TVA

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

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10 CFR 50.4(b)(6)
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U.S. Nuclear Regulatory Commission
ATTN: Document Control Desk
Washington, D.C. 20555-0001

Watts Bar Nuclear Plant, Unit 2
NRC Docket No. 50-391

Subject: **Watts Bar Nuclear Plant (WBN) Unit 2 – Final Safety Analysis Report (FSAR) – Response to Requests for Additional Information (RAIs) Related to FSAR Sections 9.2.1 and 9.2.2**

References:

1. NRC to TVA letter dated March 23, 2011, "Watts Bar Nuclear Plant, Unit 2 - Request for Additional Information Regarding Final Safety Analysis Report Amendment Related to Sections 9.2.1 and 9.2.2 (TAC No. ME4620)" (ADAMS Accession Number ML110760203)
2. TVA to NRC letter dated December 10, 2010, "Watts Bar Nuclear Plant (WBN) Unit 2 – Final Safety Analysis Report (FSAR) – Response to Requests for Additional Information" (ADAMS Accession Number ML103480708)

NRC's letter to TVA dated March 23, 2011 (Reference 1) contained several RAIs related to Unit 2 FSAR Sections 9.2.1 and 9.2.2. The RAIs and the responses are provided in Enclosure 1.

Enclosure 2 provides the list of commitments made in this letter. If you have any questions, please contact Bill Crouch at (423) 365-2004.

I declare under penalty of perjury that the foregoing is true and correct. Executed on the 13th day of April, 2011.

Respectfully,

David Stinson
Watts Bar Unit 2 Vice President

D030
NRR

Enclosures:

1. Response to RAIs Related to FSAR Sections 9.2.1 and 9.2.2

2. List of Commitments

Attachment:

1. Non-Accident Unit RCS Cooldown, Unit 1 Hot Shutdown - Unit 2 LOCA w/LOOP and Loss of Train A Power (Unit 1 Cooldown)

cc (Enclosures):

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ENCLOSURE 1

Response to RAIs Related to FSAR Sections 9.2.1 and 9.2.2

Tennessee Valley Authority - Watts Bar Nuclear Plant - Unit 2, Docket No. 50-391

Requests for Additional Information (RAI)

1. *Section 9.2.1, Essential Raw Cooling Water (ERCW) System*

Background

In a letter dated December 10, 2010, Tennessee Valley Authority (TVA) provided the following.

(a) *Enclosure 5, "Summary Heat Load and Flow Tables for RAI 9.2-ERCW-3." These tables show ERCW heat loads and flows for:*

(1) *LOOP (loss of offsite power) with loss of Train B and;*

(2) *LOOP with loss of Train A [1A & 2A].*

It appears that the loss of Train A is the worst-case single failure because only component cooling system (CCS) heat exchanger (HX) "C" receives ERCW flow while CCS HX "A" and "B" do not receive ERCW flow.

(b) *In its response to RAI 9.2-CCS-1, TVA stated that "Calculations demonstrate that there is sufficient Essential Raw Cooling Water (ERCW) and Component Cooling System capability to bring the non-accident to Cold Shutdown within 72 hours from entry into hot standby mode."*

(c) *In response to RAI 9.2.1-ERCW-3, TVA has stated that:*

(1) *In the case of Unit 1 in Hot Shutdown and Unit 2 with a loss-of-coolant accident (LOCA), there is an ERCW flow rate of 7600 gpm to CCS HX C. This results in the nonaccident (Hot Shutdown) unit entering Mode 5 (Cold Shutdown) 46 hours after shutdown. The cooldown analysis is based on maintaining the unit in Mode 3 (Hot Standby) for 18 hours, and then using the residual heat removal (RHR) system to cool the unit for 28 hours.*

(2) *In the case of Unit 1 with a LOCA and Unit 2 in Hot Shutdown, there is an ERCW flow rate of 7990 gpm to CCS HX C. This results in the non accident (Hot Shutdown) unit entering Mode 5 (Cold Shutdown) 36 hours after shutdown. The cooldown analysis is based on maintaining the unit in Mode 3 (Hot Standby) for 12 hours, and then using RHR to cool the unit for 24 hours.*

(3) *In response to RAI 9.2.1-ERCW-2, TVA stated that no operator action is required for ERCW header 1B backing up ERCW header 2A in supplying ERCW to CCS HXs A and B.*

Questions:

(a) *For (a)(1) above with LOCA (Unit 1) and Cold Shutdown (Unit 2), it appears that the ERCW is capable of removing 292,639 kBTU/hr, including the approximate 149,500 kBTU/hr removed by CCS HX A and B.*

1. *With this capability of ERCW for a LOOP and loss of Train B, explain the capability of the shared ERCW for WBN Units 1 and 2 to comply with General Design Criterion (GDC) 5, in that systems important to safety shall not be shared among nuclear power units unless it can be shown that such sharing will not significantly impair their ability to perform their safety functions, including, in the event of an accident in one unit, an orderly shutdown and cool down of the remaining unit.*

TVA Response:

Enclosure 5 (Summary Heat Load and Flow Tables for RAI 9.2-ERCW-3) of TVA's letter to NRC dated December 10, 2010 (Reference 2), provided summary heat loads and flow rates in tabular form for the various combinations of operating modes for Units 1 and 2 during dual unit operation. These heat loads and flow rates are the maximum calculated steady state heat loads anticipated during the corresponding combination of operating modes for Units 1 and 2. The tables are not intended to be used for transient analyses. The Enclosure 5 tables also did not provide heat loads and flow rates for several combinations of operating modes because they were considered unlikely and/or beyond design basis (e.g., both units in startup, both units in LOCA SI or LOCA Recirculation[beyond design basis], etc.). Since safe shutdown for WBN is considered Hot Standby, the heat loads and flow rates for one unit in LOCA Recirculation and the other unit in Hot Shutdown were not included in the Enclosure 5 tables. The Enclosure 5 tables show that the cooling capability of the ERCW system complies with GDC 5 requirements for sharing of systems using steady state heat loads and required flow rates for design basis combinations of operating modes.

A set of GDC 5 transient cooldown analyses was also conducted to demonstrate the ERCW system capability to cool down the non-accident unit and to calculate the time to reach Cold Shutdown. The GDC 5 transient analyses begin with the heat loads and flow rates experienced at the end of Hot Standby when the transition of the non-accident unit to Hot Shutdown occurs. Since a LOCA with a Loss of Offsite Power (LOOP) coupled with a Loss of Train B event is bounded by a LOCA coupled with a LOOP and a Loss of Train A event due to the cooldown utilizing just one CCS Heat Exchanger to cool down both the accident and the non-accident unit, only the Loss of Train A cases are documented in a calculation. See the discussion included in the response to ***Section 9.2.1 - Question (b)1*** regarding the capability of the shared ERCW for WBN Units 1 and 2 to comply with GDC 5 by bringing the non-accident unit to cold shutdown.

2. *What is the time to reach cold shutdown of the non-accident unit? List major assumptions.*

TVA Response:

As noted in the response to ***Section 9.2.1 - Question (a)1***, a LOCA with a LOOP coupled with a Loss of Train B event is bounded by a LOCA with a LOOP coupled with a Loss of Train A event. See the discussion included below in the response to ***Section 9.2.1 - Question (b)2*** regarding the time to reach cold shutdown of the non-accident unit and the major assumptions included in the bounding GDC 5 transient analyses.

(b) *For (a)(2) above with LOCA (Unit 1) and Cold Shutdown (Unit 2), it appears that the ERCW is capable of removing 271,860 kBTU/hr, including the approximate 128,729 kBTU/hr removed by CCS HX C.*

1. *With this capability of ERCW for a LOOP and Loss of Train A, explain the capability of the shared ERCW for WBN 1 and 2 to comply with GDC 5 as described in (a) above.*

TVA Response:

As noted in the response to ***Section 9.2.1 - Question (a)1***, the Enclosure 5 tables provided in TVA's letter to NRC dated December 10, 2010 (Reference 2), are the worst case steady state heat loads and flow requirements for the design basis combination of operating modes listed. These heat loads were not used in the GDC 5 transient cooldown analyses for the non-accident unit. The heat loads used in the transient analyses for the non-accident unit are dependent on the amount of time the non-accident unit has been in Hot Standby prior to entering Hot Shutdown.

The GDC 5 transient cooldown analyses found the most limiting case for Loss of Train A (ERCW and CCS) is Unit 2 with a LOCA and Unit 1 as the non-accident unit. The analyses assume a single failure of a complete loss of Train A power, thereby resulting in a loss of all Train A ERCW equipment. All Train B ERCW equipment is assumed to be available, including: (1) CCS Heat Exchanger C, and (2) two of four Train B ERCW pumps. Attachment 1 provides a summary of the cooldown analysis. Core decay heat for the accident unit is conservatively held constant throughout the event at 54.8 MBTU/hr. The cooldown analysis for the non-accident unit assumes that its decay heat will be removed by the Steam Generators (SGs) and SG Safety Valves until such time that its decay heat has decreased sufficiently such that the total decay heat (constant accident unit decay heat plus decreasing non-accident unit decay heat) is less than the capability of ERCW Train B. This non-accident unit decay heat is represented by Column 5 of Attachment 1. The excess heat removal capability (Column 6) results in a cooldown of the RCS (Columns 7, 8, and 9). Core decay heat loads are conservatively calculated in accordance with ANS Standard 5.1, "Decay Heat Power in Light Water Reactors," and USNRC Regulatory Guide 3.54, "Spent Fuel Heat Generation in an Independent Spent Fuel Pool Storage Installation." Additional conservative assumptions for the analysis are included in the response to ***Section 9.2.1 - Question (b).2***. The analysis determined that ERCW Train B has sufficient capability to remove decay heat for both the accident unit and the non-accident unit at 19 hours following entry of the non-accident unit into the Hot Standby mode of operation. In the non-accident unit, once cool down from 350°F using RHR begins, no additional credit is given to decay heat removal by the SGs (even though they are still available). The cooldown would proceed as shown in Attachment 1 from 350°F to Cold Shutdown

(200°F) in another 27 hours, for a total time to bring the non-accident unit to Cold Shutdown of 46 hours.

10 CFR 50, Appendix A, GDC 5 states, "Structures, system, and components important to safety shall not be shared among nuclear power units unless it can be shown that such sharing will not significantly impair their ability to perform their safety functions, including, in the event of an accident in one unit, an orderly shutdown and cooldown of the remaining units." No success criterion is specified for the term "orderly." To be consistent with the Cold Shutdown requirements of 10 CFR 50, Appendix R, 72 hours was chosen for the success criterion. The above analysis demonstrates a margin of 26 hours to the 72-hour success criterion.

CCS Heat Exchanger C carries loads for both the accident unit and the non-accident unit. The ERCW flow through CCS Heat Exchanger C is 7,600 gpm.

2. *What is the time to reach cold shutdown of the non accident unit? List major assumptions.*

TVA Response:

Cold Shutdown can be reached in 46 hours versus the 72 hour criterion.

Major Assumptions:

- Ultimate Heat Sink Temperature at the 85°F limit of Technical Specifications (TS) LCO 3.7.9
- Design Basis Heat Exchanger Fouling and Tube Plugging
- Concurrent Loss of Downstream Dam
- Degraded pumps
- Loss of Offsite Power
- Passive failure of a cable tray which results in the loss of both Train A Emergency Diesel Generators (DGs) (i.e., complete Loss of Train A Electrical Power)
- Manual re-alignment of the 1B or 2B CCS pump to the C CCS Heat Exchanger
- Time in Hot Standby: 19 hours
- If required, CCS flow to Spent Fuel Pool Heat Exchangers may be reduced or isolated when RHR is used for the final cooldown from 350°F to 200°F.

(c) *The ERCW cooldown capabilities expressed in (c)(1) and (2) above with 7600 gpm and 7990 gpm of ERCW respectively, do not appear to correlate to any of the scenarios presented in Enclosure 5, "Summary of Heat Load and Flow Tables for RAI 9.2-ERCW-3." Please Explain.*

TVA Response:

As noted in the responses to ***Section 9.2.1 - Questions (a)1 and (b)1***, the ERCW flow rates for the cooldown cases are not provided in the Enclosure 5 tables. Since "Safe Shutdown" is defined as "Hot Standby," the cooldown cases are not part of the "standard" operating modes which were typically considered and listed in Enclosure 5. Although not explicitly listed in the referenced tables, the ERCW flows through the CCS

Heat Exchangers for the cooldown cases are comparable. As provided in the response to **Section 9.2.1 - Question (b)1**, the ERCW flow through CCS Heat Exchanger C for the GDC 5 transient cooldown analysis for a Unit 1 LOCA with a LOOP coupled with a Loss of Train A event is 7,600 gpm.

(d) *How do the calculations mentioned in (b) above relate to Enclosure 5, "Summary Heat Load and Flow Tables for RAI 9.2-ERCW-3," and the cooldown times mentioned in (c) above.*

TVA Response:

The heat loads presented in the Enclosure 5 tables are the maximum steady state heat loads for each combination of design basis modes of operation. The cooldown analyses take credit for the reduction of core decay heat in the non-accident unit (but no reduction is credited in the LOCA unit) that occurs over time prior to entry into Hot Shutdown. The initial non-accident unit core decay heat that is used is the value that occurs when RHR is started to cool down the unit from 350°F to 200°F. As the unit is cooled, the core decay heat is further reduced as it decays over time.

(e) *Explain (d) above because the flow diagram, Figure 9.2-2, apparently shows flow control valve 1-FCV-67-458 as a normally-closed valve.*

TVA Response:

This response assumes that the reference to "***(d)***" in this NRC question is actually referring to ***"(c)(3)"*** from the background section and not "***(d)***" from the background section.

The discussion in ***(c)(3)*** above refers to ***NRC RAI 9.2.1-ERCW-2*** and TVA's response to the RAI in TVA to NRC letter dated December 10, 2010 (Reference 2), regarding the consequences of a passive failure of valve 2-FCV-67-81 and whether it required the realignment of ERCW Header 1B to CCS Heat Exchanger A utilizing operator action to open 1-FCV-67-458.

Based on the wording in the "Effect on System" column of Unit 2 FSAR Table 9.2-2 (*Essential Raw Cooling Water System Failure Modes and Effects Analysis*) for 2-FCV-67-81 (Item #26), ***NRC RAI 9.2.1-ERCW-2*** requested a description of the process of aligning ERCW Header 1B to CCS Heat Exchangers A and B after failure of the ERCW 2A header supply due to the failure of 2-FCV-67-81, including required operator actions. The Amendment 103 version of Unit 2 FSAR Table 9.2-2 indicates that, if 2-FCV-67-81 fails closed, there is no effect on the system's ability to perform its function as either one of two header sets of 1A and 2A or 1B and 2B can furnish full ERCW flow. The intent of this statement is to indicate either ERCW Train A (Headers 1A and 2A) or ERCW Train B (Headers 1B and 2B) can provide the required ERCW flows needed to meet its safety function. When relying on ERCW Train A, CCS receives cooling from the ERCW System through CCS Heat Exchangers A and B. When relying on ERCW Train B, CCS receives cooling from the ERCW System through CCS Heat Exchanger C. There are no operator actions required to support these alignments to the CCS Heat Exchangers and there is no need to realign CCS Heat Exchanger A to ERCW Header 1B. Unit 2 FSAR Figure 9.2-2 (1-47W845-2) correctly shows 1-FCV-67-458 in the "normally closed" position. Additionally, when ERCW Train A is unavailable, ERCW Header 1B is relied upon to provide the required ERCW cooling to other essential components including the Train B DGs and the Unit 1 Train B Room Coolers and Containment Spray Heat Exchanger.

(f) *Describe any needed revisions to FSAR Section 9.2.1 to describe its design basis for adherence to GDC 5.*

TVA Response:

A future amendment to the Unit 2 FSAR will revise Section 9.2.1.3 to add the following:

"ERCW is a versatile system capable of providing sufficient flow and heat removal for a variety of conditions in each unit. As examples,

1) during normal operations, the ERCW system can meet the highest flow demand of one unit in startup and the other in hot shutdown with a flow requirement of approximately 26,400 gpm and remove the highest heat removal demand of one unit in hot shutdown and the other unit in cold shutdown with a heat load of approximately 233,000 kBTU/hr.
2) under design basis accident conditions with offsite power available, the ERCW system can meet the highest flow demand of one unit in startup and the other in LOCA Recirculation with a flow requirement of approximately 32,900 gpm and remove the highest heat removal demand of one unit in cold shutdown and the other unit in LOCA Recirculation with a heat load of approximately 439,000 kBTU/hr.
3) under design basis accident conditions with a LOOP coupled with a Loss of Train A, Train B of the ERCW system can meet the highest flow demand of one unit in cold shutdown and the other in LOCA Recirculation with a flow requirement of approximately 19,100 gpm and remove the highest heat removal demand of one unit in cold shutdown and the other unit in LOCA Recirculation with a heat load of approximately 272,000 kBTU/hr.
4) under design basis accident conditions with a LOOP coupled with a Loss of Train B, Train A of the ERCW system can meet the highest flow demand of one unit in cold shutdown and the other in LOCA Recirculation with a flow requirement of approximately 20,300 gpm and remove the highest heat removal demand of one unit in cold shutdown and the other unit in LOCA Recirculation with a heat load of approximately 293,000 kBTU/hr."

Section 9.2.2. Component Cooling System (CCS)

Background

In December 10, 2010, letter, TVA provided the following:

(a) *Enclosure 3, "Summary Heat Load and Flow Tables for RAI 9.2-CCS-4." This table shows CCS heat loads and flows for:*

(1) *LOOP with loss of Train B*

(2) *LOOP with loss of Train A [1A & 2A]*

It is apparent that loss of Train A is the worst-case single failure with only CCS HX "C" available for Train B.

(b) *Response to RAI 9.2-CCS-1 that "The project has performed calculations which demonstrate that there is sufficient Essential Raw Water Cooling (ERCW) and Component Cooling System capability to bring the non-accident unit to Cold Shutdown within 72 hours from entry into hot standby mode."*

Questions:

(a) *For (a)(1) above with LOCA (Unit 1) and Cold Shutdown (Unit 2), it appears that the CCS is capable of removing 56,220 kBTU/hr in CCS Train 1A and 93,230 kBTU/hr in CCS Train 2A.*

1. *With this capability of CCS for a LOOP and loss of Train B, explain the capability of the shared CCS for Watts Bar 1 and 2 to comply with GDC 5 in that systems important to safety shall not be shared among nuclear power units unless it can be shown that such sharing will not significantly impair their ability to perform their safety functions, including, in the event of an accident in one unit, an orderly shutdown and cool down of the remaining unit.*

TVA Response:

Enclosure 3 (Summary Heat Load and Flow Tables for RAI 9.2-CCS-4) of TVA's letter to NRC dated December 10, 2010 (Reference 2), provided summary CCS heat loads and flow rates in tabular form for the various combinations of operating modes for Units 1 and 2 during dual unit operation. These CCS heat loads and flow rates are the maximum calculated steady state heat loads anticipated during the corresponding combination of operating modes for Units 1 and 2. The tables are not intended to be used for transient analyses. The Enclosure 3 tables also did not provide heat loads and flow rates for several combinations of operating modes because they were considered unlikely and/or beyond design basis (e.g., both units in startup, both units in LOCA SI or LOCA Recirculation[beyond design basis], etc.). Since safe shutdown for WBN is considered Hot Standby, the heat loads and flow rates for one unit in LOCA Recirculation and the other in Hot Shutdown were not included in the Enclosure 3 tables. The Enclosure 3 tables show that the cooling capability of the CCS system complies with GDC 5 requirements for sharing of systems using steady state heat loads and required flow rates for design basis combinations of operating modes.

A set of GDC 5 transient cooldown analyses was also conducted to demonstrate the CCS and ERCW system capability to cool down the non-accident unit and to calculate the time to reach Cold Shutdown. The GDC 5 transient analyses begin with the heat loads and flow rates experienced at the end of Hot Standby when the transition of the non-accident unit to Hot Shutdown occurs. Since a LOCA with a LOOP coupled with a Loss of Train B event is bounded by a LOCA coupled with a LOOP and a Loss of Train A event due to the cooldown utilizing just one CCS Heat Exchanger to cool down both the accident and the non-accident unit, only the Loss of Train A cases are documented in a calculation. See the discussion included below in the response to ***Section 9.2.2 - Question (b)1*** regarding the capability of the shared CCS for WBN Units 1 and 2 to comply with GDC 5 by bringing the non-accident unit to cold shutdown.

2. *What is the time to reach cold shutdown of the non-accident unit? List major assumptions.*

TVA Response:

As noted in the response to ***Section 9.2.2 - Question (a)1***, a LOCA with a LOOP coupled with a Loss of Train B event is bounded by a LOCA with a LOOP coupled with a Loss of Train A event. See the discussion included in the response to ***Section 9.2.2 - Question (b)2*** regarding the time to reach cold shutdown of the non-accident unit and the major assumptions included in the bounding GDC 5 transient analyses.

(b) *For (a) (2) above with LOCA (Unit 1) and Cold Shutdown (Unit 2), it appears that the CCS is capable of removing 55,162 kBTU/hr in CCS Train 1B and 73,567 kBTU/hr in CCS Train 2B.*

1. *With this capability of CCS for a LOOP and loss of Train A, explain the capability of the shared CCS for Watts Bar 1 and 2 to comply with GDC 5 as described in (A)(1) above.*

TVA Response:

As noted in the response to ***Section 9.2.2 - Question (a)1***, the Enclosure 3 tables provided in TVA's letter to NRC dated December 10, 2010 (Reference 2), are the worst case steady state heat loads and flow requirements for the design basis combination of operating modes listed. These heat loads were not used in the GDC 5 transient cooldown analyses for the non-accident unit. The heat loads used in the transient analyses for the non-accident unit are dependent on the amount of time the non-accident unit has been in Hot Standby prior to entering Hot Shutdown.

The GDC 5 transient cooldown analyses found the most limiting case for Loss of Train A (ERCW and CCS) is Unit 2 with a LOCA and Unit 1 as the non-accident unit. The analyses assume a single failure of a complete loss of Train A power, thereby resulting in a loss of all Train A CCS equipment. All Train B CCS equipment is assumed to be available, including: (1) CCS Heat Exchanger C, (2) RHR Heat Exchangers 1B and 2B, (3) CCS Pump C-S (powered from electrical Train B), and (4) either CCS Pump 1B or 2B. Core decay heat for the accident unit is conservatively held constant throughout the event at 54.8 MBTU/hr. The cooldown analysis for the non-accident unit assumes that its decay heat will be removed by the SGs and SG Safety Valves until such time that its decay heat has decreased sufficiently such that the total decay heat (constant accident unit decay heat plus decreasing non-accident unit decay heat) is less than the capability of CCS Train B. This non-accident unit decay heat is represented by Column 5 of Attachment 1. The excess heat removal capability (Column 6) results in a cooldown of the RCS (Columns 7, 8, and 9). Core decay heat loads are conservatively calculated in accordance with ANS Standard 5.1, "Decay Heat Power in Light Water Reactors," and USNRC Regulatory Guide 3.54, "Spent Fuel Heat Generation in an Independent Spent Fuel Pool Storage Installation." Additional conservative assumptions for the analysis are included in the response to ***Section 9.2.2 - Question (b).2***. The analysis determined that CCS Train B has sufficient capability to remove decay heat for both the accident unit and the non-accident unit at 19 hours following entry of the non-accident unit into the Hot Standby mode of operation. In the non-accident unit, once cool down from 350°F using RHR begins, no additional credit is given to decay heat removal by the SGs (even though they are still available). The cooldown would proceed as shown in Attachment 1 from 350°F to Cold Shutdown (200°F) in another 27 hours, for a total time to bring the non-accident unit to Cold Shutdown of 46 hours.

10 CFR 50, Appendix A, GDC 5 states, "Structures, system, and components important to safety shall not be shared among nuclear power units unless it can be shown that such sharing will not significantly impair their ability to perform their safety functions, including, in the event of an accident in one unit, an orderly shutdown and cooldown of the remaining units." No success criterion is specified for the term "orderly." To be consistent with the Cold Shutdown requirements of 10 CFR 50, Appendix R, 72 hours was chosen for the success criterion. The above analysis demonstrates a margin of 26 hours to the 72-hour success criterion.

CCS Heat Exchanger C carries both the accident unit and non-accident unit loads. The CCS flow through CCS Heat Exchanger C is 10,166 gpm.

2. *What is the time to reach cold shutdown of the nonaccident unit? List major assumptions.*

TVA Response:

Cold Shutdown can be reached in 46 hours versus the 72 hour criterion.

Major Assumptions:

- Ultimate Heat Sink Temperature at the 85°F limit of TS LCO 3.7.9
- Design Basis Heat Exchanger Fouling and Tube Plugging
- Concurrent Loss of Downstream Dam
- Degraded pumps
- Loss of Offsite Power
- Passive failure of a cable tray which results in the loss of both Train A Emergency DGs (i.e., complete Loss of Train A Electrical Power).
- Manual re-alignment of the 1B or 2B CCS pump to the C CCS Heat Exchanger
- Time in Hot Standby: 19 hours
- If required, CCS flow to Spent Fuel Pool Heat Exchangers may be reduced or isolated when RHR is used for the final cooldown from 350°F to 200°F

(c) *How do the calculations mentioned in b) above relate to Enclosure 3, "Summary Heat Load and Flow Tables for RAI 9.2-CCS-4."*

TVA Response:

As noted in the responses to ***Section 9.2.2 - Question (a)1*** and ***(b)1***, the CCS flow rates for the cooldown cases are not provided in the Enclosure 3 tables. Since "Safe Shutdown" is defined as "Hot Standby," the cooldown cases are not part of the "standard" operating modes which were typically considered and listed in Enclosure 3. The heat loads presented in Enclosure 3 are the maximum steady state heat loads for each combination of design basis modes of operation. The cooldown analyses take credit for the reduction of core decay heat in the non-accident unit that occurs over time. The initial non-accident unit core decay heat used is the value that occurs when the RHR is brought into service to cool down the non-accident unit from 350°F to 200°F at 19 hours. As the non-accident unit is cooled, the core decay heat is further reduced as it decays over time.

(d) *Describe any needed revisions to FSAR Section 9.2.2 to describe the design basis for adherence to GDC 5.*

TVA Response:

A future amendment to the Unit 2 FSAR will revise Section 9.2.2.4 to add the following:

"CCS is a versatile system capable of providing sufficient flow and heat removal for a variety of conditions in each unit. As examples,

1) during normal operations, the CCS system can meet the highest flow demand of both units in startup with a flow requirement of approximately 22,900 gpm and remove the highest heat removal demand of one unit in hot shutdown and the other unit in cold shutdown with a heat load of approximately 188,000 kBTU/hr.

2) under design basis accident conditions with offsite power available, the CCS system can meet the highest flow demand of one unit in startup and the other in LOCA Recirculation with a flow requirement of approximately 21,600 gpm and remove the highest heat removal demand of one unit in cold shutdown and the other unit in LOCA Recirculation with a heat load of approximately 150,000 kBTU/hr.

3) under design basis accident conditions with a LOOP coupled with a Loss of Train A, Train B of the CCS system can meet the highest flow demand of one unit in either cold shutdown or initial refueling and the other in LOCA Recirculation with a flow requirement of approximately 10,200 gpm and remove the highest heat removal demand of one unit in cold shutdown and the other unit in LOCA Recirculation with a heat load of approximately 129,000 kBTU/hr.

4) under design basis accident conditions with a LOOP coupled with a Loss of Train B, Train A of the CCS system can meet the highest flow demand of one unit in either cold shutdown or initial refueling and the other in LOCA Recirculation with a flow requirement of approximately 15,800 gpm and remove the highest heat removal demand of one unit in cold shutdown and the other unit in LOCA Recirculation with a heat load of approximately 149,000 kBTU/hr.

ENCLOSURE 2

List of Commitments

Tennessee Valley Authority - Watts Bar Nuclear Plant - Unit 2, Docket No. 50-391

1. A future amendment to the Unit 2 FSAR will revise Section 9.2.1.3 as delineated in the response to ***Section 9.2.1 - Question (f)***.

2. A future amendment to the Unit 2 FSAR will revise Section 9.2.2.4 as delineated in the response to ***Section 9.2.2 - Question (d)***.

ATTACHMENT 1

Non-Accident Unit RCS Cooldown

Unit 1 Hot Shutdown -
Unit 2 LOCA w/LOOP and Loss of Train A Power (Unit 1 Cooldown)

Non-Accident Unit RCS Cooldown

Unit 1 Hot Shutdown -
Unit 2 LOCA w/LOOP and Loss of Train A Power (Unit 1 Cooldown)

(1) Hour	(2) Initial Temp (deg F)	(3) RHR Hot Side Flow (m#/hr)	(4) RHR Cooling Capacity (MBTU/HR)	(5) Decay Heat (MBTU/HR)	(6) Difference (MBTU/HR)	(7) Cooling Rate (MBTU/HR/deg F)	(8) Approximate Temp Diff (deg F)	(9) Final Temp (deg F)
19	350.00	0.35	75.016	73.28	1.736	1.96	0.89	349.11
20	349.11	0.35	74.752	72.37	2.382	1.96	1.22	347.90
21	347.90	0.36	76.09	71.51	4.580	1.96	2.34	345.56
22	345.56	0.36	75.379	70.68	4.699	1.96	2.40	343.16
23	343.16	0.36	74.649	69.89	4.759	1.96	2.43	340.74
24	340.74	0.37	75.543	69.14	6.403	1.96	3.27	337.47
25	337.47	0.37	74.527	68.42	6.107	1.96	3.12	334.35
26	334.35	0.38	75.126	67.73	7.396	1.96	3.77	330.58
27	330.58	0.38	75.455	67.06	8.392	1.96	4.28	326.30
28	326.30	0.4	75.523	66.42	9.099	1.96	4.64	321.66
29	321.66	0.41	75.422	65.81	9.613	1.96	4.90	316.75
30	316.75	0.42	75.128	65.22	9.913	1.96	5.06	311.69
31	311.69	0.43	74.73	64.64	10.090	1.96	5.15	306.55
32	306.55	0.45	75.446	64.09	11.359	1.96	5.80	300.75
33	300.75	0.47	75.732	63.55	12.182	1.96	6.22	294.54

Unit 1 Hot Shutdown -
Unit 2 LOCA w/LOOP and Loss of Train A Power (Unit 1 Cooldown)

(1) Hour	(2) Initial Temp (deg F)	(3) RHR Hot Side Flow (m#/hr)	(4) RHR Cooling Capacity (MBTU/HR)	(5) Decay Heat (MBTU/HR)	(6) Difference (MBTU/HR)	(7) Cooling Rate (MBTU/HR/deg F)	(8) Approximate Temp Diff (deg F)	(9) Final Temp (deg F)
34	294.54	0.49	75.667	63.03	12.638	1.96	6.45	288.09
35	288.09	0.51	75.314	62.53	12.784	1.96	6.52	281.57
36	281.57	0.54	75.693	62.04	13.653	1.96	6.97	274.60
37	274.60	0.57	75.567	61.56	14.007	1.96	7.15	267.45
38	267.45	0.61	75.857	61.09	14.767	1.96	7.53	259.92
39	259.92	0.65	75.54	60.65	14.89	1.96	7.60	252.32
40	252.32	0.7	75.399	60.21	15.189	1.96	7.75	244.57
41	244.57	0.77	75.822	59.78	16.042	1.96	8.18	236.39
42	236.39	0.85	75.694	59.36	16.334	1.96	8.33	228.05
43	228.05	0.95	75.51	58.95	16.56	1.96	8.45	219.61
44	219.61	1.1	75.888	58.55	17.338	1.96	8.85	210.76
45	210.76	1.3	75.834	58.17	17.664	1.96	9.01	201.75
46	201.75	1.48	73.509	57.79	15.719	1.96	8.02	193.73