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John H. Garrity
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SEP 13 1991

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

Gentlemen:

In the Matter of the Application of	)	Docket Nos. 50-390
Tennessee Valley Authority	)	50-391

WATTS BAR NUCLEAR PLANT (WBN) UNITS 1 AND 2 - RESPONSE TO NRC REQUEST FOR ADDITIONAL INFORMATION (RAI) ON FINAL SAFETY ANALYSIS REPORT (FSAR) SECTION 8, AMENDMENTS 52-65

References:
1. Letter from NRC to TVA, Watts Bar Nuclear Plant - Request for Additional Information on FSAR Section 8, Amendment 52 through Amendment 65, (TACs 63606, 63649, 74502, 77061, and 80193), dated June 20, 1991
2. Meeting between NRC and TVA at WBN on August 7-8, 1991

By the referenced letter and subsequent discussions with J. Knox of your staff, NRC requested additional information regarding FSAR Section 8, Amendments 52-65 to complete the review.

Enclosed are the TVA responses to these electrical issues (Enclosure 1) and the associated proposed FSAR text changes, as required (Enclosure 2). The referenced supporting documentation is available onsite for NRC review.

Enclosure 3 provides a list of commitments pertaining to this submittal.

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U.S. Nuclear Regulatory Commission

SEP 13 1991

If there are any additional questions relative to the enclosed, please contact P. L. Pace at (615)-365-1824.

Very truly yours,

TENNESSEE VALLEY AUTHORITY

John H. Garrity

Enclosures
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50-390 TVA WATTS BAR 1

RESPONSE TO REQUEST FOR ADDL INFO RE
FSAR SECTION 8, AMDTS 52-65.

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ENCLOSURE 1
RESPONSE TO NRC REQUEST FOR ADDITIONAL INFORMATION
FSAR SECTION 8, AMENDMENTS 52 THROUGH 65

SECTION 8.2.1.1 GRID STABILITY AFTER LOSS OF BOTH UNITS

NRC CONCERN

In section 8.2.1 of the SER, the staff concluded that the applicant has met the requirements of GDC 5, "Sharing of Structures, Systems, and Components," with respect to sharing of circuits of the preferred power system. This conclusion was based in part on the assumption that for a design basis event in one unit causing its trip and a single failure trip of the remaining unit, the offsite system would remain stable such that sufficient capacity would be available to accomplish safe shutdown in both units. In Section 8.2.2 of the SER, the staff stated that the results of the applicant's grid stability analysis indicated that loss of both units themselves will not cause grid instability. However, subsequent review of the applicant's analysis results for grid stability (presented in Section 8.2.2, page 8.2.18, of Amendment 63 to the FSAR) indicates that the grid will remain stable for loss of one unit but not for both units. In order to complete the staff's review, resolution is required for this inconsistency.

TVA RESPONSE

The grid is stable in the event of the loss of both WBN units. Page 8.2-18 of the FSAR is being revised (see attached mark up) by replacing the second sentence in the first paragraph with the following:

> Results of steady-state, transient stability, and inertial pickup studies show that the offsite power sources remain intact and are reliable sources to supply the onsite electric power system for (1) the loss of both WBN nuclear units or the loss of the 500kV lines connecting both of these units into the transmission systems, or (2) the loss of one WBN nuclear unit and either the loss of the next largest generating unit on the system or the loss of the most critical 500kV transmission line.

SECTION 8.2.2.1.1 DESIGN BASIS FOR THE WATTS BAR HYDRO SWITCHYARD

NRC CONCERN

In the SER, the staff concluded that the offsite power system circuits at the Watts Bar Hydro Plant Switchyard meet GDC 17 and are acceptable pending documentation in the FSAR of the additional information submitted by letter dated October 9, 1981. In SSER 2, the staff reported that the additional information was documented in Amendment 48 and that this item was closed. However, in Section 8.1.4 of Amendment 52 to the FSAR, the applicant documented the design bases for the two offsite circuits but excluded the Watts Bar Hydro 161kV yard from this design basis. Design basis information for the Watts Bar Hydro 161kV yard has thus not been documented in the FSAR as originally concluded in SSER 2. In order to resolve this issue, additional information is required concerning the design basis for the Watts Bar Hydro switchyard. Confirmatory Issue 26 may be reopened to track this issue.

ENCLOSURE 1
RESPONSE TO NRC REQUEST FOR ADDITIONAL INFORMATION
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SECTION 8.2.2.1.1 (cont'd)

TVA RESPONSE

The two offsite preferred circuits share the Watts Bar hydro 161kV switchyard. The 161kV switchyard is protected by a relay protection system that is designed to maximize the reliability of the incoming power to the plant. The switchyard control and relaying is described in Section 8.2.1.5 (pages 8.2-6 through 8.2-9) of the FSAR. TVA considers the 161kV switchyard to meet the requirements of GDC 17.

FSAR Section 8.1.4 describing the 161kV switchyard design basis is being revised in accordance with the attached FSAR page 8.1-3.

SECTION 8.2.2.2.3 TESTING OF THE AUTOMATIC TRANSFER FROM THE NORMAL TO PREFERRED OFFSITE CIRCUITS

NRC CONCERN

Description of proposed testing for the automatic transfer from the offsite normal to the preferred source has not been included in the FSAR. In order to initiate the staff's review in this area, additional information is required which describes the proposed testing for the automatic transfer. Such information may be included in the Technical Specifications.

TVA RESPONSE

At WBN, TVA is installing new common station service transformers (CSSTs) C and D. The new CSSTs will each have two secondary windings with automatic load tap changers on each secondary winding. There will be one 6.9kV shutdown board per secondary winding. The 6.9kV shutdown boards' normal source of power will no longer be from the unit generator via the unit station service transformers (USSTs) and the 6.9kV unit boards but from the offsite preferred power system via the new CSSTs. Automatic transfers from the unit source to the preferred source will no longer be required.

An FSAR submittal to describe the above change and to revise the appropriate sections will be submitted upon completion of the design change notice (DCN) (M-12051-A) which will document the installation of the CSSTs. This information is scheduled for submittal by system completion.

ENCLOSURE 1
RESPONSE TO NRC REQUEST FOR ADDITIONAL INFORMATION
FSAR SECTION 8, AMENDMENTS 52 THROUGH 65

SECTION 8.2.2.2.4 THE USE OF THE SECOND ALTERNATE OFFSITE CIRCUIT

NRC CONCERN

Section 8.3.1.1 of Amendment 63 to the FSAR (page 8.3-4) indicates that the second alternate supply breaker is normally racked out but implies that this second supply breaker may be used during some modes of plant operation. In order to complete our review in this area, clarification is required for when this second supply may be used and the limiting conditions for plant operation and surveillance requirements when it is used.

TVA RESPONSE

The appropriate FSAR section(s) will be revised to indicate that the second alternate supply breaker will no longer be normally racked out due to the installation of the CSSTs, described above. With the new CSSTs being the normal source of power for the 6.9kV shutdown boards, the only automatic transfer for the 6.9kV shutdown boards will be from the CSSTs to the diesel generator. Existing automatic transfers between the normal to the first alternate to the second alternate will be eliminated.

The present first alternate will become the normal supply breaker. Manual transfer by the operator to the second alternate supply breaker will be permissible in the event the offsite source that is the normal source becomes inoperable. Whenever the second alternate supply breaker provides power to a 6.9kV shutdown board, the plant will be in a technical specification action statement.

SECTION 8.2.2.2.5 SEPARATION BETWEEN OFFSITE POWER TRANSFORMERS AND PREFERRED OFFSITE CIRCUITS

NRC CONCERN

The physical separation and protection provided between any one of the main or common station transformers and the two preferred offsite circuits has not been clearly described or analyzed in the FSAR. In order to complete review in this area, clarification and analysis is required to demonstrate that failure of any one transformer will not prevent at least one offsite circuit from being returned to service in time to prevent fuel damage in accordance with requirements of GDC 17.

TVA RESPONSE

The FSAR is being revised as attached (FSAR pages 8.2.-3, 8.2-4, 8.2-10, and 8.2-13) to clarify the physical separation provided between the transformers and the preferred offsite circuits.

The auxiliary power system analyses indicate that sufficient power is supplied to the safety loads to mitigate an accident in one unit and to safely shut down the other for the loss of one offsite power source or a common station service transformer or a common switchgear or a 6.9kV shutdown board feeder cable failure.

ENCLOSURE 1
RESPONSE TO NRC REQUEST FOR ADDITIONAL INFORMATION
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SECTION 8.2.2.2.6 SEPARATION OF ASSOCIATED CIRCUITS

NRC CONCERN

As discussed in Item (3) of Section 8.2 of SSER 3, the 125-V dc control power for the offsite power circuits is provided from the onsite Class 1E power system. The control power cables are treated as associated circuits and are routed in separate raceways. The staff found that this routing met the independence requirements of GDC 17 for offsite circuits and was acceptable.

By letter dated July 31, 1990, TVA provided an advance copy of the proposed updates to Sections 8.1.5.2, 8.1.5.3, 8.2.1.6, 8.3.1.4.1, and 8.3.1.4.3 so that current information concerning the Cable and Electrical Issues at Watts Bar would be available for NRC staff review. The proposed update to Sections 8.2.1.6 (page 8.2-10a) and 8.3.1.4.3 (page 8.3-48) changes the allowable separation between the 125-V dc control power cables that are associated with the two independent offsite power circuits. The allowable separation has changed from "routed in separate raceways" to "separated" such that they do not touch.

In order to initiate a review of this proposed change, additional information is required to address the following items:

(1) Results of an analysis which demonstrates that the proposed separation for control power circuits associated with the two offsite preferred circuits meets the requirements of GDC 17 for independence of offsite circuits.

(2) Identification and analysis and/or justification for this proposed routing that is in violation of separation criteria presented in the FSAR for associated circuits. The subject 125-V dc control power circuits are considered associated because they serve non-Class 1E loads located in non-Category I structures and receive power from redundant and independent 125-V Class 1E vital battery buses. FSAR criteria for associated circuits requires them to meet the same separation criteria as Class 1E circuits and when routed in non-Category 1 structures they are further required to be electrically and physically separated from other circuits (reference: FSAR Section 8.3.1.4.3, pages 8.3-47a and a 8.3-47b).

(3) Results of a cable routing analysis which demonstrates that all associated non-Class 1E circuits have been installed in accordance with separation criteria presented in the FSAR and have sufficient physical and electrical separation to meet the independence requirement of GDC 17.

ENCLOSURE 1
RESPONSE TO NRC REQUEST FOR ADDITIONAL INFORMATION
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SECTION 8.2.2.2.6 (cont'd)

TVA RESPONSE

The deficiency in the separation of the control circuits associated with the preferred offsite power sources has been previously documented in Significant Corrective Action Report (SCAR) WBP 880675 and is tracked separately. Corrective action for this SCAR includes the performance and documentation of an analysis of the separation of the P&R control power cables. The discrepancies identified by the analysis will be corrected, as required through implementation of this SCAR. The FSAR is being revised as noted in the attached FSAR Section 8.2.1.6 (page 8.2-10a) to define the minimum separation requirements for P&R control power cables. Any exceptions to the minimum separation requirements will be identified, justified, and documented in the Separation/Isolation design criteria. Upon completion of the corrective actions, the WBN design for the control power cables that are associated with the two offsite preferred circuits will be in compliance with GDC 17.

SECTION 8.2.2.2.7 DESIGN BASIS REQUIREMENTS FOR OFFSITE CIRCUIT CONTROL POWER

NRC CONCERN

In Section 8.2.1.8 (page 8.2-16) of Amendment 63 to the FSAR, the applicant indicated that the design of the control power feeders to switchgear associated with common transformers C and D and 6.9-kv shutdown boards A-A and B-B ensures compliance with GDC 17, i.e., a loss of control power will not result in a loss of offsite power. Based on the information presented in the FSAR, it is not clear how the design which used the Class 1E vital dc system for control power for offsite circuits meets the following requirement of GDC 17:

> Provisions shall be included to minimize the probability of losing electric power from any of the remaining supplies as a result of, or coincident with, the loss of power generated by the nuclear power unit, the loss of power from the transmission network, or the loss of power from the onsite electric power supplies.

In order to clarify the design basis requirements for control power, additional analysis is required to demonstrate (1) that loss of any one source of dc control power (to the offsite from the onsite Class 1E system), which may degrade or cause a loss of operability to both onsite and offsite power supplies, will not cause degradation or loss of operability to the remaining immediate access offsite power supply to the remaining minimum required safety system loads, and (2) that failure of the non-Class 1E dc control power circuits to the offsite system will not present a challenge to or cause loss of either of the onsite Class 1E power supplies.

ENCLOSURE 1
RESPONSE TO NRC REQUEST FOR ADDITIONAL INFORMATION
FSAR SECTION 8, AMENDMENTS 52 THROUGH 65

SECTION 8.2.2.2.7 (cont'd)

TVA RESPONSE

The requested information describing the effects due to the loss of one dc control power source and confirmation that the failures of the non-1E dc control power circuits do not challenge the 1E onsite power supplies is being added to the FSAR.

Replace the third and fourth paragraphs (see marked up page 8.2-16 in Enclosure 2) with the following:

> The design of the control power feeders to common station service transformers (CSST) C and D switchgear and to 6.9kV shutdown boards A-A and B-B ensures compliance with GDC 17, i.e., a loss of control power will not result in a loss of power from CSSTs C&D which provide ac power to Train A and Train B shutdown boards respectively. Specifically, common switchgear C that normally provides ac power to Train A 6.9kV shutdown board receives control power from the vital battery that provides control power to the Train A shutdown board. Similarly, the control power to common switchgear D is from the vital 1E battery that provides control power to Train B shutdown board.
>
> CSST C switchgear (circuit breakers 1712 and 2714) and 6.9kV shutdown board 1A-A feeder breakers 1716, 1718, and 1832 receive normal control power from 125Vdc vital battery board (VBB) I. CSST D switchgear (circuit breakers 1812 and 2814) and 6.9kV shutdown board 1B-B feeder breakers 1726, 1728, and 1934 receive normal control power from 125Vdc VBB II. A design basis loss of VBB I or a single failure of VBB II (lost of control power) will result in the inability to automatically trip CSSTs C or D switchgear, respectively, and will inhibit the transfer of the corresponding 6.9kV shutdown board until manual transfer to the alternate control power source is accomplished locally at the switchgear. This does not, however, result in loss of offsite power; breakers 1712 and 2714 on common switchgear C or 1812 and 2814 on common switchgear D will remain in their normally closed position.
>
> The non-1E control power circuits from the vital battery boards to common switchgear C and D have redundant protection (breaker and fuse) in the event of a failure. Selective coordination exists between the non-1E and Class 1E circuits that are fed from each of the vital battery boards. Thus, failure of all of the non-1E control power circuits on the vital battery boards will not have any effect on the 1E circuits or battery boards.

ENCLOSURE 1
RESPONSE TO NRC REQUEST FOR ADDITIONAL INFORMATION
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SECTION 8.2.2.3 COMPLIANCE WITH GDC 17 FOR THE DURATION OF OFFSITE SYSTEM CONTINGENCIES

NRC CONCERN

In Amendment 63 to the FSAR, the applicant proposed a new design for the offsite power system to be enabled only during offsite system contingencies that preclude the supply of adequate power (i.e., loss of voltage on either 6.9kv start bus A or B or for a 161kv transmission system contingency). During system contingencies, an automatic load shedding scheme would be manually enabled and a number of alternate offsite supply breakers to balance-of-plant (BOP) boards or panels would be tripped and locked out. For a trip of both units, the load shedding scheme would be initiated to trip off part of the BOP loads.

Based on information presented in Amendment 63 to the FSAR, it appears that implementation of the proposed new design will reestablish the offsite power system's compliance with the requirements of GDC 17 following offsite system contingencies. This reestablishment of compliance will permit continued operation of the plant beyond the technical specification allowable limits (generally 24 hours for loss of capability of both offsite circuits).

In order to initiate a review of the proposed new offsite system design, additional descriptive information and analysis is required to demonstrate the new design's compliance with the requirements of GDC 17 and 18. The level of information and analysis required for the new design should be consistent with the level presented in the FSAR for the current design of the offsite power system.

TVA RESPONSE

FSAR pages 8.2-15, 8.2-17, and 8.2-20 are being revised as shown in the attached marked up pages .

Insert the following between the third and fourth paragraphs (see FSAR page 8.2-15 in Enclosure 2):

> This load shedding scheme reduces the BOP loads by tripping selected loads if both Unit 1 and Unit 2 generators are tripped and a 161kV transmission system contingency exists. A 161kV transmission system contingency is when either the SQN line or Rockwood line is out of service. Initiation of the load shedding scheme is accomplished automatically by undervoltage relays and both units' generators tripped or by the operator selecting the 161kV system contingency switch mode and both units' generators being tripped. The WBN operator will manually select the 161kV contingency position on the normal/161kV contingency switch and anytime both generators are tripped the load shedding circuits will immediately initiate a load shed command. Two reactor coolant pumps and two 6.9kV unit boards per unit are tripped by the load shedding scheme when the above conditions exist. Tripping of these loads will result in a significant reduction (50 percent of the reactor coolant pumps and unit boards) of the station load.

ENCLOSURE 1
RESPONSE TO NRC REQUEST FOR ADDITIONAL INFORMATION
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SECTION 8.2.2.3 (cont'd)

The load shedding scheme consists of two redundant trip and lockout circuits for each circuit breaker receiving a load shed command. The redundant load shedding circuits are located in different 6.9kV start boards. One load shedding circuit associated with CSST A is in 6.9kV start board A, and the other which is associated with CSST B is in 6.9 kV start board B. Control power to the redundant auxiliary power system (APS) load shedding circuits is provided from separate 250V dc batteries/battery boards. APS load shedding circuit 1 receives control power from 250V dc Battery 1 via 250V Turbine Building Board 1 and APS circuit 2 from 250V dc Battery 2 via 250V Turbine Building Board 2. Loss of control power to either 250V Turbine Building Board initiates automatic transfer from the normal dc supply to the alternate dc supply with annunciation that auto transfer has occurred. This maximizes the ability of the load shedding scheme to operate if grid and generator conditions warrant such operation.

SECTION 8.2.2.4 MINIMIZING THE PROBABILITY OF A TWO UNIT TRIP FOLLOWING UNIT TRIP

NRC CONCERN

In Amendment 63 to the FSAR, the applicant indicates that upon any single unit trip, power from the offsite system is transferred from the normal circuits (via the unit transformers) to the preferred circuits (via the common transformers). The applicant also indicates that after transfer, one train of each unit will be connected to the preferred circuits. The staff is concerned that on trip of one unit, the other unit will be vulnerable to trip because its source of offsite power is being changed from the normal circuit (which has not lost its capability as a source of offsite power) to its preferred source via the common transformers. In order to resolve this concern, additional analysis is required to demonstrate compliance with the requirement of GDC 17 that design provisions be included to minimize the probability of losing electric power from any of the remaining supplies as a result of, or coincident with, the loss of power generated by the nuclear power unit.

TVA RESPONSE

For the existing design (normal source of power to the 6.9kV shutdown board being the unit board), only the shutdown boards of the unit that is tripped will transfer to the preferred source. Clarification is being made in the FSAR (see attached marked up page 8.2-15 for the revision).

ENCLOSURE 1
RESPONSE TO NRC REQUEST FOR ADDITIONAL INFORMATION
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SECTION 8.3.1 ONSITE AC POWER SYSTEM COMPLIANCE WITH GDC 17

NRC CONCERN

In the SER, the staff indicated that each of the diesel generators has a continuous rating, 2000-hour rating, and a 2-hour rating of 4400kW, 4750kW, and 5225kW, respectively. Subsequently, in Section 8.3.1.1 (page 8.3-8) of Amendment 52 to the FSAR, the applicant indicated that the diesel generator rating is 4400kW continuous or 4840kW for two hours out of 24 at a power factor of 0.8.

The above design change will be evaluated as part of the staff's review of Amendment 65.

The following items address unresolved concerns identified in the SER, new concerns raised as a result of the staff review of the FSAR through Amendment 65 and their resolution or status.

TVA RESPONSE

The manufacturer of the diesel generators (Morrison-Knudson) has provided TVA with the diesel generator's "Continuous" and "Short-time" ratings as defined by IEEE 387-1977. The diesel engines' cold dead load pickup and hot dead load pickup ratings have also been provided by M-K. The ratings are:

	kW	kVA
Continuous	4400	5500
Short-time	4840	6050
Cold Dead Load Pickup	4487	N/A
Hot Dead Load Pickup	5041	N/A

The cold and hot dead load pickup ratings will be incorporated into the FSAR with the changes required by the results of the calculation described in Section 8.3.1.1.1.

ENCLOSURE 1
RESPONSE TO NRC REQUEST FOR ADDITIONAL INFORMATION
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SECTION 8.3.1.1.1 DIESEL GENERATOR CAPACITY

NRC CONCERN

In Section 8.3.1.1 of Amendment 63 to the FSAR (page 8.3-16d) the applicant indicates that the worst case loading for the diesel generators occurs for a simultaneous loss of offsite power and a loss of coolant accident on the associated diesel unit. Results of analysis which demonstrates that adequate margin exists in all cases between worst case loading and diesel capacity, has not been presented in the FSAR. In order to complete our review, documentation is required of these analysis results.

TVA RESPONSE

The diesel generator loading calculation will be revised by system completion to incorporate proposed design changes to increase the diesel generator margin. Some of the design changes being considered are trip of selected non-1E loads that are fed from the 1E boards, replacement of the electro-mechanical timers in the load sequencer with solid-state timers, sequencing some of the 460V motors and delaying the starting of the 6600V motors by either three or five seconds. Delays of the 6600V motors will be coordinated with Westinghouse. An FSAR change will be submitted, as necessary, to document the design changes and the margins determined for the diesel generators. Each diesel generator will have the capacity to supply its worst case loading and will have margin between the worst case loading requirements and the diesel generator's capacity.

SECTION 8.3.1.2.1 ALLOWABLE TECHNICAL SPECIFICATION LIMITS FOR THE INVERSE TIME DELAY RELAY

NRC CONCERN

In the SER and SSER 2, the staff indicated that the Watts Bar design is in conformance with position B-2 of BTP PSB-1 and was found acceptable. The staff, based on a review of the FSAR through Amendment 63, reconfirmed this conclusion. With regard to technical specification requirements specified by position B-2, of BTP PSB-1, it is not clear that the proposed design (which uses an inverse time delay type relay) can reliably be shown to not trip above a maximum voltage of 4860 volts but will trip below some minimum voltage level which has not been specified in the FSAR. To clarify this issue, additional information is required for the following items.

(1) Reliability data which demonstrates that an inverse time type relay will not trip at voltages above the 70 percent voltage level of 4860 volts.

(2) Technical specification limits for maximum and minimum limits that will be in the technical specifications.

ENCLOSURE 1
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SECTION 8.3.1.2.1 (cont'd)

TVA RESPONSE

The load shedding relays are in a redundant configuration for each 6.9kV shutdown board (1 of 2 taken twice). In order for a erroneous load shed to occur, two relays would have to fail and trip prematurely at a higher voltage value than 4860 volts. The present setpoint for these relays is 4860 volts with a five second time delay to close contacts on complete loss of voltage. Each diesel generator set is capable of starting and accelerating to rated speed the required engineered safety features and shutdown loads in the required sequence. The WBN diesel generators are in compliance with RG 1.9's position on frequency and voltage decreases, i.e., at no time during the loading sequence does the frequency or voltage decrease to less than 95 percent of nominal frequency and 75 percent of nominal voltage. An accuracy calculation for the load shedding relays will be performed with the maximum upper limit restricted to 75 percent of nominal voltage. The results of this accuracy calculation will be used in the development of the applicable technical specification limits. This calculation is scheduled to be completed by system completion .

Additionally, the degraded voltage and loss of voltage relays are solid-state. Only the load shed and diesel generator start relays are of the inverse time type.

SECTION 8.3.1.7 POSSIBLE INTERCONNECTION BETWEEN REDUNDANT DIVISIONS THROUGH THE NORMAL AND ALTERNATE POWER TO THE BATTERY CHARGER

NRC CONCERN

In the SER, the staff evaluated possible interconnections for components that can be transferred between redundant divisions. For each component that can be transferred, the applicant documented its commitment to keep the alternate feed breaker at the 480-volt shutdown boards open, to provide an alarm in the control room for when this alternate feed breaker is closed, and to provide an alarm in the control room when the manual transfer switch is in the alternate position. Based on this commitment, the staff concluded that the applicant's transfer design provided sufficient independence between redundant divisions, assured correct system alignments, met the requirements of GDC 17, and was acceptable. However, by Amendment 56 to the FSAR (Section 8.3.1.1 page 8.3-6), the applicant indicates that the alternate feed breaker at the 480-volt shutdown boards will normally be kept open except for three identified cases where the power supply alignment is not important. Also, the applicant indicated that the alternate feed breakers would be verified open in accordance with the technical specifications, i.e., no control room alarms will be provided on the alternate feed breakers or on the manual transfer switches.

ENCLOSURE 1
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SECTION 8.3.1.7 (cont'd)

To initiate review of the proposed design for transferring loads manually between redundant divisions, the following additional information is required for each load identified in Table 8.3-10 of the FSAR.

1. Results of analysis which demonstrates that the Watts Bar design will meet the requirements of GDC 17 when the load is being supplied from its alternate power source.

2. Proposed frequency for verifying the alternate supply breaker is open.

3. Proposed limiting conditions for operation with the load being supplied through the alternate supply breaker. Limiting conditions should be defined for operating modes 5 and 6 and for modes 1 through 4.

4. Basis and justification for the frequency for verification of alignment and limiting conditions for operation described in items 2 and 3 above.

5. Administrative provisions with justification for assuring correct or normal system alignments.

TVA RESPONSE

An alternate feeder analyses will be performed on components having manual transfer between power divisions prior to the integrated tests of the safety systems. The following statement is being added to the FSAR to reflect the acceptance criteria for alternate feeders;

Insert the following in the second paragraph after the second sentence on page 8.3-6 (see attached marked up pages).

> Breaker position for alternate feeders will either be alarmed in the main control room when closed or will be verified to be open on a weekly basis unless analysis verifies that the alternate feeder and its source have the capability/capacity to carry the load for the worst case loading conditions.

Use of the alternate feeders to the battery chargers (I-IV) and inverters listed in Table 8.3-10 will result in the plant being in a technical specification statement. This is due to the diesel generator capacity and the requirement that two diesel generators of the same train and their associated batteries are required to mitigate an accident in one unit and to safely shutdown the other unit. The position of the alternate feeder supply breakers for the battery chargers and inverters will be monitored weekly.

ENCLOSURE 1
RESPONSE TO NRC REQUEST FOR ADDITIONAL INFORMATION
FSAR SECTION 8, AMENDMENTS 52 THROUGH 65

SECTION 8.3.1.7.1 TRANSFER OF LOADS BETWEEN POWER SUPPLIES ASSOCIATED WITH THE SAME LOAD GROUP BUT DIFFERENT UNITS

NRC CONCERN

In Section 8.3.2.2, page 8.3.63 of Amendment 63 to the FSAR, the applicant indicates that each essential load which is supplied power from the Class 1E DC system's distribution system boards, has a redundant supply which is electrically separate from its first supply. The supply cables are routed so as to provide complete physical separation from the two supplies to each load. The staff is concerned that, when the redundant supply is used, the system alignment may be such that the design basis requirements, which includes four independent power trains, will not be maintained.

In order to resolve this concern, the following additional information is required for each load (AC or DC) that can be transferred between power trains of the same load group.

1. Results of analysis which demonstrates that the Watts Bar design will meet the independence requirements of GDC 17 when one or more of the loads are being supplied from its alternate power source.

2. Proposed frequency for verifying the alternate supply breaker is open.

3. Proposed limiting conditions for operation with the load being supplied through the alternate supply breaker.

4. Basis and justification for the frequency for verification of alignment and limiting conditions for operation described in items 2 and 3 above.

5. Administrative provisions with justification for assuring correct or normal system alignments.

ENCLOSURE 1
RESPONSE TO NRC REQUEST FOR ADDITIONAL INFORMATION
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SECTION 8.3.1.7.1 (cont'd)

TVA RESPONSE

The FSAR is being revised to identify the "essential" loads and to define the acceptance criteria for loads which may be transferred between power supplies associated with the same load group but different units. The first paragraph on page 8.3-63 will be revised to read (see attached marked up pages in Enclosure 2):

> Each dc control bus on the 6.9kV and 480V shutdown boards has a normal and alternate supply. The alternate supply is redundant and electrically separate from the normal supply. The normal and alternate power supplies for Train A shutdown boards control buses are batteries I and III and for Train B shutdown boards batteries II and IV. The supply cables are routed so as to provide complete physical separation from the two supplies to each load. The overall design of the system (including batteries, chargers, distribution boards, and cabling) incorporates sufficient capacity and capability to deliver the maximum design load currents required at each remote point and also to clear any possible short-circuit fault currents.

Analyses will be performed to indicate that the batteries' capacity is sufficient with the alternate feeders energized to mitigate an accident in one unit and to safely shutdown the other unit with a loss of the battery charger for 30 minutes. Analyses for station blackout are being performed and the limitations with respect to the alternate feeders such as load shedding within a period of time will be included within the technical specifications. The station blackout analyses are presently scheduled for the latter part of 1992.

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SECTION 8.3.1.10 NO LOAD OPERATION OF THE DIESEL GENERATOR

NRC CONCERN

Section 8.3.1.1 (page 8.3-11) of Amendment 55 to the FSAR indicates that the manufacturer recommends that diesel generators not be run for extended periods of time at less than 50 percent of continuous rated load. The FSAR further indicates that diesel engines have been tested for no-load operation for four hours. After four hours of operation at less than 30 percent load, the diesel generator will be run at a minimum of 50 percent load for at least 30 minutes. And after an accident situation when the diesel generator has run for an extended period of time at low or no-load, the load is to be gradually increased until the exhaust smoke is approximately twice as dense as normal. The increasing load is then stopped until the smoke clears. This procedure is repeated until full load can be carried with a clear exhaust. For all situations, the applicant has loads continuously available to the operator that exceed 50 percent of the continuous rated load.

The staff is concerned that the diesel generator may not have sufficient capability to supply required power within the specified accident analysis time limits following an accident, prolonged operation of the diesel generators at no-load, and a loss of offsite power. In order to resolve this concern, the following additional information is required.

(1) The manufacturer test results that verify the capability of the diesel generator to accept design basis loads within the specified accident analysis time limits following four hours of no-load operation.

(2) The accident analysis results which demonstrate that sufficient time is available to load the diesel generator slowly as described in the FSAR after four or greater hours of operation of the diesel generator at no-load.

(3) A description of the administrative procedures for assuring that the diesel will never be expected to provide power to accident loads after the diesel has operated for greater than four hours under no load conditions.

(4) During accident conditions, it is a standard technical specification requirement that onsite and offsite power circuits not be paralleled. For this condition of operation (i.e., the offsite circuits are supplying loads required to safely shut the reactor down following an accident), describe how the available loads will be connected to the diesel generator so the diesel will not be operated at no-load for prolonged periods of time. Describe the circuit design that automatically makes available the onsite power source in the event of a loss of offsite power.

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SECTION 8.3.1.10 (cont'd)

TVA RESPONSE

(1) The manufacturer does not have test results to verify the diesel generator's ability to pick up design basis loads after four hours of no-load operation, however, the following evaluations address the ability of the diesel generator to perform under the stated condition;

A. The impact on the diesel engine -

Having the engine running at no-load long before it is required to pickup load would be a positive impact. The engine is warm and the lube oil is hot. Under this condition, the engine is able to respond to hot load demand, and provide more power than during cold start-up condition.

B. The impact on the turbocharger and the exhaust system -

Long term operation of the diesel in the no-load condition would cause soot and other carbonous residual to build up on the turbocharger and the exhaust piping. Previously in the nuclear industry, diesel generators were tested under no-load or low load condition. After months or years of testing, the turbochargers were damaged. Therefore, the industry recommends the diesel engine should be loaded sufficiently to burn out the soot before it is shutdown. The WBN diesel generator procedures follow this recommendation. If the diesel is operating under the specific event of LOCA with offsite power available, it would be operating in a no-load condition. The soot buildup to the turbocharger and the exhaust system during this one specific event would be minimal and would have no effect on the diesel's ability to meet its design intend.

In conclusion, under the specific event of a LOCA with offsite power available, the diesel engine can meet its design load pickup requirement with minimal soot buildup to the turbocharger and the exhaust system.

The WBN FSAR lists loss of offsite power or loss of offsite power concurrent with a LOCA as one of the design basis events for the onsite power systems. Loss of offsite power with a delayed safety injection or a safety injection with a delayed loss of offsite power are considered to be bounded by loss of offsite power concurrent with a LOCA. This conclusion is based on internal NRC memoranda that state that the delayed loss of offsite power and safety injection cases do not significantly contribute to the probability of core melt. The NRC staff has previously indicated their approval of the TVA position for Sequoyah Nuclear Plant regarding these conditions and have agreed that this need not be considered as a design event (see NUREG-1232, Vol. 2).

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SECTION 8.3.1.10 (cont'd)

(2) TVA does not load the DG slowly following a loss of offsite power (see FSAR page 8.3-11; Amendment 67 deleted this information). After an accident and a delayed loss of offsite power, the diesel generator will be automatically loaded with the accident loads if the SI signal has not been reset and with the nonaccident loads if the SI has been reset.

(3) If a loss of offsite power occurs four hours after an accident and the diesel generator has been operating at no load during this time, the diesel generator is still expected to perform its emergency function, i.e., provide power to the onsite power system. Operating procedures have certain requirements to prohibit operating the diesel generator below 60 percent load except for an emergency.

(4) The diesel generator will be automatically loaded by the load sequencer in the event of a loss of offsite power. The circuit design that automatically makes available the onsite power source in the event of a loss of offsite power is described in FSAR Section 8.3.1.1, pages 8.3-4, 8.3-5, 8.3-6, and 8.3-10.

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SECTION 8.3.1.11 TEST AND INSPECTION OF THE VITAL POWER SYSTEM

NRC CONCERN

In Section 8.3.1.1, page 8.3-21 of Amendment 63 of the FSAR, the applicant indicated that the following items will be tested prior to placing the vital ac system in operation but will not be subsequently tested during plant operation. In order to complete the staff's review, substantiating analysis is required which demonstrates that there will be reasonable assurance that each of these items will maintain its capability to perform its design basis safety function over the operational life of the plant without further testing.

(1) The output voltage and frequency of each inverter.

(2) The capability of the inverter to deliver 100 percent of its output while operating on either the normal or emergency supplies.

(3) Calibration of the panel and board mounted instruments.

(4) Proper trip operation of circuit breakers on each instrument power board.

(5) Fuse verification with respect to size and type.

TVA RESPONSE

Test procedures will be developed to ensure the vital ac system remains functional over the life of the plant according to the following;

(1) The output voltage and frequency of each inverter is verified every 18 months during load testing.

(2) The capability of the inverter to deliver 100 percent of its output while operating on either the normal or emergency supplies is tested every 18 months. In the test, the inverter is loaded to 20kW at 1.0 power factor and transferred to the emergency 125V dc supply while maintaining voltage and frequency. The inverter is also inspected for signs of overheating, damaged components, loose connections, and excessive dust on a yearly basis.

(3) The panel and board mounted instruments are calibrated on an 18- month cycle.

(4) Test procedures for proper trip operation of circuit breakers on each instrument power board will be developed to test the circuit breakers using test sets that simulate a fault current. Page 8.3-22 of the FSAR is being revised to clarify this type of testing (see attached marked up page).

(5) The activities concerning fuse verification are the subject of the Master Fuse List Special Program currently undergoing NRC review (TAC M76973).

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SECTION 8.3.1.12 THE CAPABILITY AND INDEPENDENCE OF OFFSITE AND ONSITE SOURCES WHEN PARALLELED DURING TESTING

NRC CONCERN

In Amendment 63 to the FSAR, page 8.2-11, the applicant stated that for test and exercise purposes, a diesel generator may be manually paralleled with the normal or preferred power source. While offsite and onsite sources are paralleled, the applicant also indicated that both a loss of offsite power and a safety injection signal are required to automatically override the manual controls and establish the appropriate alignment.

When there is a safety injection signal alone without a loss of offsite power or when there is a loss of offsite power by itself without a safety injection signal, the staff is concerned that the capability and independence of offsite and onsite sources may be compromised when they are paralleled during testing. To complete this review, additional information is required to demonstrate in accordance with the requirements of GDC 17 that appropriate provisions have been included in the design to minimize the probability of losing both offsite and onsite power supplies given an accident or loss of offsite power during testing with the offsite and onsite sources paralleled.

TVA RESPONSE

FSAR pages 8.2-15, 8.2-16, 8.3-11, and 8D-3 are being revised to describe the component operation in the event of a loss of offsite power (see attached marked up pages).

> Loss of the offsite supply would cause the instantaneous overcurrent relay to trip the standby circuit breaker, the loss of voltage relays to trip the supply breaker and loads, and subsequently the diesel generator load sequencer to load the shutdown board with the non-LOCA loads. If an accident signal is initiated during testing of the standby supply, the parallel connection is maintained unless loss of offsite power also occurs. Should a LOCA and a loss of offsite power occur when the diesel generator is parallel with the grid under test, the same sequence of events take place as loss of offsite power except the diesel generator sequencer will load the accident loads. Only one diesel generator will be in the test mode at any given time.

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SECTION 8.3.1.13 THE USE OF AN IDLE START SWITCH FOR DIESEL GENERATORS

NRC CONCERN

In Section 8.3.1.1 of Amendment 57 to the FSAR, page 8.3-11, the applicant has indicated that an idle start switch is provided to start and run the diesel engine at idle speed for durations of unloaded operation. During this type of operation, any emergency signal will cause the engine to go to full speed and complete the emergency start sequence.

Detailed design and testing information demonstrating that the idle start switch will not degrade below an acceptable level the capability of safety systems from performing their safety functions has not been presented in the FSAR. In order to initiate this review of the installed idle start switch, additional design and testing information is required.

TVA RESPONSE

FSAR page 8.3-11 is being revised to include the following description (see Enclosure 2 for the marked up changes).

> A local idle start switch is provided by the diesel manufacturer to start and run the engine at idle speed for periods of unloaded operation. The mode selector switch in the main control room must be in the local mode for the local idle start switch to be enabled. The local idle start switch circuitry has normally open relay contacts from the normally energized control circuit that is deenergized by the automatic or emergency start signals. Therefore, during idle operation, any automatic or emergency start signals will disable the idle start circuitry and will command the engine to go to full speed. As part of the diesel generator testing required by Plant Technical Specifications, proper function of this bypass circuit is ensured.

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SECTION 8.3.2.2 DC SYSTEM MONITORING AND ANNUNCIATION

NRC CONCERN

As discussed in SSER 3, the staff determined that the following items had not been included in the design of the Watts Bar diesel generator DC monitoring and annunciation system.

(1) Battery circuit input current is not monitored.

(2) DC bus undervoltage is not alarmed in the control room.

In order to complete the staff's review, justification is required which demonstrates that each of these items has been included or adequately covered in the design for monitoring the diesel generator dc system.

In Section 8.3.1.1, page 8.3-16b, of Amendment 63 to the FSAR, the main control room alarm for battery charger output breaker open was removed. In addition to the above two items, justification is required which demonstrates that the diesel generator dc system is adequately monitored without the battery charger output breaker being alarmed in the main control room. Thus, proposed License Condition 13 remains unresolved.

TVA RESPONSE

TVA provides the following clarifications regarding the monitoring and annunciation of the dc system.

(1) Monitoring of Battery Circuit Input Current

The battery current is monitored locally. The diesel generator dc distribution panel contains low and high range shunts in the battery bus. The shunts are located such that only current flowing to or from the battery will be measured. The shunts are connected through a selector switch to the battery ammeter located on an adjacent instrument panel. This ammeter monitors both battery input and output current. Battery discharge is alarmed in the Main Control Room (MCR).

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SECTION 8.3.2.2 (cont'd)

(2) DC Bus Undervoltage Not Alarmed in the Control Room

The dc bus undervoltage alarm function is provided by the battery charger low output voltage alarm in conjunction with the battery discharge alarm. In the event the battery charger was disconnected from the distribution panel main bus, the battery discharge alarm would be actuated. The dc bus voltage has local indication.

Section 8.3.1.1, page 8.3-16b, Amendment 63, was revised to remove the statement that the battery charger output breaker being in the open position is alarmed. The battery charger is connected to the battery bus via a branch circuit breaker on the diesel generator dc distribution panel. The branch circuit breaker does not have a position alarm, however, the condition would be detected by other means. The battery discharge alarm would be actuated in the event the breaker was opened or tripped. Additionally, if the battery charger breaker or fuse were open, the low dc voltage alarm would be actuated.

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SECTION 8.3.2.4 DIESEL GENERATOR BATTERY SYSTEM

NRC CONCERN

In the SER and SSER 2, the staff, based on information presented through Amendment 48 to the FSAR, found the diesel generator 125-V dc control power system to be acceptable. However, based on subsequent revisions to the FSAR documented by Amendments 57, 63, and 65, the staff is no longer clear that the design continues to be in compliance with the applicable GDCs, Regulatory Guides, and IEEE standards. In order to clarify compliance, additional information is required for the following items.

(1) Justification for noncompliance with position C.1.c. of Regulatory Guide 1.32, Revision 2 or clarification of compliance.

(2) Description of and justification for areas of noncompliance with IEEE Standard 308-1971 or clarification of compliance.

(3) Capacity and capacity margin over required design loads to be maintained as a design basis requirement.

TVA RESPONSE

(1)& (2) A description of WBN compliance of the DG battery system with the applicable GDCs, Regulatory Guides, and IEEE standards is documented in FSAR Section 8.3.1.1 (pages 8.3-16b and 8.3-16d).

Additionally, TVA is revising FSAR pages 8.3-57 and 8.3-58 (see Enclosure 2) to further clarify the location of this material, as follows:

> For a detail description of the 125V diesel generator battery system refer to the paragraph on diesel generator control power in Section 8.3.1.1. Also, statements of compliance of the 125V diesel generator battery system with the applicable GDCs, regulatory guides, and IEEE standards are included in Section 8.3.1.1.

(3) As stated in the FSAR (page 8.3-16d) describing the TVA compliance with IEEE 308-1971, each battery has sufficient capacity to meet the power demand and time requirement of each connected load.

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SECTION 8.3.2.5 NONSAFETY LOADS POWERED FROM THE DC DISTRIBUTION SYSTEM AND VITAL INVERTERS

NRC CONCERN

In the SER, the staff concluded, based on information presented in the FSAR through Amendment 48, that the powering of nonsafety loads from the dc distribution system would not degrade the Class 1E systems below an acceptable level and was therefore acceptable. This conclusion was based in part on the applicant's statement documented in Section 8.3.2.1.1 of the FSAR that the batteries have the capacity to supply all connected loads (Class 1E and non-Class 1E) for a minimum of two hours and that the batteries will be tested periodically in accordance with the Technical Specifications to ensure this capacity.

Subsequent review of information presented in Section 8.3.2.1.1 of the FSAR through Amendment 65 indicates that batteries may not have sufficient capacity to supply all connected (or connectible) loads as originally concluded in the SER. In order to clarify or establish the minimum design basis requirements for battery capacity with margin and in order to determine required administrative procedures to assure nonessential loads do not use any of this minimum required design basis capacity, additional information is required to address each of the following items.

(1) As a design basis requirement, define the load currents each battery is expected to supply for specified time periods for all modes of plant operation (i.e., battery duty cycle as defined in IEEE Standard 485). Accident with loss of offsite power, loss of offsite power without accident, and loss of both offsite and onsite ac sources without accident (i.e., station blackout) should be included in the duty cycle.

(2) Define the design margin that will be maintained for the capacity of the battery and/or the size of loads included in the battery duty cycle.

(3) Describe how the battery capacity with margin will be maintained and periodically verified over the life of the plant.

(4) Describe the additional capacity that has been provided in each battery for nonessential loads.

(5) Describe the administrative procedures and/or other provisions that will be implemented to assure nonessential loads do not use any of the capacity required for essential loads for all modes of plant operation.

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SECTION 8.3.2.5 (cont'd)

TVA RESPONSE

TVA provides the following information to clarify the NRC concerns noted above:

(1) Battery Load Currents, Duty Cycles Relative to Design Basis Requirements

WBN's battery/battery charger sizing calculation (WBN EEB-MS-TI11-0003) evaluates battery loading under the following design basis conditions:

(a) loss of both offsite and onsite ac sources without accident (two hours)

(b) accident with loss of offsite power and chargers plus a single failure (30 minutes)

(c) full-load rejection, no accident or loss of power.

Loss of offsite power without accident is bounded by (a) and (b) and is not analyzed separately.

This calculation determines loading for each battery for the design basis conditions, develops load profiles for the worst cases, and determines battery capacity margins using the IEEE 485 methodology. FSAR load tables 8.3-23 through 8.3-26 have been previously revised by Amendment 67 to reflect the latest battery load values. The evaluation of the fifth vital battery has indicated that the fifth battery is capable of substituting for the worst case (most heavily loaded) of batteries I through IV and is included in the calculation.

(2) Battery Capacity Margins

As recommended by IEEE 485, the batteries were sized in the initial design for an aging margin of 25 percent and a design margin for load growth of 10 percent. Utilizing minimum voltage requirements, minimum ambient temperature derating, and an aging margin of 25 percent, calculation WBN EEB-MS-TI11-0003 determines how much design margin remains considering all connected loads. The design margin must be greater than or equal to zero. The design margin in the current revision of the battery sizing calculation is approximately 5 percent. The battery loading calculation assumes the vital inverters are fully loaded although the vital inverter loading calculation indicates actual loading to be 60 percent to 90 percent.

SECTION 8.3.2.5 (cont'd)

(3) Maintenance and Verification of Battery Capacity Margins

Maintenance and verification of battery capacity margins over the life of the plant is achieved through control of design changes and verification of battery performance by periodic tests.

Any design changes affecting battery load are procedurally required to have supporting calculations. This would consist in part of revising the battery/battery charger sizing calculation to determine a design's impact on the remaining margins for load growth.

Battery performance capability is verified by tests. WBNP Surveillance Instruction, "125V DC Vital Battery Service Test", is performed at least once every 18 months to supply simulated emergency loads. WBNP Surveillance Instruction, "125V DC Vital Battery Discharge Test", verifies that the battery is at least 80 percent of the manufacturers' capacity rating. This surveillance is performed at least once every 60 months or at least once every 18 months if the battery shows signs of degradation or is approaching end of service life.

(4)& (5) Battery Capacity for Non-Essential Loads and Administrative Controls

The battery sizing calculation considers both essential and nonessential connected loads. Although no specific capacity has been allotted to nonessential loads, priority must be given to essential loads to prevent the battery margins from being exceeded when considering a design change.

TVA Nuclear Engineering Procedure, "Calculations", requires that design changes must have supporting calculations issued prior to release of the change document. Watts Bar Engineering Procedure, "Change Review Checklist for Electrical Calculations", specifies the methodology for identifying the affected or required electrical calculations.

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SECTION 8.3.2.7 THE FIFTH VITAL BATTERY SYSTEM

NRC CONCERN

By Amendment 58 to the FSAR, the applicant documented its proposed addition of a fifth vital battery system to be used as a temporary replacement for any one of the four 125v dc vital batteries during their testing, maintenance, and outages with no loss of system reliability under any mode of operation.

In Section 8.3.2.1.1 of the FSAR, page 8.3-54, the applicant stated that the four channels of the vital dc power system are electrically and physically separated so that a single failure in one channel will not cause a failure in another channel.

When one of the four batteries of the electrically and physically separated vital dc power system described above has been temporarily replaced by the fifth battery, it is not clear, based on the information presented, that the four channels will remain electrically and physically separate so that a single failure in one channel will not cause a failure in another channel. In order to clarify the design's compliance with the single failure criterion when the fifth battery is being used, additional information is required to address each of the following items.

(1) Description of the support systems for each of the vital dc power systems.

(2) Description of system and support system alignments which assures that failure of any one channel of the vital dc power system will not cause a failure in another channel of the dc power systems.

(3) Description of the support systems for the fifth battery when it is being used as a temporary replacement for one of the four 125v dc system batteries.

(4) Results of analysis demonstrating that when the fifth battery is being used as temporary replacement for one of the four 125v dc system batteries, failure of any one channel of the vital dc power system will not cause a failure in another channel of the dc power systems.

(5) Proposed limiting conditions for operation for when the fifth battery is being used as a temporary replacement for one of the four 125v dc system batteries.

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SECTION 8.3.2.7 (cont'd)

TVA RESPONSE

The information requested appears in various sections of the FSAR. The following identifies the FSAR pages that describe each item.

(1) Description of the support systems for each of the vital dc power systems.

(a) Physical Location/Separations - FSAR pages 8.3-45, 8.3-54, and 8.3-62.

(b) Ventilation - FSAR pages 8.3-54a and 8.3-56 and FSAR Section 9.4.

(c) Battery Chargers - FSAR pages 8.3-58, 8.3-59, 8.3-54, and 8.3-64

(2) System and system support alignments - FSAR pages 8.3-53, -53a, -54, -62, and -62a.

(3) A description of the support systems for the fifth battery, as requested is included as follows;

Battery charger - FSAR page 8.3-53a.

Additionally, the ventilation system of the fifth vital battery room has redundant intake and exhaust fans with one set of fans (intake and exhaust) being supplied from Train A auxiliary power system and the other set from Train B.

(4) FSAR Figure 8.3-56 shows the transfer switches on the 125V Vital Distribution Board V and the 125V Distribution Panels A and B. The transfer switches are manually actuated and mechanically interlocked with break before make contacts to ensure that the four channels remain electrically separated. In addition, each channel has an associated distribution panel designated as Panel 0 with a normally open breaker that must be closed to complete the circuit from the fifth vital battery board to the replaced battery's board. See pages 8.3-62, 8.3-62a,and - 59 for additional information.

(5) There is no limiting condition for operation action statement required when the fifth battery replaces any one of the four batteries.

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SECTION 8.3.2.8 REENERGIZING THE BATTERY CHARGER FROM THE ONSITE POWER SOURCES MANUALLY VERSUS AUTOMATICALLY IMMEDIATELY FOLLOWING A LOSS OF OFFSITE POWER

NRC CONCERN

Based on information presented in Section 8.3.1 of the FSAR, the applicant implied that the battery chargers are a Class 1E load that are automatically reconnected to the onsite power supply following a loss of offsite power with or without an accident signal. However, in Section 8.3.2 of the FSAR, the applicant implied that the charger may be reconnected manually 30 minutes following a loss of offsite power. In order to complete review of this item, clarification with justification of the design is required for supplying power to the battery charger following loss of offsite power.

TVA RESPONSE

The WBN design does not shed the Class 1E vital battery chargers, and upon loss of offsite power, the battery chargers receive power when the diesel generator is automatically connected to the 6.9kV shutdown board. However, in battery sizing, it is assumed that the chargers are unavailable for 30 minutes following the accident, and the battery charger is sized to provide the accident loads and recharge the battery within 12 hours following an accident. Table 8.3-2 is a list of loads that are automatically tripped following a loss of offsite power and a review of this table will confirm that the battery chargers are not tripped automatically.

FSAR page 8.3-58 is being revised (see Enclosure 2) to clarify the WBN design basis rather than the assumptions utilized in the battery sizing calculations.

SECTION 8.3.3.1.1 SUBMERGED ELECTRICAL EQUIPMENT AS A RESULT OF A LOSS OF COOLANT ACCIDENT

NRC CONCERN

In the SER, the staff indicated that the design for the automatic deenergizing of circuit loads as a result of a loss-of-coolant accident (LOCA) would be verified as part of the staff's site visit/drawing review. By letter dated January 16, 1985, the applicant submitted electric schematic drawings for each valve that has been identified to be automatically deenergized by a LOCA signal. On the basis of a review of drawing numbered 45W760-30-8, Revision 10, the staff concluded that the design for power removal is acceptable pending resolution of surveillance requirements that were to be reviewed with and included in the Technical Specifications.

In the SER, the staff similarly indicated that the design using power lockout or protective devices was acceptable pending resolution of surveillance requirements that were to be reviewed with and included in the Technical Specifications.

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SECTION 8.3.3.1.1. (cont'd)

Subsequently, as part of a technical specification improvement program, the staff concluded that the above type of surveillance requirements were not appropriate for inclusion in the technical specifications but should be reviewed with and included in the FSAR as licensing commitments. In order to initiate review of the required surveillance, additional information is required for the following items.

(1) Description of the proposed surveillance for automatically deenergizing in the event of a LOCA, power lockout provisions, and proper operation of protective devices.

(2) Results of analyses or other justification that demonstrates the proposed surveillance will demonstrate the operability of all components used in the designs for automatically deenergizing , power lockout, and protective devices.

(3) The frequency for which the proposed surveillance will be performed with justification.

TVA RESPONSE

The following information is being added to FSAR Section 8.3.1.2.3 page 8.3-33 (see attached marked up pages).

The components listed in Table 8.3-28 are automatically deenergized by the accident signal and the accident signal must be reset to remove the automatic trip signal from each component. Testing to ensure the operability of the components used in the design for automatic deenergization is performed in conjunction with the test which verifies ESFAS actuation circuitry. Acceptance criteria for this test is that the devices will assume their accident conditions and maintain those conditions after the accident signal is reset. This test is performed every 18 months.

SECTION 8.3.3.1.3 FAILURE ANALYSIS OF CIRCUITS ASSOCIATED WITH CABLES AND CABLE SPLICES UNQUALIFIED FOR SUBMERGENCE

NRC CONCERN

Failure Analysis of Circuits Associated with Cables and Cable Splices Unqualified for Submergence

Amendment 63 removed the following phrase from the FSAR:

"Cables and cable splices are qualified for submergence".

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SECTION 8.3.3.1.3 (cont'd)

With the removal of this phrase, the staff concludes that cables and splices used to supply Class 1E or non-Class 1E equipment that may or may not be submerged following a LOCA are not qualified for submergence. The staff is concerned that the circuits associated with these unqualified cables and cable splices were not included in the failure analysis to demonstrate the ability of the electric power system to withstand failure of submerged electrical components from the postulated LOCA flood levels inside containment. In order to resolve this concern, additional clarifying information is required which indicates that circuits associated with these unqualified cables and splices were included in the failure analysis.

TVA RESPONSE

The submergence calculation evaluated and analyzed the loads and cables that are required to mitigate an accident (50.49), and the loads below the flood level that receive power from Class 1E boards to ensure that the affected systems can perform their intended safety functions. The loads and cables determined to be required to mitigate an accident were previously relocated above the flood level. The calculation will be revised by December 1991 to address cables that could be submerged which provide power to nonrequired loads above the flood level and receive power from the 1E boards.

SECTION 8.3.3.1.4 THE USE OF WATERPROOF SPLICES IN POTENTIALLY SUBMERSIBLE SECTIONS OF UNDERGROUND DUCT RUNS

NRC CONCERN

Section 8.3.1.2.3 of Amendment 63 to the FSAR indicates that Class 1E cables routed underground between the Auxiliary Building and the Diesel Generator Building and the Intake Pumping Station are provided with waterproof splices in the potentially submersible sections of the duct runs. Position 9 of Regulatory Guide 1.75 states that cable splices in raceways should be prohibited. The basis for Position 9 further states that if cable splices exist, the resulting design should be justified by analysis and that the analyses should be submitted as part of the Safety Analysis Report. In order to evaluate the use of cable splices in raceways, additional justifying analyses is required which will demonstrate compliance with the requirements of GDC 2, 4, and 17.

ENCLOSURE 1
RESPONSE TO NRC REQUEST FOR ADDITIONAL INFORMATION
FSAR SECTION 8, AMENDMENTS 52 THROUGH 65

SECTION 8.3.3.1.4 (cont'd)

TVA RESPONSE

The FSAR is being revised to clarify that the splices are in the manholes of the underground duct run, as follows;

Replace the next to last paragraph on page 8.3-36 with the following (see Enclosure 2):

> Conduit duct bank runs are generally long runs which can exceed standard cable reel lengths, thus requiring splices. The long runs may also cause cable pull tension to be exceeded unless the pulled length is shortened by splicing shorter cable sections together. Manholes in conduit duct bank runs provide the same function as junction boxes in other conduit runs by providing a cable pullpoint and a location for cable splices. Manholes are enclosed structures with very limited space and the cable tray raceway in the manhole provides support and protection of cables and splices from damage while in manholes. Also, redundant cable divisions are either installed in separate manholes or in the same manhole with a concrete barrier between the divisions. Sump pumps with level switches for automatic pump operation are located in the manholes to prevent water accumulation due to leakage into the manhole. Manholes will be included in the plant preventive maintenance program and will be inspected every 12 months for sump pump operability and flooding.

Also, the second sentence in the last paragraph on page 8.3-36 is being clarified to state that the waterproof splices are located in the manholes (see Enclosure 2 for the marked up FSAR pages).

ENCLOSURE 1
RESPONSE TO NRC REQUEST FOR ADDITIONAL INFORMATION
FSAR SECTION 8, AMENDMENTS 52 THROUGH 65

SECTION 8.3.3.2.1 SHARING OF DC DISTRIBUTION SYSTEMS AND POWER SUPPLIES BETWEEN UNITS 1 AND 2

NRC CONCERN

In the SER, the staff concluded (based on results of an analysis provided by letter dated January 7, 1982) that there was reasonable assurance that the sharing would not significantly impair the ability of the dc system from performing its safety function, meets the requirements of GDC 5, and was acceptable. However, after further review of the results of the analysis provided by letter dated January 7, 1982, and information documented in the FSAR, the staff feels that it is no longer clear that the sharing of raceways will not significantly impair the ability of the dc system from performing its safety function for any given single failure in accordance with the requirements of GDC 5 and 17. The staff is concerned that a single failure of the shared A train (or B train) raceway may cause failure of two dc vital battery systems. To resolve this concern, additional information is required for the following items:

(1) Descriptive analysis or clarification of the separation design to demonstrate that failure of the A train (or B train) will not cause loss of more than one dc vital battery system.

(2) Documentation in the FSAR of the results of the analysis of the vital 125-volt dc system with respect to position C.2 of Regulatory Guide 1.81 that was provided by letter dated January 7, 1982.

TVA RESPONSE

(1) Electrical and physical separation of the four vital battery systems (I, II, III, and IV) prevent a single failure from causing loss of more than one vital battery system.

Loss of Unit 1 and Unit 2 Train A power would result in the loss of the battery chargers associated with Batteries I and III; similarly, loss of Unit 1 and Unit 2 Train B would result in loss of the battery chargers for batteries II and IV. However, the dc systems would still be capable of performing their function(s) in the event of an accident for a period of time in excess of 30 minutes. To mitigate an accident in one unit and to safely shutdown the other unit, either Train A diesel generators (Unit 1 and Unit 2) or Train B diesel generators (Unit 1 and Unit 2) must be available. Batteries I and III are associated with A Train and II and IV with Train B. Loss of two battery systems would immediately result in the trip of both units and operations would be using the emergency operating reactor trip procedure (see attached FSAR Table 8.2-27).

Each battery board has channel, train and nontrained cables associated with it in accordance with the following:

Battery	Channel	Train
I	D	A
II	E	B
III	F	A
IV	G	B

ENCLOSURE 1
RESPONSE TO NRC REQUEST FOR ADDITIONAL INFORMATION
FSAR SECTION 8, AMENDMENTS 52 THROUGH 65

SECTION 8.3.3.2.1 (cont'd)

(2) Cables with channel/train designations are allowed only in raceways having the same channel/train assignment, i.e., D channel cables are only in D conduits or D trays, etc. Nontrained cables may run in raceways with either Train A or Train B as associated circuits. The analysis of associated circuits is discussed in Section 8.3.1.4.3. In summary, the design is capable of the safe shutdown in one unit and the mitigation of an accident in the other unit for loss of battery combinations I and III or II and IV.

The following is being added to FSAR Section 8.3.2.2 (see attached marked up FSAR page 8.3-62a).

Analysis of Vital 125 Volt DC System for Compliance to Regulatory Guide 1.81 Position C.2

The following results were obtained in an analysis of the vital 125-volt dc system with respect to position C.2 of Regulatory Guide 1.81 (each item is addressed in the order it appears in position C.2 of the Regulatory Guide):

a. Watts Bar is a two-unit plant.

b. The vital 125-volt dc batteries are designed to supply all connected loads. This includes the safety system loads energized by a spurious accident signal (single failure) in a nonaccident unit concurrent with the safety loads energized in an accident unit. Therefore, assuming a loss of offsite power, a false or spurious accident signal in the nonaccident unit concurrent with an accident in the other unit will not preclude the vital 125-volt dc system from performing its intended safety function.

c. Assuming the loss of offsite power, a design basis accident in one unit, a full load rejection in the other unit, and a single failure (loss of a vital battery), sufficient capacity is available in the remaining vital 125-volt dc batteries to support a safe and orderly shutdown of the plant.

d. Only one of the four vital 125-volt batteries will be removed from service for maintenance or testing at any one time. Therefore, this condition will not preclude the ability to safely shutdown both units, assuming the loss of offsite power.

e. No interface between the unit operators is required to meet items b and c. above since the batteries are designed to supply all connected loads for the events identified in b and c.

f. Status indications for the vital 125-volt dc system are provided in each unit's main control room (MCR).

ENCLOSURE 1
RESPONSE TO NRC REQUEST FOR ADDITIONAL INFORMATION
FSAR SECTION 8, AMENDMENTS 52 THROUGH 65

SECTION 8.3.3.2.2 SHARING OF AC DISTRIBUTION SYSTEMS AND STANDBY POWER SUPPLIES BETWEEN UNITS 1 AND 2

NRC CONCERN

In the SER, the staff indicated (1) that sharing of onsite ac and dc systems had not been adequately described or analyzed in Section 8.3 of the FSAR; (2) that the applicant, by letter dated January 7, 1982, had provided the required description and analyses; and (3) that the design met, on the basis of the information presented in this January 7, 1982 letter, the guidelines of Regulatory Guide (RG) 1.81 and was acceptable pending revision of the FSAR that reflects requirements of the shared safety systems.

In SSER 3, the staff determined that information presented in Amendment 48 and a letter dated January 17, 1984 were consistent with information presented in the applicant's letter of January 7, 1982 and was acceptable pending confirmation that the information in the January 17, 1984 letter was incorporated into the FSAR.

The staff reviewed information presented in the FSAR through Amendment 63 with respect to the January 7, 1982 and January 17, 1984 letters. As a result of this review, a number of discrepancies were identified. In order to resolve these discrepancies, additional information and justification is required to address each of the following items.

(1) Due to the lack of physical separation provided between unit 1 and 2 distribution system cables at Watts Bar (e.g., unit 1 train A cables are routed in the same raceway with unit 2 train A cables), a single failure of A train cables can cause loss of the two diesel generator power supplies or two dc system power supplies that are associated with the A train. Likewise, single failure of B train cables can cause a loss of the two diesel generator power supplies or two dc system power supplies that are associated with the B train. Provide the results of analysis which demonstrates that sufficient diesel generator and DC system power is available to attain a safe and orderly shutdown of both units following a design basis event in one unit and a single failure which causes the failure of two diesel generators or two dc battery systems.

(2) Technical Specification requirements for inoperability of any part of a power train.

(3) Test and maintenance restriction due to shared systems.

(4) Extent of coordination required between units due to shared systems.

(5) The availability of complete information for both control room operators regarding the status of systems such as the DC vital battery and the AC and DC distribution systems that are shared between units.

Thus, Confirmatory Issue 32 remains unresolved.

ENCLOSURE 1
RESPONSE TO NRC REQUEST FOR ADDITIONAL INFORMATION
FSAR SECTION 8, AMENDMENTS 52 THROUGH 65

SECTION 8.3.3.2.2 (cont'd)

TVA RESPONSE

If one train or a diesel generator is unavailable due to the performance of maintenance and/or a test, a Technical Specification limiting condition for operation is entered and an additional failure is not considered. Even in this condition, WBN is capable of mitigating an accident in one unit and safely shutting down the other unit with or without offsite power.

The FSAR description regarding compliance with RG 1.81(d) (see attached FSAR page 8.1-11) is being revised to state that "only one of the redundant power trains per plant" can be taken out for maintenance or tested at one time.

TVA provides the following information to address each of the NRC concerns noted above.

(1) A discussion on loss of two diesel generators or batteries is included in Section 8.3.3.2.1 of this submittal. Also, see the FSAR description for compliance with RG 1.81, Position C.2 located on FSAR page 8.1-11.

(2) A copy of the proposed technical specifications for WBN Unit 1 was submitted to NRC by letter dated April 17, 1990 (L44 900419 800).

(3) Test and maintenance procedures ensure that test or maintenance activities will not be performed on safety-related equipment if the redundant counterpart equipment is inoperable.

Maintenance and Surveillance procedures require the SROs sign-off to perform any test or maintenance activity.

(4) No interface between unit operators is required to meet RG 1.81 C.2(b) or C.2(c). For justification, refer to the description of the WBN compliance to RG 1.81 Position C.2(b) and (c) on page 8.1-11 of the FSAR.

(5) FSAR page 8.1-12, paragraph (f) provides the requested information.

ENCLOSURE 1
RESPONSE TO NRC REQUEST FOR ADDITIONAL INFORMATION
FSAR SECTION 8, AMENDMENTS 52 THROUGH 65

SECTION 8.3.3.3(3) SEPARATION CRITERIA BETWEEN CLASS 1E AND NON-CLASS 1E CIRCUITS

NRC CONCERN

In the SER, the staff indicated that surveillance requirements for protective devices will be reviewed with the Technical Specifications. Since issuance of the SER, the staff as part of its technical specification improvement program has established that surveillance requirements for the subject protective devices that are to be used to assure independence of circuits at Watts Bar should be included in and be evaluated as part of the FSAR. In order to initiate this review, additional information is required describing the surveillance requirements for the protective devices.

TVA RESPONSE

Additional information describing the surveillance requirements for non-1E circuits fed from 1E boards may be found in WBN Surveillance Instruction, "Periodic Testing and Inspection of Circuit Breakers Protecting 1E Busses from Non-1E Loads."

The following is being added to FSAR Section 8.3.1.4.3 page 8.3-47b for single circuit breakers (see attached FSAR marked up pages).

> The electrically operated circuit breaker and molded case circuit breakers actuated by a fault current and installed as an isolation device will have at least a random 10 percent of each type of breaker tested every 18 months and will have the recommended maintenance performed on 100 percent of the breakers within a 60 month period. For any breaker failure or breaker found inoperable, an additional 10 percent of that type breaker will be tested until no more failures are found or all electrically operated circuit breakers of that type have been tested. The tests will ensure operability by simulating a fault current with an approved test set.

TVA continues to review the testing methods of the MCCBs and will provide a subsequent submittal to provide the necessary description and justification in the event a more efficient method is determined.

ENCLOSURE 1
RESPONSE TO NRC REQUEST FOR ADDITIONAL INFORMATION
FSAR SECTION 8, AMENDMENTS 52 THROUGH 65

SECTION 8.3.3.5.1 COMPLIANCE WITH REGULATORY GUIDE 1.108 AND 1.118

NRC CONCERN

In the SER, the staff indicated that the applicant by letter dated October 16, 1981 has documented that the FSAR will be revised to indicate full compliance with Regulatory Guide 1.118 ("Periodic Testing of Electric Power and Protection Systems"). The staff found this commitment to indicate full compliance acceptable. Subsequently, in Amendment 63 to the FSAR, the applicant indicated that the Watts Bar design complies with all of the positions of Regulatory Guide 1.118, Revision 2 except for position C.6(a).

Position C.6(a) allows (as an exception to Section 6.4(5) of IEEE Standard 338-1977) the use of temporary jumper wires when portable test equipment is used during testing. For the temporary jumper wires to be acceptable, the position requires that the safety system equipment undergoing a test be provided with facilities specifically designed for connection of this portable test equipment and that these facilities must be considered part of the safety system undergoing test and must meet all the requirements of IEEE Standard 338-1977.

In justification of this exception, the applicant documented in the FSAR that where feasible test switches or other necessary equipment will be installed permanently to minimize the use of temporary jumpers in testing.

In order for the staff to initiate its review of this exception, additional information and/or justification is required in the following areas.

(1) Identification of each safety system component where temporary jumpers are used that do not meet position C.6(a) or Regulatory Guide 1.118.

(2) Justification which demonstrates that the use of each jumper identified in item (1) will not compromise the design basis safety function of the system component being tested.

(3) Design commitment which indicates that the test switches or other necessary permanent equipment will be installed to minimize the use of temporary jumpers in testing will meet all the requirements of IEEE Standard 338-1977.

In the FSAR, the applicant identified an exception to position C.2.a(2) of Regulatory Guide 1.108. Position C.2.a(2) requires that the emergency loads be sequenced onto the diesel generator unit with each load operating at its full load rating (i.e., each pump operating at full flow). The applicant indicated that as part of preoperational testing, the loads would be operated at full flow while being sequenced on the diesel generator but that, during the 18-month periodic testing, loads would be operated at miniflow while being sequenced on the diesel generator. Miniflow produces a loading of less than full load. In the SER, the staff found the use of miniflow loads during periodic testing to be acceptable.

ENCLOSURE 1
RESPONSE TO NRC REQUEST FOR ADDITIONAL INFORMATION
FSAR SECTION 8, AMENDMENTS 52 THROUGH 65

SECTION 8.3.3.5.1 (cont'd)

Because testing at full load is not practical, the staff continues to find the use of miniflow loads during periodic testing to be acceptable; however, the staff is concerned that this acceptability for the use of miniflow loads may be misinterpreted to mean that a successful test at miniflow translates, without further analysis or evaluation, to a successful demonstration of the diesel generators capability to sequence loads at full flow. In order to resolve this concern, additional information is required with regard to modeling, trending, analysis, and/or other methodology performed on the miniflow test data to periodically demonstrate the capability of the diesel generator to sequence the full-flow design basis loads.

TVA RESPONSE

(1)& (2) To support the use of temporary jumper wires, TVA will identify each safety system component where temporary jumpers are utilized in surveillance procedures implemented periodically, and will analyze these cases (e.g., a 10 CFR50.59 type of analysis) to demonstrate that the jumper will not compromise the design basis of the system or component being tested.

(3) The design commitment to IEEE Standard 338-1977 is being added to paragraph 8.1.5.3, note 8 in the FSAR (marked up page 8.1-14 is attached).

The diesel generator's dynamic response to the sequential loading will be baselined for each diesel generator during preoperational testing. A motor's starting current (locked rotor) is the same at a given voltage, regardless of whether the pump is operating at full-flow or miniflow . Results of testing at other TVA plants have shown that the voltage dip due to the starting motor is essentially the same magnitude, regardless of DG preloading prior to the sequenced load step. The only difference in the DG dynamic response to the sequential loading due to a pump being in miniflow versus full-flow is the length of time required for acceleration. A trending program will be established to compare the DG dynamic loading responses recorded for the 18-month periodic miniflow testing cycles to the baseline established during the preoperational tests. Adverse variations in the diesel generator loading response resulting from the baseline comparison or from the trending analyses will be analyzed and justified or corrective actions to restore the diesel generator to an acceptable status will be implemented.

ENCLOSURE 1
RESPONSE TO NRC REQUEST FOR ADDITIONAL INFORMATION
FSAR SECTION 8, AMENDMENTS 52 THROUGH 65

SECTION 8.3.3.5.2 TESTING OF ONE OF TWO CLASS 1E POWER SYSTEMS VERSUS ONE OF FOUR SYSTEMS

NRC CONCERN

In the SER, the staff indicated that the applicant, by letter dated October 9, 1981, documented the commitment that only one of the four power trains of the plant (Unit 1 and 2) would be tested at one time. The staff concluded that this commitment was acceptable pending its documentation in the FSAR. In SSER 2, the staff indicated that the applicant had provided the required documentation by Amendment 48 to the FSAR. The staff in its review of Amendment 63 to the FSAR was however unable to locate the specific commitment which states that only one train would be tested at one time. In order to resolve this item, additional clarifying information is required as to the location of the specific commitment in the FSAR or to the new proposed testing restrictions with appropriate justification that have been documented in the FSAR.

TVA RESPONSE

The commitment to test only one train at a time is stated on:

(1) Page 8.3-9

In the paragraph on system testing, the statement "The tests are to be performed on only one of the four power trains per plant at any one time" is made.

(2) Page 8.3.-12 (see attached markup)

Third paragraph, the statement is made "Only one diesel will ever be in the test mode at any one time." This statement is being revised to read; "Only one diesel will be in the test mode at any one time unless both units are in cold shutdown." Both diesel generators of the same train may then be in the test mode since the technical specification requires either Train A Unit 1 and Unit 2 or Train B Unit 1 and Unit 2 diesel generators to be available for modes 5 and 6.

ENCLOSURE 1
RESPONSE TO NRC REQUEST FOR ADDITIONAL INFORMATION
FSAR SECTION 8, AMENDMENTS 52 THROUGH 65

SECTION 8.3.3.6 COMPLIANCE WITH GDC 50

NRC CONCERN

In the SER, the staff required a reevaluation of the penetrations' capability to withstand, without seal failure, the total range of available time-current characteristics assuming a single failure of any over current protective device. In SSER 3, the staff found the results of the applicant's reevaluation acceptable pending confirmation that information presented in a January 17, 1984, letter was incorporated into the FSAR. Based on a review of information documented in the FSAR through Amendment 63, the staff has reconfirmed that the applicant's reevaluation is acceptable. Therefore, the staff considers information presented in the January 17, 1984 letter to be incorporated into the FSAR, and Confirmatory Issue 35 resolved.

In Section 8.1.5.3 of the FSAR, the applicant indicated, as an exception to the testability requirements of RG 1.63, that, in lieu of the testing of fuses by resistance measurement, a fuse inspection and maintenance program would be established. Because justification was not presented in the FSAR for this exception, the staff, in Section 8.3.3.6 of the SER, indicated that periodic resistance measurement of fuses and their terminal connections would be required as part of its Technical Specification.

By letter dated September 15, 1982 and Amendment 55 to the FSAR, the applicant provided information as to why periodic resistance measurement is not practical and provided justification for the adequacy of the proposed inspection and maintenance program in lieu of testing of fuses by resistance measurement. However, the applicant, by Amendment 63 to the FSAR, removed the justification for demonstrating the adequacy of inspection and maintenance. Therefore, based on information presented in the FSAR, the staff is unable to find the applicant's proposed inspection and maintenance program acceptable.

In regard to the SER statement that periodic resistance measurement of fuses and their terminal connections would be required as part of its Technical Specifications, the staff has subsequently concluded as part of the Standard Technical Specification improvement program that this type of testing requirement should not be included in the plant's Technical Specification but should be included instead in the FSAR as a design basis requirement for the plant. Periodic resistance measurement of fuses and their terminal connections will therefore not be required as part of the technical specifications as indicated in the SER but will be addressed as part of the staff's review of the FSAR. In order for the staff to resolve this issue, justification is required which addresses the adequacy of the proposed inspection and maintenance program.

ENCLOSURE 1
RESPONSE TO NRC REQUEST FOR ADDITIONAL INFORMATION
FSAR SECTION 8, AMENDMENTS 52 THROUGH 65

SECTION 8.3.3.6 (cont'd)

TVA RESPONSE

The following justification is being provided in the FSAR (see attached marked up page 8.1-9).

> Fuse manufacturers have also stated that the protective characteristics of fuses do not deteriorate with service life. Service temperatures above the rated temperature, current surges, and unusual cycling conditions all reduce the fuses service life, i.e., the fuse becomes more protective. Under no conditions will a fuse become less protective during its service life.

ENCLOSURE 2
PROPOSED FSAR REVISIONS RESULTING FROM THE TVA
RESPONSE TO THE NRC SECTION 8 RAI

Offsite (Preferred) Power System

1. Each of the two offsite power circuits has sufficient capacity, is continuously energized, and is available to supply the plant safety loads within a few seconds following a loss of coolant accident (LOCA) to assure that core cooling, containment integrity, and other vital safety functions are maintained.

2. The two offsite power circuits ~~(not including the Watts Bar Hydro 161kV yard)~~ are designed to be physically independent so as to minimize the likelihood of their simultaneous failure under operating and postulated accident and environmental conditions. The two offsite power circuits do share the Watts Bar Hydro 161 KV switchyard which is permitted by GDC 17.

8.2.2.1.1

Onsite (Standby) Power Systems

1. The onsite power systems are designed to provide sufficient capacity to assure that acceptable fuel design limits and design conditions of the reactor coolant pressure boundary are not exceeded as a result of anticipated operational occurrences. Further, these systems provide sufficient capacity to ensure that the core is cooled and containment integrity and other vital functions are maintained in the event of postulated accidents in one unit and to safely shutdown the other unit.

2. The onsite power systems are capable of performing their safety functions assuming a single failure.

3. The onsite power systems are located within Category 1 structures so that they are protected from natural phenomena.

4. The onsite power systems are designed to perform their safety function considering the effects of the following events:

   a. postulated accident environment

   b. fires

   c. accident-generated missiles

   d. fire protection system operation

   e. accident-generated flooding, sprays, or jets

   f. single act, event, component, failure, or circuit fault that could cause multiple equipment malfunctions.

   g. Loss of all offsite power or loss of all offsite power concurrent with a LOCA.

5. The onsite power systems are designed to permit appropriate surveillance, periodic inspections, and testing of important areas and features to assess the continuity of the systems

In addition to the single failure criterion of IEEE 279, the following requirements of IEEE 279 are met as follows:

Testability: The overcurrent protection system provided for 6900V penetration circuits include drawn out-type relays which are field testable using manufacturer provided test sets or TVA test sets to simulate fault currents following established procedures. Low voltage power circuit breakers and molded case circuit breakers are field tested using test sets built by Multiamp Corporation or equal. Testing is done by simulating fault current following established procedures.

Periodic resistance measurement is not practical for containment penetration conductor overcurrent protection fuses. Resistance verification is performed as one of the final steps in the manufacturing process, assuring proper construction and rating. Manufacturers do not publish this baseline data since construction changes are made based on design and material improvements. Because of this, no baseline data would be available if periodic resistance measurements were performed. Routine removal of fuses for testing is not prudent according to the manufacturer. Routine removal can result in damaging of the fuse holder and contact points. In lieu of field testing by resistance, we will establish a fuse inspection and maintenance program that will ensure: (1) that the proper size fuse is installed, (2) that the fuse shows no sign of deterioration, and (3) that the fuse connections are tight and clean. (See IEEE Std 242-1975, Recommended Practice for Protection and Coordination of Industrial and Commercial Power Systems). Should a problem arise with a specific brand or model of fuse, necessary corrective action would be initiated through the plant's experience review program.

8.3.3.6

Penetration protective devices in 480V circuits energized during plant operation are mounted in either motor control centers, Class 1E low voltage switchgear, or panel boards. Both Class 1E and non-Class 1E motor control centers are ITE Imperial Corporation series 5600 supplied under the same contract. All 480V non-Class 1E distribution equipment that houses penetration protective devices are located in the same seismic structure as Class 1E distribution equipment. Equipment bought to Class 1E standards is qualified to operate both during and after an operating basis earthquake

Fuse manufacturers have also stated that the protective characteristics of fuses do not deteriorate with service life. Service temperatures above the rated temperature, current surges, and unusual cycling conditions all reduce the fuses service life, i.e., the fuse becomes more protective. Under no conditions will a fuse become less protective during its service life.

of power) thus a single failure and/or a loss of offsite power does not prevent the safe and orderly shutdown of either unit.

Plant common loads such as emergency gas treatment are supplied from unit 1, channels I and II.

In no case does the sharing inhibit the safe shutdown of one unit while the other unit is experiencing an accident. All shared systems are sized to carry all credible combinations of normal and accident loads.

RG-1.81
Position C2

a. Watts Bar is a two-unit plant.

b. With a single failure (loss of a battery or loss of a diesel generator) in the plant sufficient ESF loads are still automatically available to the accident unit and to safely shutdown the remaining unit. The shared safety systems are designed so that one complete header (train) can shutdown one unit with a design basis accident and the other unit with a concurrent full load rejection. For these events, electric motors driving equipment in the shared systems are connected without regard to which unit has initiated the accident signal. Therefore, a spurious accident signal in the nonaccident unit concurrent with an accident in the other unit will not cause a standby power supply (diesel generator on vital battery) to be overloaded.

c. The most severe DBE is an accident in one unit and a trip of the other unit. Sufficient diesel generator (DG) power is available to attain a safe and orderly shutdown of both units with the loss of one DG unit. Assuming the loss of offsite power, a design basis accident in one unit, and a full load rejection in the other unit, one division of ESF equipment can be used to bring the plant to a safe and orderly cold shutdown. Therefore, the safe shutdown could be achieved with the complete failure of a power train in one unit or even with the complete failure of the same power train (-A or-B) in both units.

d. The DG units and the onsite distribution system are arranged in two redundant trains per unit with one C-S diesel generator that can be manually substituted for any one of the other diesel generator units. Due to the shared ESF system (example: ERCW) only one DG unit per plant can be taken out for maintenance or tested at a time. If the existing diesel generator unit (EDGU) remains or is expected to remain out of service for longer than the technical specification time limit, the additional diesel generator unit (ADGU) may be aligned for service and is qualified to serve indefinitely as a replacement for the disabled EDGU. With only one DG unit unavailable, this will ensure power is supplied to enough ESF equipment to safety shutdown both units, assuming the loss of offsite power. 57 63

only one of the redundant power trains per plant and

8.3.3.2.2

8. The Watts Bar design complies with all of the positions of Regulatory Guide 1.118, Rev. 2 except as follows:

   Position C.6(a) - Where feasible test switches or other necessary equipment will be installed permanently to minimize the use of temporary jumpers in testing in accordance with the requirements in IEEE Standard 338-1977.

8.3.3.5.1

9. Full compliance for Fifth Vital Battery Only.

10. WBN is in full compliance with the intent of RG 1.47 (BISI) Rev. 0.

11. The Watts Bar Design complies with position C.1(b) of Regulatory Guide 1.106 R1 except as follows:

    Position C.1(b) requires bypass of the thermal overload (TOL) contacts of all safety-related motor-operated valves (MOVs) during accident conditions. TVA will bypass the TOL contacts of all active valves (valves required to perform a mechanical function after a safety injection (SI) signal). Since active valves are the only ones required to change position to shutdown the reactor or to mitigate the effects of a design basis event, they are the only MOVs requiring this assurance of position change. (The list of the active motor-operated valves which require TOL bypass are identified in WBN Calculation, "Selection Criteria for MOVs Requiring Thermal Overload Bypass," WBN-OSG4-095.).

8.1.6 REFERENCES

1. TVA Submittal to NRC "WBN Unit 1 Supplemental Information on WBN Cable Issues" L44900615803 Enclosure 4

2. TVA Submittal to NRC "WBN Unit 1 Electrical Cable Damage - Assessment & Resolution Plan" L44901011801 Enclosure 1

approximately 7.38 miles long. It is terminated on bus 1, section 3 in the Watts Bar Hydro Plant switchyard. At Spring City this line is terminated on the 161-kV bus along with a 161-kV line that extends to Great Falls Hydro Plant. The Spring City and Winchester lines that extend from Watts Bar Hydro Plant cross near the switchyard.

The Watts Bar-Rockwood and the Watts Bar-Winchester 161-kV transmission lines are terminated on bus 2, section 4, in the Watts Bar Hydro Plant switchyard. The Rockwood line is approximately 23.67 miles long and is terminated on the Rockwood 161-kV bus along with 161-kV lines from the Crossville 161-kV substation and the 161-kV switchyard of the Roan County substation. The 161-kV transmission line from Roan is looped into the Harriman 161-kV substation. Two MOD's at Harriman provide for automatic sectionalizing of the Rockwood-Harriman-Roan 161-kV transmission line in the event of a permanent fault on the line. The Crossville 161-kV substation and Kingston Steam Plant are further connected to the TVA 161-kV transmission system network. The Watts Bar-Rockwood line is on a separate right of way and does not cross other lines that terminate at Watts Bar Hydro switchyard. The Winchester 161-kV transmission line is approximately 76.2 miles long and terminates at Winchester 161-kV substation by way of the Dayton and Coalmont 161-kV substation taps. The Winchester, Spring City, and Great Falls 161-kV transmission lines have crossings near the Watts Bar Hydro Plant switchyard. 48

The transmission line for CSST A and D terminates on

Two 161-kV transmission lines extend approximately 1.5 miles from Watts Bar Hydro Plant switchyard to the Watts Bar Nuclear Plant site to furnish preferred power to the nuclear plant. ~~One of these lines is terminated on~~ bus 1, section 1 and bus 2, section 2. This line does not cross other 161-kV lines. ~~The other preferred power 161-kV transmission line is terminated~~ on bus 2, section 4 and bus 1, section 3 in the hydro plant switchyard. This line crosses over the Spring City and the Great Falls 161-kV transmission lines near the hydro plant switchyard (Figure 8.2-2).

8.2.2.2.5

Transmission line for CSST B and C terminates

The transmission line structures for all 161-kV lines described are designed to exceed load requirements specified in the National Bureau of Standards Handbook No. 81 (National Electric Safety Code Part 2). Designing to these requirements ensures the adequacy of lines for wind and heavy icing conditions in excess of those that would be expected to occur in this area. The phase conductor and shield wire design tensions are selected to avoid vibration and galloping conductor problems. Long experience with area transmission lines verifies that TVA design practices have been successful in avoiding vibration problems. No galloping conductor conditions have been observed in the eastern portion of the TVA transmission system.

Transmission lines in the 161-kV voltage class have two overhead ground wires provided for lightning protection. This shielding has been effective for an area isokeraunic level of 55 and is reflected in the average operating record of only 3.86 flashover interruptions annually per 100 miles of line. The use of circuit breakers with high speed reclosing relays results in the majority of these interruptions being momentary.

8.2.1.2 Transmission Lines, Switchyard, and Transformers

The two 161-kV and the five 500-kV lines connecting the nuclear plant with the TVA transmission network are indicated functionally on Figure 8.2-1. The onsite transmission line arrangement is shown on Figure 8.2-3 and the offsite transmission line routing in the vicinity of the Hydro Plant switchyard is shown on Figure 8.2-4. Preferred power is supplied from the existing Watts Bar Hydro 161-kV switchyard over two radial 161-kV overhead lines approximately 1.5 miles long. These lines are routed to minimize the likelihood of their simultaneous failure.

8.2.2.5

The location of common station service transformers A and B is shown on Figures 8.2-3 and 8.2-5. Physical separation is 61 feet, centerline to centerline and 32 feet 9 inches between closest parts. Each transformer has a single primary and two secondary windings. The primary voltage is 161-kV with the winding rated 57/76/95 MVA, OA/FA/FOA (Future). The secondary voltage is 6.9 kV and each winding is rated 36/48/60 MVA, OA/FA/FOA (Future).

52

48

The location of common station service transformers C and D is also shown on Figures 8.2-3 and 8.2-6A. Physical separation is 70 feet, centerline-to-centerline and 48 feet 4 inches between closest parts. Each transformer has a single primary winding and two secondary windings. The primary voltage is 161-kV, the winding is rated 27/36/45 MVA, OA/FA/FA. The secondary voltage is 6.9-kV and each winding is rated 15/20/25 MVA, OA/FA/FA.

52

Fire protection is provided for each common station service transformer by a water sprinkler system which can be automatically activated by thermostats or the transformer electrical protection devices.

8.2.1.3 Arrangement of the Start Boards, Unit Boards, Common Boards, and Reactor Coolant Pump (RCP) Boards

From the low-voltage side of common station service transformers A and B, 6.9-kV station service buses supply the 6.9-kV common, unit, and RCP boards via the 6.9-kV start boards. The station service (start) buses are outdoor, nonsegregated, partially ventilated, metal-clad structures and are shown on Figure 8.2-5. At the 6.9-kV start board these buses enter the outdoor metal-clad switchgear and connect to supply breakers. The design of

The transmission lines for CSST A and D and CSST B and C are routed to the south and north of the transformer yard respectively.

made from the normal breaker to the alternate breaker and are delayed until the bus residual voltage reduces to 30% of nominal. All automatic transfers are initiated by undervoltage on the bus. The 250V dc normal control power for the pair of breakers feeding start bus A is supplied from a separate battery and dc distribution board from that of the normal control power for the two breakers feeding start bus B. Alternate control power feeders are similarly segregated.

Manual control of the circuit breakers is provided on the electrical control board in the Main Control Room where the operator has instrumentation showing the voltage on each of the two buses and current flowing in each of the four feeder breakers. The following annunciation is provided:

1. Start Bus Fan Failure
2. Start Bus Transfers
3. Start Bus Failures or Undervoltage

Annunciation No. 3 is composed of bus differential relay operation, bus a.c. voltage failure, and control bus dc voltage failure. Start bus A is the normal feeder to 6.9 kV common board A and the alternate feeder to 6.9 kV unit boards 1A, 1C, 2A, and 2C. Start bus B is the normal feeder to 6.9 kV common board B and the alternate feeder to 6.9 kV unit boards 1B, 1D, 2B, and 2D.

This circuit is designated as R.

6.9 kV Switchgear C and D

The secondaries of common station service transformers C and D feed into 6.9 kV switchgear C and switchgear D (Figure 8.1-2A). Each switchgear contains two circuit breakers. Common station service transformer C provides alternate No. 1 (preferred) power to 6.9 kV shutdown boards 1A-A and 2A-A through circuit breaker 1712 and alternate No. 2 (preferred) power to 6.9 kV shutdown boards 1B-B and 2B-B through circuit breaker 2714. Common station service transformer D provides alternate No. 1 (preferred) power to 6.9 kV shutdown boards 1B-B and 2B-B through circuit breaker 2814 and alternate No. 2 (preferred) power to 6.9 kV shutdown boards 1A-A and 2A-A through circuit breaker 1812. These feeders are protected by overcurrent and ground overcurrent relays. All of these feeder breakers are normally closed. All alternate No. 2 feeder breakers located on the 6.9 kV Shutdown Boards are racked out during normal plant operation and are utilized only when the alternate No. 1 power supply is not available (i.e., the alternate No. 2 feeder breakers are not intended for use under any normal operating conditions). All transfers between the normal and alternate No. 1 and No. 2 feeders take place at the 6.9 kV shutdown boards.

8.2.2.2.5

6.9 kV Switchgear C and D Control

The normal control power for circuit breakers 1712 and 2714 is supplied from the existing 125V dc vital battery board I: the

This circuit is designated as P.

normal control power for circuit breakers 1812 and 2814 is supplied from the existing 125V dc vital battery board II. This arrangement provides a physically and electrically independent supply control power for each switchgear. The cables providing this control power have been uniquely identified as P and R circuits. ~~P-designated cable/wiring shall be separated from R-designated cable/wiring. P and R cable/wiring shall be minimally separated such that they do not touch~~. P-designated cables shall be routed in separate raceways from R-designated cables with any exceptions and their justifications documented in the design criteria.

8.2.2.2.6

The alternate control power for circuit breakers 1712 and 2714 is supplied from existing 125V dc vital battery board III: the alternate control power for circuit breakers 1812 and 2814 is supplied from existing 125V dc vital battery board IV. These cables have been routed such that with either breakers 1712 and 2714 or breakers 1812 and 2814 receiving control power from the designated alternate source (and with the other breaker pair receiving control power from the normal source) physical and electrical independence of control power for each switchgear is maintained.

Manual control of the circuit breakers is provided on the electrical control board in the main control room where the

One preferred OSP circuit that is connected to CSST A and D is designated P while the other preferred OSP circuit that is connected to CSST B and C is designated R.

Regulatory Guide 1.6

Regulatory Guide 1.6 requires that 'Each ac load group should have a connection to the preferred (offsite) power source. A preferred power source may serve redundant load groups.'

Regulatory Guide 1.32

Regulatory Guide 1.32 states that 'Criterion 17 delineates the design requirements regarding availability of power from the transmission network. Accordingly, a preferred design would include two immediate access circuits from the transmission network. An acceptable design would substitute a delayed access circuit for one of the immediate access circuits provided that availability of the delayed access circuit conforms to General Design Criterion 17.'

Each of the above requirements and the provisions included in the design to meet then is addressed in the discussion which follows:

The discussion is arranged in two parts:

(1) Physical measures for achieving independence and physical measures taken to minimize the likelihood of failures of portions of the offsite power system inducing failure of the other power sources and

(2) functional provisions for achieving adequate capacity, capability, and availability; functional measures taken to minimize the likelihood of failure of portions of the offsite power system inducing failure of other power sources.

Physical Measures

8.2.2.2.5

The common station service transformers (CSST) and buses are connected and arranged to provide two physically independent offsite power circuits (OSP) to the onsite (Class 1E) distribution system. ~~One OSP circuit is designated P and the other OSP circuit is designated R~~. Circuits designated P and R are routed in separate conduits and trays to assure physical independence. ~~One preferred OSP circuit is connected through CSSTs A and D while the other preferred power circuit is connected through CSSTs B and C~~. Non-segregated phase buses are used to connect the secondaries of CSSTs C and D to switchgear C and switchgear D, respectively. Switchgear C & D are separated by 70 feet between centerlines. The outdoor portions of the buses, are weatherproof and equipped with 120V, single-phase heaters to maintain the temperature inside the housing at least 5°C above outside temperature. The conductors are fully insulated with flame-retardant material, bus supports are flame retardant and the metal enclosures will prevent any arcing fault in one bus from damaging the other bus. 63

Switchgear C and switchgear D are connected to the 6.9-kV shutdown boards by cables arranged to provide two physically independent sources of offsite power. The cables from both switchgear C and D are in an underground conduit bank to a conduit vault located 144 feet west of switchgear C and 42 feet east of the turbine building wall. From the conduit vault to the turbine building, the cables are in overhead trays that are 17 feet above ground (Reference FSAR figures 8.2-6A and 8.2-6B). The cables 63

other. All buses are provided with gas-resistant seals at entry to the switchgear.

Functional Measures

GDC 17

Each of the two 161 kV circuits providing offsite power to Watts Bar Nuclear Plant is supplied through two power circuit breakers connecting with separate sections of the main bus in the Watts Bar Hydro Plant switchyard. The two overhead transmission lines are routed to minimize the probability of their simultaneous failure. Each 161-kV line terminates at a pair of 161 - 6.9 kV common station service transformers (A and D, and B and C, respectively). Each pair of transformers, as well as the buses and cables that are used to connect them to the onsite power (standby) distribution system at the 6.9 kV shutdown boards are physically and electrically independent.

8.2.2.4 Upon any unit trip the affected units 6.9 kV shutdown boards are automatically connected to the offsite power circuits via common station service transformer (CSST) C or D, with one power train of ~~each~~ the tripped unit connected to each transformer through the 6.9 kV shutdown boards alternate No. 1 supply breaker. If a loss of power from either CSST C or D occurs under these conditions, the affected 6.9 kV shutdown board loads will be sequentially loaded onto their respective diesel generator.

For an acceptable range of 161 kV grid conditions, either offsite power circuit can start and supply all electrical equipment that would be supplied from the Class 1E distribution systems for a design basis accident in one unit and concurrent full-load rejection in the other unit (via transformers C or D), and power at least half of all running BOP loads through transformers A or B. For this event, transformer C or D would be operating within its OA rating and adequate voltage would be supplied to the safety-related buses. When the 6.9 kV shutdown boards are being supplied from transformers C and D, the load on transformers A and B has little or no effect on the 6.9 kV shutdown board voltage. A load shedding scheme is provided that would reduce the BOP loads if the 161 kV transmission system experiences any system problem that precludes the supply of adequate power to the shutdown boards.

Insert paragraphs 1 & 2

8.2.2.3 The 6.9 kV shutdown boards are provided with loss-of-voltage relays that initiate transfer from the normal (6.9 kV unit boards) supply, to the common station service transformer C or D alternate supply, to the standby (diesel generator) power supply, in that order of preference. Unit generator trip signals cause automatic fast (6 cycles or less) transfer from normal supply (unit board) to the alternate power supply. If the standby supply is paralleled with one of the other power supplies for testing, loss of the standby supply would cause reverse power relays to trip the standby circuit breaker. ~~If an accident signal is initiated during testing of the standby supply, the parallel connection is automatically broken, and the onsite distribution system returned to the proper configuration~~

Add paragraph 3
8.3.1.12

Insert the following between the third and fourth paragraphs (FSAR page 8.2-15):

(1) This load shedding scheme reduces the BOP loads by tripping selected loads if both Unit 1 and Unit 2 generators are tripped and a 161kV transmission system contingency exists. A 161kV transmission system contingency is when either the SQN line or Rockwood line is out of service. Initiation of the load shedding scheme is accomplished automatically by undervoltage relays and both units' generators tripped or by the operator selecting the 161kV system contingency switch mode and both units' generators being tripped. The WBN operator will manually select the 161kV contingency position on the normal/161kV contingency switch and anytime both generators are tripped the load shedding circuits will immediately initiate a load shed command. Two reactor coolant pumps and two 6.9kV unit boards per unit are tripped by the load shedding scheme when the above conditions exist. Tripping of these loads will result in a significant reduction (50 percent of the reactor coolant pumps and unit boards) of the station load.

(2) The load shedding scheme consists of two redundant trip and lockout circuits for each circuit breaker receiving a load shed command. The redundant load shedding circuits are located in different 6.9kV start boards. One load shedding circuit associated with CSST A is in 6.9kV start board A, and the other which is associated with CSST B is in 6.9 kV start board B. Control power to the redundant auxiliary power system (APS) load shedding circuits is provided from separate 250V dc batteries/battery boards. APS load shedding circuit 1 receives control power from 250V DC Battery 1 via 250V Turbine Building Board 1 and APS circuit 2 from 250V DC Battery 2 via 250V Turbine Building Board 2. Loss of control power to either 250V Turbine Building Board initiates automatic transfer from the normal dc supply to the alternate dc supply with annunciation that auto transfer has occurred. This maximizes the ability of the load shedding scheme to operate if grid and generator conditions warrant such operation.

(3) Loss of the offsite supply would cause the instantaneous overcurrent relay to trip the standby circuit breaker, the loss of voltage relays to trip the supply breaker and loads, and subsequently the diesel generator load sequencer to load the shutdown board with the non-LOCA loads. If an accident signal is initiated during testing of the standby supply, the parallel connection is maintained unless loss of offsite power also occurs. Should a LOCA and a loss of offsite power occur when the diesel generator is parallel with the grid under test, the same sequence of events take place as loss of offsite power except the diesel generator sequencer will load the accident loads. Only one diesel generator will be in the test mode at any given time.

8.3.1.12

~~to power the safety related loads~~. Therefore, loss of any onsite power generation will not prevent the distribution system from being powered from the offsite circuits.

Common station service transformers C and D both have two 6.9 kV secondary windings. One secondary of each transformer is the first alternate power supply for one 6.9 kV shutdown board in each unit. The other secondary is the second alternate power supply for the other 6.9 kV shutdown board in each unit. The impedance between the two 6.9 kV secondary windings is more than 95 percent of the sum of the H to X and H to Y winding impedances, (H refers to the primary winding). The loading on one 6.9 kV winding has little effect on the voltage at the other winding, although this effect was considered in establishing grid interface requirements.

Overcurrent relaying and loss-of-voltage relaying for the shutdown boards are coordinated so that a faulted or overloaded bus will not be transferred from one preferred power circuit to another because of depressed voltage resulting from the fault or overload. For the range of grid conditions identified as acceptable, loss of power from one offsite power circuit, whether from failure at the transmission grid interface, failure of any part of the preferred power circuit itself, or failure of part of the onsite distribution system, will not cause lost or degradation of the other offsite power circuit.

Replace with the attached

~~The design of the control power feeders to common station service transformers~~ (CSST) C and D switchgear and to 6.9 kV shutdown boards A-A and B-B ensures compliance with GDC-17, i.e., a loss of control power will not result in a loss of power (CSSTs C and D).

8.2.2.2.7

CSST C switchgear (circuit breakers 1712 and 2714) and 6.9 kV shutdown board 1A-A feeder breakers 1716, 1718, and 1932 receive normal control power from 125 VDC vital battery board (VBB)I. CSST D switchgear (circuit breakers 1812 and 2814) and 6.9 kV shutdown board 1B-B feeder breakers 1726, 1728, and 1934 receive normal control power from 125 VDC VBBII. A design basis loss of VBBI and a single failure of VBBII (lost of control power) will result in the inability to automatically trip CSSTs C and D switchgear and will inhibit the automatic transfer of 6.9 kV shutdown boards 1A-A and 1B-B to the CSSTS. This does not, however, result in loss of offsite power; breakers 1712, 2714, 1812 and 2814 remain in their normally closed position and breakers 1716, 1932, 1728, and 1934 may be manually closed as necessary. Thus, TVA is in full ~~compliance with GDC 17~~.

Regulatory Guide 1.6 has been implemented by providing each a.c. load group with a connection to each of the preferred source circuits. Figure 8.1-2 indicates that redundant power trains in each unit are fed from different preferred source circuits. The

Replace the third and fourth paragraphs (FSAR page 8.2-16) with the following:

The design of the control power feeders to common station service transformers (CCST) C and D switchgear and to 6.9kV shutdown boards A-A and B-B ensures compliance with GDC-17, i.e., a loss of control power will not result in a loss of power from CSSTs C&D which provide ac power to Train A and Train B shutdown boards respectively. Specifically, common switchgear C that normally provides ac power to Train A 6.9 kV shutdown board receives control power from the vital battery that provides control power to the Train A shutdown board. Similarly, the control power to common switchgear D is from the 1E battery that provides control power to Train B shutdown board.

CCST C switchgear (circuit breakers 1712 and 2714) and 6.9 kV shutdown board 1A-A feeder breakers 1716, 1718, and 1832 receive normal control power from 125 VDC vital battery board (VBB) I. CCST D switchgear (circuit breakers 1812 and 2814) and 6.9kV shutdown board 1B-B feeder breakers 1726, 1728, and 1934 receive normal control power from 125 VDC VBBII. A design basis loss of VBBI or a single failure of VBBII (lost of control power) will result in the inability to automatically trip CCSTs C or D switchgear, respectively, and will inhibit the transfer of the corresponding 6.9kV shutdown board until manual transfer to the alternate control power source is accomplished locally at the switchgear. This does not, however, result in loss of offsite power; breakers 1712 and 2714 on common switchgear C or 1812 and 2814 on common switchgear D will remain in their normally closed position.

The non-1E control power circuits from the vital battery boards to common switchgear C and D have redundant protection (breaker and fuse) in the event of a failure. Selective coordination exists between the non-1E and Class 1E circuits that are fed from each of the vital battery boards. Thus, failure of all of the non-1E control power circuits on the vital battery boards will not have any effect on the 1E circuits or battery boards, TVA is in full compliance with GDC-17.

boards, 6.9 kV RCP boards, and the associated 6.9 kV buses were procured in accordance with certain TVA standards and industry standards. TVA specifications require conformance of this equipment to such standards as the following. The overall construction, ratings, tests, service conditions, etc., are required to be in conformance to ANSI C37.20 and NEMA SG-5; the power circuit breakers are referenced to ANSI C37.4 through C37.9 and NEMA SG-4; associated relays are specified to conform to ANSI C37.1, instrument transformers to ANSI C57.13 and NEMA EI-2 and wiring to IPCEA S-61-402 and NEMA WC5. 63

The design of the equipment arrangement was also implemented to comply with GDC 3 for fire protection and with GDC 18 and Regulatory Guide 1.22 for each of periodic tests and inspections.

Criterion 18

General Design Criterion 18 requires that the offsite power circuits be designed to permit periodic inspection and testing to show:

a. "The operability and functional performance of the components" of the circuits,

b. The operability of the circuits as whole systems, and

C. "Under conditions as close to design as practical. the full operation sequence that brings the system into operation."

The offsite power system has been designed to permit appropriate periodic inspection and testing. Transfers from the normal supply to the preferred (offsite) supply or from the preferred supply to the standby supply may be manual or automatic. Testing of these transfers while the nuclear unit is at power could result in transients that could cause tripping of the reactor or turbine. For this reason, testing of the manual and automatic sequence will be performed by causing a transfer from the normal supply to the first alternate (preferred) supply. Transfers from the normal to the first alternate supply is required to satisfy GDC 17 and will be tested at intervals specified in the technical specifications. Testing of the transfers from the normal supply to the second alternate (preferred) supply, and from the first alternate (preferred) supply to the second alternate (preferred) supply may be performed by TVA for economic reasons at intervals specified by TVA. Provisions exist for individual testing of the load shedding circuits and yet maintain the load shedding capability of the circuit not being tested for any 161 KV grid contingencies. 63 56

8.2.2.3

8.2.2 Analysis

Each 161 kV circuit and its two associated transformers has sufficient capacity and adequate voltage to supply the essential

the onsite electric power system for the loss of both WBN nuclear units or the loss of the 500kV lines connecting both of these units into the transmission systems, or the loss of one WBN nuclear unit and either the loss of the next largest generating unit on the system or the loss of the most critical 500kV transmission line.

safety auxiliaries of one unit under loss of coolant accident conditions in addition to the power required for shutdown of the non-accident unit. Figure 8.2-8 shows the station service condition when normal power for the operation of the nuclear units is supplied from the unit stations service transformers.

Physical separation of lines, primary and backup protection systems, and a strong transmission grid minimize the probability of simultaneous failures of offsite power sources. Results of steady-state, transient stability. and inertial pickup studies show that the offsite power sources remain intact and are reliable sources to supply ~~the onsite electric power system for the loss of either nuclear unit, the loss of 500 kV lines connecting either of these units into the transmission system and the loss of the next largest generating unit on the system, or the loss of the most critical 500 kV transmission line~~. The effect on the offsite power system resulting from the loss of the largest unit on the system is illustrated in Figure 8.2-8a, Sheets 1 and 2. 63

8.2.1.1

Transient stability studies included conditions of three-phase faults on transmission lines connecting the nuclear units into the transmission system. Studies of these faults included stuck-breaker conditions in which one nuclear unit and its 500 kV lines were disconnected automatically from the transmission system. The results of these studies are shown in Figure 8.2-8a, Sheets 3 through 12. These plottings show the voltage and frequency of the offsite power system during and following these disturbances. Transient stability studies of the 161 kV system supplying preferred power to the nuclear plant included three-phase faults, stuck-breaker conditions, and main bus section interruptions. 63

Due to the large number of diverse generating units and strong interconnections, the likelihood of an outage of a sufficient part of the transmission system to cause the loss of all sources of offsite power is considered to be extremely remote. An example considered to be the most severe condition of postulated transmission disturbances is one in which one nuclear unit is under loss-of-coolant accident conditions during the time when power is required for shutdown of the other non-accident unit. The study of this contingency shows that the transmission system remains stable with negligible disturbance to the sources of offsite power supply as indicated by the Watts Bar Hydro 161 kV bus voltage and frequency response curves in Figures 8.2-9 and 8.2-10.

System Operation

Each 6.9 kV shutdown board can be powered through any one of four shutdown board supply breakers. For unit startup and normal operation, power is supplied from the 6.9 kV unit board circuit, the breaker shown normally closed on Figure 8.1-2a. Shown normally open are the breakers connecting the first alternate (preferred) and the second alternate (preferred) offsite power circuits to the shutdown board (via common station service transformers C and D), and the breaker connecting the shutdown

second sequence is long enough to allow operator action but will not result in damage to connected safety-related equipment. At the end of five minutes if the degraded voltage condition has not been corrected, load shedding will be initiated and the shutdown board subsequently transferred to its diesel generator.

To protect the Class 1E equipment from a sustained over-voltage, each of the two 6.9 kV Class 1E buses per unit are provided with a set of two instantaneous solid-state overvoltage relays. These relays are arranged in a one-out-of-two coincidence logic which will annunciate in the main control room. The relays will have a nominal voltage setpoint of 7260 volts ± 1 percent (110 percent of motor rated voltage with a time-delay of 300 seconds). The operator will take the necessary action to reduce the voltage.

The loss of voltage load shedding relays are not bypassed when on diesel power, but will remain in the circuit at all times. TVA"s basis for retention of this feature is that it provides for automatic resequencing of the loads following any temporary loss of bus voltage. Since the loss-of-voltage load shedding relay setpoint is fixed at 4860 volts ± 5 percent (70 percent of nominal) with an inverse time delay, the starting of the largest driven load will not cause actuation of the load shedding feature. Therefore, the operation of the load shedding relay system is:

1. To shed the loads to prevent overloading the diesel generator.

2. Allow the diesel generator to recover to rated speed and voltage.

3. And reconnect the loads in proper sequence.

Overcurrent and differential overcurrent protective relays are provided for each shutdown board to lockout all supply breakers if the loss of voltage is caused by overload or an electrical fault. This prevents transfer of a fault between offsite power circuits or to the diesel generator. This minimizes the probability of losing electrical power from the transmission network on the onsite electrical power source.

8.2.2.3 *Each of the offsite preferred power sources is monitored by an undervoltage relay.* In the event of a loss of voltage on either 6.9 kV start bus A or B or a 161 kV transmission system contingency (load shedding trip circuits are manually enabled) and both unit 1 and unit 2 tripped, the load shedding scheme will be initiated. This load shedding scheme will trip off part of the BOP loads. The alternate supply breakers on 6.9 kV unit boards 1C, 1B, 2C, and 2B; 6.9 kV RCP boards 1C, 1D, 2C and 2D; and 6.9 kV common board A, panel 16 will be tripped and locked out. The load shedding scheme is armed at all times and two redundant trip and lockout circuits are provided for each circuit breaker being load shed. These redundant circuits have coincident logic features to minimize the probability of failure to operate and spurious trips. Functional test capability is built into each load shedding circuit. The test features allow independent testing of each circuit while maintaining the load shedding feature of the circuit not undergoing testing. 8.2.2.3 *The redundant load shedding circuits will be tested periodically.*

shutdown board starts the diesel generator and initiates (after an additional 3.5 seconds) logic that trips the normal or alternate feeder breakers, all 6900V loads (except the 480V shutdown board transformers), and the major 480V loads. Table 8.3-2 shows the loads that are automatically stripped. Figures 8.3-6 thru 8.3-13 show the load stripping schematically. When the diesel generator has reached rated speed and voltage, the generator will be automatically connected to the 6.9 kV shutdown board bus. (Refer to Figure 8.3-14.) This return of voltage to the 6.9 kV shutdown bus initiates logic which connects the required loads in sequence. Table 8.3-3 shows the order of applied loads. The standby (onsite) power system's automatic sequencing logic is designed to automatically connect the required loads in proper sequence should the logic receive an accident signal prior to, concurrent with, or following a loss of all nuclear unit and preferred (offsite) power.

There are no automatic transfers of board supplies between redundant power sources. All 480V shutdown boards and all motor control centers have alternate feeders to their respective board buses. Transfers between the normal and alternate feeders are manual. Some manual transfers of loads between power trains are used. These transfers are tabulated in Table 8.3-10. 56 63

All circuit breakers supplying the alternate feeders for the manual transfers in Table 8.3-10 [with the exception of the spent fuel pit pump C-S, the 125V auxiliary feedwater turbine (AFWT) dc manual transfer switch (units 1 and 2), and the 120V AFWT AC manual transfer switch (units 1 and 2)] are normally opened. The transfer switches are mechanically interlocked to prevent closing a switch in a manner to parallel both feeds. 8.3.1.7 For the components where power supply alignment is critical (battery chargers, inverters, and component cooling water pump C-S) the alternate feeder breakers are verified open in accordance with the technical specifications. For the other components (spent fuel pit pump C-S and turbine driven auxiliary feedwater pump control power) where power supply alignment is not important; breaker position verification is not required. 56 63

A manual means of supplying power to the 480V Auxiliary Building common board (which is not normally supplied power from the diesel generators during a condition where offsite power is lost) is provided. Provisions have been made to manually connect this board to the 480V shutdown boards 1B2-B and 2B2-B. This is shown in Figure 8.3-15. The purpose of these feeders is to provide power to operate the ice condenser refrigeration units, located on the 480V Auxiliary Building common board and glycol pumps, located on the 480V Auxiliary Building MCC B and C, during the unlikely condition of a loss of offsite power that exceeds 2 to 3 days. The two normal bus feeder breakers must be moved from their normal compartments to the compartments which are connected to the 480V shutdown boards 1B2-B and 2B2-B.

System Instrumentation

Remote instrumentation of the 6.9 kV shutdown boards consist of

Breaker position for alternate feeders will either be alarmed in the main control room when closed or will be verified to be open on a weekly basis unless analysis verifies that the alternate feeder and its source have the capability/capacity to carry the load for the worst case loading conditions.

The events which initiate a safety injection signal are discussed in Chapter 7.

8.3.1.12 For test and exercise purposes, a diesel generator may be manually paralleled with a normal or preferred power source. A loss of offsite power ~~and a safety injection signal~~ will automatically override the manual controls and establish the appropriate alignment. 63

The diesel can be started by manually operated emergency start switches located on the unit control board in the Main Control Room and Auxiliary Control Room. (The diesel also has a local manual start switch as well as remote start from the Main Control Room for test purposes). Automatic starting is from an accident signal or a loss of voltage or degraded voltage signal. All automatic and emergency start signals operate to deenergize a normally energized control circuit. These signals also operate a lockout relay that removes all manually operated stop signals except emergency stop and all protective relaying on the generator except generator differential. The lockout relay must be manually reset to return the D/G to its standby alignment at the diesel generator relay panel in the diesel building or the ADGU Building. ~~A local idle start switch is provided to start and run the engine at idle speed for durations of unloaded operation. During this type operation any emergency signal will cause the engine to go to full speed and complete the emergency start sequence~~. 57

8.3.1.13

Internal combustion engines operate most reliably at the rating for which they are designed. At extended light load operation, lube oil can be expected to accumulate in the exhaust system.

Manufacturer's recommendations are that the diesel generators not be run for extended periods of time at less than 50% of continuous rated load. For all situations, TVA has loads continuously available to the operator that exceed 50% of the continuous rated load.

The manufacturer has indicated that the diesel engines have been tested for no-load operation for four hours.

After four hours of operation at less than 30-percent load, the diesel generator is run at a minimum of 50-percent load for at least 30 minutes. 55

After an accident situation when the diesel generator has run for an extended period of time at low or no-loads, the load is to be gradually increased until the exhaust smoke is approximately twice as dense as normal. The increasing load is then stopped until the smoke clears. This procedure is repeated until full load can be carried with a clear exhaust.

A local idle start switch is provided by the diesel manufacturer to start and run the engine at idle speed for periods of unloaded operation. The mode selector switch in the main control room must be in the local mode for the local idle start switch to be enabled. The local idle start switch circuitry has normally open relay contacts from the normally energized control circuit that is deenergized by the automatic or emergency start signals. Therefore, during idle operation, any automatic or emergency start signals will disable the idle start circuitry and will command the engine to go to full speed. As part of the diesel generator testing required by Plant Technical Specifications, proper function of this bypass circuit is ensured.

load, there is 6000-hour cumulative time limit. After the time limit has been reached for a particular load level, this component will be replaced. If a unit is to be run in both the above load ranges, the 3000-hour time limit will be used. 55 57

In general, after starting, the diesel generators will continue to run until manually shutdown. However, there are protective devices installed to shutdown a diesel generator automatically to prevent heavy damage in the event of a component malfunction. These protective devices are listed below. Protective devices marked with an asterisk (*) are operative at all times while the others are operative only during the test mode of operation. These devices must be manually reset before the engine can be restarted. The status and operability of the trip bypass circuits can be tested and abnormal values of all bypass parameters are alarmed in the Control Room.

Generator

phase balance relay
reverse power relay
voltage restrained overcurrent relay
generator differential relay*
overcurrent relay
loss of field relay (there is no loss of field relay in the ADGU protection scheme) 57 63

Engine

overspeed switch (*)
Crankcase pressure switch
low lube oil pressure switch
high water jacket temperature switch

Only one diesel will ~~ever~~ be in the test mode at any one time. One diesel generator may be stopped by its protective devices without jeopardizing the safe shutdown of a unit during all postulated design basis events. The protective devices will prevent excessive damage to a diesel generator and plant personnel will be able to return the diesel generator to its operating state with a minimum of outage time. Also, the additional diesel generator is available to be substituted. 57

The diesel can be stopped by manually operated emergency stop switches located in the Main Control Room, Auxiliary Control Room, and on the diesel control panel in the diesel building or ADGU Building. A manual stop switch is provided in the Main Control Room for stopping the engine under normal conditions. Under accident or loss of offsite power conditions this stop switch is automatically disconnected from the stop circuit. The normal stopping of the engine will position the hydraulic governor at the lower limit and allows the engine to run for 10 minutes at idle speed (450 rpm) before bringing the engine to zero speed. 57

unless both units are in cold shutdown then both diesel generators of the same train maybe in test.

8.3.3.5.2

8.3.1.11

be calibrated. (using test sets that simulate a fault current) For the instrument power board, circuit breakers will be tested for proper trip operation, fuses will be checked to verify that the sizes and types specified on the master fuse report have been installed, and the board instruments will be calibrated. During plant power operations the vital 120V ac control power system will be periodically tested and inspected to ensure its continued capability to perform its operation. The inverters will be tested for their capability to transfer between the 480V ac normal power source and the 125V dc emergency power source. The inverter and auctioneering equipment may be removed from service for inspection and test by synchronizing and manually transferring to the maintenance power source. The surveillance instrumentation will provide continuous monitoring of the system.

Vital Power System Load Data

Tables 8.3-11 through 8.3-18 list all loads supplied from the vital ac system. The basis for the load current data is indicated and was determined by estimation, or obtained from manufacturer's data. The capability of the vital a.c. system to supply power to its loads is verified by analyses in Section 8.3.1.2.2.

Design Bases and Criteria for Safety-Related Motors, Switchgear Interrupting Capacity, Circuit Protection, and Grounding

The design bases for safety-related motors are the applicable Onsite Power System design bases listed in Section 8.1.4. In particular, bases 1, 3, 4, 5, and 6 apply to safety-related motors. The criteria which are applied to motor size, starting torque, and insulation are as follows.

Motor Size and Starting Torques

Each motor has adequate capacity and operating characteristics for all conditions of starting and running which the connected equipment may impose.

The motor nameplate horsepower rating is not normally exceeded when the connected equipment is operating at rated capacity. The motor horsepower rating, based on nameplate or vendor data, may be exceeded on a continuous basis up to its service factor rating for specific cases after a design review to ensure that the temperature limits of the insulation system are not exceeded.

certified to operate within the environmental requirement called for in the design criteria. (Refer to Section 3.11). The arrangement of circuit interrupters and switches permits easy isolation of the installed assemblies for future test and maintenance purpose.

8.3.1.2.3 Safety-Related Equipment in Potentially Hostile Environment

Electrical equipment located inside containment has been designed to maintain equipment safety functions and to prevent unacceptable spurious actuations. All power cables feeding equipment inside containment are provided with individual breakers to protect the power sources (both IE and non-IE) from the effects of electrical shorts. Reactor coolant pumps have two circuit breakers. All other power cables are provided with a cable protector fuse which, in the event of a breaker failure, is designed to protect the containment penetration. These breakers and protector fuses ensure that, should an electrical short occur inside containment, the electrical power source will not be affected.

— have a high impedance fault

that are

A failure analysis has been made on the ability of the electrical power (both AC and DC) systems to withstand failure of submerged electrical components from the postulated LOCA flood levels inside containment (see Appendix 8A and 8B). Some of the identified components are automatically deenergized in event of a LOCA. ~~and other components are disconnected during normal operation~~. The remaining components powered from a Class 1E source ~~or sharing a raceway with Class 1E circuits,~~ were assumed to ~~be electrically shorted~~ for the analysis. The results of the evaluations indicate that the submergence of electrical components will not prevent the Class 1E electric (either AC or DC) systems from performing their intended safety function for the postulated submerged condition.

The magnitude of the leakage currents used in the analysis is the maximum value of current that each protective device would carry for an indefinite period in the unlikely event of thermal rating

63

.3.3.1.1

A listing of major non-safety-related electrical components located inside containment that may be inundated following a LOCA appears in Table 8.3-28 along with an explanation of the safety significance of the failure of the equipment due to flooding. In addition to the electrical equipment listed in the table, the water level inside containment may also flood non-safety-related local control stations, electrical sensors, electric motors for motor operated valves, and electric solenoids for air-operated valves. The flooding of this equipment will not affect the plant safety. All local control stations located inside containment are provided with manual throw switches located outside containment at the motor control center. These manual switches are used to remove control power from the local control stations during normal operation. In order to utilize the local control stations during operating conditions where containment access is permitted, the manual

8.3.3.1.1

The components listed in Table 8.3-28 are automatically de-energized by the accident signal and the accident signal must be reset to remove the automatic trip signal from each component. Testing to ensure the operability of all of the components used in the design for automatic de-energization is performed in conjunction with the test which verifies ESFAS actuation circuitry. Acceptance criteria for this test is that all devices will assume their accident conditions and maintain those conditions after the accident signal is reset. This test is performed every 18 months.

The assemblies are capable of maintaining containment integrity when subjected to a borated water spray solution of approximately 2000-ppm boron as boric acid and sufficient sodium to bring the pH to 8.0 to 8.5.

The penetration assembly is capable of continuous operation at the normal environmental conditions listed below:

Parameter	Inside Containment	Outside Containment	
Temperature	30 to 150°F	30 to 125°F	63
Pressure	-2 to +2 psig	-2 to +2 psig	
Relative Humidity	20% to 100%	20% to 100%	
Accumulated radiation dose	1×10^5 rad		55

Underground Cable Installation

The design and installation of the underground cables conform to the applicable requirements of General Design Criteria 1, 2, 3, 4 and 17 and Section 5.2.1 of IEEE Std. 308-1971. Compliance to the GDC's is discussed in Section 3.1. Also, conformance to GDC 17 and IEEE Standard 308-1971 is discussed in Sections 8.2.1.8, 8.3.1.4, and 8.3.1.2.1. 63

The Class 1E cables between the auxiliary building and the diesel generator building, and the intake pumping station are installed in seismic Category I structures. Figure 3.8.4-37 shows the physical location of the seismic Category I manholes and duct runs (conduit banks); and Figures 3.8.4-38 through 3.8.4-46 show the details of these structures. A description of these manholes and duct runs is given in Section 3.8.4.1.5. The Class 1E cables between the diesel generator building and the ADGU building are also installed in Category I structures. 57

8.3.3.1.4

~~The duct runs have been separated or otherwise protected to prevent a common mode failure of the redundant cable system. Some of the manholes have 12 inch concrete divider walls separating the redundant cables. The manholes have watertight covers and are provided with sump pumps~~.

Cables are designed to operate in wet conditions. The Class 1E cables required to operate the plant in the flooded condition are continuous or provided with a waterproof splice ~~in the potentially submersible sections of the duct runs.~~ a manhole Cables have been tested at the factory by the manufacturer according to TVA standard specifications, which includes tests in submerged conditions, such as

Conduit duct bank runs are generally long runs which can exceed standard cable reel lengths, thus requiring medium splices. The long runs may also cause cable pull tension to be exceeded unless the pulled length is shortened by splicing shorter cable sections together. Manholes in conduit duct bank runs provide the same function as junction boxes in other conduit runs by providing a cable pullpoint and a location for cable splices. Manholes are enclosed structures with very limited space and the cable tray raceway in the manhole provides support and protection of cables and splices from damage while in manholes. Also, redundant cable divisions are either installed in separate manholes or in the same manhole with a concrete barrier between the divisions. Sump pumps with level switches for automatic pump operation are located in the manholes to prevent water accumulation due to leakage into the manhole. Manholes will be included in the plant surveillance program and will be inspected every 12 months for sump pump operability and flooding.

associated and non-Class IE cables provides a reliable means of meeting the intent of Regulatory Guide 1.75 to not degrade Class IE cables:

1. A circuit breaker and fuse in series
2. Two circuit breakers in series
3. A single fuse

All of the installed protective devices and those added to further protect the associated and Non-Class IE cables are of a high quality commensurate with their importance to safety.

A majority of the associated circuits analyzed have either two protective devices provided or the calculated short-circuit current is effectively limited to a value less than the conductor's continuous current rating. The remaining eighteen associated circuits have only one protective device. Of these circuits, sixteen are protected by a fuse and two by a circuit breaker. Where practical, an additional protective device has been added to these two circuits protected by a single circuit breaker; otherwise the single circuit breaker is being tested in accordance with the plant's technical specifications.

Non-Class IE power and control cables routed in nondivisional tray, not meeting Regulatory Guide 1.75 separation requirements, similarly have one of the protective schemes described above. Otherwise, the single circuit breaker that protects each non-Class IE power or control cable is tested in accordance with the plant's technical specifications.

8.3.3.3 (3)

There are certain safety-related components, such as the component cooling water pump C-S and the steam turbine-driven auxiliary feedwater pumps 1A-S and 2A-S, which receive power from redundant divisions (channels or trains) through manual transfer devices. In addition, there are certain safety-related components, such as the additional diesel generator unit (ADGU), and the fifth vital battery which are capable of supplying power to redundant divisions (channels or trains) through manual transfer devices. These components will have suffix S added to their labels. A suffix S will be added to their respective raceway and cable designations. The S cables from the transfer device to the component require special separation and are routed in separate raceways with no other circuits with the following exception. Cables with a suffix S may be routed together provided the following two conditions are satisfied: (1) voltage levels are compatible, and (2) circuits are designed such that under any design basis event all cables in the raceway will always be of the same divisions (channel or train) where energized. These circuits are identified by a

The electrically operated circuit breaker and molded case circuit breakers actuated by a fault current and installed as an isolation device will have at least 10 percent of each type of breaker tested every 18 months and will have the recommended maintenance performed on 100 percent of the breakers within the past 60 months. For any breaker failure or breaker found inoperable, an additional 10 percent of that type breaker will be tested until no more failures are found or all electrically operated circuit breakers of that type have been tested. The tests will ensure operability by simulating a fault current with an approved test set.

three operation conditions for which load values are tabulated. The 135V column indicates actual loads expected while the battery charger (set at "float voltage") supplies the battery board load. The 125V column represents the actual loads expected with the battery board being supplied from the vital battery (480V ac unavailable), at its normal charged state. The 105V column represents the actual loads expected with the battery board being supplied from the vital battery (480V ac unavailable), at its minimum charged state. The actual load current during an ac power outage will depend on the discharge state of the battery. This subject is also treated in the section on Tests and Inspections. Loads are assigned to the systems according to the loads' divisional requirements. Four divisional loads are assigned to the four channels, two divisional loads are assigned to Channels I or III and II or IV. The loads primarily associated with unit 1 are assigned to Channels I and II while loads primarily associated with unit 2 are assigned to Channels III and IV. Nondivisional loads primarily associated with unit 1 are assigned to Channels I or II. Similarly, nondivisional loads associated with unit 2 are assigned to Channels III or IV. Nondivisional loads that are primarily associated with plant common services are distributed among the four channels. Some loads have a normal and alternate feeder. The normal feeder is from one channel while the alternate feeder is from another channel. These loads are listed in Tables 8.3-19 through 8.3-26. The transfer of the loads between the two feeders is manual and is interlocked to prevent paralleling the redundant power sources.

Maximum steady state dc loads (during battery recharge following an ac outage, the inverters and lighting loads are supplied from ac power) for each channel are supplied from a battery charger when it has either normal or standby ac power available from the 480V shutdown boards. If the normal charger is unavailable, the loads are supplied from either the associated battery or a spare charger which can be manually connected to the battery board.

125V Diesel Generator Batteries 1A-A, 1B-B, 2A-A, 2B-B, and C-S

Reference: Figure 8.3-46

~~These batteries are located in the diesel generator buildings in the room with the associated diesel. Each battery (except battery C-S) is equipped with its own exhaust hood and each diesel generator room is equipped with its own heating and ventilating system independent of~~

8.3.2.4

For a detail description of the 125V diesel generator battery system refer to the paragraph on diesel generator control power in Section 8.3.1.1. Also, statements of compliance of the 125V diesel generator battery system with the applicable GDCs, regulatory guides, and IEEE standards are included in Section 8.3.1.1.

8.3.2.4 ~~all others. The heating and ventilating systems are designed to provide an ambient room temperature between 60°F and 104°F and a maximum relative humidity of 98%~~.

Normal DC Supply

Reference: Figure 8.1-3

The normal supply of dc current to the battery boards is from the battery charger in each channel. Each charger maintains a floating voltage of approximately 135 volts on the associated battery board bus (the battery is continuously connected to this bus also) and is capable of maintaining 140 volts during an equalizing charge period (all loads can tolerate the 140 volt equalizing voltage). The charger supplies normal steady state dc load demand on the battery board and maintains the battery in a charged state. Normal recharging of the battery from the design discharged condition can be accomplished in 12 hours (with accident loads being supplied) ~~following a 30 minute ac power outage~~ and in approximately 36 hours (with normal loads being supplied) following a 2-hour ac power outage. Two spare chargers are available for the four channels (one each for two channels). Each spare charger can be connected to either of its two assigned channels. It can substitute for or operate in parallel with the normal charger in that channel.

8.3.2.8

AC power for each charger is derived from the station auxiliary power system via two 480V ac 3-phase circuits which are physically and electrically independent. Each circuit has access to a preferred (offsite) and a standby (onsite) source. If the normal circuit supplying a charger is unavailable, the alternate circuit is selected by a manual transfer. The transfer switches are mechanically interlocked to prevent closing switches in a manner to parallel both foods. The alternate 480V feeder breakers are verified open in accordance with the technical specifications. Each charger is equipped with a dc voltmeter, dc ammeter, and charger failure alarm. Malfunction of a charger is annunciated in the Main Control Room. Upon loss of normal power to a charger, each may be energized from the standby power system.

The charger is a solid-state type which converts a 3-phase 480V ac input to a nominal 125V dc output having it rated capacity of 200 amperes. Over this output current range the dc output voltage will vary no more than ±1.0% for a supply voltage amplitude variation of ±7.5% and frequency variation of ± 2.0%.

Some operational features of the chargers are an (1) an output voltage adjustable over the range of 125 to 140 volts, (2)equalize and float modes of operation (the charger normally

Component	Location
125V Vital Distribution Board V	Auxiliary Bldg, A5-T, El 772
125V Vital Distribution Panel A	Auxiliary Bldg, A5-R, El 757
125V Vital Distribution Panel B	Auxiliary Bldg, A11-R, El 757
Panel 0, Battery Board I	Auxiliary Bldg, A5-R, El 757
Panel 0, Battery Board II	Auxiliary Bldg, A5-R, El 757
Panel 0, Battery Board III	Auxiliary Bldg, A11-R, El 757
Panel 0, Battery Board IV	Auxiliary Bldg, A12-R, El 757

6

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Thus, the system design, equipment location, separation, and redundancy assure ability to meet the requirements for the applicable accident events described and evaluated in Chapter 15 and is in full compliance with NRC General Design Criteria 17 and Regulatory Guide 1.6, revision 0. 63

8.3.3.2.1

The normal or preferred power source to each distribution board is from the battery charger which is supplied from either one of two 480-volt ac shutdown distribution boards. The battery

Analysis of Vital 125-Volt, DC System for Compliance to Regulatory Guide 1.81 Position C2

The following results were obtained in an analysis of the vital 125-volt dc system with respect to position C2 of Regulatory Guide 1.81 (each item is addressed in the order it appears in position C2 of the Regulatory Guide):

a. Watts Bar is a two-unit plant.

Continued on next page

8.3.3.2.1

b. The vital 125-volt dc batteries are designed to supply all connected loads. This includes the safety system loads energized by a spurious accident signal (single failure) in a non-accident unit concurrent with the safety loads energized in an accident unit. Therefore, assuming a loss of offsite power, a false or spurious accident signal in the non-accident unit concurrent with an accident in the other unit will not preclude the vital 125-volt dc system from performing its intended safety function.

c. Assuming the loss of offsite power, a design basis accident in one unit, a full load rejection in the other unit, and a single failure (loss of a vital battery), sufficient capacity is available in the remaining vital 125-volt dc batteries to support a safe and orderly shutdown of the plant.

d. Only one of the four vital 125-volt batteries will be removed from service for maintenance or testing at any one time. Therefore, this condition will not preclude the ability to safely shutdown both units, assuming the loss of offsite power.

e. No interface between the unit operators is required to meet items b and c. above since the batteries are designed to supply all connected loads for the events identified in b and c.

f. Status indications for the vital 125-volt dc system are provided in each unit's main control room (MCR).

serves as an emergency source in the event the battery charger source is lost or is inadequate for the load required. The total design load for each board with 480-volt ac available is shown by Tables 8.3-19 through 8.3-22. The primary charger supplying each board is of more than ample capacity to supply load currents and maintain full charge on the battery. The total design load for each board with the 480-volt ac unavailable is shown in Tables 8.3-19 through 8.3-22. Since each battery has an emergency 2-hour rating of 686 amperes (712 amperes for vital battery V) at 60°F with a minimum of 105 volts (108.5 volts for vital battery V) dc at the battery terminals, ~~and the startup time on the diesels is less than 30 minutes~~, the battery capacity far exceeds the maximum design load requirements for each board. 58 63

8.3.1.7.1 ~~Each essential load has a redundant supply which is electrically separate from its first supply. The supply cables are routed so as to provide complete physical separation from the two supplies to each load. The overall design of the system (including batteries, chargers, distribution boards, and cabling) incorporates sufficient capacity and capability to deliver the maximum design load currents required at each remote point and also to clear any possible short-circuit fault currents.~~

The load demand from battery boards I, II, III and IV can be grouped into essentially three categories for analysis purposes. These are (1) the vital inverters, (2) 6900- and 480- volt shutdown board control power, and (3) miscellaneous control and instrumentation loads. The output fuse and breaker trip ratings and trip times are coordinated to provide protection and isolation for the cables leaving the board. 56

Referring to Figure 8.1-3, it can be seen that each of the three groups of loads are supplied from the main bus through a fuse to a stub bus from which the power is delivered to each load circuit via a molded-case automatic circuit breaker. Each stub bus may supply one or more breakers. Figures 8.3-37 through 8.3-40 show the exact circuit distribution. Each breaker and fuse has a current interrupting rating greater than the maximum short-circuit current capability of the battery and charger combined. Each breaker and fuse is sized in accordance with circuit requirement. The interposing fuse between the main and stub buses not only provides high-speed clearing for a very severe close-in feeder fault, but it also provides redundant protection of the feeder in the event an

Each dc control bus on the 6.9kV and 480V shutdown boards has a normal and alternate supply. The alternate supply is redundant and electrically separate from the normal supply. The normal and alternate power supplies for Train A shutdown boards control buses are batteries I and III and for Train B shutdown boards batteries II and IV. The supply cables are routed so as to provide complete physical separation from the two supplies to each load. The overall design of the system (including batteries, chargers, distribution boards, and cabling) incorporates sufficient capacity and capability to deliver the maximum design load currents required at each remote point and also to clear any possible short-circuit fault currents.

Table 8.3-27

VITAL 125V D.C. BATTERY LOSS CONCURRENT WITH LOSS OF OFFSITE POWER

8.3.3.2.1

Battery	D.C. Control Power Failure Effect	Safety-related 120V A.C. Instrument Power Board Failure Effect: Multiple Failures	Channels
I	'A' Train Class 1E Power System (Unit 1 & Unit 2)	SSPS(A) & (B) Ch I Input Relays	1-I, 2-I
		NIS Ch 1 Volt Reg Inst Power	1-I, 2-I
		NIS Control Power Ch I	1-I, 2-I
		Process Protection Set I	1-I, 2-I
II	'B' Train Class 1E Power System (Unit 1 & Unit 2)	SSPS(A) &(B) Ch II Input Relays	1-II, 2-II
		NIS Ch II Volt Reg Inst. Power	1-II, 2-II
		NIS Control Power Ch II	1-II, 2-II
		Process Protection Set II	1-II, 2-II
III	'A'Train Class 1E Power System (Unit 1 & Unit 2)	SSPS(A) & (B) Ch III Input Relays	1-III, 2-III
		NIS Ch III Volt Reg Inst Relays	1-III, 2-III
		NIS Cont Power Ch III	1-III, 2-III
		Process Protection Set III	1-III, 2-III
IV	'B'Train Class 1E Power System (Unit 1 & Unit 2)	SSPS(A) & (B) Ch IV Input Relays	1-IV, 2-IV
		NIS Ch IV Volt Reg Inst. Relays	1-IV, 2-IV
		NIS Cont Power CH IV	1-IV, 2-IV
		Process Protection Set IV	1-IV, 2-IV

1200g

APPENDIX 8D (Con't)
WATTS BAR NUCLEAR PLANT - FSAR

Requirement	Compliance
(1) Full short-time load rejection	C
(2) Margin to allow overspeed . . .	C
(3) As a minimum, the generator, exciter, and flywheel . . .	C
5.6.1.4 Governor Operation	C
5.6.1.5 Voltage Regulator Operation	C
5.6.2 Control	
5.6.2.1 Control Modes	C
5.6.2.2 Automatic Control	C
8.3.1.12 (1) . . . override all other operating modes . . .	~~C~~ (1) An SI signal will not trip the DG supply breaker when the DG is in test but a subsequent loss of offsite power will result in the DG's overcurrent relay tripping the DG supply breaker and the DG load sequencer automatically loading the accident loads.
(2) . . . shall not override . . . manual . . .	C
5.6.2.3 Control Points	C
5.6.3 Surveillance Systems	
5.6.3.2 Modes Surveyed	C
(1) Unit not running	C
(2) Unit running - not loaded	C
(3) Unit running - loaded	C
(4) Unit out of service	C
5.6.3.3 Surveillance Instructions	C
(1) Starting system	C
(2) Lubricating system	C
(3) Fuel	C
(4) Primary cooling system	C
(5) Secondary cooling system	C
(6) Combustion air system	
(7) Exhaust system	C
(8) Generator system	C
(9) Excitation system	C
(10) Volt regulation system	C
(11) Governor system	C
(12) Auxiliary electric system	C

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ENCLOSURE 3
LIST OF COMMITMENTS

(1) TVA will revise the FSAR as described in the marked up FSAR pages included in Enclosure 2 of this submittal.

(2) An FSAR submittal to describe the new CSSTs and to revise the appropriate sections will be submitted upon engineering completion of the design change notice (DCN) (M-12051-A) which will document the installation of the CSSTs. This information is scheduled for submittal by system completion.

The appropriate FSAR section(s) will be revised to indicate that the second alternate supply breaker will no longer be normally racked out due to the installation of the CSSTs, described above.

(3) The diesel engines' cold and hot dead load pickup ratings will be incorporated into the FSAR with the changes required by the results of the calculation described in Section 8.3.1.1.1

(4) The diesel generator loading calculation will be revised by system completion to incorporate and the proposed design changes to increase the diesel generator margin.

(5) An FSAR change will be submitted, as necessary, to document the design changes and the margins determined for the diesel generators in item 4 above (see Section 8.3.1.1.1 of this submittal).

(6) An accuracy calculation for the load shedding relays will be performed with the maximum upper limit restricted to 75 percent of nominal voltage.

(7) An alternate feeder analyses will be performed on components having manual transfer between redundant power divisions prior to the integrated tests of the safety systems.

(8) Analyses will be performed to indicate that the batteries' capacity is sufficient with the alternate feeders energized to mitigate an accident in one unit and to safely shutdown the other unit with a loss of the battery charger for thirty minutes (see Section 8.3.1.7.1).

(9) Test procedures will be developed to ensure the vital ac system remains functional over the life of the plant (see Section 8.3.11 of Enclosure 1).

(10) The submergence calculation will be revised by December 1991 to address cables that could be submerged which provide power to nonrequired loads above the flood level and receive power from the 1E boards.

ENCLOSURE 3
LIST OF COMMITMENTS

(11) To support the use of temporary jumper wires, TVA will identify each safety system component where temporary jumpers are utilized in surveillance procedures implemented periodically, and will analyze these cases (e.g., a 10 CFR50.59 type of analysis) to demonstrate that the jumper will not compromise the design basis of the system component being tested.

(12) A trending program will be established to compare the DG dynamic loading responses recorded for the 18-month periodic miniflow testing cycles to the baseline established during the preoperational tests (see Section 8.3.3.5.1).

(13) Manholes will be included in the plant preventive maintenance program and will be inspected every 12 months for sump pump operability and flooding (see Section 8.3.3.1.4).