WBN2Public Resource

From: Boyd, Desiree L [dlboyd@tva.gov]
Sent: Monday, December 06, 2010 1:36 PM
To: Wiebe, Joel; Poole, Justin; Raghavan, Rags; Milano, Patrick; Campbell, Stephen
Cc: Crouch, William D; Hamill, Carol L; Boyd, Desiree L; Elton, Thomas L
Subject: 12-6-10 _SSER 22 RAI Responses_Final.pdf
Attachments: 12-6-10 _SSER 22 RAI Responses_Final.pdf

Please see attached letter that was sent to the NRC today.

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December 6, 2010

10 CFR 50.4(b)(6)
10 CFR 50.34(b)
10 CFR 2.390(d)(1)

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 – Safety Evaluation Report Supplement 22 (SSER22) – Response to Requests for Additional Information

This letter responds to a number of NRC staff requests for additional information (RAIs) necessary to complete Supplement 22 to the WBN SER.

Enclosure 1 provides the responses to the RAIs.

Enclosure 2 provides the new commitments contained 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 6th day of December, 2010.

Sincerely,

Masoud Bajestani
Watts Bar Unit 2 Vice President

Enclosures:

1. Response to RAIs Necessary to Complete Supplement 22 to the WBN SER
2. List of New Regulatory Commitments

References:

1. TVA letter to NRC dated July 31, 2010, “Watts Bar Nuclear Plant (WBN) Unit 2 – Final Safety Analysis Report (FSAR) – Response to Preliminary Requests for Additional Information and Requests For Additional Information” (ADAMS ML102290258)

2. TVA letter to NRC dated March 4, 2009, “Watts Bar Nuclear Plant (WBN) Unit 2 - Operating License Application Update” (ADAMS ML090700378)

3. TVA letter to NRC dated February 2, 2010, “Watts Bar Nuclear Plant (WBN) - Unit 2 - Developmental Revision B of the Technical Specifications (Ts), TS Bases, Technical Requirements Manual (TRM), TRM Bases; and Pressure and Temperature Limits Report (PTLR)” (ADAMS ML100550326)

Attachments:

1. MKW’s July 15, 1994, Concurrence With Tennessee Valley Authority’s DIESEL GENERATOR MAXIMUM KW CAPABILITY

   Sequoyah Nuclear Plant (SON)

   Watts Bar Nuclear Plant (WBN)

cc (Enclosures):

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ENCLOSURE 1

Response to RAIs Necessary to Complete Supplement 22 to the Watts Bar SER

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

SER Section 8.1, General

8.1 - 1. *For scenario with an accident one unit and spurious ESF actuation in the other unit with offsite power, TVA stated that there is no design requirement per the FSAR when supplied from off-site power. TVA also stated that the auxiliary power system and supporting analysis complies with the requirements of position C.2.b of RG 1.81. Therefore, analysis with one unit in accident and the spurious actuation of ESF loads in the second unit has not been performed.*

The staff noted that the design criteria provided in SRP Section 8.2, Part 111.9 (April 1978) requires the staff to evaluate the capability of preferred power system for spurious or false accident signals (i.e., should not overload the preferred power source circuits).

Provide this analysis for the staff to review.

Response: Analysis with one unit in accident and the spurious ESF actuation in the other unit with offsite power has been performed. TVA reviewed the results for the following two bounding configurations: (1) all four Shutdown boards on either the C or D CSST, and (2) two shutdown boards on either the A or B CSSTs and two shutdown boards on either the C or D CSSTs. This review determined that the CSSTs have adequate capacity to support all ESF loads for one unit in accident and spurious ESF actuation in the other unit. The transient voltage due to block starting of the ESF motors recovers to reset the degraded voltage relays in ≤ 5 seconds. The minimum time (analytical lower limit) for degraded voltage relay reset is 8.5 seconds so as to not isolate the offsite power and transfer to onsite power (diesel generators).

8.1 - 2. *For scenario with a dual-unit trip as a result of an abnormal operational occurrence in accordance with GDC 17, the applicant did not provide any specific analysis to conclude that both offsite and onsite power systems have adequate capacity and capability.*

Provide this analysis for the staff to review.

Response: A separate analysis was not performed to verify loading under abnormal operational occurrence (e.g., two unit full load rejection). The loading for a dual unit trip is enveloped by the analysis for a spurious accident signal on one unit with an accident on the other unit (see the response to **RAI 8.2.2 - 1.** for loading). The diesel loading analysis is performed based on worst case accident loading on the diesel generators, which bounds a dual unit trip.

ENCLOSURE 1

Response to RAIs Necessary to Complete Supplement 22 to the Watts Bar SER

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

SER Section 8.2.1, Compliance with GDC 5

8.2.1 - 1. *FSAR Section 8.2.2, "Analysis," stated that each 161 kV circuit and CSSTs C and D have sufficient capacity and adequate voltage to supply the essential safety auxiliaries of a unit under loss-of-coolant accident (LOCA) conditions concurrent with a simultaneous worst-case single transmission system contingency.*

Provide clarification to show that the loads from the second unit were considered in this analysis.

Response: TVA confirmed that the auxiliary power system analysis performed in calculation EDQ00099920070002 for two unit operation includes loads for the second unit. Excerpts from the calculation were provided in TVA letter to NRC dated July 31, 2010 (Reference 1).

Amendment 103 to the Unit 2 FSAR will revise the first paragraph of Section 8.2.2 to replace "Each 161kV circuit and CSSTs C and D have sufficient capacity and adequate voltage to supply the essential safety auxiliaries of a unit under loss of coolant accident conditions concurrent with a simultaneous worst-case single transmission system contingency." with "Each 161 kV circuit and CSSTs C and D have sufficient capacity and adequate voltage to supply the essential safety auxiliaries of a unit under loss-of-coolant accident (LOCA) conditions and the other unit in concurrent orderly shutdown with a simultaneous worst-case single transmission system contingency."

8.2.1 - 2. *TVA submitted selective excerpts from calculation WBN-EEB-EDQOOO-999-2007-0002 for AC Power Systems Analyses, which evaluated plant loading conditions. This calculation assumed that the existing rating of CSST A and B will be upgraded from 57/76MVA OAIFA to a design rating of 95MVA (Primary-winding) and 60MVA (secondary & tertiary winding) by retrofitting with an additional cooling system.*

Clarify whether the proposed change is essential to provide adequate capacity for the shared station service transformers to handle plant loads for all postulated conditions and schedule for completing this modification. Specifically, verify that each service transformer can supply the Class 1E power system for both units under all postulated design conditions including: (a) a design-basis accident with single failure on one unit and a spurious accident signal with full load rejection on the other unit and (b) a dual-unit shutdown due to abnormal operating occurrence.

Response: Based on the auxiliary power system analysis, TVA concluded that the upgrade of CSSTs A and B to 95MVA (primary winding) and 60MVA (secondary and tertiary winding) is not required for two unit operation.

Additionally, CSSTs A and B will not simultaneously be credited as an independent source of offsite power for the Class 1E system. Therefore, only one train shall be transferred to CSSTs A and B at any given time. Additionally, CSSTs A or B cannot be credited as an offsite source if all Balance of Plant station loads are supplied by one CSST (i.e., B or A CSST out of service).

Analysis has been performed that verified the adequacy of CSSTs A and B to support shutdown of both units (one unit in accident and other unit in orderly shutdown or with spurious ESF loads actuation) with one train of Class 1E system transferred.

8.2.2 Compliance with GDC 17 and GDC 18

8.2.2 - 1. *In view of the Unit 2 loads being applied to the CSSTs along with Unit 1 loads, the staff requested a summary of the calculations and analyses that detail the loading for both units (or added loads of Watts Bar Unit 2 to the existing loads of Unit 1), including the design margin in the CSSTs with a design-basis accident (DBA) in one unit and a concurrent shutdown of the other unit. The applicant's response showed that all operational configurations for offsite power supply to the units yield loadings well within the rating of the transformer with design margins from 10% to as high as 48%.*

Provide a summary of similar margin studies based on scenarios as described below for CSSTs A, B, C, and D.

a. A dual-unit trip as a result of abnormal operational occurrence.

b. Accident in one unit and concurrent shutdown of the second unit (with and without offsite power).

c. Accident in one unit and spurious engineered safety features (ESF) actuation in the other unit (with and without offsite power).

Response: The loading for a dual unit trip (item a) is slightly less than the loading with one unit in accident and a spurious accident signal in the other unit. Therefore, a separate load flow was not performed. Steady State Load summary for one unit in accident and concurrent shutdown of the other unit (item b) was supplied in response to a **RAI for Unit 2 FSAR Section 8.2** included in TVA letter dated July 31, 2010 (Reference 1). For item c, the loading is provided in the following table:

	STEADY STATE LOADING			**RATING**
	MW	**MVAR**	**MVA**	**MVA**
CSST C - X	11.92	5.66	13.20	24/32/40
CSST C - Y	12.25	6.04	13.66	24/32/40
CSST C - P	24.21	13.05	27.50	33/44/55

(The above loading on CSST C is with both ESF trains of both units powered from this transformer; CSST D is out of service)

CSST D - X	11.91	5.67	13.19	24/32/40
CSST D - Y	12.25	6.05	13.66	24/32/40
CSST D - P	24.21	13.06	27.51	33/44/55

(The above loading on CSST D is with both ESF trains of both units powered from this transformer; CSST C is out of service)

CSST A - X	21.86	9.28	23.75	36/48/60*
CSST A - Y	31.80	19.23	37.16	36/48/60*
CSST A - P	53.98	35.36	64.53	57/76/95*

(The above loading on CSST A is with one ESF train of each unit transferred to this transformer. CSST D is out of service; CSSTs C, A, and B are available.)

CSST B - X	21.86	9.28	23.75	36/48/60*
CSST B - Y	33.13	19.90	38.65	36/48/60*
CSST B - P	55.34	36.51	66.30	57/76/95*

(The above loading on CSST A is with one ESF train of each unit transferred to this transformer. CSST D is out of service; CSSTs C, A, and B are available.)

∗ CSSTs A and B second's FA rating is "FUTURE."

Note: The worst case loading on CSSTs A and B is when one of the CSSTs is out of service and all BOP loads for both units are transferred to CSST A or CSST B which is as follows:

CSST A - X	21.86	9.28	23.75	36/48/60*
CSST A - Y	38.46	24.84	45.78	36/48/60*
CSST A - P	60.32	34.12	69.30	57/76/95*

This additional analysis will be included in the next revision of the AC Auxiliary Power System Analysis Calculation EDQ00099920070002.

8.2.2 - 2. *Provide the results of the grid stability analyses to indicate that loss of the largest capacity being supplied to the grid, loss of the largest load from the grid, loss of the most critical transmission line, or loss of both units themselves will not cause grid instability in accordance with specifications after trip of a station unit in accordance with GDC 17.*

Response: Calculation TSS (E32 100920 614) evaluates each transmission element within TVA's service area out-of-service (pre-event) followed by a WBN unit trip and LOCA loading. There were no conditions which resulted in grid instability. Included in this analysis are:

- Loss of the largest capacity being supplied to the grid: Sequoyah Unit 2.
- Loss of the largest load from the grid: largest load line from Watts Bar Hydro is WBH-Smith-Winchester 161kV line. This is the bounding largest load in the grid which provides the worst case voltage drop at the WBN Hydro Switchyard.
- Loss of the most critical transmission line: Sequoyah to Watts Bar Hydro 161kV transmission line.
- Loss of both units, both WBN single and dual unit operation were studied.

<u>**8.3.1.2, Low and/or Degraded Voltage Condition**</u>

8.3.1.2 - 1. *Confirm that the analytical values for the degraded voltage settings will be suitably accounted in the final Technical Specifications*

Response: The degraded voltage relay setpoints and allowable values are provided in Item 2 of Table 3.3.5-1 of the Unit 2 Technical Specifications (TS).

The Unit 2 TS version for this table was submitted in TVA to NRC letter dated March 4, 2009 (Reference 2).

8.3.1.2 - 2. *The loss-of-voltage relay lower time delay of 0.4 seconds may be too short for the transmission line protection to clear the short circuit fault. Confirm the longest time setting for the 161 kV transmission line protections to clear a short circuit fault (such as time setting in a second or third zone of distance protection) does not cause the actuation of the LOV relay.*

Response: For the offsite study, TVA evaluates clearing time based on Zone 1 and 2 protection. For our 161kV system, this protection has a nominal clearing time of 5 cycles or less. 161kV voltage recovery analysis after a fault was performed as part of the Grid Voltage Study. This analysis was performed with one line removed from service pre-event and then applying a 3 phase fault on another line (there are six 161kV lines which terminate at WBN plant). After T = 0.0833 seconds (5 cycles), the fault is cleared. Based on the worst case (slowest) voltage recovery, the voltage recovers to 0.9 per unit (90%) or 145kV after about 0.3 seconds from the start of the fault. Based on this worst case voltage recovery time, it is concluded that 0.4 second time delay provides ample margin for the loss of voltage relay setting. This additional analysis will be included in the next revision of Calculation EDX00099920040002 *(Transmission System-Grid Voltage Study of WBN's Off-Site Power System*).

Zone 3 was not used since it is always a backup form of protection, and we were studying NERC Category B faults (N-1 events).

8.3.1.11, Automatic Sequencing of Loads

8.3.1.11 *Describe the resequencing of loads (with time delays involved) in the scenario of LOCA followed by Delayed LOOP and ensure that all loads will be sequenced within the time assumed in the accident analysis.*

Response: A LOCA followed by a delayed LOOP is not a Design Basis Event for WBN. However, the load sequencing circuitry has features which minimize the impact of this event on the onsite power system. The design basis event as described in Unit 2 FSAR Section 8.3.1.1 is "A loss of offsite power coincident with a safety injection signal." A safety injection signal received during the course of non-accident shutdown loading sequence will cause the actions described below (reference the *Standby Diesel Generator Operation* portion of Unit 2 FSAR Section 8.3.1.1):

1. Loads already sequentially connected which are not required for an accident will be disconnected.
2. Loads already sequentially connected which are required for an accident will remain connected.
3. Loads awaiting sequential loading that are not required for an accident will not be connected.
4. Loads awaiting sequential loading that are required for an accident will either be sequentially loaded as a result of the non-accident loading sequence or will have their sequential timers reset to time zero. They will then be sequentially loaded in accordance with the accident sequence.

8.3.1.12, Bus Ratings/Connected Loads

8.3.1.12 *Revise the wording in FSAR Section 8.3.1.1, which continues to state that the connected load and the maximum demand are shown in FSAR Tables 8.3-4 through 8.3.7 (which is contrary to TVA statement that these Tables describe the board/bus rating in kilovoltampere (kVA) and do not represent the connected load or the maximum demand).*

Response: Unit 2 FSAR Tables 8.3-4 through 8.3-7 show the Board/Bus rating in calculated kVA (calculated based on the bus ampere rating at 6.9kV or 480V as applicable).

Amendment 103 to the Unit 2 FSAR will revise the *Equipment Capacities* portion of Section 8.3.1.1 to match the information Tables 8.3-4 through 8.3-.7.

8.3.1.13, Standby Diesel Generator Operation

8.3.1.13 *In its explanation of "appropriate alignment" of the EDGs, TVA considered the scenario "a loss of offsite power and an accident" while in the FSAR the appropriate alignment refers to the scenario of "a loss of offsite power" only. Resolve this apparent discrepancy and explain the appropriate alignment in the FSAR based on the actual design of the Standby Diesel Generator Operation.*

Response: The explanation as provided in the FSAR is correct. The words “and an accident” were erroneously added and should be considered as deleted from the previous response.

8.3.1.14, Adequacy of Diesel Generator Capacity

8.3.1.14 *Provide the explanation or basis of the maximum transient rating indicated as 4785 kW (0 to 180 second) and 5073 kW (180 second to End), and maximum step load increase rating as 8000 kVA (0 second to End).*

Response: The maximum transient rating of the diesel generator (DG) set at 900 rpm, 90^{o}C intake air, elevation less than 10,000 ft and a guaranteed efficiency of 96.6% is calculated as follows:

2000 hr/yr: 6640 (BHP-tandem) x 0.746 KW/HP) x 0.966 = 4785 KW

30 min/yr: 7040 (BHP-tandem) x 0.746 KW/HP) x 0.966 = 5073 KW

This analysis was performed by TVA and concurred by the DG supplier, MKW Power Systems, Inc. via their Telefax dated July 15, 1994; Attachment 1 provides a copy.

Similarly, the maximum step load increase was calculated based on maximum voltage dip as per the guaranteed contract data. The maximum kVA load step increase without exceeding the minimum voltage limit prescribed by RG 1.9 (75% nominal) was calculated as 8700 kVA. However, to be conservative, a load step increase value of 8000 kVA is used. The maximum load step increase as per the DG Loading Analysis is only approx 4400 KVa; therefore, significant margin is available between the actual load step increase and the allowable value of 8000 kVA.

8.3.1.15, Underground Cables

8.3.1.15 *Provide documentation that the cables are designed for submergence, or the measures provided in the raceways system are adequate to prevent submergence.*

Response: The discussion in Unit 2 FSAR Section 8.3.1.2.3 pertains to submergence of the cables for the design basis flood. It is not intended to address the issues associated with long-term submergence of energized cables such as “treeing.” At WBN, underground cables are installed in seismically qualified concrete enclosed ductbanks. The safety-related manholes are equipped with sump pumps to remove any ground water and have alarms to monitor water level or improper operation of the pumps. The medium voltage cables are evaluated by a testing program which is based on Very Low Frequency (VLF) testing.

8.3.2.3, Availability of the Battery Supplies to Vital Buses

8.3.2.3 - 1. *TVA provided a summary of the results of calculations used for determining the size of the inverters, battery chargers, batteries, and fuses.*

Explain why load shedding is necessary if the battery has been sized appropriately. The battery sizing concern will remain open until the applicant can confirm that the vital batteries are sized adequately.

Response: Load shedding is only required for coping with station blackout. The original design requirement for the vital batteries for a loss of all ac power was 2 hours. Subsequent application of station blackout requirements in Regulatory Guide 1.155, Station Blackout, resulted in the necessity for the vital batteries to supply essential loads for 4 hours. The shedding of nonessential loads to cope with station blackout is in accordance with RG 1.155, Section 3.2.6, and is consistent with considerations recognized in IEEE Standard 946, IEEE Recommended Practice for the Design of DC Auxiliary Power Systems for Generating Stations, Section 5.2. Unit 1 presently has a requirement for a more limited scope of load shedding, and the load shedding planned for two unit operation at WBN is very similar to that already in place at WBN’s “sister” plant, Sequoyah. With the two unit load shedding, the batteries are sized adequately to respond to a 4 hour coping duration for station blackout.

8.3.2.3 - 2. *TVA stated that the design change notices (DCNs) are required or anticipated for completion of Watts Bar Unit 2 and that this is an unverified assumption.*

Verification that the completion of the changes.

Response: TVA will ensure that required Design Change Notices (DCNs) and Engineering Document Construction Releases (EDCRs) in the DC system analysis Calculation EDQ00023620070003 listed as an unverified assumption in support of Unit 2 completion are implemented prior to Unit 2 fuel load.

8.3.2.3 - 3. *TVA stated that due to duty cycle limitation imposed by IEEE Standard 450-1995, Section 5.4, it has not developed a modified performance test duty cycle or an implementing procedure for Watts Bar. Based on this response, the staff considers this issue as open and finds that the modified performance discharge test is not approved for Unit 2.*

Response: The design requirements for a modified performance test have been established as follows: The duty cycle shall consist of two steps: (1) a one minute discharge rate of 575A (non-ambient compensated) with a minimum voltage of 114V (117.8V battery V), followed by (2) a continuous discharge rate of 413A (ambient compensated) with a minimum voltage of 105V (108.5V battery V) and a minimum duration of 4 hours. The percent capacity shall be determined based on discharge time to minimum voltage as a percent of 5 hours.

Service Test		Modified Performance Test	
0 - 1 min:	575A	0 - 1 min:	575A
1 - 239 min:	350A	1 - $\geq$ 240 min:	413A (a)
239 - 240 min:	355A		

(a) Ambient compensated.

The battery is sized in accordance with IEEE 485 such that under service conditions a battery degraded to 80% capacity and at worst case design temperature is capable of providing the minimum required voltage at critical points of the duty cycle. The discharge rate for the modified performance test is established to bound the service test duty cycle when at 80% capacity and is adjusted for the effects of temperature using the manufacturer's battery discharge characteristic curves and capacity ratings. A battery capable of providing a 4 hour duration at 80% capacity would have capability for a 5 hour duration at 100% capacity. The 5 hour discharge rate to 1.75V per cell is 413A. The discharge rate considering the ambient adjustment factor for minimum design temperature (60°F) would be 413A/1.11 = 372A which exceeds the largest duty cycle current (355A) occurring after the first minute and will thus bound the service test currents under any actual test condition within design limits.

These requirements will be included in Design Criteria WB-DC-27 (AC and DC Control Power) by February 25, 2011.

8.3.2.3 - 4. *Based on the duty cycle limitation imposed by IEEE Standard 450-1995, Section 5.4, TVA stated that it has not developed a modified performance test duty cycle or an implementing procedure for Watts Bar.*

Provide the justification for not incorporating the duty cycle limitation.

Response: See the response to **RAI 8.3.2.3 - 3**.

8.3.2.3 - 5. *In its 125 VDC battery system analysis, TVA assumed starting of safe shutdown of the non-accident unit at 30 seconds is conservative. In this analysis, Unit 1 has been assumed under DBA and Unit 2 as a non-accident unit. The assumption appears nonconservative because it does not consider a DBA and LOOP at one unit concurrent with LOOP at the other unit in which case the operation of some breakers would be simultaneous. Explain the apparent nonconservatism.*

Response: The normal alignments for switchgear dc control feeders ensure that only the ESF loads for one unit are applied to one vital battery. An exception is the auxiliary feedwater pump turbine controls which are powered from sources for the other unit to create independence. The analysis therefore considers the auxiliary feedwater pump turbine control loads of the other unit applied simultaneously. Alternate feeder alignments which could potentially apply ESF loads of both units to a single battery would only occur during periods of maintenance for a shutdown unit. Additionally, only one train would be aligned to alternate feeders such that the minimum required ESF loads of the other train would remain independent and be available in the event of a single failure including the effects of a simultaneous spurious accident signal in the non-accident unit. The analysis conservatively demonstrates adequate voltage and capacity considering the effects of alternate switchgear control feeders in service wherein LOOP loads are applied simultaneously for the non-accident unit.

8.3.3.2, Compliance with GDC 5

8.3.3.2 *TVA credited selective coordination between protective devices to assure adequate protection of safety related dc systems from failures in non 1E circuits between common circuits or safety/nonsafety-related circuits. For circuits that have short circuit current above the instantaneous setting of successive devices, selective coordination may not be achievable. Clarify the coordination in the instantaneous region of the protective devices for such circuits.*

Response: Calculation WBNEEBMSTI070005 (125V DC Protection and Coordination Calculation) demonstrates the selective coordination between sub-distribution breakers and its corresponding load group protective device. This ensures adequate protection of safety-related dc systems from failure in the non-1E circuits and common or safety/nonsafety-related circuits. All cascaded fuses were tested for selective coordination with the upstream protective devices as documented in the calculation.

8.3.3.2.1, Sharing of DC Distribution Systems and Power Supplies Between Units 1 and 2

8.3.3.2.1 *Address the potential consequences of a spurious accident signal in the non accident unit concurrent with an accident in the other unit and a single failure.*

Response: In accordance with Regulatory Guide 1.81, Section C.2.b, a spurious accident is considered to be a single failure; therefore, no additional single failure is assumed. The DC analysis is performed considering the worst case loading for each channel considering both offsite and onsite power is available. This results in the same loading that would be seen with an accident on one unit and a spurious accident signal on the other.

Address the DC system capability for a dual-unit trip as a result of abnormal operational occurrence.

Response: As discussed in Unit 2 FSAR Section 8.3.2.1.1, Vital 125V DC control power system is capable of supplying required load during normal operation and permitting safe shutdown of the unit for the loss of all ac power condition subject to a single failure. The 125V DC system is composed of four redundant channels. Each channel is electrically and physically independent from the equipment of the other channels such that a single failure in one channel will not cause a failure in another channel. The 125V DC system has been evaluated for the worst loading scenario LOOP concurrent with accident. Loading due to a dual unit trip is enveloped by the current battery system analysis.

8.3.3.2.2, Sharing of AC Distribution Systems and Standby Power Supplies Between Units 1 and 2

8.3.3.2.2 *Provide an evaluation for CCS and other shared systems regarding cross train single failures, one per each unit, that could can potentially disable header valves and restrict flow resulting in inadequate cooling for operating equipment.*

Response: This scenario is beyond the design basis for WBN. In accordance with Regulatory Guide 1.81, Section C.2.b, one single failure is considered in the design of the plant.

8.3.3.2.4, Possible Sharing of DC Control Power to AC Switchgear

8.3.3.2.4 *Confirmation that the requirement that all possible interconnections between redundant divisions through normal and alternate power sources to various loads be identified in FSAR Table 8.3-10 regardless of the source of power and will meet the staff's positions identified in Section 8.3.1.7 of the staff SER dated June 30,1982.*

Also, confirm that redundant divisions are not cross-tied when both units are at power.

Response: As discussed in the *Physical Arrangements of Components* portion of Unit 2 FSAR Section 8.3.2.1.1, the interconnection between redundant divisions of normal and alternate power sources for the components listed in FSAR Table 8.3-10 is arranged to provide adequate physical isolation and electrical separation to prevent a common mode failure. The listed components in Unit 2 FSAR Table 8.3-10 also meet the staff's positions identified in Section 8.3.1.7 of the staff SER dated June 30, 1982.

A review of the components listed in Unit 2 FSAR Table 8.3-10 verified that their normal and alternate power supplies are physically and electrically separated. Furthermore, the Integrated Safeguards Test conducted in accordance with Regulatory Guide 1.41, *"Preoperational Testing of Redundant Onsite Electric Power Systems to Verify Proper Load Group Assignments,"* will demonstrate the independence of the divisions. These components are energized to support Unit 1 operation and no design change is required for their normal and alternate power supplies in support of two unit operation.

8.3.3.3, Physical Independence (Compliance with GDC 17)

8.3.3.3 *Associated Circuits*

Confirm that for those circuit breakers which are required to be tested periodically, the surveillance requirements for both items 8.3.3(2) and 8.3.3(3) have been provided in the Technical Requirements Manual.

Response: Breaker testing requirements are provided in TR 3.8.1 of the Unit 2 Technical Requirements Manual (TRM).

This section of the TRM was originally provided per a TVA to NRC letter dated March 4, 2009 (Reference 2). It was updated per a TVA to NRC letter dated February 2, 2010 (Reference 3.)

8.3.3.4 , Compliance with NUREG-0737 Items

8.3.3.4 - 1. *Emergency Power for Pressurizer Equipment (II.G.1)*

Confirm that for Unit 2, the PORVs and block valves will be powered from different emergency power sources, (for example, PORV on dc power and the associated block valve on ac power), both power sources emanating from the same division, but different buses.

Response: TVA has confirmed that the Unit 2 PORVs (dc power supply) and block valves (ac power supply) are powered from the same division and from different buses. The Unit 2 Division A PORV is powered from Battery Board III, and the associated AC block valve is powered from 480V Reactor MOV Board 2A1-A. The Division B PORV is powered from Battery Board IV, and the associated AC block valve is powered from 480V Reactor MOV Board 2B1-B.

8.3.3.4 - 2. *Emergency Power Supply for Pressurizer Heaters (II. E.3.1)*

Confirm Watts Bar 2 design continues to meet the guidelines of Item 11.E.3.1 of NUREG-0737.

Response: TVA has confirmed that the WBN Unit 2 power supply for the Pressurizer Heaters meets the requirements of NUREG-0737, Section II.E.3.1. The design for Unit 2 heaters is identical to that for the Unit 1 heaters. The Unit 2 heaters are fed from offsite power through safety-related 6.9kV Shutdown Boards (2A-A and 2B-B), and 6900/480V transformers. In case of loss of offsite power, the backup heaters are automatically loaded on to the emergency DGs after 90 seconds or they can be manually loaded by the operator in accordance with procedures (Abnormal Operating Instruction for Loss of Offsite Power, AOI-35 and System Operating Instructions, SOI-68-Series).

Two groups of Pressurizer Heaters are powered from each Class 1E divisional power (6.9kV Shutdown Boards 2A-A and 2B-B). The Pressurizer Heaters are automatically tripped on receipt of safety injection actuation signal. Control Power for the Pressurizer Heaters circuits is fed from the 125V DC bus on the associated 6.9kV shutdown Board. The Class 1E interface with the main power and control power is via 6.9kV safety-related breakers and fuses, respectively. Loading on the DGs is monitored by the operator to ensure that the load on the DGs is within the limits specified in System Operating Instructions (SOI-82-Series).

8.4.1 , Station Blackout Duration

8.4.1 *TVA has referenced the documents (Design Criteria WB-DC-40-64 and WBN calculation EPMMA041592), which had not been submitted to the staff for review on the docket. TVA should either submit the referenced documents to the staff for review or provide a summary of the results that pertain to the information requested in the RAI dated July 12, 2010. In RAI, the staff had requested TVA to validate and provide relevant information on the factors listed in 10 CFR 50.63 for determining specified coping duration to withstand and recover from an SBO, and the expected frequency of grid related loss of offsite power in the last 20 years did not exceed once per 20 years at the WBN Unit 2 site.*

Response: 10 CFR 50.63 requires that each plant determine the duration of an SBO event based on the following factors:

(i) the redundance of the onsite emergency AC power sources;

(ii) the reliability of the onsite emergency AC power sources;

(iii) the expected frequency of loss of offsite power; and

(iv) the probable time needed to restore offsite power.

Items (i) and (iv) are features of the facility; therefore, the information provided to the NRC in the August 31, 1992, response remains valid.

Item (ii) is addressed in the **response to RAI 8.4.6**.

For item (iii), as indicated in the August 31, 1992, response, Watts Bar “Site Susceptibility to Grid-Related Loss of Offsite Power (LOOP),” classification (P-Group) was determined to be P1. Part of that determination was the assumption that the site would not have more than one (1) LOOP event in a 20 year interval (i.e., the classification is not P3). In the last 20 years, WBN has had one (1) LOOP event (i.e., on September 27, 2002, when the Watts Bar Hydro Station had an internal fire). Other aspects of item (iii) are features of the facility and remain unchanged since the August 31, 1992 response; therefore, the P-Group classification remains at P1.

8.4.2.1, Condensate Inventory for Decay Heat Removal

8.4.2.1 *Resolve the differences in the information provided to the staff originally (submittal dated August 31, 1992) and the information provided in its response dated July 31, 2010, regarding CST and the amount of condensate required for a 4 hour coping duration.*

Response: The August 31, 1992, response indicated that WBN was a Hot Standby Safe Shutdown plant and that cooling to Cold Shutdown was not required to be considered during the four (4) hour SBO coping period. That being the case, the required CST inventory at the end of the SBO coping period (76,960 gallons) was significantly less than the CST inventory available. That position was accepted by the NRC. Regardless, when cooldown is included (and margin is added to account for vortexing), there is still sufficient CST inventory reserved for the AFW system to cooldown the SBO unit. See the following table:

Parameter	08/31/1992 (gals)	07/31/2010 (gals)	Resolved (gals)	Comments
Total CST Inventory reserved for AFW	210,000	Not Provided	210,548	Each CST has 210,548 gal of water reserved for AFW.
Minimum Technical Specifications (TS) required inventory	210,000	200,000	200,000	Subsequent to the August 31, 1992 submittal, when the Unit 1 TS were finalized, the value of 200,000 gal was established. Note that LCO 3.7.6 of the Unit 2 TS submitted in TVA to NRC letter dated March 4, 2009 (Reference 2) contains the same value.
Total CST Inventory required when reactor started at 100% RTP without Cooldown	75,451	75,500	75,451	July 31, 2010, response was rounded-up. This is significantly less than the CST inventory available.
Total CST Inventory required when reactor started at 102% RTP without Cooldown	76,960	Not provided	76,960	Value is significantly less than both the TS and reserved AFW inventory in the CST

Parameter	08/31/1992 (gals)	07/31/2010 (gals)	Resolved (gals)	Comments
Additional Condensate required for Cooldown	121,200	121,200	121,200	Although WBN is a Hot Standby Safe Shutdown plant and is not required to cooldown during the SBO coping period, this is the additional quantity of water necessary to cooldown the unit.
Additional Inventory for Vortexing	Not Provided	Not Provided	2,851	This is the amount of water remaining in the CST at the onset of vortexing / air ingestion.
Total Required with Cooldown	Not Provided	197,200	201,011	Value is greater than the minimum TS required CST inventory, but is less than the actual amount of volume of water physically reserved in the CST for AFW. There is typically a much larger volume of water available in the 385,000 gal CST. Also cooldown is not required during the four (4) hour SBO coping period.

<u>8.4.2.2, Class IE Battery Capacity</u>

8.4.2.2 *Clarify what analysis was used for the batteries in order to reach a conclusion that batteries have adequate capacity to achieve and maintain a safe shutdown and recover from an SBO for a 4-hour coping duration.*

Response: As discussed in Unit 2 FSAR Section 8.3.2.1.1 (*Vital 125V dc Control Power System*), 125V dc battery analysis has been performed for each battery using normal system alignment with loss of all ac power to both the units. The 125V dc system analysis demonstrates that each vital battery has adequate capacity to supply the required loads to achieve and maintain a safe shutdown of both the units and to recover from the SBO event.

8.4.2.3, Compressed Air

8.4.2.3 *It is not clear from TVA's response whether the completed modifications to install bottled nitrogen to supply TDAFWP LCVs were for both WBN Unit 1 and Unit 2, or just WBN Unit 1. Since WBN Unit 2 was not licensed after issuance of the staff final SE on SBO on September 9, 1993, TVA needs to confirm whether these modifications included WBN Unit 2.*

Response: Design change packages have been issued to install the nitrogen bottles for the Unit 2 TDAFWP LCVs.

8.4.2.5, Containment Isolation

8.4.2.5 *Confirm that the original information submitted to the staff is applicable to the Watts Bar Unit 2, or provide additional information to ensure that valves which must be capable of being closed or operated (cycled) during an SBO event can be positioned (with indication) independent of the blacked-out unit's power supplies.*

Response: The containment isolation system for Unit 2 is the same as for Unit 1. The information submitted by TVA to the NRC in August 31, 1992, is applicable to Unit 2. With the exceptions noted in the August 31, 1992 and July 31, 2010 responses, and repeated here, the Unit 2 containment isolation valves were reviewed against (and are consistent with) the exclusion criteria provided in NUMARC 87-00, Revision 1, Section 7.2.5. The exceptions for both units (and the basis for their acceptability) are:

Penetration	Valve	Evaluation
X-19A & B	FCV-63-72	These valves (closed during an SBO) are in the Auxiliary Building in an area that is not habitable during an SBO. These valves are normally CLOSED during operation and fail "As-Is" during an SBO. The system outside containment is a closed system.
X-19A & B	FCV-72-44	
X-19A & B	FCV-63-73	
X-19A & B	FCV-72-45	
X-44	FCV-62-61	Valves FCV-62-61 (Reactor Building) and FCV-62-63 (Auxiliary Building) are in-series normally OPEN valves that fail "As-Is" during an SBO. FCV-62-63 can be manually CLOSED by an operator.
X-44	FCV-62-63	
X-107	FCV-74-2	This valve (closed during an SBO) is a normally CLOSED valve that fails "As-Is.

8.4.2.6, Reactor Coolant Inventory

8.4.2.6 *TVA needs to include the shrinkage due to cooldown in its assessment of the RCS inventory for an SBO of 4-hour coping duration. Also TVA needs to resolve the differences in the information provided to the staff originally (submittal dated August 31, 1992) and the information provided in its response to RAI dated July 31, 2010, regarding the amount required for 4-hour coping.*

Response: Information in the July 31, 2010, response is consistent with the August 31, 1992, response. The August 31, 1992, response indicated that WBN is a Hot Standby Safe Shutdown plant, and that primary coolant shrinkage associated with cooldown is not required to be considered. That being the case, the remaining primary coolant inventory was greater than the reactor vessel volume; therefore, the core remained covered. That position was accepted by the NRC. Regardless, when shrinkage is included, there is still sufficient primary coolant inventory to completely fill the reactor vessel; therefore, the core still remains covered. See the following table:

Parameter	Value (ft^3)	Comments
RCS Volume	12,145	
Leakage	3,530	Includes TSs LCO 3.4.13 limit of 10 gpm identified leakage plus 25 gpm leakage through each RCP shaft seal.
Remaining	8,615	Remaining volume, not including shrinkage due to system cooldown
Shrinkage	3,653	Shrinkage due to system cooldown
Remaining	4,962	Remaining volume following shrinkage due to system cooldown
Reactor Vessel Volume	4,945	Volume of the reactor vessel, including plenum above active fuel

8.4.4, Proposed Modifications

8.4.4 *TVA did not elaborate on whether the completed modifications to install bottled nitrogen to supply TDAFWP LCVs were for both WBN Unit 1 and Unit 2, or just WBN Unit 1 since WBN Unit 2 was not licensed after issuance of the staff final SE on SBO on September 9, 1993.*

Confirmation that the modifications to install bottled nitrogen to supply TDAFWP LCVs for WBN Unit 2 have been completed, or will be completed before startup of WBN Unit 2.

Response: Design change packages have been issued to install the nitrogen bottles for the Unit 2 TDAFWP LCVs.

8.4.5, Quality Assurance and Technical Specifications

8.4.5 *Plant procedures related to SBO will reflect the appropriate testing and surveillance requirements to ensure the operability of the necessary SBO equipment.*

Provide an affirmation that the original commitment documented in its submittal of August 31, 1992, applies to WBN Unit 2.

Response: Unit 2 will have proceduralized testing and surveillance requirements consistent with those discussed in the August 31, 1992 response. Unit 2 will meet the requirements of RG 1.155, Revision 0, “Station Blackout,” Appendices A and B.

8.4.6, EDG Reliability Program

8.4.6 *Confirm that the 2 EDGs credited for WBN Unit 2 are covered under the guidelines of RG 1.155, Section 1.2, or NUMARC 87-00, Revision 1, Appendix E to maintain their target reliability of 0.975.*

Response: WBN’s August 31, 1992, letter to the NRC, committed to establish an Emergency Diesel Generator (EDG) reliability of 0.975. TVA’s fleet procedure NETP-100 (*Emergency Diesel Generator Reliability Program*) applies to the EDGs at TVA’s three nuclear sites (including WBN Unit 2). Section 3.7 of this procedure implements the commitment by stating, “The reliability goal for WBN and SQN EDGs is 0.975 in accordance with Station Blackout Analysis.” Current reliability data indicates that the EDGs are meeting that goal.

ATTACHMENT 1

MKW's July 15, 1994, Concurrence With Tennessee Valley Authority's
DIESEL GENERATOR MAXIMUM KW CAPABILITY

Sequoyah Nuclear Plant (SON)

Watts Bar Nuclear Plant (WBN)

JUL 15 1994

(4)

T41 940721 988

MKW POWER SYSTEMS, Inc.

301 South Church Street
Station Square, Suite 100
Rocky Mount, NC 27804
Phone: (919) 977-2720
TWX: (510) 929-0725
FAX: (919) 446-1134

TELEFAX

DATE: July 15, 1994

COMPANY: TVA - Corp. Engineering

FAX NUMBER: 615/365-1504

ATTENTION: Mark D. Bowman

REFERENCE: EDG Motor Starting Capability

FROM: Donald D. Galeazzi

IF YOU DO NOT RECEIVE ALL PAGES LISTED, PLEASE CALL EXTENSION 253.

PAGES (INCLUDING COVER SHEET): 4

Dear Mr. Bowman:

I have reviewed the DIESEL GENERATOR MAXIMUM KW CAPABILITY analysis for the Sequoyah and Watts Bar EDG's which you transmitted to me on 6/23/94. The analysis is acceptable and therefore derating of the EDG motor starting capability is not required for the specified 115°F engine intake air temperature.

Yours very truly,

MKW POWER SYSTEMS, INC.

Donald D. Galeazzi

Tennessee Valley Authority

DIESEL GENERATOR MAXIMUM KW CAPABILITY

Sequoyah Nuclear Plant (SQN)
Watts Bar Nuclear Plant (WBN)

The intent of this document is to establish the maximum KW capability of the SQN/WBN diesel generators (DG) for starting motors in incremental steps during a design basis load sequence. The SQN/WBN DGs (TVA Contracts 71C61-92652 and 74C63-83090) are powered by two EMD 16-645E4B diesel engines operating in tandem. The generators are manufactured by Electric Products and have a guaranteed efficiency of 96.6% at full rated load. The DG set ratings at 900 rpm, 90°F intake air, and elevations less than 10,000 feet are:

2000 hr/yr: 6640 (BHP-tandem) x 0.746 (KW/HP) x 0.966 = 4785 KW
30 min/yr: 7040 (BHP-tandem) x 0.746 (KW/HP) x 0.966 = 5073 KW

Each engine is equipped with a turbocharger which is driven by the engine gear train during the first three minutes of operation. After three minutes, the engine exhaust gas is sufficient to drive the turbocharger off the engine gear train by means of an over-riding clutch. Therefore, there are two levels of engine capability; one for a "cold" turbocharger and one for a "hot" turbocharger.

MK/PSD Report 6981-8B[1] establishes that the maximum KW capability of the "cold" engine for motor starting (in small steps such as during a load sequence) is the 2000 hour rating at 90°F. The maximum KW capability of the "hot" engine is the 30 minute rating at 90°F. MK/PSD Report 6981-8A[2] establishes that any derating of the engine capability for motor starting transients (short durations of approximately 2 to 5 seconds) is dependent solely on the density of the intake air charge. This density is affected by air temperature as well as elevation.

The baseline temperature/elevation for the EMD 16-645E4B engine ratings is 90°F @ 10,000 feet above sea level. Both SQN and WBN DG buildings are situated at less than 800 feet elevation with maximum intake air temperatures of less than 115°F. The U.S. Standard Atmosphere[3] yields a density ratio of 0.7385 @ 10,000 feet compared to sea level conditions. The density ratio at 800 feet is approximately 0.98. Thus, there is an increase in air density of about 33% at 800 feet versus 10,000 feet. The decrease in air density caused by an increase in temperature from 90°F to 115°F is approximately 4%. It is seen that the increase

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1 MK/PSD Report No. 6981-8B, 12-21-88, TVA Contract 88NJL-74472A, "Report Addressing and Resolving Attachment 1 and Attachment 2 of TVA No. 968398 (Including Review of Loading)"

2 MK/PSD Report No. 6981-8A, 12-21-88, TVA Contract 88NJL-74472A, "Establish the Rating of the Emergency Diesel Generator and Provide Deration Curves for Elevated Ambient Combustion Air Temperatures"

3 Mark's Standard Handbook for Mechanical Engineers, Copyright 1978, 1967, 1958 by McGraw-Hill, Inc., Table 11.4.1, "U.S. Standard Atmosphere"

in intake air density gained at SQN/WBN site elevation is considerably greater than any decrease caused by elevated intake air temperature. Therefore, no derating of the DG maximum KW capability is required.

Based on the above discussion, the SQN/WBN DG maximum KW capability for motor starting in the site service environment (intake air temperature less than 115°F and elevation less than 800 feet) is:

"Cold" Engine (first 3 minutes of load sequence): 4785 KW
"Hot" Engine (fully turbocharged): 5073 kW

ENCLOSURE 2

List of New Regulatory Commitments

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

1. Amendment 103 to the Unit 2 FSAR will revise the first paragraph of Section 8.2.2 to replace "Each 161kV circuit and CSSTs C and D have sufficient capacity and adequate voltage to supply the essential safety auxiliaries of a unit under loss of coolant accident conditions concurrent with a simultaneous worst-case single transmission system contingency." with "Each 161 kV circuit and CSSTs C and D have sufficient capacity and adequate voltage to supply the essential safety auxiliaries of a unit under loss-of-coolant accident (LOCA) conditions and the other unit in concurrent orderly shutdown with a simultaneous worst-case single transmission system contingency."

   [from response to **RAI 8.2.1 - 1.**]

2. This additional analysis will be included in the next revision of the AC Auxiliary Power System Analysis Calculation EDQ00099920070002.

   [from response to **RAI 8.2.2 - 1.**]

3. This additional analysis will be included in the next revision of Calculation EDX00099920040002 *(Transmission System-Grid Voltage Study of WBN's Off-Site Power System*).

   [from response to **RAI 8.3.1.2 - 2.**]

4. Amendment 103 to the Unit 2 FSAR will revise the *Equipment Capacities* portion of Section 8.3.1.1 to match the information Tables 8.3-4 through 8.3-7.

   [from response to **RAI 8.3.1.12**]

5. TVA will ensure that required Design Change Notices (DCNs) and Engineering Document Construction Releases (EDCRs) in the DC system analysis Calculation EDQ00023620070003 listed as an unverified assumption in support of Unit 2 completion are implemented prior to Unit 2 fuel load.

   [from response to **RAI 8.3.2.3 - 2.**]

6. These requirements will be included in Design Criteria WB-DC-27 (AC and DC Control Power) by February 25, 2011.

   [from response to **RAI 8.3.2.3 - 3.**]

7. Unit 2 will have proceduralized testing and surveillance requirements consistent with those discussed in the August 31, 1992 response. Unit 2 will meet the requirements of RG 1.155, Revision 0, "Station Blackout," Appendices A and B.

   [from response to **RAI 8.4.5**]