TVA

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

William J. Museler
Site Vice President, Watts Bar Nuclear Plant

FEB 07 1994

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

Gentlemen:

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

WATTS BAR NUCLEAR PLANT (WBN) - DIESEL GENERATOR (DG) TESTING IN PARALLEL WITH OFFSITE POWER (TAC M63649)

This letter supplements and corrects information that was previously provided in letters dated August 5, 1993, and September 13, 1991, about WBN's design provisions for testing a DG in parallel with offsite power. In particular, the letter describes a recent design modification that was done to conform with applicable regulatory guidance by tripping the output breaker of a DG in test when an accident signal is initiated. The information in the letter also updates TVA's response to Item 8.3.1.12 included in a request for additional information (RAI) dated June 20, 1991. This item in the RAI expressed an NRC staff concern about the capability and independence of WBN's offsite and onsite electric power sources when paralleled during testing.

The RAI identified 32 issues concerning the design of WBN's electric power system. Item 8.3.1.12 (one of the 32 issues) requested justification of the design features related to receipt of an accident signal (i.e., safety injection (SI) signal) and loss of offsite power (LOOP) while a DG is being operated in parallel with offsite power for testing. TVA responded to the RAI, including Item 8.3.1.12, in a letter dated September 13, 1991. During the ensuing two years, the NRC staff and TVA discussed the various RAI issues in a series of telephone conversations and meetings. The NRC staff eventually requested a detailed written statement for Item 8.3.1.12 describing how WBN's design complies with Regulatory Guide (RG) 1.108, Revision 1, Regulatory Position C.1.b(3), which states: "Periodic testing of diesel generator units should not impair the capability of the unit to supply emergency power within the required time. Where necessary, diesel

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generator unit design should include an emergency override of the test mode to permit response to bona fide signals." TVA provided the requested information about the design provisions that were believed to meet the intent of this regulatory guidance in a letter dated August 5, 1993.

In summary, TVA's letters dated August 5, 1993, and September 13, 1991, as well as related information in WBN's Final Safety Analysis Report (FSAR), stated that WBN's design was adequate to met the intent of RG 1.108, Revision 1, Regulatory Position C.1.b(3). These letters and the FSAR explained that the output breaker of a DG being tested in parallel with offsite power would trip open on instantaneous overcurrent if an accident signal occurred concurrent with a LOOP. Once the DG was disconnected from its 6.9-kV shutdown board, the DG's emergency start mode would be enabled and it would perform identically to a DG that had received an accident signal concurrent with a LOOP while in its standby (non-test) alignment.

During reviews in preparation for preoperational testing of WBN's DGs and subsequent to the letter dated August 5, 1993, TVA identified a set of conditions that could prevent a DG from responding to an accident signal concurrent with a LOOP as described above. Specifically, the instantaneous overcurrent relay on the DG breaker would be disabled for a LOOP that is caused by or results in tripping of the supply breaker to the 6.9-kV shutdown board from the in-service common station service transformer (CSST) which is supplying the shutdown board in parallel with the DG under test. Tripping of the supply breaker from the in-service CSST could occur due to a transformer overcurrent or fault condition or a switchyard fault. For this scenario, the DG breaker may not trip and, if it did not trip, automatic load shedding for the 6.9-kV shutdown board would not occur since the shutdown board would not experience an undervoltage or loss of voltage condition. The DG would attempt to supply power to all of the loads that are already connected to its shutdown board and to the emergency loads that are started in response to the accident signal. Consequently, the DG would be overloaded with the emergency loads that are powered from the shutdown board when they start simultaneously.

TVA notified Messrs. Paul Frederickson and Peter Tam of the NRC by telephone on November 12, 1993, that some of the information included in the letter dated August 5, 1993, was in error because of the design deficiency created by the above-described set of conditions. TVA stated that the previously provided information would be revised following investigation and resolution of the deficiency through WBN's corrective action process. Also, the deficieincy was evaluated in accordance with 10 CFR 50.55(e). TVA is submitting that evaluation separately in Construction Deficiency Report 50-390/94-01 and 50-391/94-01.

TVA has issued a design change to WBN's electric power system to correct the deficiency and reestablish compliance with RG 1.108, Revision 1, Regulatory Position C.1.b(3). The design change modifies the DG control circuitry to trip the output breaker of any DG that is in its test mode and is operating in parallel with offsite power whenever an SI signal or a fault signal associated with the normal offsite power source is actuated. Tripping open the DG breaker satisfies a control logic interlock within the accident response circuits so that an SI signal will realign the DG to its "emergency start" mode and override the manual controls used in its "test" mode. Also, opening the DG breaker when LOOP conditions exist ensures that the associated 6.9-kV shutdown board is deenergized and that its undervoltage relays will pickup to initiate load-shedding. After this occurs, the DG operates identically to the way it would have operated if it had been in its standby alignment when the SI signal was actuated. Once the DG is in its emergency start mode and loads have been stripped from its shutdown board, control circuits associated with the load shedding logic and DG voltage/speed status signals close the DG breaker to reenergize the 6.9-kV shutdown board. These circuits also start the load sequencer to connect emergency loads to the shutdown board at preset time intervals.

FSAR changes have been prepared for a future amendment to incorporate the design modification for tripping the DG breaker when an accident signal is initiated and the DG is being tested in parallel with offsite power. A set of FSAR page markups showing these changes is enclosed. (Refer to markups of pages 8.2-15, 8.2-16, 8.3-12, and 8.3-19.)

For completeness, the enclosure also includes page markups showing the other changes to FSAR Chapter 8 ("Electric Power") that have been identified since it was last updated in Amendment 75. Note that one of these changes describes WBN's compliance with RG 1.9, Revision 3, which was issued in July 1993 and which provides more recent regulatory guidance superseding RG 1.108. However, the guidance in Regulatory Position 1.5 of RG 1.9, Revision 3, is essentially the same as that quoted above for Regulatory Position C.1.b(3) of RG 1.108, Revision 1. Regulatory Position 1.5 states: "The (emergency diesel generator) units should be designed to automatically transfer from the test mode to an emergency mode upon receipt of emergency signals." As with Regulatory Position C.1.b(3), WBN also complies with Regulatory Position 1.5 based on the recent design modification to trip the output breaker of a DG being tested in parallel with offsite power when an accident signal is initiated.

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If you have any questions about the information provided in this letter, please telephone John Vorees at (615) 365-8819.

Very truly yours,

W. J. Museler

William J. Museler

Enclosure
cc (Enclosure):

NRC Resident Inspector
Watts Bar Nuclear Plant
P.O. Box 700
Spring City, Tennessee 37381

Mr. P. S. Tam, Senior Project Manager
U.S. Nuclear Regulatory Commission
One White Flint, North
11555 Rockville Pike
Rockville, Maryland 20852

U.S. Nuclear Regulatory Commission
Region II
101 Marietta Street, NW, Suite 2900
Atlanta, Georgia 30323

ENCLOSURE

FSAR Page Markups

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Requirements reflected in this IE Circular are implemented within the Watts Bar design by wiring the control circuits in all active valves as follows:

1) The opening torque switch will be removed from the control circuit by removing connecting wires from the torque switch or by installation of a permanent electrical bypass.

2) The closing torque switch on all position-seated valves will be removed from the control circuit by removing the connecting wires from the torque switch or by installing a permanent electrical bypass.

3) The closing torque switch on all torque-seated valves will be bypassed during travel by a position limit switch, allowing the torque switch to open the control circuit only on seating. (The list of the active motor-operated valves which require torque switch bypass is identified in WBN calculation, "Selection Criteria for MOVs Requiring Thermal Overload Bypass," WBN-OSG4-095).

27. ICEA P-54-440, Ampacities Cables in Open-Top Cable Trays, and National Electrical Code, NFPA-70-1987 (See Electrical Design Standard DS-E12.6.3)

28. ANSI C37.40-1969, "IEEE Standard Service Conditions and Definitions for High-Voltage Fuses, Distribution Enclosed Single-Pole Air Switches, Fuse Disconnecting Switches, and Accessories."

29. ANSI C37.90-1972, "Relays and Relay Systems Associated with Electric Power Apparatus."

8.1.5.3 Compliance to Regulatory Guides and IEEE Standards

The extent to which the recommendations of the applicable NRC regulatory guides the IEEE standards are followed is shown below. The symbol (F) indicates full compliance. Those which require further clarification or are not fully implemented are discussed in the footnotes as indicated.

Regulatory Guide 1.6 (Safety Guide 6), Revision 0 "Independence Between Redundant Standby (Onsite Power Sources and Between Their Distribution Systems." (F)

Regulatory Guide 1.9 ~~(Safety Guide 9)~~, Revision ~~2~~ 3 "Selection, Design, Qualification, and Testing of ~~Diesel~~ Emergency Diesel Generator ~~Set Capacity for Standby Power Supplies~~ Units Used as Class 1E Onsite Electric Power Systems at Nuclear Power Plants" (7)

Regulatory Guide 1.22 (Safety Guide 22), Revision 0, "Periodic Testing of Protection System Actuation Functions." (F) [Note 2 of Table 7.1-1]

Regulatory Guide 1.29, Revision 0, "Seismic Design Classification." (F)

Regulatory Guide 1.30 (Safety Guide 30), Revision 0, "Quality Assurance Requirements for the Installation, Inspection and Testing of Instrumentation and Electric Equipment." (See Chapter 17, Section 17.1)

Regulatory Guide 1.32 (Safety Guide 32), Revision 0, "Use of IEEE Std 308-1971," "Criteria for Class 1E Electric Systems for Nuclear Power Generating Stations." (F)

Regulatory Guide 1.40, Revision 0, "Qualification Tests of Continuous Duty Motors Installed Inside the Containment of Water-Cooled Nuclear Power Plants." (F)

Regulatory Guide 1.41, Revision 0, "Preoperational Testing of Redundant Onsite Electric Power Systems to Verify Proper Load Group Assignments." (F)

Regulatory Guide 1.47, Revision 0, "Bypassed and Inoperable Status Indication for Nuclear Power Plant Safety Systems." (F) (10)

Regulatory Guide 1.53, Revision 0, "Application of the Single-Failure Criterion to Nuclear Power Plant Protection Systems." (F) [Note 3 of Table 7.1-1]

Regulatory Guide 1.62, Revision 0, "Manual initiation of Protective Actions. (F)

Regulatory Guide 1.63, Revision 2, "Electric Penetration Assemblies in Containment Structures for Water-Cooled Nuclear Power Plants." (F) (1)

Regulatory Guide 1.73, Revision 0, "Qualification Tests of Electric Valve Operators Installed Inside the Containment of Nuclear Power Plants." (F)

Regulatory Guide 1.75, Revision 0, "Physical Independence of Electric Systems." (2)

Regulatory Guide 1.81, "Shared Emergency and Shutdown Electric Systems for Multi-Unit Nuclear Power Plants." (3)

Regulatory Guide 1.89, Revision 1, "Environmental Qualification of Certain Electrical Equipment Important to Safety for Nuclear Power Plants." (4) (Only applicable to equipment within the scope of 10 CFR 50.49)

Regulatory Guide 1.93, Revision 0, "Availability of Electric Power Sources. (F)

Regulatory Guide 1.100, Revision 0, "Seismic Qualification of Electric Equipment for Nuclear Power Plants." (5)

Regulatory Guide 1.106, Rev. 1, "Thermal Overload Protection for Electric Motors on Motor Operated Valves." (11)

WITHDRAWN BY NRC - AUGUST 1993 ← revise

Regulatory Guide 1.108, ~~Rev. 1, "Periodic Testing of Diesel Generator Units Used as Onsite Electric Power Systems at Nuclear Power Plants." (6)~~

Regulatory Guide 1.118, Rev. 2, "Periodic Testing of the Electric Power and Protection Systems." (8)

IEEE Trial-Use Std 338-1971, "Criteria for the Periodic Testing of Nuclear Power Generating Station Protection Systems." (F)

IEEE Std 344-1971, "Guide for Seismic Qualification of Class 1E Equipment for Nuclear Power Generating Stations." (F)

IEEE Std 387-1984, "Criteria for Diesel Generator Units Applied as Standby Power Supplies for Nuclear Power Stations." (See Appendix 8D).

IEEE 450-1980, "IEEE Recommended Practice for Maintenance, Testing, and Replacement of Large Lead Storage Batteries for Generating Stations and Substations." (F)

IEEE Std. 484-1975, "IEEE Recommended Practice for Installation Design and Installation of Large Lead Storage Batteries for Generating Stations and Substations." (9)

IEEE Std. 485-1978, "IEEE Recommended Practice for Sizing Large Lead Storage Batteries for Generating Stations and Substations." (9)

IEEE Std. 535-1979, "IEEE Standard for Qualification of Class 1E Lead Storage Batteries for Nuclear Power Generating Stations." (9)

Notes:

1. RG-1.63

C.1 Full Compliance: The electric penetrations have been designed to maintain mechanical integrity for the maximum short circuit current that could occur and the time duration required for the backup protective device to operate. A redundant overcurrent protection system is provided for all penetrations except instrumentation circuits where fault current is not a problem.

The only 6.9kV circuit feeding loads inside the containment are for the reactor coolant pumps (RCP). The breaker used for control of the RCPs is backed up by a second breaker to provide the redundant overcurrent protection system required by RG 1.63. The breakers are each provided with independent dc control power from different batteries so that failure of either battery will not violate the single failure criteria. Provisions for testing are described below.

The 480V load center circuits have a low voltage power circuit breaker backed up by a current limiting fuse. The penetration withstands the available fault current vs. time duration for the load center breaker and fuse. The breakers have direct acting trips and are independent of control power. The fuse is located in the cable termination compartment of the load center bolted to the breaker cable terminal.

The 480V motor control center (MCC)-circuits have a molded case circuit breaker backed up by a fuse. The penetration withstands the available fault current vs. time duration for the breaker and fuse. Molded case breakers have direct acting trips. The breaker-fuse combination was furnished in the standard design of the MCC and are located in the same compartment with approximately one inch of air space separation. This is considered adequate because of the diverse principle of operation of the fuse and breaker.

3. Unit 2 "A" train - 125V dc Vital Battery III, 120V a.c. Vital UPS 2-III.

4. Unit 2 "B" train - 125V dc Vital Battery IV, 120V a.c. Vital UPS 2-IV.

Thus, the ESF loads are not shared.

The 120-volt a.c.vital instrument power is supplied by four UPS units per unit. They furnish power for the four-channel reactor protection system (RPS) input relays. The relays fail safe, (i.e., actuate reactor protection system (RPS) signal, on a loss of power) thus a single failure and/or a loss of offsite power does not prevent the safe and orderly shutdown of either unit.

Some plant common loads are supplied from unit 1, channels I and II and other plant common loads are supplied from unit 2.

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

and an assumed loss of offsite power, Revise

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 load group (Train 1A & 2A or Train 1B & 2B) can mitigate a design basis accident in one unit and accomplish an orderly shutdown of the other unit. 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 or vital battery) to be overloaded.

c. The most severe DBE is an accident in one unit with a loss of offsite power. 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 and a design basis accident in one 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 of the redundant power trains 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.

e. No interface of the unit operators is required to meet Position 2.b. and 2.c.

f. Control and status indication for the DG units is provided on a central control board (Panel 0-M-26) available to both unit operators. DC system status (volts, current, etc.) is provided on a unit basis.

g. The recommendation of Regulatory Guide 1.6, 1.9 except as discussed in Note 7, and 1.47 are met.

Position C.3

h. The construction permit for WBNP was issued before June 1, 1973.

4. Regulatory Guide 1.89, Revision 1, endorses methodology for equipment qualification in accordance with 10 CFR 50.49. For details of Watts Bar environmental qualification of Class 1E equipment see Reference [1] of Section 3.11.

5. Regulatory Guide 1.100 Rev. 0 reflects the requirements of IEEE Std. 344-1975. Although Watts Bar Nuclear Plant Class 1E equipment was seismically qualified to IEEE Std. 344-1971, the qualification procedures are consistent with the requirements of IEEE Std. 344-1975.

6. Deleted ADD The Watts Bar design complies with all of the position of Regulatory Guide 1.108, Rev. 1, except as follows:

a. Position C. 1(5) - Does not comply. However, on all diesel generator protective trips, such as differential overcurrent targets have been provided to indicate which protective devices installed to shutdown the diesel generator unit for generator or engine trouble are alarmed in the main control room. Where more than one protective device target is operated, an analysis of the problem will be done to determine which device operated first.

b. Position C.2.a(2) - It is TVA's understanding that this requirement means that the emergency loads be sequenced onto the diesel generator unit (DGU) with each load operating at its full load rating (that is a pump would be operating at full flow). This will be done as part of the preoperational testing program. For periodic testing done after preops, the loads will be sequenced on as designed except the pumps will be operated with their miniflow connection open and not a full flow. At all times the voltage and frequency will be monitored to assure they are within design limits.

7. Since Regulatory Guide 1.9 has been revised, the following information defines the degree of conformance with Regulatory Guide 1.9 R2 3 for the design bases listed in Section 8.1.4.

The following information defines the degree of conformance with RG 1.9 R3.

Position C.0	WBN meets the intent of IEEE 387-1984
Position C1.1	Full compliance
Position C1.2	Full compliance
Position C1.3	Does not comply - Revision 2 of RG 1.9 Position C2 required the predicted loads not to exceed the short time rating. This Position has required the predicted loads not to exceed the continuous rating. WBN diesel generators load assignment was based on the RG 1.9 R2's limit. (see FSAR 8.3-18)
Position C1.4	Full compliance
Position C1.5	Full compliance ~~WBN meets the intent of this position. However, WBN DG is not designed to automatically transfer from the test mode to an emergency mode upon receipt of emergency signals. This position is documented in a letter to NRC. (T04 930805 950)~~
Position C1.6	Full compliance
Position C1.7.1	Full compliance
Position C1.7.2	Does not comply - Although a first-out surveillance system is not installed for the DG system at WBN, DG protective trips such as differential overcurrent have been provided with targets to indicate which protective device operated. In addition, the status of protective devices installed to shut down the DG for generator or engine trouble are alarmed in the MCR. Where more than one protective device function group is operated, the information is fed to the MCR computer/printer which would provide the information as to which device operated first.
Position C1.8	Full compliance
Position C2.2.1	Full compliance
Position C2.2.2	Full compliance
Position C2.2.3	Full compliance
Position C2.2.4	Full compliance

Revise

Position C2.2.5

WBN meets the intent of this position. The diesel generators associated with the nuclear unit affected by the SI event are started by 1E circuits. However, the starting of the diesel generators of the non-SI unit is implemented with a non-1E circuit (common start circuit). The intent of this position is to have all the DGs started in case there is a loss of off-site power (LOOP). WBN meets this precautionary requirement with the common start circuit. In the event of a LOOP, the 1E LOOP circuits also start the DGs, independent of the common start circuit.

Position C2.2.6

Does not fully comply. The design basis at WBN is a simultaneous LOOP/LOCA, not LOOP followed by LOCA. Although there are some design features to meet the effects of LOOP followed by LOCA, there is no analysis to demonstrate the design will meet the DG voltage and frequency requirements.

Position C2.2.7 Full compliance

Position C2.2.8 Full compliance

Position C2.2.9 Full compliance

Position C2.2.10 Full compliance

Position C2.2.11 Full compliance

Position C2.2.12 Full compliance

Position C2.2.13

Full compliance

~~WBN meets the intent of this position. However, WBN DG is not designed to automatically transfer from the test mode to an emergency mode upon receipt of emergency signals. This position is documented in a letter to NRC. (T04 930805 950)~~

Position C2.2.14 Full compliance

Position C2.3.1

Full compliance with the exceptions identified by C2.2.5, C2.2.6, and C2.2.13

Position C2.3.2 Full compliance

Position C3 Full compliance

Position C4 Full compliance

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TABLE 8.1-1 (cont)

SAFETY LOADS AND FUNCTIONS

Safety Loads	Function	Power
Reactor Lower Compartment Cooling Fans	To keep reactor lower compartment temperature within bounds	480V a.c.
Control Rod Drive Mechanism Cooling Fans	To protect control rod drive mechanisms against excessive temperatures	480V a.c.
Containment Air Return Fans	To prevent vacuum conditions in the reactor lower compartment during accident conditions	480V a.c.
Emergency Air Conditioning	Maintains safe air temperature in operating areas	480V a.c.
Ventilation System	Controls air temperature and/or source and/or radioactive content prior to, during, and following emergency conditions	480V a.c. & 125V d.c.
Vital Battery Chargers	Maintain 125V vital batteries at proper charge level	480V a.c.
Hydrogen Recombiner	Maintain a safe level of hydrogen in the containment	480V a.c.
Motor Control Centers	Provide power for small motors, fans, MOV's, heaters, and small pumps associated with safety-related equipment	480V a.c.
~~Trace Heating Cabinets~~	~~Provide heat for pipe lines carrying boric acid solution~~	~~480V a.c.~~

DELETE

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. Since 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, but no credit is taken for load shedding in the system analyses.

This load-shedding scheme reduces the BOP loads by tripping selected loads if both Unit 1 and Unit 2 generators are tripped and a 161-kV transmission system contingency exists. A 161-kV transmission system contingency occurs 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 161-kV system contingency switch mode and both units' generators being tripped. The WBN operator will manually select the 161-kV contingency position on the normal/161-kV contingency switch. Anytime both generators are tripped, the load-shedding circuits will immediately initiate a load-shed command. Two reactor coolant pumps and two 6.9-kV 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% of the reactor coolant pumps and unit boards) of the station load.

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 6.9-kV start boards. One load-shedding circuit associated with CSST A is in 6.9-kV 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 separated 250V dc batteries and 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.

The 6.9-kV shutdown boards are provided with loss-of-voltage and degraded-voltage relays that initiate transfer from the normal supply, to the standby (diesel generator) power supply. If the standby supply is paralleled with one of the offsite supplies for testing, loss of the standby supply would cause reverse power relays to trip the standby circuit breaker.

Insert A ~~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 ~~perallel connection is~~ standby breaker is tripped and the emergency loads are automatically energized by the offsite power supply.

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For a loss of offsite power during diesel generator testing, the diesel generator will switch to the emergency mode of operation with one exception. The diesel generator will remain in the testing mode if the 6.9KV shutdown board's offsite power feed is through the alternate feeder. In this case, the diesel generator's overcurrent relays are active to prevent the diesel generator from being overloaded.

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~~maintained unless loss of offsite power also occurs~~. Should a LOCA and a loss of offsite power occur when the diesel generator is paralleled with the grid under test, ~~the same sequence of events takes 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 unless both units are in cold shutdown; then, both diesels of the same train may be in test. Therefore, loss of any onsite power generation will not prevent the distribution system from being powered from the offsite circuits.

the standby and supply breakers are tripped, load shedding occurs and the

Common station service transformers C and D both have two 6.9-kV secondary windings with automatic load-tap changer units. Each secondary of the transformer is the normal power supply for one 6.9-kV shutdown board in each unit. Each secondary is also the alternate power supply for the opposite train, opposite unit 6.9-kV shutdown board in each unit.

The impedance between the two 6.9-kV secondary windings is more than 93% 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 loss or degradation of the other offsite power circuit. CSST transformers A, B, C and D trips are initiated by any transformer or line failure relay such as fault-pressure, transformer-overcurrent, ground-current, line-protection, or differential relaying, which cause an automatic fast transfer from the normal supply to the alternate.

The design of the control power feeders to common station service transformers (CSSTs) 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 from CSSTs C and 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 vital battery that provides control power to Train B shutdown board.

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 (loss of control power) will result in the inability to automatically trip CSSTs C and D switchgear, respectively, and will inhibit the automatic transfer of the respective 6.9-kV shutdown board until manual transfer to the alternate control power source is accomplished locally at the switchgear. However, this does not result in loss of offsite power; breakers 1712 and 2714 on common switchgear C or breakers 1812 and 2814 on common switchgear D will remain in their normally closed position.

Generator

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

Engine

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

Only one diesel is in the test mode at any one time unless both units are in cold shutdown; then, both diesel generators of the same train may be in test. 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.

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.

Emergency stopping bypasses this 10 minute idle speed time and brings the engine directly to zero speed. Should an emergency start signal be initiated during the 10 minutes idle speed time of a normal stop condition the engine will automatically return to synchronous speed and emergency operation.

Diesel engine speed may be manually controlled remotely from the Main Control Room while the diesel generator is being operated unloaded. During testing when the diesel generator unit is connected in parallel to one of the offsite power supplies, the diesel loading may be varied by use of the speed control switch or voltage control switch. When in the test mode, an accident start signal will ~~not~~ automatically trip the diesel/generator supply breaker and switch the diesel generator unit to the operate mode. ~~unless a loss of offsite power signal occurs (see diesel generator operational testing).~~

A "Local-Remote" manual selector switch, located in the diesel generator building (or ADGU building) must be in the "Remote" position for all manual remote control from the control room to be in effect, with the exception of emergency start. Similarly, for the manual controls located in the diesel building (or ADGU building) to be in effect the switch must be in the "Local" position. The switch is manually operated from the "Remote" to the "Local" position. This operation, however, requires an electrical permissive interlock signal initiated from the Main Control Room. These operations are shown in Figure 8.3-24.

Diesel Generator Description

Each diesel-generator set is furnished by Power Systems-A Morrison-Knudsen Division and consists of two 16-cylinder engines (EMD 16-645E4 or E4B) directly connected to a 6.9-kV Electric Products generator. The continuous rating of each set is 4400 kW at 0.8 power factor, 6.9-kV, 3-phase, and 60 Hz. Each diesel-generator set also has an additional rating of 4840 kW for two hours out of 24. The normal operating speed of the set is 900 rpm. The diesel-generator set uses a tandem arrangement; that is, each set consists of two diesel engines with a generator between them connected together to form a common shaft. The five generator sets are physically separated, electrically isolated from each other, and located above the water level of the maximum possible flood (740.1 ft).

Governor Control of the Diesel-Generator Sets

The governor consists of the following:

(a) Woodward EGB-13P actuator on each engine.

(b) 2301 Computer (reverse biased).

(c) Frequency pickup.

The Woodward EGB-13P actuator used with the 2301 computer is a proportional governor which moves the fuel rack in inverse proportion to the voltage signal from the computer. There is a governor actuator on each engine and they are electrically connected in series so that the loss in signal to one would also be the loss in signal to the other. Based upon the input from the generator, the electronic network sounds electric signals to the actuators on the two engines. This signal goes to the coils of each actuator that are connected in series so that each coil sees the same electric signal. The terminal shaft of each actuator will move exactly the same amount for each change in signal. This means that the fuel control shaft movement on each engine will be identical.

Attached to the fuel control shaft through an appropriate linkage is an injector rack for each cylinder which by its position meters the fuel injected into its cylinder. This rack is set with a standard factory gauge so that each cylinder will receive the same amount of fuel. Each injector rack is spring loaded to prevent any single injector that may stick from affecting the remaining racks on that engine.

Two devices produce alarm signals should the two engines of a diesel-generator set receive different amounts of fuel. One of these devices is a synchro device that gives an alarm signal should the difference in the actuator control positions for the two engines exceed a certain tolerance. The other such device is an exhaust temperature difference alarm.

The mechanical governor is set to control the unit speed ~~at 930 rpm rather~~ at a higher RPM than the 900 rpm of the electrical governor but below the mechanical trip point. Since the electrical system is reverse biased, a failure in the electrical system would cause the engine speed to increase until it reached the setpoint of the mechanical governor and at that point the mechanical governor would control the engine.

systems' safety loads are separated into redundant load groups such that loss of any one group will not prevent the minimum safety functions from being performed. Also, there are no provisions for manually or automatically interconnecting the redundant load groups of this system.

IEEE Std. 308-1971

As discussed in the above paragraphs, the overall system design of the diesel generator 125V dc control power system incorporates appropriate functional requirements, redundancy, capability and surveillance in order to meet the intent of this criteria. In addition, the system design is such that the battery is immediately available during normal operations and following loss of power from the alternating-current system. Also, each battery has sufficient capacity to meet the power demand and time requirement of each connected load.

Prior to placing the 125V dc diesel generator battery system into service, the system components will be tested to ensure their proper operation. See the discussion under "Diesel Generator Control Power" for a test description.

Diesel Generator Capacity

In compliance with Regulatory Guide 1.9, Rev. 3 the table below compares worst case loading of the diesel generators with their continuous rating and their 2-hour rating. Worst case loading occurs for a simultaneous loss of offsite power and a loss-of-coolant accident on the unit the diesel is associated with. Adequate margin exists between worst case loading and diesel capacity. To satisfy the continuous rating, it may be necessary for operator action to remove certain loads not required for accident mitigation within 2 hours of starting a diesel.

	Diesel Generator			
	1A-A	1B-B	2A-A	2B-B
Worst Case Loading	4393	4264	4351	4492
Short Time (2-hr) rating (kW)	4840	4840	4840	4840
Continuous rating (kW)	4400	4400	4400	4400
Cold Dead Load Pickup @ 95°F (kW)	4446	4446	4446	4446
Hot Dead Load Pickup @ 95°F (kW)	4995	4995	4995	4995

Diesel Generator Operational Testing

The operational testing of the diesel generator is accomplished from the diesel generator control panel located in the powerhouse Main Control Room. Full load test on a unit requires that the unit be paralleled with the offsite power system. Should a loss of offsite power occur ~~under these conditions~~, while in the test mode the diesel generator will switch to the emergency mode of operation with one exception. The diesel generator will remain in the testing mode if the 6.9KV shutdown board's power feed is through the alternate feeder. In this case, the diesel generator's instantaneous overcurrent relays are active. ~~instantaneous over current relays actuate to prevent the diesel generator from being overloaded by tripping the diesel generator feeder breaker to the 6.9 kV shutdown boards. This action does:~~

Tripping of the diesel generator feeder breaker:

(1) Places the diesel generator in an automatic asynchronous mode of operation.

(2) Creates a loss of offsite power condition on the 6.9-kV shutdown board which will initiate its load shedding logic.

(3) As soon as the offsite power supply feeder breaker to the 6.9-kV shutdown board is tripped and the under voltage load stripping relays operate, the diesel generator feeder breaker to the board will close and initiate the load sequencing logic.

Fuel Consumption Tests

Each unit was loaded at loads of 1666.5, 3333, and 5000 kW at .8 pf, and the time to consume 100 pounds of fuel was recorded. The duration of the test at each load after temperature stabilization was 1/2 hour with the time to consume 100 pounds of fuel varying from 5 minutes 41 seconds at 1666.5 kW to 2 minutes 28 seconds at 5000 kW.

Transient Tests

Full load transient tests were made to verify that voltage and frequency transient characteristics of the system. Loads of 4400 kW and 4750 kW at 0.8 pf were picked up and dropped three times, each with the following characteristics results:

Peak Freq. Change %

Load change	Unit 1	Unit 2	Unit 3	Unit 4	Unit 5
+4400 kW	-1.6	-1.3	-1.3	-2.0	-2.5
-4400 kW	+1.6	+2.0	+1.3	+1.8	+1.3
+4750 kW	-1.6	-1.6	-1.3	-2.5	-3.2
-4750 kW	+2.0	+1.6	+2.0	+2.3	+2.3

Peak Voltage Change %

Load change	Unit 1	Unit 2	Unit 3	Unit 4	Unit 5
+4400	-6.0	-6.9	-8.7	-13.0	-2.1
-4400	+6.0	+8.7	+10.4	+10.4	+2.6
+4750	-6.0	-8.7	-8.7	-17.4	-2.1
-4750	+6.0	+8.7	+10.4	+13.0	+3.0

Safety systems that are shared between the two Watts Bar units are discussed in Section 3.1.2 under Criterion 5 (GDC-5) - Compliance. Therefore, there are electric motors powered by the onsite distribution system of one unit that drive safety-related machinery (i.e. essential raw cooling water pumps, component cooling system pumps) required for safe shutdown of the other unit. For example, the ERCW system is arranged in two headers (trains) each serving certain components in each unit (see Section 9.2.1.2). There are eight ERCW pumps arranged electrically so that two pumps are fed from each shutdown board (1A-A, 1B-B, 2A-A, 2B-B). Only one pump per board can be automatically loaded on a DGU at any one time. The pumps supplied from the 'A' boards pump into the 'A' train header and likewise the 'B' pumps. The minimum combined safety requirements for one 'accident' unit and one 'non-accident' unit are met by only two pumps on one header (train).

8.3.1.2 Analysis

8.3.1.2.1 Standby AC Power Systems

The standby ac power system is designed to comply with the requirements set forth in GDC 17 and 18. The design also conforms with Regulatory Guides 1.6 R0 and 1.9 R2 and IEEE Std 308-1971. The following paragraphs discuss each of the requirements.

Capacity, Capability, and Margin

General Design Criteria 17

The standby ac power system is designed to provide sufficient capacity and capability to assure that (1) specified acceptable fuel design limits and design conditions of the reactor coolant pressure boundary are not exceeded as a result of anticipated operational occurrences, and (2) 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.

Regulatory Guide 1.9 R2

Each diesel generator set is capable of starting and accelerating to rated speed, in the required sequence, all the needed engineered safety feature and shutdown loads. At no time during the loading sequence does frequency or voltage decrease to less than 95% of nominal and 75% of nominal, respectively. During recovery from transients caused by step load increases or resulting from disconnection of the largest single load, the speed of the diesel generator set does not exceed 115% of nominal. Voltage is restored to within 10% of nominal and frequency within 2% of nominal in less than 60% of each load sequence time interval.

IEEE Std 308-1971

Each distribution circuit is capable of transmitting sufficient energy to start and operate all required loads in that circuit.

A failure of any unit of the standby power source (diesel) does not jeopardize the capability of the remaining standby power sources (diesels) to start and run the required shutdown systems, emergency systems, and engineered safety feature loads.

Design Test

All inverters were electrically tested to assure that each unit is capable of performing all requirements as specified.

All boards were subjected to and satisfactorily passed the following tests as specified under the indicated paragraphs of Section 20-5 of ANSI C37.20-1969:

20-5.3.2 - Mechanical Operation

20-5.3.4.1 - Control Wiring Continuity

20-5.3.4.2 - Control Wiring Insulation

All molded-case circuit breakers comply with NEMA Publication No. AB-1-1964 requirements. All control circuit wiring has self extinguishing insulation rated 600 volts in accordance with paragraph 6.1.3.1 of ANSI C37.20-1969. All equipment is 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 a LOCA 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 1E and non-1E) 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.

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 Appendices 8A and 8B). Some of the identified components are automatically deenergized in event of a LOCA. The remaining components that are powered from a Class 1E source were assumed to have a high impedance fault for the analysis. 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, i.e., the protective device's thermal rating. 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.

delete

A listing of major ~~nonsafety-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. 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. In addition to the electrical equipment listed in the table, the water level inside containment may also flood nonsafety-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 switch must be closed to provide power to the local stations. Indications are provided in the main control room whenever the manual throw switches are in the closed position. Thus, spurious operation of safety-related equipment due to post-LOCA submergence of the local control station is prevented.

There are no electric motor-operated valves located inside containment below the maximum LOCA water level that are required to function for other than containment isolation. Valves used for containment isolation will receive a signal to close on the initiation of the accident signal. The valves will close in 10 seconds and will remain closed since failure of the control circuitry can only yield operation in the closed direction from the motors before the flooding takes place. Therefore, these valves will not be required to operate during or after the flooding.

The control air supply is automatically isolated outside containment in the event of a LOCA. Therefore, the submergence of electric solenoids serving air-operated valves cannot affect the safe positioning of these valves.

The plant operators are instructed to rely on the qualified post accident monitors following a LOCA so that any spurious indications from non-qualified electrical sensors that could become submerged would not jeopardize appropriate operator actions.

The safety-related electrical equipment that must operate in a LOCA environment during and/or subsequent to an accident is identified below.

Inside Primary Containment

Low Voltage Power and Control Cables

The single- and multiple-conductor cables, insulated and jacketed with flame-retardant thermoplastic and thermosetting compounds, are suitable for installation in a nuclear environment.

Auxiliary power, control power, and control cables at voltages not exceeding 600 volts between conductors, either DC or 60 Hertz AC, are insulated with silicone rubber, crosslinked polyethylene, or ethylene propylene rubber. The rated conductor temperature for silicone rubber is 125°C. (For 10 CFR 50.49 applications, the rating is 90°C). The rated conductor temperature for crosslinked polyethylene and ethylene propylene rubber is 90°C. Single conductor silicone rubber insulated cable is jacketed with asbestos, synthetic yarns, or aramid fibers. Single conductor crosslinked polyethylene or ethylene propylene rubber insulated cables are jacketed with chlorosulfonated polyethylene. Single conductors of a multi-conductor silicone rubber insulated cable are jacketed with a glass braid and have an overall jacket of asbestos braid, synthetic yarns, or aramid fibers. Single conductors of a multi-conductor crosslinked polyethylene or ethylene propylene rubber cable are not jacketed, but the multi-conductor assembly does have an overall chlorosulfonated polyethylene jacket.

Signal cable, at voltages not exceeding 600 volts, is insulated with cross-linked polyethylene (or other material meeting TVA approval) and jacketed with chlorosulfonated polyethylene (or other material meeting TVA approval). The conductors are twisted together and then an overall shield (with copper drain wire) applied under the jacket. The conductor temperature rating for signal cable is 90°C maximum.

~~Pressurizer Heater Cable~~

~~The low voltage power cable, not exceeding 600 volts between conductors, is either insulated with silicone rubber for 200°C conductor temperature and jacketed with asbestos braid or insulated with high grade reinforced MICA tape for 250°C conductor temperature and jacketed with glass braid.~~

Electrical Penetration Cables

The cables are derated and sized according to their ampacities for the penetration ambient temperatures. The cables have passed tests conforming to IEEE Standards for Electrical Penetration Assemblies in Containment Structures for Nuclear Fueled Power Generating Stations, IEEE 317-1976.

Electrical Penetrations

The electrical penetration assemblies (see Section 8.1.5.3) are designed to maintain containment integrity during all design basis events including temperature rise under fault-current conditions. To assure that electric power is continuously available to operate required equipment, penetrations for redundant cables are located in two or more separate areas in the containment structure.

System Description

There are three basic types of electrical penetrations: medium voltage power, low voltage (power and control), and instrumentation types. Modular type penetrations are used for all electric conductors passing through the primary containment. A double pressure seal is formed within each module through which the conductors pass. The modules are inserted into header plates with factory attached weld rings that are field welded to the outboard end of each containment nozzle. The modules are retained in the header plate by a threaded midlock capnut and are sealed to the header plates with a dual midlock ferrule arrangement except for the high voltage modules which use a double O-ring seal.

To provide suitable termination of cables at the penetration, junction boxes or dead-ended covered cable trays are provided inside containment. These enclosures serve as an electrical splicing box for field connection of conductors.

engineering judgment as an aid to prudent and conservative layout of electrical cable trays, wireways, conduits, etc., through the plant (both inside and outside the containment).

Mechanical Damage (Missile) Zone

Zones of potential missile damage exist in the vicinity of heavy rotating machinery or near other sources of mechanical energy, such as pipe whip, steam release, or pipes carrying liquids under high pressure. Layout and arrangement of cable trays, conduit, wireways, etc., are such that no locally generated force or missile can disable ~~destroy both redundant engineered safety feature functions~~ sufficient equipment to prevent safe shutdown of the reactor, removal of decay heat from the core, or to prevent isolation of the primary containment. In rooms or compartments having heavy rotating machinery, such as the reactor coolant pumps, the reactor feedwater turbines, or in rooms containing high pressure feedwater piping or high-pressure steam lines such as exist between the steam generators and the turbine, a minimum separation of 20 feet, or a minimum 6-inch-thick reinforced concrete wall is provided between trays containing cables of different divisions of separation. In an area containings an operating crane, such as the upper compartment of the reactor building, there is a minimum horizontal separation of 20 feet or a minimum 6-inch-thick reinforced concrete wall between trays containing cables of the different divisions of separation.

Fire Hazard Zone

Electrical cabling required to safely shutdown the plant in the event of a fire is protected in accordance with the separation criteria of 10 CFR 50, Appendix R, Section III.G.2 (See Fire Protection Report.) Other ESF cabling are arranged so as to eliminate, insofar as is practical, all potential fire damage to cables and to separate the divisions of Engineered Safety Features cabling. Such arrangement minimizes the possibility of a fire in one division from damaging cables in another division. Routing of cables for engineered safety features, power or control, through rooms or spaces where there is potential for accumulating large quantities (gallons) of oil or other combustible fluids through leakage or rupture of lube oil or cooling system - has been avoided. In cases where it is impossible to provide other routing, only one division of engineered safety features cables are allowed in any such space, and the cables are protected from dripping oil by the use of conduits or flange covered cable trays designed to prevent oil from reaching the cables. No engineered safety features cables are routed through rooms containing oil storage tanks. In any room (except the auxiliary instrument room and the annulus) or space in which the only source of fire is of an electrical nature, cable trays carrying cables of separation. The color coding scheme used to identify divisions of separation is given in Section 7.1.2.3, except black lettering, may be used on conduit and cable tags at terminations for all but black background; white lettering is used on black background tags.

8.3.1.4.6 Spacing of Power and Control Wiring and Components Comprising the Class 1E Electrical Systems in Control Boards, Panels, and Relay Racks

Redundant power and control wiring and components associated with Class 1E electrical systems in control boards, panels, and relay racks are separated by either a minimum of six inches of air space or a metal barrier. See Section 7.1.2.2 for more detail of spacing of wiring and components in control boards, panels, and relay racks.

8.3.1.4.7 Fire Barriers and Separation Between Redundant Trays

The criteria for separation between redundant trays for various zones or areas of the plant is described in Section 8.3.1.4.2. For details of the fire protection system, see Section 9.5.1.

8.3.2 DC Power System

8.3.2.1 Description

8.3.2.1.1 Vital 125V dc Control Power System

The vital 125V dc control power system is a Class 1E system whose safety function is to provide control power for engineered safety features equipment, emergency lighting, vital inverters, and other safety-related dc powered equipment for the entire plant. The system capacity is sufficient to supply these loads during normal operation and to permit safe shutdown and isolation of the reactor for the "loss of all ac power" condition. The system is designed to perform its safety function subject to a single failure.

The 125V dc vital power system shall be composed of the four redundant channels (designated as channels I, II, III, and IV) and consists of four lead-acid-calcium batteries, six battery chargers (including two spare chargers), four distribution boards, battery racks, and the required cabling, instrumentation and protective features. Each channel is electrically and physically independent from the equipment of all other channels so that a single failure in one channel will not cause a failure in another channel. Each channel consists of a battery charger which supplies normal dc power, a battery for emergency dc power, and a battery board which facilitates load grouping and provides circuit protection. These four channels are used to provide emergency power to the 120V ac vital power system which furnishes control power to the reactor protection system. No automatic connections are used between the four redundant channels.

Battery boards I, II, III, and IV have a charger normally connected to them and also have manual access to a spare (backup) charger for use upon loss of the normal charger. Additionally, battery boards I, II, III, and IV have manual access to the fifth vital battery system. The fifth 125V dc Vital Battery System is intended to serve 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. See Figure 8.3-56. (delete)

TABLE 8.3-11

120V A.C. VITAL INSTRUMENT POWER BOARD 1-I LOAD DATA

Load	Safety Related	Accident and Nonaccident Load (Amp, 118V A.C.)	Basis for Load
PNL 1-R-14 Process Cont Group I	No	12.57	Note 1
PNL 0-M-27B Inst Bus 1-TR-70-161, PR-65-21	No	.5	EST
PNL 1-M-5 Plugmold Inst Bus I	No	5.7	EST
PNL 1-M-6 Plugmold Inst Bus I	No	5.4	EST
PNL 0-L-426 Vent. Sys A	No	.4	EST
PNL 1-M-4 Inst Bus I PIC-1-12A, -23A	No	.5	EST
TR A Assoc. Lvl. Sw.	No	.2	EST
Boric Acid Tanks A and C ~~Heaters~~ TEMP. INDICATOR	~~Yes~~ NO	1.2	EST
PNL 1-R-73 Toilet & Locker Room Dampers	Yes	.3	EST
PNL 0-L-450 Chlorine Detector	Yes	.5	EST
1-M-10 PASF Sol. Valves	Yes	4.0	EST
1-RE-90-130 Cont Purge Air Exhaust Rad. Mon.	Yes	4.0	EST
PNL 1-M-9 Aux Boiler Cont Valve	Yes	.3	EST
PNL 1-R-52 SSPS(A) CH I Input & Train A Output Relays	Yes	6.35	EST

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TABLE 8.3-12

120V A.C. VITAL INSTRUMENT POWER BOARD 1-II LOAD DATA

Load	Safety Related	Accident and Nonaccident Load (Amp, 118V A.C.)	Basis for Load
PNL 1-R-17 Process Cont Group 2	No	10.26	Note 1
PNL 0-L-427 Vent. System B Bus	No	.4	EST
PNL 0-M-27B Inst Bus	No	.5	EST
PNL 0-R-139 Loose Parts Monitor	No	10.0	EST
PNL 1-M-3 Plugmold Inst Bus 2	No	5.4	EST
Sys 31 TR B Ass. Flow SW	No	.2	EST
PNL 1-M-6 Plugmold Inst Bus 2	No	1.2	EST
Boric Acid Tanks A and C Heaters	Yes	1.2	EST
Toilet, Locker & Spreading Rms Isol Dampers	Yes	.3	EST
0-RE-90-126 Rad Monitor	Yes	1.0	EST
PNL 0-L-451 Chlorine Detector	Yes	.2	EST
PNL 1-M-10 PASF Sol. Valves	Yes	4.0	EST
Aux Boiler Isol. Valve	Yes	.25	EST
1-RF-90-131 Cont Purge Air Exhaust Rad. Mon.	Yes	4.0	EST
PNL 0-L-428 AB Gas Treatment	Yes	.6	EST

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CHANGE PACKAGE # 906

0906 PKG

TABLE 8.3-12

120V A.C. VITAL INSTRUMENT POWER BOARD 1-II LOAD DATA

Load	Safety Related	Accident and Nonaccident Load Amp (118V A.C.)	Basis for Load Amp
PNL 1-R-17 Process Cont Group 2	No	11.5	EST
PNL 0-L-427 Vent. System B Bus	No	.4	EST
PNL 0-M-27B Inst Bus	No	.5	EST
PNL 0-R-139 Loose Parts Monitor	No	10.0	EST
PNL 1-M-3 Plugmold Inst Bus 2	No	5.4	EST
Sys 31 TR B Ass. Flow SW	No	.2	EST
PNL 1-M-6 Plugmold Inst Bus 2	No	1.2	EST
~~Boric Acid Tanks A and C Heaters~~	~~Yes~~	~~1.2~~	~~EST~~ DELETE
Toilet, Locker & Spreading Rms Isol Dampers	Yes	.3	EST
0-RE-90-126 Rad Monitor	Yes	1.0	EST
PNL 0-L-451 Chlorine Detector	Yes	.2	EST
PNL 1-M-10 PASF Sol. Valves	Yes	4.0	EST
Aux Boiler Isol. Valve	Yes	.25	EST
1-RF-90-232 Cont Purge Air Exhaust Rad. Mon.	Yes	4.0	EST
PNL 0-L-42B AB Gas Treatment	Yes	.6	EST

CHANGE PACKAGE # 906

0906 PKG

TABLE 8.3-17

120V A.C. VITAL INSTRUMENT POWER BOARD 2-III LOAD DATA

Load	Safety Related	Accident and Nonaccident Load Amp (118V A.C.)		Basis for Load Amp
		Acc	Nonacc	
2-R-20 Process Cont Group 3	No	7.5	7.5	EST
2-M-3 Inst & Trans Pwr FIC-3-48, -70	No	.5	.5	EST
PNL 2-M-23A UHI Inst Bus 3	No	.5	.5	EST
PNL 2-M-23A UHI Acc Isol Valve FCV-87-23	Yes	1.91	1.91	EST
2-RE-90-130 Cntmt Purge Air Exhaust Rad Mon	Yes	4	4	EST
ERCW 'A' Inst Loops	Yes	2.4	2.4	EST
2-R-48 SSPS(A) Ch III Input & Train A Output Relays	Yes	6.35	6.35	EST
2-M-4 Aux Feedwater Pump A Press Cont PIC-3-122A	Yes	.5	.5	EST
2-M-10 PASF Sampling Valve	Yes	4.0	4.0	EST
2-R-54 NSSS Aux Relay Rack Relay Bus	Yes	6.0	5.0	EST
2-R-73 Misc Relay Rack Sep & Aux Relays	Yes	6.0	5.0	EST
2-L-303 Boric Acid Tank B ~~Cont~~ TEMP INDICATOR	~~Yes~~ No (REVISE)	.6	.6	EST
2-L-11A Aux Cont Panel Relay Bus	Yes	6.0	5.0	EST
RCP 3 Sensor Panel 2	YES	1.0	1.0	EST

(Sheet 1)

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0906 PKG

TABLE 8.3-18

120V A.C. VITAL INSTRUMENT POWER BOARD 2-IV LOAD DATA

Load	Safety Related	Accident and Nonaccident Load Amp (118V A.C.)	Basis for Load Amp
PNL 2-R-22 Process Cont Group 4	No	15.0	EST
PNL 2-M-4 PIC-1-5A, -30A & Nuclear Monitor Wiremold	No	7.3	EST
PNL 2-M-23B UHI Bus 4	No	.5	EST
PNL 2-M-23B UHI Acc Isol Valve FCV-87-24	Yes	1.91	EST
2-RE-90-131 Containment Purge Air Exhaust Rad Mon	Yes	4.0	EST
ERCW 'B' Inst Loops	Yes	2.4	EST
PNL 2-R-46 SSPS(A) Ch IV Input Relays	Yes	2.68	EST
PNL 2-R-51 SSPS(B) Ch IV Input & Train B Output Relays	Yes	6.35	EST
NIS Channel IV Volt Reg NIS Inst Pwr Ch IV	Yes	2.12	EST
PNL 2-M-10 PASF Solenoid Valve	Yes	4.0	EST
PNL 2-M-13 NIS Cont Pwr Ch IV	Yes	2.2	EST
PNL 2-R-12 Process Protection Set IV	Yes	7.6	EST
~~PNL 2-L-303 Boric Acid Tank B/Htr Cont~~	~~Yes~~	~~.6~~	~~EST~~
RCP 4 Sensor Panel 2	Yes	1.0	EST

DELETE

(Sheet 1)
REVISED BY AMENDMENT 52

CHANGE PACKAGE # 0906

0906 PKG

TABLE 8.3-28

delete

MAJOR ~~NON-SAFETY-RELATED~~ ELECTRICAL EQUIPMENT
THAT COULD BECOME SUBMERGED FOLLOWING A LOCA

Equipment	Evaluation
Motors for the fans of the control rod drive mechanism coolers	These coolers are used to maintain the ambient temperature in the area of the control rod drives within an acceptable range during normal operation. ~~Their function is not required for LOCA mitigation~~ (Ref. Section 9.4.7)
Reactor Coolant Drain Tank Pumps	These pumps remove from inside containment the normal leakage of the reactor coolant system that has been collected in the reactor coolant drain tank. This is not a safety function. The discharge path of the pumps is automatically isolated in a LOCA. (Ref. Section 9.3.3.3)
Floor and Equipment Drain Sump Pumps	These pumps remove from inside containment any leakage inside containment that is not collected in the reactor coolant drain tank. This is not a safety function. The discharge path of the pumps is automatically isolated in a LOCA (Ref. Section 9.3.3.3)
Pressurizer Heaters	Automatically deenergized in the event of a LOCA.
add Reactor Lower Compartment Cooler Fans	These fans are required for safe shutdown per 10CFR50 Appendix R. Also, they are required to perform the safety-related function of operating after a non-LOCA accident to recirculate air through lower containment and equipment compartments. This system is not required to perform after a LOCA. (Ref. Section 9.4.7)

add — The CRDM coolers are required for safe shutdown per 10CFR50 Appendix R.

1011 S00 PKG
~~988, 800~~ PKG

APPENDIX 8D

IEEE STD 387-~~1977~~ 1984 FOR DIESEL-GENERATING UNITS APPLIED AS STANDBY POWER SUPPLIES FOR NUCLEAR POWER GENERATING STATIONS

C = full compliance

SECTION	DEGREE OF COMPLIANCE
5.1	WBN meets the intent of this section. However, 1E criteria meets IEEE 308-1974, and 1E qualification meets IEEE 323-1974.
5.2	C
5.3	C
5.4	C
5.5	C ~~WBN does not fully comply with this section. Specifically, WBN does not comply with Section 5.5.2.2. WBN DG is not designed to automatically transfer from the test mode to an emergency mode upon receipt of emergency signals. This position is documented in a letter to NRC. (T04 930805 950)~~
6.1	C
6.2	WBN meets the intent of this section. The diesel generator factory production tests do not have the detailed requirements of IEEE 387-1984. The tests were conducted as required by the IEEE 387-1977 Section 6.2.
6.3	WBN does not fully comply with this section. Specifically, WBN does not comply with Section 6.3.4. This section requires that the load rejection test be conducted from the short-time rating. RG 1.9 R3 requires the test be conducted from 90% to 100% of continuous rating (RG 1.9 R3 Section 2.2.8).
6.4	C
6.5	C
7.1	WBN meets the intent of this section. The NRC-SRP-0800, Section 3.11 states that for qualification of mild environment equipment, (e.g., DGs) the design/purchase specification must envelope the normal/abnormal environments.

Revise

988. S00 PKG

APPENDIX 8D (Cont'd)

7.2.1	WBN does not fully comply with this section. Specifically, WBN does not comply with Section 7.2.1(3). This section requires that the load rejection test be conducted using the short-time rating. The qualification test was performed using continuous rating as required by IEEE 387-1977. Futhermore, the 1993 requirement stated in RG 1.9 R3 requires the test be conducted using 90% to 100% of continuous rating (RG 1.9 R3 Section 2.2.8).
7.2.2	WBN meets the intent of this section. The WBN diesel generator reliability qualification tests were conducted before IEEE 387-1984 and 1977 were in effect. Therefore, all 300 tests were conducted with the diesels at standby temperature. However, TVA purchased an additional diesel generator unit (ADGU). This ADGU consists of an EMD 16-645-E4B diesel engine with an Electric Products (Part No. 0-09232-C) generator which is essentially identical to those originally purchased for WBN. The ADGU was tested a total of 56 times in the normal operating temperature range. A step load equal to 100% of the nameplate rating was applied after the unit reached rated speed. All tests were successful. The tests are documented in the Power System documentation package IWO-6036. These tests demonstrate that the WBN DGs are capable of starting at normal operating temperature as specified by this section.
7.2.3	C
7.3	WBN meets the intent of this section. The NRC-SRP-0800, Section 3.11 states that for qualification of mild environment equipment, (e.g., DGs) the design/purchase specification must envelope the normal/abnormal environments.

parse

APPENDIX D (Cont'd)

7.4	WBN meets the intent of this section, although, the seismic qualification is not conducted per IEEE 344-1975. Please refer to FSAR Table 3.10-1, sheet 2, for a summary of the seismic qualification of electrical equipment including the diesel generators. Further, please refer to the FSAR Table 3.10-3, sheets 11 through 20 for tests, results, and references of the seismic qualification of various components of the diesel generator unit.
7.5	C
7.6	C
7.7	WBN takes exception to this section. Since WBN does not commit to IEEE 323-1983, the documentation requirement of this code does not apply. Please see comment to section 7.3.

Revise

APPENDIX 8D (Cont'd)

Requirement	Degree of Compliance
(4) Report of test results. The report shall include:	C
(a) Objective	C
(b) Equipment tested	C
(c) Description of test facility	C
(d) Test procedures	C
(e) Test date and accuracy (results)	C
(f) Summary, conclusions, and recommendations	C
(g) Supporting data	C
(h) Approval signature and date	C
6.1.5 Analyses	C
6.1.6 If type qualification tests are at the engine . . .	C
6.2 Factory Production Tests	C
(1) Diesel engine	C
(2) Generator	C
(3) Excitation, control and other accessories/auxiliaries	C
6.3 Type qualification testing procedures and methods	C - Except seismic was not done per IEEE 344-1975 Justification: It is TVA's position that the intent of this position has been fully met. Please refer to FSAR Table 3.10.1, sheet 2, for a summary of the seismic qualification of electrical equipment including the diesel generators. Also, Table 3.10.3 "Watts Bar Seismic Qualifications," sheets 11 through 20 for tests, results, and references of the seismic qualification of various components of the diesel generator unit.

Delete

APPENDIX 8D (Cont'd).

Requirement	Degree of Compliance
6.3.1 Load capability qualification	
(1) Load . . . continues . . . 22 hrs	C
(2) Then 2-hr rating	C
(3) The continuous load rejection . . .	C
(4) Light load equal	C
6.3.2 Start and load acceptance qualification 300 valid start . . .	C
The start and load tests shall be conducted as follows:	
(1) Engine cranking shall begin . . .	C
(2) Immediately following (1) . . .	C
(3) At least 270 of the tests . . .	C
(4) At least 30 of the tests . . .	C
(5) If these tests are performed on more than one unit . . .	C*
If cause of failure . . . without penalty . . .	
(a) Unsuccessful start attempts . . .	C
(b) A starting or load or both tests . . .	C

*When the WBN diesel generator reliability qualification tests were conducted IEEE-387-1977 had not been issued and, therefore, all 300 tests were conducted with the diesels at standby temperature. However, TVA has purchased an additional diesel generator unit (DGU). This DGU consists of an EMD 16-645-E4B diesel engine with an Electric Products (Part No. 0-09232-C) generator which is essentially identical to those originally purchased for WBN with the following differences:

a. Heavy-duty turbocharger is supplied with the referenced above (being added to original DGUs).

b. Lube oil modifications have been added to the original DGUs.

c. The original model of miscellaneous valves, fuel filter, and thermocouple hardware that was supplied on the original DGUs are no longer available. Equivalent hardware was substituted.

This DGU was tested a total of 56 times in the normal operating temperature range. A step load equal to 100 percent of the nameplate rating was applied after the unit reached rated speed. All tests were successful. The tests are documented in the Power System (Division of Morrison-Knudson) documentation package IWO-6036. These tests demonstrate that the WBN DGUs are capable of starting at normal operating temperature as specified by IEEE-387-1977.

Delete

9∅8. S00 PKG

APPENDIX 8D (Cont'd)

Requirement	Degree of Compliance
(c) Test performed . . . trouble shooting	C
(d) Successful start . . .	C
(e) Failure of temporary . . .	C
6.3.3 Margin & Qualification the criteria for the margin qual. are as follows:	
(1) Demonstrate the ability of gen. and excitation system . . .	C
(2) Demonstrate that there is sufficient engine torque . . .	C
6.4 Site Test Categories	
6.4.1 Starting Test	C
6.4.2 Load Acceptance Test	C
6.4.3 Rated Load Test	
(1) A load equal to continuous rating . . . plus 1 hour	C
(2) A load equal to short-time rating . . . for 2 hours	C
6.4.4 Design Load Test	C
6.4.5 Load Rejection Test	C
6.4.6 Electrical Test	C
6.4.7 Subsystem Test	C
6.5 Site Acceptance Testing	
6.5.1 Test Loads	C
6.5.2 Test Conduct	C
6.5.3 Tests: The tests to be given to the DGU . . .:	
(1) Starting test	C
(2) Load acceptance tests	C
(3) Rated load tests	C
(4) Design load tests	C
(5) Load rejection tests	C
(6) Electrical tests	C
(7) Subsystem tests	C

← Delete

APPENDIX 8D (Cont'd)

Requirement	Degree of Compliance
6.6 Periodic Testing	C
6.6.1 Availability Test	C
6.6.2 Operational Test. The DGU . . . one cycle or each . . .	
(1) Starting tests	C
(2) Load acceptance tests	C
(3) Design load tests	C
(4) Load rejection tests	C
(5) Subsystem tests	C
6.7 Preventive Maintenance, Inspection, and Testing	C

Delete