revised action levels do not change, add, or delete WBN site flood mode preparation actions, only the entry point criteria for the abnormal operating instruction (AOI) for external flooding. These revised action levels will be incorporated in the TVA River Operations instructions prior to implementation of the final NRC-approved license amendment in accordance with TVA procedures.

There are no other changes, additions, or deletions to WBN Unit 1 site flood mode preparation actions based on the revised PMF and DBF levels, or the reevaluation of flood warning times, in the updated hydrologic analysis.

There are other flood mode preparation actions that have been revised as improvements were identified as a result of simulations and validation of the AOI and instructions performed by TVA. These changes are not required as a result of the updated hydrologic analysis, but rather as a result of improving implementation of flood mode preparation and operation procedures and instructions to ensure the current licensing basis requirements for meeting flood warning times are met.

2.0 AHPB RAI Question 2

Have there been any changes to training? Please provide any information regarding changes to training or qualifications as a result of this LAR.

2.1 TVA Response - AHPB RAI Question 2

Changes to WBN site procedures and instructions are evaluated as part of the existing Site Training Program. These changes to the procedures and instructions to comply with the WBN UFSAR changes are required to be implemented prior to the implementation date of the final NRC-approved license amendment.

The required changes to the procedures and instructions have been identified, and a training needs analysis in accordance with the Site Training Program will determine the final content and schedule for training. Changes to abnormal operating instructions that require training are communicated through the use of a standing order to brief operators on the major changes, and classroom training is conducted during the next scheduled licensed operator requalification cycle.

ENCLOSURE 1

RESPONSE TO NRC HEALTH PHYSICS AND HUMAN PERFORMANCE BRANCH (AHPB) REQUEST FOR ADDITIONAL INFORMATION (RAI)

3.0 AHPB RAI Question 3

It is not clear from the submittal whether a new task analysis was completed to identify any functional requirements. Please describe any new task analysis results that may provide insight into function allocation.

3.1 TVA Response - AHPB RAI Question 3

Abnormal Operating Instruction AOI-7.01, "Maximum Probable Flood," controls the overall timing and sequence of implementing actions for flood mode preparations and operations, and utilizes implementing work orders, general operating instructions, emergency operating instructions, flood preparation maintenance instructions, and other AOIs to complete the required actions by the applicable WBN site organizations. As a result of the WBN LAR, AOI-7.01 will be revised to address required actions during a Stage I Flood Warning and required actions during a Stage II Flood Warning. AOI-7.01 will be revised prior to implementation of the final NRC-approved license amendment in accordance with TVA procedures. Further details are provided in the response to AHPB RAI Questions 8 and 9.

Other changes to AOI-7.01 have been made that are not directly the result of the WBN LAR. These changes address the results of simulations performed to verify the capability to complete required flood mode preparations within the required Stage I and Stage II Flood Warning times, and are not a result of the updated hydrologic analysis which does not revise these limiting times.

As discussed in the response to AHPB RAI Question 2, required changes to the procedures and instructions have been identified, and are required to be implemented prior to the implementation date of the final NRC-approved license amendment. In accordance with the Site Training Program, a training needs analysis will determine the final content and schedule for training when the applicable procedures and instructions have been revised.

4.0 AHPB RAI Question 4

Please describe any changes to physical interfaces (control room, etc.).

4.1 TVA Response - AHPB RAI Question 4

There are no changes to the simulator required as a result of the updated hydrologic analysis and the resulting minimal required changes to the AOI-7.xx series of procedures for flood mode preparations, including associated changes to implementing work orders, general operating instructions, emergency operating instructions, flood preparation maintenance instructions, and other AOIs. The physical interim compensatory measures and the replacement permanent modifications made to the facility do not affect the physical layout and control or software requirements for the simulator. There are no other changes to physical interfaces.

RESPONSE TO NRC HEALTH PHYSICS AND HUMAN PERFORMANCE BRANCH (AHPB) REQUEST FOR ADDITIONAL INFORMATION (RAI)

5.0 AHPB RAI Question 5

Are there any applied insights from industry operating experience? If so, please provide those insights.

5.1 TVA Response - AHPB RAI Question 5

Changes to the procedures and instructions have been implemented to address human performance lessons learned from operating experience and the Fukushima incident. In addition, changes have been implemented based on informal reviews of procedures from the other TVA sites. For example, a review of Fort Calhoun Station procedure prompted the need to improve the guidance for transitioning from offsite power to the emergency diesel generators during a flooding event. After a review of the method contained in the TVA Sequoyah Nuclear Plant (SQN) procedures, the WBN flood mode preparation procedures were revised to adopt the method employed by SQN. In addition, review of operating experience from Dresden Nuclear Power Station in response to NRC questions resulted in the need for additional detail associated with the site boat in the AOI-7.xx series of procedures for flood mode preparations.

6.0 AHPB RAI Question 6

How many people will be needed to construct staged sandbags into the berm? How much do the sandbags weigh, how long will this action take.

6.1 TVA Response - AHPB RAI Question 6

The general strategy of task performance for flood mode preparations is that a three person maintenance team is assigned to specific activities as directed by the AOI-7.xx series of procedures. A reasonable expectation is that five maintenance teams are available for flood mode preparations. One of these teams will be directed to install the sandbags as further described in the response to AHPB RAI Question 8. The sandbag structure being built is not complex. It must be a minimum of one foot high and approximately six feet in length.

The sandbags weigh approximately 40 pounds and installation is expected to require 1-1/2 hours including travel time. Sandbags are staged at the Intake Pumping Station.

ENCLOSURE 1

RESPONSE TO NRC HEALTH PHYSICS AND HUMAN PERFORMANCE BRANCH (AHPB) REQUEST FOR ADDITIONAL INFORMATION (RAI)

7.0 AHPB RAI Question 7

The second paragraph on page 2 of the submittal states, "For the IPS [intake pumping structure], a compensatory measure of staged sandbags to be constructed into a berm at any time prior to or during the event of a Stage I flood warning has been implemented." Please clarify this statement.

7.1 TVA Response - AHPB RAI Question 7

Maintenance Instruction 0-MI-17.004, "Movement of Equipment, Flood Mode Preparation," provides the instructions for construction of the sandbag berm at the IPS. AOI-07.01 directs the performance of 0-MI-17.004 following issuance of a Stage I Flood Warning. Therefore, the sandbag berm will be constructed during the Stage I Flood Warning preparation time.

8.0 AHPB RAI Question 8

Are the actions for staging the sandbags controlled and specified in a procedure?

8.1 TVA Response - AHPB RAI Question 8

As discussed in the response to AHPB RAI Question 1, the revised DBF elevation outside of the IPS results in a compensatory measure of staged sandbags to be constructed into a berm at any time prior to or during the event of a Stage I flood warning. 0-MI-17.004 provides the instructions for construction of the sandbag berm at the IPS. As directed in 0-MI-17.004, sandbags and plastic sheeting is staged either on the Raw Cooling Water (RCW) pump deck or elevation 741 ft of the IPS near doors W001 and W002. AOI-07.01 directs the performance of 0-MI-17.004 following issuance of a Stage I Flood Warning.

9.0 AHPB RAI Question 9

On page 8 of Enclosure 1, the first paragraph of the Enclosure states, "However, there are exceptions that require temporary modifications to ensure adequate flood protection in the interim, with permanent plant modifications planned to restore or gain additional margin between the revised DBF [design based flood] elevations and limiting safety-related systems, structures, and components." What temporary modifications and permanent modifications are being done? If they include any human interfaces, what human factor reviews and inputs are/were used?

9.1 TVA Response - AHPB RAI Question 9

As discussed in the response to AHPB RAI Question 1, the following equipment has additional actions required because of the increased DBF levels. For each new action, a description of the human interface each requires is provided below.

The revised DBF elevation outside of the IPS results in a compensatory measure of staged sandbags to be constructed into a berm at any time prior to or during the event

of a Stage I flood warning was implemented. During a Stage I Flood Warning, AOI-7.01 requires the performance of 0-MI-17.004, which directs the construction of the sandbag berm as discussed in the responses to AHPB RAI Questions 6, 7, and 8. This action requires a maintenance team using standard mobile equipment.

The revised DBF elevation inside of the Auxiliary Building results in the possibility of flooding of the TBB Pump Motors. As a result of this increase, a permanent plant modification to protect the TBB Pump Motors from a DBF, including permanent engineered flood barriers, has been implemented. During a Stage I Flood Warning, the seal leak off floor drain will be temporarily modified by disconnecting the piping between the pump seal leak off and a floor drain, and plugging the floor drain connection. MI-17.003, "Flood Mode Preparation Storage Locations and Periodic Inventory," includes periodic inspection to ensure staging of the seal leak off floor drain plug. AOI-7.01 requires the performance of 0-MI-17.004, "Movement of Equipment, Flood Mode Preparation," which directs the installation of the plug for the seal leak off floor drain. This action requires a maintenance team using tools and materials, including plugs, which are staged nearby and periodically inventoried in accordance with MI-17.003.

None of the actions discussed above are complex, and can be readily accomplished during the allowed flood warning times by the available personnel.

10.0 AHPB RAI Question 10

On page 2.4-68 of Attachment 1, the submittal mentions "TVA's climatic monitoring, flood predicting systems and flood control facilities permit early identification of potentially critical flood producing conditions and reliable prediction of floods which may exceed plant grade well in advance of the event." Is prediction done using a controlled procedure consistent with the assumptions of the hydrology analysis? What specific timing is associated with the term "well in advance"?

10.1 TVA Response - AHPB RAI Question 10

TVA's climatic monitoring, flood predicting systems and flood control facilities are under the jurisdiction of TVA River Operations. This organization is responsible for balancing the competing demands of the Tennessee River and its tributaries with respect to flood-damage control, navigation, dam safety, hydroelectric power production, recreation, water supply, and water quality. Within the TVA River Operations organization, the staff of TVA River Scheduling is responsible for scheduling day-to-day operations of the TVA integrated river system, including flood-damage control, navigation, power production, water quality, water supply, and recreation.

Within TVA River Scheduling, the River Forecast Center staff is responsible for developing, dispatching, and monitoring real-time multipurpose operating plans for the impoundment and releases of water from TVA-managed reservoirs. Operating plans are developed 365 days a year and monitored around-the-clock from the River Forecast Center in Knoxville, Tennessee. The River Forecast Center balances

operating plans in order to meet system demands for flood-risk reduction, navigation, hydroelectric generation, water quality, water supply, and recreation. The River Forecast Center also coordinates daily operating plans with the U. S. Army Corps of Engineers.

In developing forecasts, the River Forecast Center uses state-of-the-art equipment to monitor the river system and adjusts operations based on the continuously changing demand for water. Weather conditions, rain data, reservoir inflows and outflows, and reservoir elevations are monitored in real-time through satellite and hard-lined communication equipment. Continuous monitoring of reservoir information allows the River Forecast Center to quickly respond to system demands during critical periods. Once collected and validated, the data is used as input for modeling tools for simulating reservoir releases and developing strategies for multiple operating scenarios. The river forecasts are used to disseminate information regarding reservoir levels and scheduled water releases to internal and external stakeholders. Information from the forecasts can then be used in a wide variety of decision-support tools, including bulk electric system planning, evaluating thermal cooling needs at TVA coal fired and nuclear plants, emergency management, river-shipper planning, and recreational user scheduling. The River Forecast Center serves as the focal point of information for any issue related to operating the Tennessee River system.

TVA River Operations is responsible for notification and response in any type of emergency at one or more of its assets that has the potential to affect the health and safety of the TVA workforce or the general public, the environment, or TVA property. River Operations is also responsible for agency-level support during large-scale emergencies that affect more than one strategic business unit or the whole agency. The Emergency Preparedness group in River Operations has developed procedures guiding emergency response for such emergencies and maintains testing, training, and exercises to ensure effective emergency planning and readiness by emergency staff.

RO-SPP-35.1, "Emergency Response Plan," is the highest tier emergency response procedure in River Operations. It covers the overall emergency response philosophy (based on the National Incident Management System (NIMS) and Incident Command System), and addresses the systematic approach to responding to emergencies. This procedure prescribes a consistent response process that applies to any emergency that may occur at a River Operations asset such as dam safety, fire, environmental releases, terrorist attack, etc. The response procedures contained within RO-SPP-35.1 are consistent with Homeland Security Presidential Directive 5 (HSPD-5), Management of Domestic Incidents, which requires the use of NIMS by the Federal Government in domestic incident management and emergency prevention, preparedness, response, recovery, and mitigation activities.

ROR-SPP-35.3, "Dam Safety Emergency Action Plans," describes the development and approval of individual Emergency Action Plans for dam safety for each of the River Operations 49 projects (i.e., dams and associated reservoirs). The procedure contains the generic language and process that apply for response to a dam safety emergency at any of the River Operations projects. Each project-specific Emergency Action Plan

contains a generic response section detailing the purpose of the Emergency Action Plan, roles and responsibilities, response processes, and response aids such as a notification flow chart and checklists for primary users. Individual Emergency Action Plans also include a location specific emergency notification directory, flood inundation maps unique for each project, and other specific dam safety resources appropriate for the project in question. Emergency Action Plans are controlled documents which are distributed within TVA and to external emergency response partners such as county emergency-management agencies, the National Weather Service, the U.S. Army Corps of Engineers, and other entities which may be affected by or engaged with TVA in the unlikely event of a dam breach or probable maximum flooding. The top priority for River Operations during a dam safety emergency is to maintain system integrity and ensure the safety of the public and TVA property, to the greatest extent possible. The Emergency Action Plans are maintained and exercised in accordance with procedures TVA-SPP-27.6, "Emergency Preparedness for Dams," and RO-SPP-27.6, "River Operations Emergency Preparedness for Dams," which draw on the *Federal Guidelines for Dam Safety* and the *Federal Energy Regulatory Commission Engineering Guidelines for the Evaluation of Hydropower Projects.*

RO-SPP-35.4, "Continuity of Operations (COOP) Plan," ensures that River Operations remains capable of conducting its essential functions under all threats and conditions in order to support the TVA Mission Essential Functions. The procedure provides plans for continuing to operate if one of River Operations primary operating locations (Knoxville, Tennessee or Chattanooga, Tennessee) is rendered unusable. The process provides for identification of essential personnel and alternate operating locations for such personnel so that they may continue to perform their essential functions.

In order to be able to implement the requirements of River Operations emergency response procedures, the Emergency Preparedness program provides training to staff, coordinates with outside agencies to maintain working relationships, and manages the TVA River Operations Emergency Operations Center (REOC) located in Chattanooga, Tennessee. This facility provides a location for emergency staff to gather to support response actions at the site of an emergency. The Emergency Preparedness staff is also responsible for coordinating with the agency-level emergency entity, Crisis and Emergency Management, to ensure agency procedures and programs are being supported and incorporated effectively into River Operations processes.

The River Forecast Center staff is responsible for forecasting inflows, scheduling outflows, and running hydrothermal models; monitoring rainfall, stream flows, reservoir headwaters, tailwater elevations, reservoir releases, dissolved-oxygen levels, and temperature monitoring stations; running forecast models for the integrated operations of the Tennessee River and reservoir system; making internal and external notifications as appropriate; and serving as the point of contact for river system emergency actions. The River Forecast Center staff forecasts inflows into the Tennessee Valley watershed for a 14-day period, which involves assessing rain on the ground and determining how much of that rain will end up in the Tennessee River system as runoff, as well as considering the likelihood of future rain in weather forecasts.

The River Forecast Center serves as the point of contact for river system emergency actions within the Tennessee Valley and makes notifications of high flows, elevations and other system impacts to appropriate emergency management agencies and other internal and external entities, including notifications to the WBN control room supervision of Stage I and Stage II Flood Warnings, as specified in the TVA River Scheduling Notification Directory, a desktop instruction that is maintained by TVA River Scheduling for use by the River Forecast Center staff during emergencies. Rainfall, stream flows, reservoir headwaters, reservoir tailwaters and reservoir releases are monitored on a 24-hour basis for compliance with planned operations. Reservoir elevations and discharge flow rates are also forecast for the system for a 14-day period. A computer-based RiverWare model is used to simulate weather conditions, reservoir inflows, reservoir outflows, and reservoir elevations. RiverWare is a river-basin modeling software system developed by the University of Colorado, under primary sponsorship by TVA and the U.S. Bureau of Reclamation. Optimization and simulation functions of this model have been used for several years by TVA to schedule the operation of the reservoir system.

The formal Stage I and Stage II Flood Warning notifications from the River Forecast Center staff, under the direction of the River Scheduling Lead Engineer, are made to WBN control room supervision based on rainfall on the ground observed measurements, with no consideration of forecasted rainfall. This is consistent with the assumptions of the current hydrology analysis. However, the River Forecast Center maintains an ongoing forecast of reservoir levels for a 14-day period. The forecast (prediction) is based on normal forecasting processes utilized by the River Forecast Center on a daily basis for forecasting reservoir flows and elevations for multiple purposes, including flood control, as described above and documented in TVA Standard Programs and Processes TVA-SPP-20.1, "Forecasting, Scheduling, and Monitoring the Tennessee River System."

There are various postulated 9-day rain events which could result in potentially reaching the Stage I and Stage II Flood Warning thresholds. The initial trigger point for activation of the REOC is based on predicted headwater elevations at each dam. Therefore, it would be possible for the River Forecast Center to forecast the rain events and predict the trigger headwater elevations several days in advance. Thus, early declaration of Stage I and Stage II Flood Warnings are possible for these situations. For additional discussion of the methods and instructions used by the River Forecast Center to determine conditions for issuing Stage I and Stage II Flood Warnings, refer to the response to AHPB RAI Question 13.

The discussion in the WBN LAR of climatic monitoring and early identification of potentially critical flood producing conditions is based on the use of predicted rainfall by the River Forecast Center in addition to the rainfall which has already occurred. Within the limitations of weather forecasting techniques, the predicted rainfall forecasts provide additional guidance regarding the possible severity of future precipitation up to days in advance. The River Forecast Center river forecasts routinely incorporate predicted rainfall, and can accurately predict river elevations that would occur if the rainfall event happened as forecast over the next 10 days. However, as defined in the

WBN LAR, the formal Stage I and Stage II Flood Warning plans are based solely on observed rainfall, which is shown to provide the minimum time of 31 hours from the critical rainfall occurring until elevation 727 ft is observed at WBN (10 hours for Stage I, 17 hours for Stage II, and four hours for additional margin). Because of the extensive historical experience and knowledge of operations of the Tennessee River watershed by the River Forecast Center, the quality of climatic monitoring and early identification of potentially critical flood producing conditions is assured.

11.0 AHPB RAI Question 11

Page 2.4-71 of Attachment 1 iii the Basic Analysis section, the submittal declares "the forecast procedure to assure safe shutdown of WBN for flooding is based upon an analysis of 17 hypothetical PMP [probable maximum precipitation] storms, including their antecedent storms. In the proposed change, the procedure is based upon an analysis of nine of the 17 hypothetical storms up to PMP magnitude judged to be controlling." Is this procedure owned and controlled by the plant? If so, what is the procedure number?

11.1 TVA Response - AHPB RAI Question 11

As described in the response to AHPB RAI Questions 17 and 18, the decisions to declare a Stage I or Stage II Flood Warning are controlled by procedures used by the River Forecast Center, and not by the Nuclear Power Group. However, the River Forecast Center staff will predict flood levels based on rainfall on the ground that is consistent with the results of the calculations controlled by the Nuclear Power Group as described in detail in the response to AHPB RAI Question 16. These calculations determine from the analysis of the nine hypothetical storms the criteria to be used by the River Forecast Center for Stage I and Stage II Flood Warning target conditions. Refer to the response to AHPB RAI Questions 16, 17, and 18 for more details.

12.0 AHPB RAI Question 12

Also referencing question 11, what is the criterion used to determine which 9 of the 17 hypothetical PMP storms analyses would be used?

12.1 TVA Response - AHPB RAI Question 12

As described in the response to AHPB RAI Question 16, the calculations to determine the hypothetical storms to be used to develop the flood warning times originally considered 17 hypothetical storms. This earlier analysis tested the effects of varied time distribution of rainfall by alternatively placing the maximum daily rainfall on the first, middle, and the last day of the three-day main storm to ensure that the shortest warning times were captured for the hypothetical storms. This analysis showed that the fastest rising floods occur when the heavy rainfall is applied at the end of the storm. Therefore, the current analysis consisted of nine hypothetical storms ranging from slightly more than five inches (equivalent to the largest flood event since regulation) up to Probable Maximum Precipitation (PMP) and enveloped potentially critical areal, seasonal variations and time distribution of rainfall. The shortest warning

time is based on those storm situations which resulted in the shortest time interval between watershed rainfall and elevation 727.0 ft. Refer to the response to AHPB RAI Question 16 for more details.

13.0 AHPB RAI Question 13

The Hydrologic Basis for Warning System section on page 22 of the submittal mentions a Stage I, Stage II, and the times associated with each stage. How was the time validated for each stage, 10 hours for Stage I and 17 hours for Stage II? Clarify how this integrates with the Emergency Plan (EP) (e.g., when emergency classifications are made, and whether the EP call-in methods will give them enough people to implement the flood plan(s) in enough time).

13.1 TVA Response - AHPB RAI Question 13

In response to the nuclear fuel damage at Fukushima Daiichi due to earthquake and subsequent tsunami, the United States Nuclear Regulatory Commission (USNRC / NRC) requested information pursuant to Title 10 of the Code of Federal Regulations, Section 50.54(f) (NRC Letter to Licensees, dated March 12, 2012, Regarding Recommendations 2.1, 2.3, and 9.3 of the Near Term Task Force (NTTF) Review of Insights from the Fukushima Dai-ichi Accident). As part of this request, a reasonable simulation was performed of the flood response AOI in accordance with an approved procedure, CTP-FWD-100, "Flood Protection Walkdowns." The USNRC issued an Endorsement Letter on May 31, 2012 that endorsed the Nuclear Energy Institute (NEI) 12-07, "Guidelines for Performing Verification Walkdowns of Plant Flood Protection Features" document. The guidance followed for the reasonable simulation was consistent with NEI 12-07.

During the reasonable simulation, a current Senior Reactor Operator (SRO) stepped through the procedure and, with the assistance of a current Assistant Unit Operator, a retired Shift Manager SRO, a Maintenance Supervisor, and a Chemistry Supervisor, developed a timeline for the steps of the procedure. Reasonable simulations were also performed in the field of critical maintenance procedures using Health Physics (HP) personnel along with multiple maintenance craft. Personnel required for each step were also determined in order to assess the adequacy of available resources, ensuring that a full complement of required personnel would be available to perform the required flood mode preparation actions.

The ability of the plant to complete flood mode preparations within the Current Licensing Basis (CLB), and consistent with the proposed licensing basis in the WBN LAR, was evaluated during initial reasonable simulation results. Discussion and evaluation of the instructions given in AOI-7.01, "Maximum Probable Flood," were made during the reasonable simulation. As each step of the procedure was discussed, estimates of time to perform the actions in the procedure were made. The flood scenario identified as most critical in the Updated Final Safety Analysis Report (UFSAR) was used as the basis for evaluating whether the instructions could be implemented in the available time. The reasonable simulation also assessed

implementation of any actions required for flood protection features. An example of a time dependent activity is the time to install the spool pieces to realign the systems.

The reasonable simulations occurred between August 27, 2012 and September 5, 2012. WBN Unit 1 was assumed to be at 100% power when the Stage I Flood Warning was received from the River Forecast Center staff. The reasonable simulations included the following steps:

1. Raw data tabulation was performed from individual procedure step and reasonable simulation exercises required to complete flood mode preparations. No integration or resource loading had occurred.

2. The raw data was integrated and resource loaded considering the flood mode AOI actions, maintenance instructions actions, and chemistry sampling. These activities were sequenced and the actions were evaluated to determine which could be performed in parallel versus in series.

3. Stage I activities included the rapid shutdown of the plant using AOI-39, "Rapid Load Reduction," and plant communications with local media and state government agencies. Stage I Flood Warning activities also included communications made to acquire off-site plant personnel required to implement the flood protection procedures.

4. Additional off-site personnel assumed to be available to implement the flood mitigating preparation procedures were determined in the following manner. The PMF event was conservatively assumed to start on a holiday weekend night to minimize on-site staff and off-site staff availability for being phoned in for work. The assumptions for the manpower required are provided below:

   a. Maintenance available for call in during PMF flood response includes the following:

      - 40 total craft personnel plus foreman that includes Mechanical, Electrical and Instrument and Controls (I&C) per shift
      - Normal Operating Crew (NOC) includes two Mechanical, one Electrical, one I&C, and a supervisor; the NOC is already on site and not available for call in
      - This results in 35 additional personnel per shift not on site but available for call in
      - Assumed 67% (approximately 23) of available personnel not on site to have Fitness for Duty (FFD) issues or other complications due to local flooding and unable to respond to site
      - Total of 12 maintenance personnel expected to respond to the call

b. Total craftsmen available after call in to mitigate flood event includes the following:

- 12 expected to respond to the call
- Five personnel (NOC) already on-site
- Total 17 personnel available to mitigate flood event
  - Assumes craft: nine Mechanical, three Electrical, and three I&C
  - Assumes two supervisors
- Utilizing five crews of three craft with two supervisors

c. NOC Operations includes the following:

- One Shift Manager – SRO
- Three SROs
- Three Reactor Operators
- Eight Assistant Unit Operators

5. The Stage I Flood Warning activities were successfully accomplished within the CLB 10 hour time period, which is the same as in the WBN LAR.

6. The critical path Stage II Flood Warning activities were determined by development of a timeline.

The reasonable simulation verified that the actual number of personnel required to implement the flood mode preparation activities were bounded by the assumption of available personnel described in item 4 above. Therefore, based on the reasonable simulation, it was determined that the required personnel are available and capable of implementing the Stage I and Stage II Flood Warning preparations within the overall flood mode preparation completion time of 27 hours allowed by the updated hydrologic analysis.

After the River Forecast Center staff has determined that a Stage I Flood Warning is required then the actions of AOI-7.01 are implemented. AOI-7.01 requires the WBN control room supervisors to evaluate Emergency Plan Implementing Procedure EPIP-1, "Emergency Plan Classification Logic," to determine the Emergency Action Level requirements. EPIP-1 requires declaration of a Notification of Unusual Event whenever river reservoir level is at Stage I Flood Warning as reported by the River Forecast Center staff, and declaration of an Alert whenever river reservoir level is at Stage II Flood Warning as reported by the River Forecast Center staff. Therefore, the Emergency Action Levels reflect actual Stage I and Stage II Flood Warning declarations by the River Forecast Center staff regardless of the actual flood elevations existing at the WBN site.

ENCLOSURE 1

RESPONSE TO NRC HEALTH PHYSICS AND HUMAN PERFORMANCE BRANCH (AHPB) REQUEST FOR ADDITIONAL INFORMATION (RAI)

14.0 AHPB RAI Question 14

Ending page 18 and beginning page 17 of Enclosure 1, discusses the communication reliability during emergencies. Will flooding affect any of the communications systems? If so, which one(s). Will any group or individual become unable to communicate because of the failure(s)?

14.1 TVA Response - AHPB RAI Question 14

During emergencies such as a PMF event, WBN site operations and Emergency Plan personnel have several communication methods available to communicate with the control room, technical support center, and other plant areas. As described in the WBN UFSAR Subsection 9.5.2, the normal primary intraplant communications systems for voice and plant paging are the sound powered telephone systems, intraplant radio system, Telephone Switching System (TSS) telephone equipment, and loud speaker paging.

As described in WBN UFSAR Figure 9.5-19, the communications equipment that is assured to be available for intraplant communications during a PMF event with and without a loss of offsite power includes portion of the sound powered telephone system, except for those components of the system that could be submerged during the event but not needed because the areas are inaccessible during the flood.

To prevent loss of the sound powered phones during a PMF event, AOI-7.01 requires performance of flood preparation maintenance instruction MI-17.010, "Flood Preparation Cutting of Sound-Powered Telephone Cables," during Stage II Flood Warning preparations. The purpose of this instruction is to describe the procedure for disconnecting sound powered telephone cables 1-3T-251-1221 and 2-3T-251-1221 to prevent interruption in communications in other areas as a result of a PMF event. Portions of the sound powered telephone systems that remain above the flood levels are available during a PMF event. Therefore, wired voice communications above the DBF levels are assured throughout a PMF event.

The intraplant very high frequency (VHF) radio system provides voice communications throughout the plant for plant personnel. This system consists of repeaters, remote control units and VHF portable radios. An intraplant cellular radio system provides a diverse communications system for voice, paging, and text messaging that is available both onsite and offsite. The system interfaces with the VHF intraplant system in the turbine building to allow communications through the existing VHF Distributed Antenna System. The intraplant radio system may or may not be available during an external flood event with a loss of offsite power, depending on actual flood conditions, but is not available once flooding reaches plant grade.

The TSS is installed to provide primary 2-way communications throughout WBN as well as access to offsite circuits, and provides for loud speaker paging through the general plant public address system discussed below. The TSS is powered from a 48V DC source. This source consists of a telephone battery charger, a spare battery charger, a regulating power board, and a battery. The telephone battery charger is fed

from a non-1E source with an alternate feed from a Train A diesel-backed board. The spare battery charger is fed from a Train A diesel-backed board with an alternate feed from a Train B diesel-backed board. The 48V batteries and chargers which power this system are below the DBF level. Therefore, the TSS may or may not be available during an external flood event with a loss of offsite power, depending on actual flood conditions, but is not available once flooding reaches plant grade.

Paging speakers for the general plant public address system are installed in the auxiliary, reactor, turbine, and control buildings. Paging handsets are provided in both unit control and the auxiliary control room. In addition to the paging handset locations, this equipment may be accessed from any TSS telephone. The speaker-amplifiers are fed in parallel from an alternating current lighting source. The paging equipment is dispersed in the control building and powerhouse areas. Single or multiple open circuits or amplifier failure in individual units will not prevent the remaining equipment from functioning. The failure of the equipment will not impair the use of the paging equipment from the local paging stations located in the control room, or the auxiliary control room. The general plant public address system may or may not be available during an external flood event with a loss of offsite power, depending on actual flood conditions, but is not available once flooding reaches plant grade.

In response to the nuclear fuel damage at Fukushima Daiichi due to earthquake and subsequent tsunami, the NRC requested information pursuant to Title 10 of the Code of Federal Regulations, Section 50.54(f) (NRC Letter to Licensees, dated March 12, 2012, Regarding Recommendations 2.1, 2.3, and 9.3 of the Near Term Task Force (NTTF) Review of Insights from the Fukushima Dai-ichi Accident). As part of this request, TVA provided additional information requested regarding plans to enhance existing communications systems power supplies until the communications assessment in response to Recommendation 9.3 and the resulting actions are complete. As stated in the response provided by letter from TVA to the NRC, "Tennessee Valley Authority (TVA) - 90-Day Response to NRC Request for Information Pursuant to Title 10 of the Code of Federal Regulations 50.54(f) Regarding Recommendation 9.3 of the Near-Term Task Force Review of Insights from the Fukushima Dai-ichi Accident," dated June 11, 2012 (ADAMS Accession No. ML12164A678), TVA deployed 17 satellite phones at each licensed operating TVA nuclear facility. These phones replaced and upgraded older phones that were previously located at each site. An additional 17 satellite phones were deployed at TVA Nuclear Power Group (NPG) offices in the TVA Corporate headquarters located in Chattanooga, Tennessee. TVA also purchased 20 portable generators. These 2000-Watt portable generators were obtained to keep the satellite phone batteries charged. Five of these generators have been placed at each of the three TVA licensed operating nuclear facilities, and the remaining five generators were sent to the Central Emergency Control Center (CECC), TVA's offsite emergency center, located in Chattanooga, Tennessee. These generators at each site are stored in a secured location on the site owner-controlled area. Radios and sound-powered phone systems are also available at TVA licensed operating facilities for onsite communications with operators in the field and the control room for safe shutdown and recovery. Jacks for the installed sound-powered phone systems are located in areas needed to support monitoring and operation of essential equipment. TVA nuclear facilities were

previously provided with radios dedicated for response to postulated large area fires within the plant. Upon a loss of radio towers these radios can still be used in the radio-to-radio mode within the facility. Batteries for these radios may also be charged using the portable generators previously mentioned. TVA has developed documented guidance for deploying the portable generators described above during and after a Beyond Design Basis External Event.

15.0 AHPB RAI Question 15

Page 37 of Enclosure 1: Are there any other actions (other than those listed) in the corrective action items that address the update of the Hydro analysis? For example, does the corrective action item describe the permanent modifications that are being considered?

15.1 TVA Response - AHPB RAI Question 15

As stated in the WBN LAR, TVA's established corrective action program requirements are being implemented to address the need for additional compensatory measures necessary to provide flood protection for the IPS internal systems and components, including the need for permanent plant modifications. Although the compensatory measure of staged sandbags to be constructed into a berm at any time prior to or during the event of a Stage I flood warning is an effective action, future plans exist for two temporary flood barriers designed to be installed at any time prior to or during the event of a Stage I flood warning instead of the use of sandbags. The temporary flood barriers will prevent floodwater intrusion through the elevation 741 ft Stairwell 1L door W1 and Stairwell 1R door W2 into elevation 722 ft floor, and provide a two foot margin above the DBF elevation which includes wind wave run-up to the IPS. These barriers will protect the electrical equipment associated with the ERCW and HPFP pumps and motors, with permanent mounting locations and storage racks located nearby. There are no other actions required for the IPS to address the updated hydrologic analysis.

16.0 AHPB RAI Question 16

On page 28 of Enclosure 1, a calculation for shutdown procedures for extreme events has been analyzed for 27 hours. Has there been any physical validation of the TVA calculation that confirms that 27 hours are available? Has NRC seen and approved this calculation?

16.1 TVA Response - AHPB RAI Question 16

The calculation for assessing the Stage I and Stage II Flood Warning times provides the technical basis which shows that sufficient warning time is available for implementation of a flood warning plan for WBN, and provides the basis which documents consistency with regulatory guidelines. This calculation is prepared and verified as a safety-related and quality-related calculation in accordance with the TVA Nuclear Power Group Quality Assurance Program (NQAP). While this calculation and the other calculations developed to address flood warning preparations have not been

approved by the NRC, the calculations can be made available to the NRC for review if requested.

As stated in the WBN LAR, the plant grade elevation at WBN is 728 ft, which is 11.2 ft below the design basis flood elevation 739.2 ft. The plant grade elevation at WBN can be exceeded by large rainfall and seismically induced dam failure floods. The calculation of warning times is in accordance with Regulatory Position 2, Regulatory Guide 1.59, Revision 2, August 1977. The warning time for WBN was reevaluated because the initial median reservoir levels and flood operational guides have been revised, dam rating curves have changed at some dams, and the Simulated Open Channel Hydraulics (SOCH) model of the Tennessee River has been updated to meet current quality assurance standards.

This calculation demonstrates that time is available for TVA's River Forecast Center forecast and warning procedures to provide at least 27 hours before river levels reach elevation 727.0 ft. Use of elevation 727.0 ft, one foot below plant grade, provides enough margin to prevent wind generated waves from endangering plant safety during the final hours of shutdown activity. Flood warning will be based upon rainfall already reported to be on the ground on the watershed above WBN.

Earlier analyses tested the effects of varied time distribution of rainfall by alternatively placing the maximum daily rainfall on the first, middle, and the last day of the three-day main storm to ensure that the shortest warning times were captured for the hypothetical storms. This analysis showed that the fastest rising floods occur when the heavy rainfall is applied at the end of the storm. Therefore, the current analysis consisted of nine hypothetical storms ranging from slightly more than five inches (equivalent to the largest flood event since regulation) up to PMP and enveloped potentially critical areal, seasonal variations and time distribution of rainfall. The shortest warning time is based on those storm situations which resulted in the shortest time interval between watershed rainfall and elevation 727.0 ft.

The warning time is divided into two stages: Stage I, a minimum of 10 hours long and Stage II, a minimum of 17 hours long so that unnecessary economic consequences can be avoided, while adequate time is allowed for preparing for operation in the flood mode. Stage I allows preparation steps causing minimal economic consequences to be sustained but will postpone major economic damage to the plant until a Stage II warning predicts a likely forthcoming flood above plant grade. If the flood does not develop beyond a Stage I warning, major economic damage will be avoided.

To be certain of 27 hours for pre-flood preparation, flood warnings with the prospect of reaching elevation 727.0 ft must be issued early when lower target elevations are forecast. Consequently, some of the Stage I warnings may not progress into a Stage II warning. For this reason pre-flood preparations are divided into two stages. Stage I steps requiring 10 hours are easily revocable and cause minimum economic consequences to the plant.

Additional rain and stream-flow information obtained during Stage I activity would determine if the more serious steps of Stage II need to be taken with the assurance that at least 17 hours would be available before elevation 727.0 ft is reached.

The methods used to compute flood flows and elevations for those flood conditions which establish controlling elements of the warning times are described in the TVA calculation for determining the PMF at WBN, and TVA calculations for determining PMF and warning time inflows for the watershed.

The results of the six simulations performed as part of this calculation, together with the results of the three simulations presented in the TVA calculation for determining the PMF at WBN, were used to develop the relationship between basin average rainfall and peak river elevation at WBN. The maximum calculated water surface elevation at WBN for each storm was plotted against average basin rainfall depth. Summer and winter relationships were developed using a polynomial curve. This approach did not result in curves which passed through all calculated points. To ensure that the curve would envelop the calculated points, a systematic adjustment of the polynomial coefficients was applied until the curve passed thru the calculated points or was within 0.1 ft above.

The adopted warning time curves developed in the calculation envelop all routing simulation results for their respective seasons using inflows from the selected worst case storm events. Therefore, these curves are a bounding condition for determining the warning times at WBN.

The warning time to assure safe shutdown of WBN for flooding resulting from seismic dam failures coincident with flood events is based on analysis of potentially critical combinations of dam failures. The procedures used to compute flood flows and elevations from seismic events are described in TVA calculations for determining PMF inflows for the watershed and for determining flood levels at WBN from seismic dam failures.

Flood warnings are issued in real-time by the River Forecast Center. Flood control operations for a major storm that spans the majority of the Tennessee Valley would necessitate the integrated operation of all the reservoirs in the system. The flood storage available to TVA for minimizing flood damages is finite, and does not allow TVA to eliminate flooding at all sites along the regulated rivers. Thus, TVA efforts are directed toward using the available flood storage to minimize downstream flooding, rather than eliminating downstream flooding. During extreme flood events, TVA would focus on minimizing downstream flood damage to the extent possible, operating the projects to ensure the safety and integrity of the dams and appurtenant structures, and providing frequent flood warning time and elevation forecasts.

Refer to the response to AHPB RAI Question 13 for a discussion of the validation of flood mode preparation procedures and instructions that ensure required Stage I and Stage II actions can be completed in the required timeframe.

ENCLOSURE 1

RESPONSE TO NRC HEALTH PHYSICS AND HUMAN PERFORMANCE BRANCH (AHPB) REQUEST FOR ADDITIONAL INFORMATION (RAI)

17.0 AHPB RAI Question 17

Page 30 of Enclosure 1, the seventh paragraph says "Flood warnings are issued in real-time by TVA RO [River Operations]." What does this statement mean specifically regarding "real-time"? Exactly, how does this go from a warning to implementation of the flood plan? What is the sequence of events/actions?

17.1 TVA Response - AHPB RAI Question 17

Flood notification from the River Forecast Center staff, under the direction of the River Scheduling Lead Engineer, may occur in advance of the 27-hour preparation period. Refer to the response to AHPB RAI Question 18 for additional details on the forecast and notification process. The River Forecast Center staff will predict flood levels based on rainfall on the ground or potential failure problems with one or more dams combined with critical water-head elevations and flood producing rainfall. During these events communications are established directly between WBN control room supervision and the River Forecast Center staff every three hours, until the River Forecast Center staff determines that the potential for flooding above plant grade no longer exists. Once the River Forecast Center staff declares that a Stage I Warning Plan threshold has been reached, AOI-7.01 requires that these communications can be established and maintained between the WBN control room operators and the River Forecast Center staff in the REOC once every three hours.

The following conditions require entry into the performance of AOI-7.01, and are discussed in further detail in the response to AHPB RAI Question 18:

- Notification from the River Forecast Center of a Stage I Flood Warning.
- Extremely high rainfall in the upstream watershed as indicated by National Weather Service bulletins (discussed in AOI-7.01 Appendix C that discusses flood warning logic).
- Maintenance activities in progress requiring a special condition allowance (advanced flood warning greater than 27 hours), and failure of the River Forecast Center to provide a daily update to the three-day advanced flood notification during this special condition allowance timeframe.
- Notification from the River Forecast Center that major flood producing storm (area average rainfall of six inches above Chattanooga) is developing. When this situation occurs, the REOC is activated and three-hour communications is established between the REOC and WBN control room supervision.

For a rainfall induced flood, the most likely entry will be the projection that a major flood producing storm is developing. When this projection is made, the River Forecast Center notifies WBN control room supervision and AOI-7.01 is entered. Three-hour communications are established between the River Forecast Center and WBN control room supervision. WBN then staffs the Outage Control Center and begins to review

the flood protection plan. Efforts undertaken from this point forward will rely on communications and forecasts provided by the River Forecast Center. Some preparatory work can be accomplished, but the next major trigger point for plant action is when a Stage I Flood Warning is issued. When a Stage I Flood Warning is issued, a plant shutdown would begin and other recoverable actions are taken to prepare for flood mode. When Stage II Flood Warning is issued, further plant alignments are made to ensure plant protection while flooded.

18.0 AHPB RAI Question 18

Page 31 of Enclosure 1 states: " ... lower forecast threshold warning flood elevations are used in some situations to assure that the 27 hours pre-flood transition interval is always available." Who makes this decision and on what basis?

18.1 TVA Response - AHPB RAI Question 18

The River Forecast Center staff within the TVA River Operations organization, under the direction of the River Scheduling Lead Engineer, is responsible for determining when Stage I and Stage II Flood Warnings are to be issued. Prior to declaring a Stage I or Stage II Flood Warning at the WBN site, the River Forecast Center continuously monitors rainfall and monitors the headwater elevation behind the upstream dams. Upon predicting a critical headwater elevation for each dam based on observed rainfall the River Forecast Center staff makes notification based on the River Operations Emergency Response Plan to the Asset Owner for River Operations non-power assets (the TVA River Scheduling General Manager). This notification includes the time at which the critical headwater elevation is forecasted to occur. The Asset Owner (i.e., the responsible person for operations of the affected dam) directs the REOC to activate in 'advisory' status. An 'alert' status is initiated for the REOC at the request of the Incident Commander after the contractor is notified to mobilize equipment for closure of the public access (PA) gaps in the HESCO modular flood barriers at Cherokee Dam, Fort Loudoun Dam, Tellico Dam, and Watts Bar Dam as described in TVA River Operations Cherokee Dam, Fort Loudoun/Tellico Dams, and Watts Bar Dam Emergency Action Plans (EAPs). These actions take place at predicted flooding conditions below those required for a Stage I or Stage II Flood Warning at the WBN site, which allow for early prediction of meeting Stage I and Stage II Flood Warning threshold levels.

If the River Forecast Center staff observes a specified critical headwater elevation behind the dams, the Asset Owner (i.e., the responsible person for operations of the affected dam) is notified of the flooding condition. The Asset Owner declares a dam safety emergency - Condition YELLOW (based on TVA River Operations procedure RO-SPP-35.1) and notifies the REOC. The REOC goes to 'activation' status. The REOC Incident Support Staff supports site activities throughout activation of the REOC.

The River Forecast Center maintains an ongoing forecast of reservoir levels for a 14-day period. The forecast (prediction) is based on normal forecasting processes utilized by the River Forecast Center on a daily basis for forecasting reservoir flows

and elevations for multiple purposes, including flood control, as described above and documented in TVA Standard Programs and Processes TVA-SPP-20.1, "Forecasting, Scheduling, and Monitoring the Tennessee River System." There are various postulated 9-day rain events which could result in potentially reaching the Stage I and Stage II Flood Warning thresholds. The initial trigger point for activation of the REOC is based on predicted headwater elevations at each dam. Therefore, it would be possible for the River Forecast Center to forecast the rain events and predict the trigger headwater elevations up to days in advance. Thus, early declaration of Stage I and Stage II Flood Warnings are possible for these situations.

The requirements for the final Stage I and Stage II Flood Warning determinations are addressed by the TVA River Scheduling Notification Directory, a desktop instruction that is maintained by TVA River Scheduling for use by the River Forecast Center staff during emergencies. For WBN, a primary number and an alternate number are provided to ensure that the WBN control room supervision is notified regarding potential flooding events. The TVA River Scheduling Notification Directory includes criteria for early warning as well as for Stage I and Stage II Flood Warning thresholds being reached. The early warnings include notification that the REOC is activated for either a flood condition, or for a dam safety emergency involving a WBN-critical dam, which includes Cherokee, Douglas, Norris, Tellico, and Fontana Dams. Early warning will also be issued in the interim if "Emergency Condition Red" (i.e., emergency classification that represents a very serious situation where failure of a dam has already occurred or could occur in less than 24 hours) exists for a WBN-critical dam prior to activating the REOC.

A Stage I Flood Warning is issued when the specified WBN threshold flood warning level for the season of the year is predicted to be exceeded at WBN in 27 hours or more. A Stage II Flood Warning is issued when the specified WBN threshold flood warning level of elevation 727 ft (one foot below plant grade elevation 728 ft) is predicted to be exceeded at WBN in 17 hours or more. There are three specific potential flood scenarios addressed in the TVA River Scheduling Notification Directory, which includes the following:

1. For potential seismic dam failure(s) or other dam safety emergencies, the River Forecast Center staff would be required to take the following actions:

    a. An Early Warning is immediately issued to WBN control room supervision (at the specified primary and alternate numbers) of a dam safety "Emergency Condition Red" involving a WBN-critical dam, and interim communications are maintained using a specified interim phone number prior to activating the REOC.

    b. An Early Warning is immediately issued to WBN control room supervision when the REOC is activated by River Forecast Center staff for flood conditions and/or for a dam safety emergency involving a WBN-critical dam.

    c. Communications are maintained with WBN control room supervision on at least three-hour intervals (or more frequently, if needed).

d. If a dam failure is confirmed, a Stage I Flood Warning is immediately declared. Dam failure outflow and resulting downstream river elevations are modeled. If analyses show that elevation 727 ft would not be exceeded at WBN, the WBN control room supervision is immediately notified that the potential for site flooding no longer exists.

e. If necessary, a Stage I Flood Warning is declared and communicated to WBN control room supervision at least 27 hours before the flood elevation at the site could exceed elevation 727 ft.

f. If necessary, a Stage II Flood Warning is declared and communicated to WBN control room supervision at least 17 hours before the flood elevation at the site could exceed elevation 727 ft.

g. WBN control room supervision is immediately notified and flood warnings are rescinded when the potential for site flooding no longer exists.

2. For major flood producing storms (area average rainfall of six inches in 72 hours or more above Chattanooga, Tennessee), with no critical dam failure or dam safety emergencies, the River Forecast Center staff would be required to take the following actions:

a. The REOC is activated and operated until the condition no longer exists.

b. Communications are maintained with WBN control room supervision on at least three-hour intervals (or more frequently, if needed).

c. WBN control room supervision is notified of conditions (rainfall and flood predictions) and that the REOC has been activated.

d. If necessary, a Stage I Flood Warning is declared and communicated to WBN control room supervision when flood level at the site, based on rainfall on the ground, is forecast to reach the appropriate threshold flood warning levels for the season of the year.

e. If necessary, a Stage II Flood Warning is declared and communicated to WBN control room supervision 17 hours or more from the time when flood level at the site, based on rainfall on the ground, is forecast to reach elevation 727 ft.

f. The flooding is assessed on an on-going basis to ensure that a minimum 27 hour notice for Stage I Flood Warning and a minimum 17 hour notice for Stage II Flood Warning are maintained.

g. WBN control room supervision is immediately notified and flood warnings are rescinded when the potential for site flooding no longer exists.

3. For times when either WBN unit is in Mode 5 (Cold Shutdown) or Mode 6 (Refueling) as defined in the plant Technical Specifications (usually during refueling or major maintenance), WBN control room supervision requires extra warning regarding flood conditions. In Mode 5 or 6, extra time would be needed to establish open mode cooling. To ensure sufficient awareness, WBN management and the River Forecast Center staff discuss dates for refueling or major maintenance in advance of scheduled outages, and communicate at least once per day during this condition to notify the River Forecast Center staff of plant outage configuration and expected time to complete outage. WBN management notifies the River Forecast Center staff when this plant configuration is no longer applicable.

During refueling or major maintenance, the River Forecast Center staff provides WBN control room supervision with an assessment of forecasted river elevations based both on rainfall on the ground and "maximum" rain forecast. As directed by the TVA River Scheduling Notification Directory, the River Forecast Center forecast indicates whether or not the expected river elevation will exceed elevation 727 ft within the next 99 hours to provide additional warning time regarding predicted flood conditions. If heavy rain develops or is forecast, the River Forecast Center staff notifies WBN control room supervision of any decrease of the 99 hour flood warning time forecast if applicable.

After the River Forecast Center staff has determined that a Stage I Flood Warning is required then the actions of AOI-7.01 are implemented. AOI-7.01 requires the WBN control room supervisors to evaluate Emergency Plan Implementing Procedure EPIP-1, "Emergency Plan Classification Logic," to determine the emergency action level requirements. EPIP-1 requires declaration of a Notification of Unusual Event whenever river reservoir level is at Stage I Flood Warning as reported by the River Forecast Center staff, and declaration of an Alert whenever river reservoir level is at Stage II Flood Warning as reported by the River Forecast Center staff. Therefore, the emergency action levels reflect actual Stage I and Stage II Flood Warning declarations by the River Forecast Center staff regardless of the actual flood elevations existing at the WBN site.

19.0 AHPB RAI Question 19

Pages 36 and 37 of Enclosure 1, are there any plant modes, other than 100 percent power, that could complicate planned responses or extend response times? What procedures would be entered if there is a change with the initial assumptions?

19.1 TVA Response - AHPB RAI Question 19

Two modes of flood mode operation are outlined in the AOI-7.xx series of procedures, these are the open and closed mode. In open mode, the reactor vessel head is off and the spent fuel pit cooling (SFPC) system is cross connected with residual heat removal (RHR) piping to remove heat from the reactor and spent fuel pool. In the closed mode, the reactor coolant system (RCS) remains intact. Decay heat removal is provided by connecting spool pieces between the auxiliary feedwater system and HPFP system and feeding the steam generators with river water.

The mode of operation of the plant at the time of flood warning will determine which mode is used. In most cases, there really is not a decision to be made, as only one of the modes will be attainable at a given time. For example, if the reactor vessel head is removed during an outage, then it is not practical to expect the head can be replaced, the RCS made intact and that the plant can be transitioned to natural circulation cooling in the time required, thus the open mode was developed. Conversely, at 100% power, it is not feasible that a cooldown and reactor vessel head removal could be performed in the time required.

The most challenging plant conditions are those involved during an outage in which the plant is in an intermediate state between open and closed. An example of such a time is when the RCS might be drained with the reactor vessel head in place. There is a special condition allowance contained in the WBN Init 1 UFSAR Subsection 2.4.14.11 as stated below:

> "The flood protection plan is based upon the minimum time available for the worst case. This worst case provides adequate preparation time including contingency margin for normal and anticipated plant conditions including anticipated maintenance operations. It is conceivable, however, that a plant condition might develop for which maintenance operations would make a longer warning time desirable. In such a situation the Plant Manager determines the desirable warning time. He contacts TVA's RO to determine if the desired warning time is available. If weather and reservoir conditions are such that the desired time can be provided, special warning procedures will be developed, if necessary, to ensure the time is available. This special case continues until the Plant Manager notifies TVA's RO that maintenance has been completed. If threatening storm conditions are forecast which might shorten the available time for special maintenance, the Plant Manager is notified and steps taken to assure that the plant is placed in a safe shutdown mode."

Technical Requirements Instruction 0-TRI-100-1, "Flood Protection Communications," contains the procedural guidance for the advanced warning.

20.0 AHPB RAI Question 20

On page 2.4-61 of Attachment 1, Post-Flood Period section, please explain why detailed procedures are not available for post flood actions?

20.1 TVA Response - AHPB RAI Question 20

This question is related to WBN Unit 1 UFSAR text that is not technically revised in the WBN LAR or affected by the updated hydrologic analysis. However, there is a WBN engineering design guide that discusses the requirements for post flood actions. The reason why post flood actions are not specifically prescribed in advance of an external flooding event is due to the need to develop a specific recovery plan based on actual conditions created by the flooding event. Development of a recovery plan requires that

a damage assessment, which can only be accurately performed after the flood has receded, be completed.

The WBN engineering design guide specifies that the plant is designed to continue safely in the flood mode for 100 days even though the water is not expected to remain above plant grade for more than one to four days. After recession of the flood, damage will be assessed and detailed recovery plans developed. Arrangements will then be made for reestablishment of offsite power and removal of spent fuel. A decision based on economics will be made on whether or not to regain the plant for power production. In either case, detailed plans will be formulated after the flood, when damage can be accurately assessed. The 100 day period provides a more than adequate time for the development of procedures for any maintenance, inspection, installation of replacements, for the recovery of the plant or for a continuation of flood mode operations in excess of 100 days.

21.0 AHPB RAI Question 21

Page 2.4-62 of Attachment 1 Spent Fuel Pool (SFP) Section: This system *cooling* relies on Essential Raw Cooling Water (ERCW), which is one of the two systems requiring additional protection. What procedure would be used if the ERCW fails?

21.1 TVA Response - AHPB RAI Question 21

Should a complete loss of ERCW occur, cooling water to the emergency diesel generators would be lost, and the flood protection plan would not function as designed.

The only site procedural guidance that currently exists for a complete loss of ERCW is Extensive Damage Mitigation Guideline MA-1, "Recovery from Loss of Shutdown Power and Loss of ERCW." This procedure was developed from a mass casualty perspective and was not specifically written to complement the stations flood protection plan. However, portable equipment used in this procedure is identified in AOI-7.01 and is staged above PMF level during Stage I Flood Warning preparations to allow its use if needed.

MA-1 recovers ERCW using a portable diesel fire pump. Normally the pump would be located at the IPS, or at the cooling towers. However, should the plant be flooded above plant grade, these locations could not be accessed. The procedure does specify that the Site Emergency Director can specify location for use of this equipment.

Should a localized failure of ERCW to the SFPC system occur, HPFP system water could be used to replenish spent fuel pool inventory to maintain cooling of the assemblies. The vaporization rates that would be expected on a loss of cooling are approximately 102 gpm. The response to AHPB RAI Question 22 contains a description of the current capacity of the HPFP system. Considering single unit operations, this amount of water capacity remains available to fill the SFPC system.

ENCLOSURE 1

RESPONSE TO NRC HEALTH PHYSICS AND HUMAN PERFORMANCE BRANCH (AHPB) REQUEST FOR ADDITIONAL INFORMATION (RAI)

22.0 AHPB RAI Question 22

The first paragraph on 2.4-62 of Attachment 1 states, "Heat removal from the steam generators is accomplished by adding river water from the High Pressure Fire Protection (HPFP) System and relieving steam to the atmosphere through the power operated relief valves." Will there be sufficient capacity in the HPFP to also maintain the SFP level if necessary? If not, what actions would be taken?

22.1 TVA Response - AHPB RAI Question 22

A TVA calculation verifies the capability of the HPFP system to supply the steam generators through the auxiliary feedwater system during flood mode operations. The calculation is based on reactor decay heat load 10 hours post shutdown.

HPFP system makeup rate requirements for SFPC system at maximum decay heat production rate from the spent fuel pool water loss by vaporization Is approximately 55 gpm. The calculation lists the following flow requirements that are required to be provided by HPFP system during flood mode operations:

- WBN Unit 1 Steam Generators - approximately 231 gpm
- WBN Unit 2 Steam Generators - approximately 244 gpm
- Available for makeup to spent fuel pool or auxiliary boration tank - 60 gpm

Therefore, there is sufficient capacity to provide both removal of decay heat from both units' reactors and to maintain spent fuel pool inventory during flood mode operations. The calculation is for two unit operations with each unit removing heat with two steam generators. For single unit operations, the capacity dedicated to the opposite unit but not needed would provide additional capability to add water to the spent fuel pool if needed.