UNITED STATES
NUCLEAR REGULATORY COMMISSION
WASHINGTON, D.C. 20555-0001

March 14, 1994

Docket Nos. 50-259, 50-260
and 50-296

LICENSEE: Tennessee Valley Authority (TVA)

FACILITY: Browns Ferry Nuclear Plant, Units 1, 2, and 3

SUBJECT: SUMMARY OF THE MARCH 8, 1994 MEETING WITH THE TENNESSEE VALLEY AUTHORITY REGARDING EXTENSION OF ALLOWED OUTAGE TIME TO SUPPORT CONTROL POWER BATTERY REPLACEMENT

A meeting was held on March 8, 1994 in Rockville, Maryland, between representatives of the NRC staff and the Tennessee Valley Authority (TVA). This meeting was requested by TVA to discuss its planned application to extend the technical specification allowed outage time (AOT) for certain battery systems at the Browns Ferry Nuclear Plant (BFN) Units 1, 2, and 3. TVA has identified the required technical specification amendments as a cost-beneficial licensing action. Meeting attendees are listed in Enclosure 1. A copy of the handout provided by TVA is in Enclosure 2.

TVA plans to request an extension of the AOT for the BFN Shutdown Board Control Power batteries from 5 days to 45 days. The planned AOT extension is a temporary change to permit battery replacement while BFN Unit 2 is operating. The batteries are being replaced because they are approaching the end of their service life, and because additional capacity is needed to support multi-unit operations.

TVA plans to request a 45-day AOT interval based on their evaluation of the time required for each battery replacement, with some margin. The staff cautioned TVA to be certain that the requested interval is adequate to avoid operational and licensing problems as the work is performed.

A total of five batteries will by replaced. One will be replaced during the BFN Unit 2 refueling outage scheduled to begin in October 1994. The others will be replaced sequentially on roughly a 2-month interval starting in early 1995.

Using a BFN PRA model, TVA has estimated an increase in core damage frequency of about 0.3% for the year in which the battery replacement is performed. The staff indicated that while it is able to use PRA arguments to justify amendments such as this, TVA should take care to ensure adequate information is provided to permit a thorough staff review. In response to staff questions, TVA indicated plant operators will have procedures available addressing what measures are required to deal with transients or accidents which may occur during the extended AOT interval. TVA was also asked to examine whether recovery from a plant shutdown could be inhibited during the battery modifications.

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TVA has identified this proposed change as a cost-beneficial licensing action (CBLA). Alternatives, such as an extension of the BFN Unit 2 refueling outage or a temporary battery installation to supplement the existing batteries during the replacement, are not being pursued because of their relatively high cost. Since the PRA indicates low safety impact, TVA does not believe these high costs are justified. Therefore, TVA plans to request this action be considered as a CBLA for staff approval by December 1, 1994. TVA plans to submit the proposed change in late April 1994.

Original signed by
Joseph F. Williams, Project Manager
Project Directorate II-4
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Office of Nuclear Reactor Regulation

Enclosures:
1. Attendance List
2. TVA Handout

cc w/enclosures:
See next page

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DATE	3/11/94	3/11/94	3/14/94	3/14/94	

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ENCLOSURE 1

ATTENDEES

TVA/NRC MEETING

MARCH 8, 1994

NAME	ORGANIZATION
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Proposed Cost Beneficial Licensing Action

Shutdown Board Control Power Battery Replacement

NRC/TVA Meeting

March 8, 1994

Proposed Cost Beneficial Licensing Action

Shutdown Board Control Power Battery Replacement

NRC/TVA Meeting

March 8, 1994

TVA

SHUTDOWN BOARD CONTROL POWER BATTERY REPLACEMENT

AGENDA

I.	OPENING REMARKS	P. SALAS
II.	SCOPE OF WORK	R. H. WRIGHT
III.	SYSTEM DESCRIPTION	R. H. WRIGHT
IV.	SAFETY SIGNIFICANCE OF LCO EXTENSION	R. H. WRIGHT
VI.	CBLA CONSIDERATIONS	P. SALAS

I. OPENING REMARKS

- REQUEST FOR TEMPORARY AMENDMENT
  - Technical Specification 3.9.B.8
  - Five-day allowed outage time (AOT)
  - Extend AOT to 45 days

- UPGRADE 250-V DC SHUTDOWN BOARD CONTROL POWER SUPPLY SYSTEM
  - Batteries approaching end of service life
  - Increase capacity for multi-unit operation
  - Improve maintainability and reliability

- WORK SCOPE INVOLVES REPLACING
  - Batteries
  - Battery chargers
  - Distribution boards and associated hardware

PS

I. OPENING REMARKS
(CONTINUED)

- OVERVIEW INVOLVED SYSTEMS
  - AC electrical distribution system
  - 250-V DC power supplies

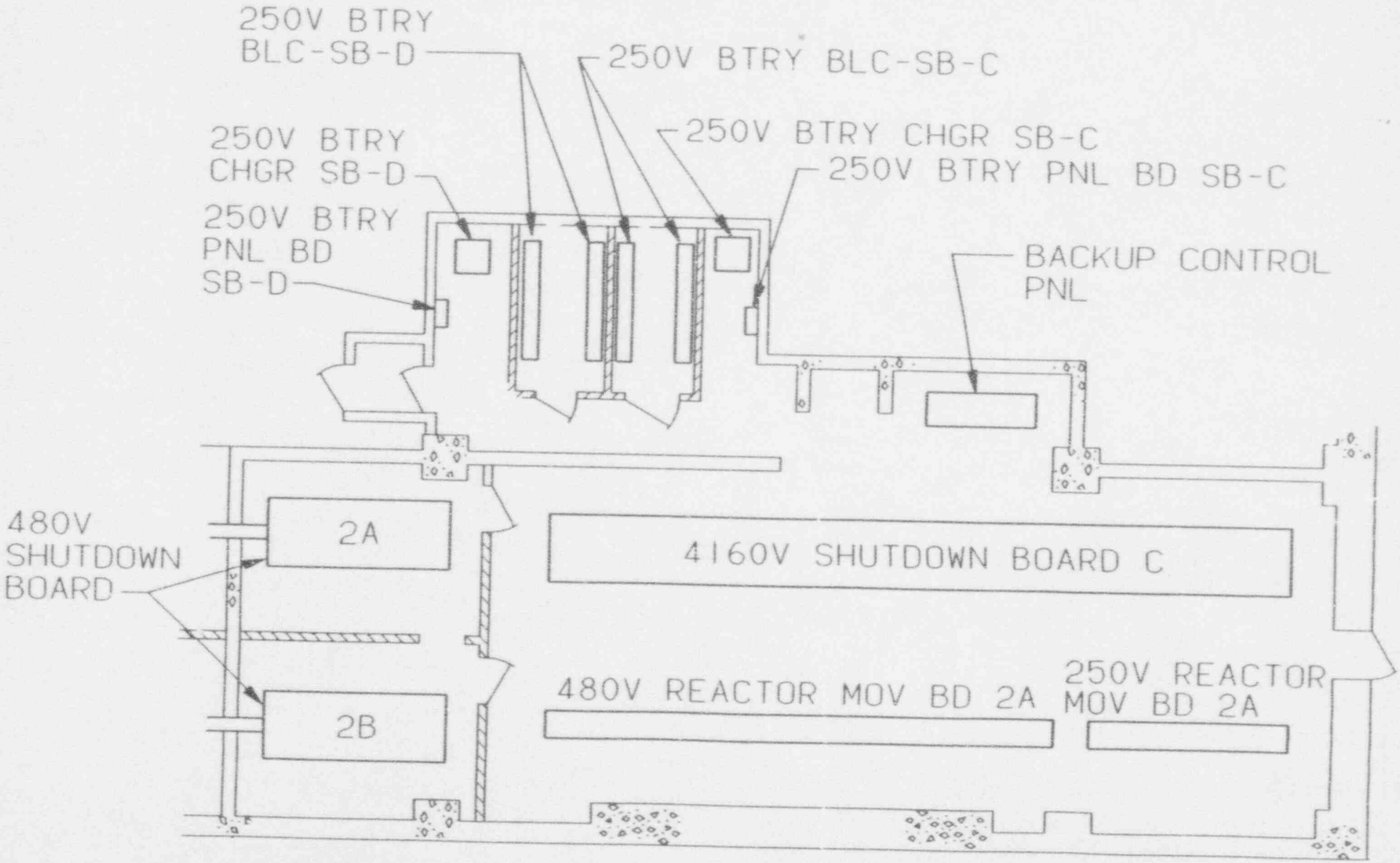
- DISCUSS SAFETY SIGNIFICANCE OF LCO EXTENSION
  - Ample margin with single unit operating
  - Diverse electrical system
  - PRA shows low risk

- COST BENEFICIAL LICENSING ACTION (CBLA)
  - Alternatives involve high cost
  - Allowed outage time extension involves low safety significance

II. SCOPE OF WORK

- APPROXIMATELY 40 DAYS NEEDED TO REPLACE 250-V DC CONTROL POWER SUPPLY SYSTEM COMPONENTS
  - Batteries
  - Battery racks
  - Battery chargers
  - Distribution panels
  - Associated hardware
  - Physical lay-out limits speed of work

II. SCOPE OF WORK
(CONTINUED)



II. SCOPE OF WORK
(CONTINUED)

- APPROXIMATELY 5 DAYS NEEDED FOR POST MODIFICATION TESTING
  - Calibrate meters
  - Load test charger
  - Cell connection resistance verification
  - Equalizing charge
  - Discharge test
  - Equalizing charge

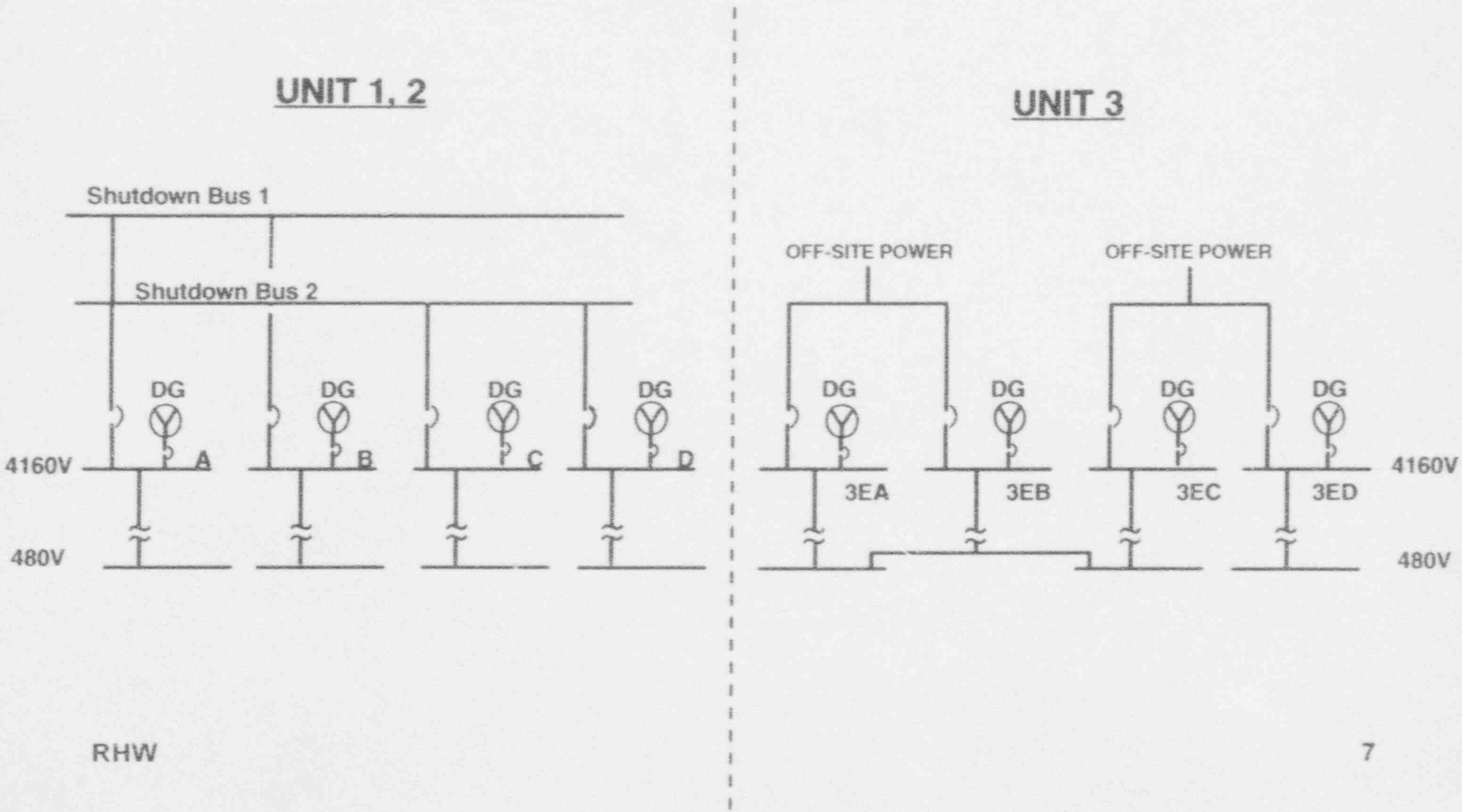
III. SYSTEM DESCRIPTION

- DIVERSE AC ELECTRICAL DISTRIBUTION SYSTEM
  - Four Unit 1/2 4160-V AC busses
  - Four Unit 3 4160-V AC busses
  - Eight Emergency Diesel Generators
  - 480-V AC bus off each 4160-V bus
  - Two divisions per unit

- DIVERSE 250-VOLT DC POWER SYSTEM
  - Three safety related 250-V DC unit power supplies
  - Five safety related 250-V DC shutdown board control power supplies.

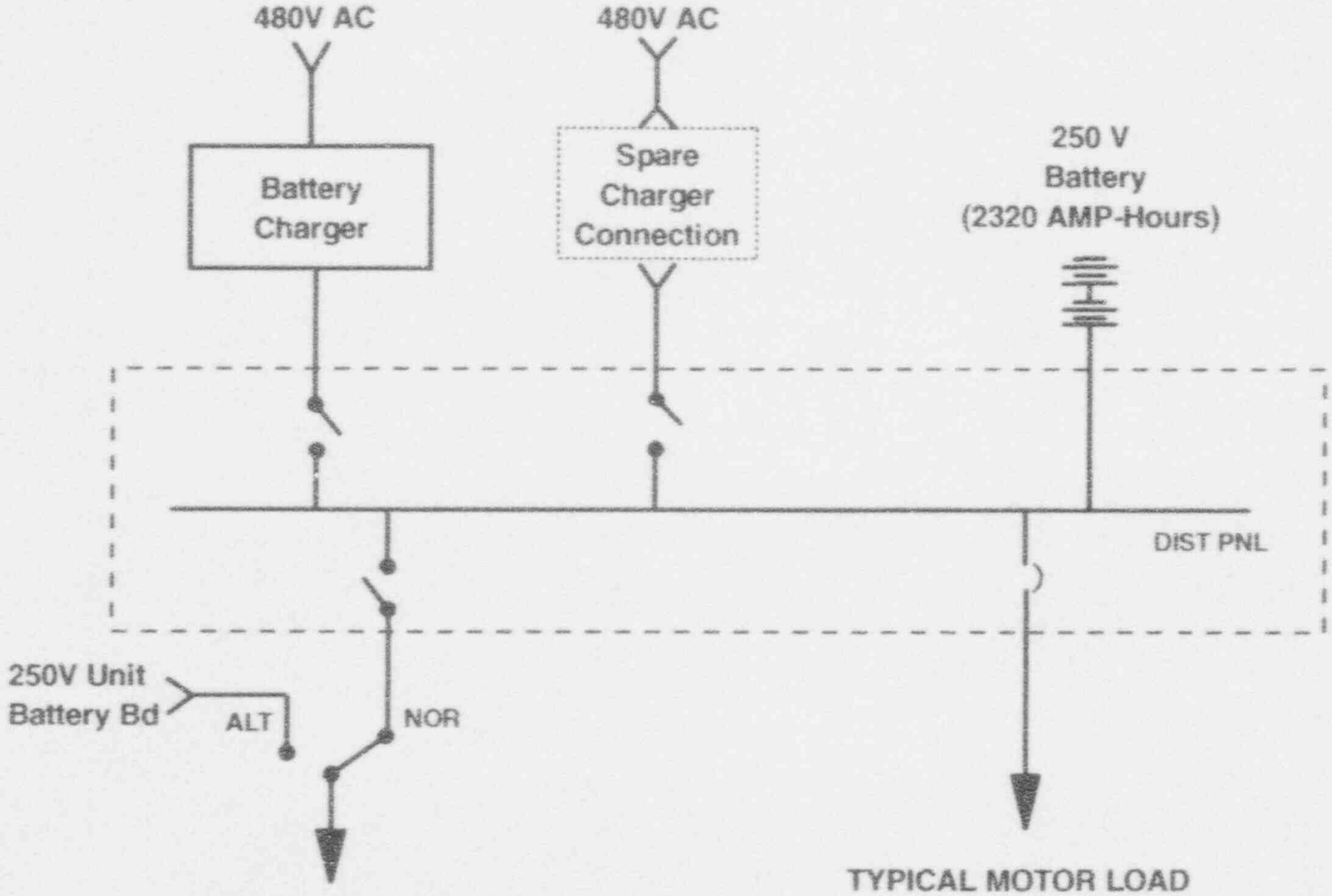
III. SYSTEM DESCRIPTION
(CONTINUED)

AC ELECTRICAL DISTRIBUTION SYSTEM
TYPICAL



III. SYSTEM DESCRIPTION
(CONTINUED)

SAFETY RELATED 250-VOLT DC UNIT POWER SUPPLY
TYPICAL

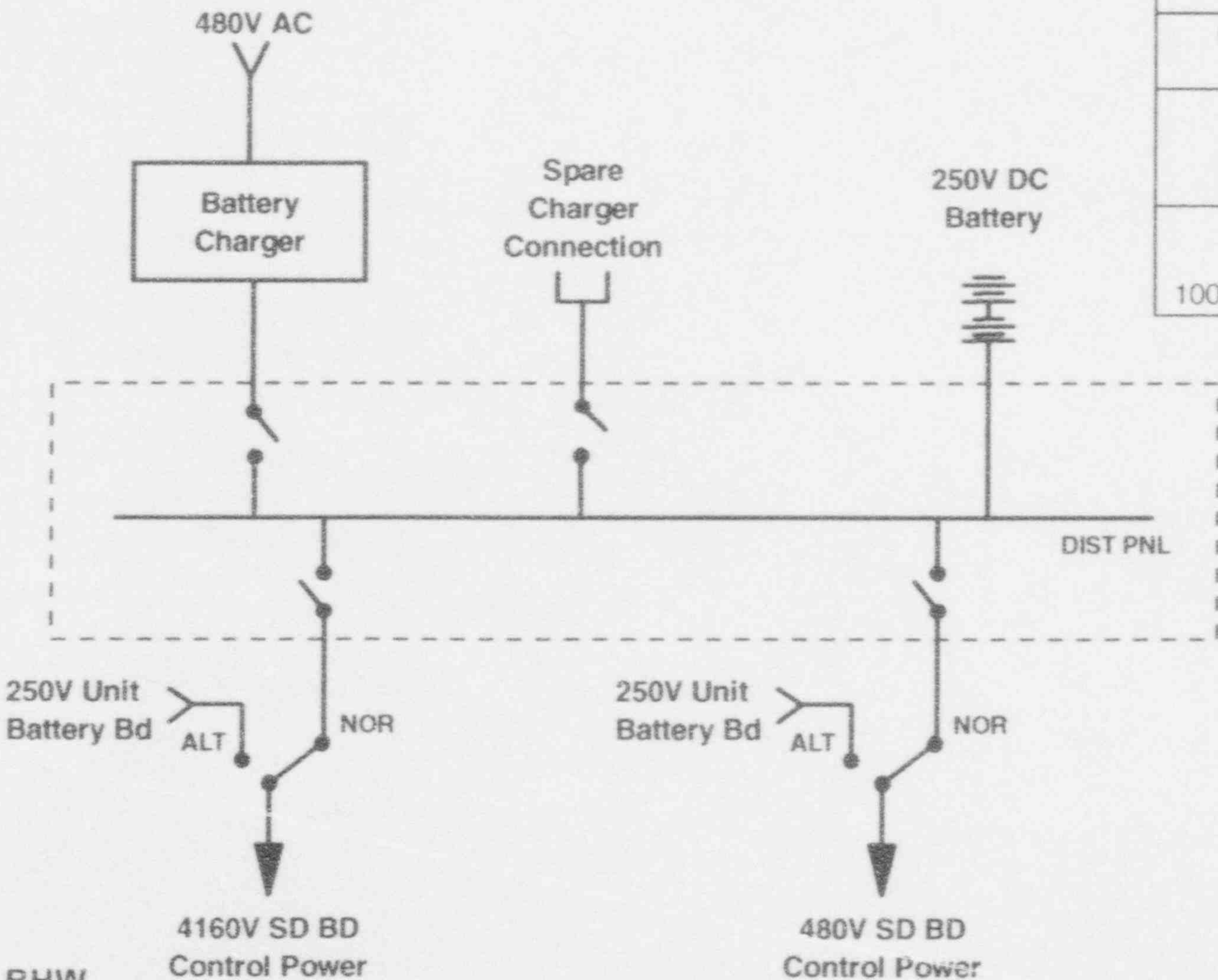


TYPICAL LOADS
- MOV BOARD
- 480V SHUTDOWN BOARD CONTROL POWER (U3)
- 4160 V SHUTDOWN BOARD CONTROL POWER (U-3)
- DISTRIBUTION PANEL

III. SYSTEM DESCRIPTION
(CONTINUED)

250-VOLT DC SHUTDOWN BOARD CONTROL POWER SUPPLY
TYPICAL

OLD	NEW
C&D TYPE 3DCU-9	C&D TYPE KCR-11
1 MINUTE RATING- 148 AMPS	1 MINUTE RATING 500 AMPS
8-HOUR RATING 100 AMP-HOURS	8-HOUR RATING 410 AMP-HOURS



IV. SAFETY SIGNIFICANCE OF LCO EXTENSION

- SINGLE UNIT OPERATING
  - System lightly loaded
  - Redundant and diverse electrical supplies

- FULLY QUALIFIED ALTERNATE POWER SUPPLIES
  - Battery systems highly reliable
  - Batteries recently replaced
  - Batteries and chargers adequate for additional load
  - Associated hardware (e.g., cables, circuit breakers) adequate for additional load

IV. SAFETY SIGNIFICANCE OF LCO EXTENSION
(CONTINUED)

- EXTENSION TO EXISTING AOT
  - Common power supply to accident initiation logic
  - Power available to pumps and valves

- COMPENSATORY MEASURE
  - Temporary power supply cable available

- MITIGATING MEASURES
  - Pre-job briefings
  - Minimize testing/maintenance impact during work
  - Battery outages in series
  - Incorporate lessons learned from 3EB work

IV. SAFETY SIGNIFICANCE OF LCO EXTENSION
(CONTINUED)

- PRA SHOWS NEGLIGIBLE IMPACT ON CORE DAMAGE FREQUENCY.
  - Each situation modeled
  - Base core damage frequency - 4.6E-5/year
  - Change in core damage frequency - 0.325%

- OVERALL INCREASE IN SAFETY
  - Better system reliability
  - Reduced maintenance
  - Larger capacity batteries

V. CBLA CONSIDERATIONS

- 250 VDC CONTROL POWER SUPPLY SYSTEM REQUIRED WHENEVER IRRADIATED FUEL IS IN THE VESSEL
  - 5 day allowed outage time during power operation
  - Minimum 2 power supplies during refueling for TS required equipment (not including 3EB).

- REFUELING OUTAGE DURATION INSUFFICIENT
  - Current schedule - approximately 40 days (no core off-load)
  - Approximately 120-day outage needed to perform modifications

- MODIFICATIONS NEEDED PRIOR TO UNIT 3 RESTART (~ OCTOBER 1995 FUEL LOAD)

V. CBLA CONSIDERATIONS
(CONTINUED)

- ALTERNATIVES TO LCO EXTENSION INVOLVE HIGH COST
  - 80-day refueling outage extension ($235,000/day replacement power) - ~ $18.8 million
  - Temporary control power installation - ~ $1 million

- SAFETY RISK ASSOCIATED WITH INSTALLATION OF TEMPORARY POWER
  - Abnormal plant configuration
  - Limited space availability

V. CBLA CONSIDERATIONS
(CONTINUED)

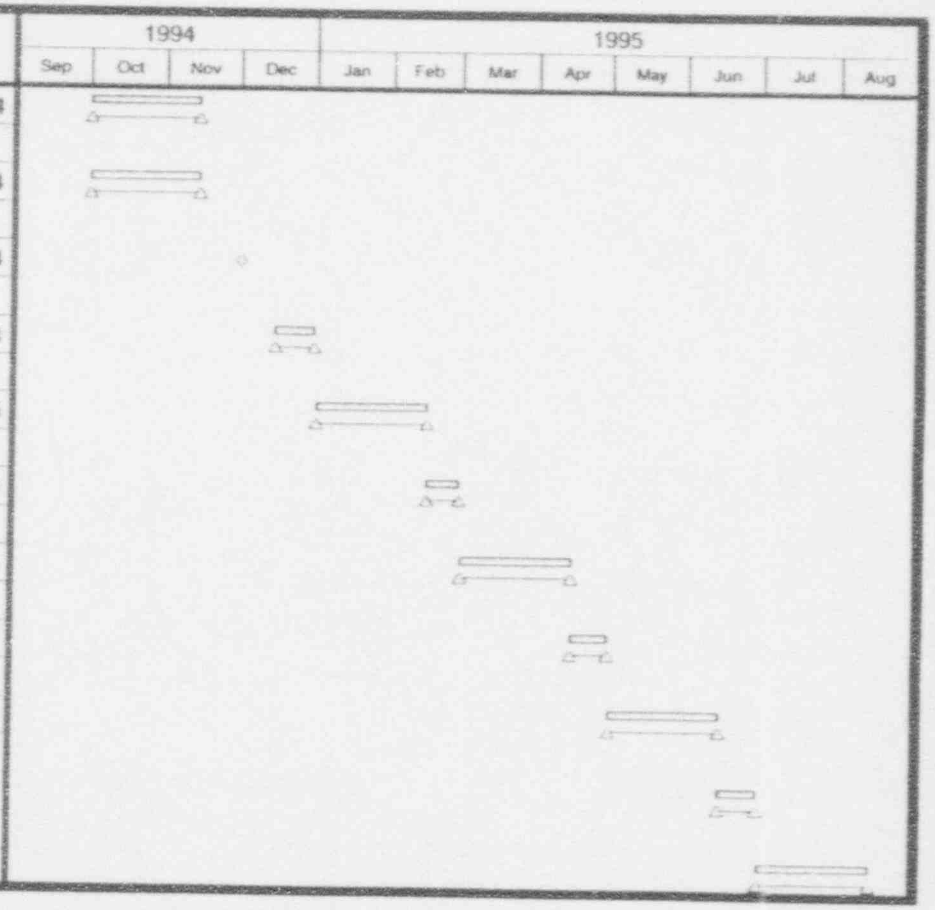
- LOW SAFETY SIGNIFICANCE IF ALLOWED OUTAGE TIME EXTENDED
  - PRA shows low risk
  - Adequate compensatory/mitigation measures
  - Personnel trained

- AMENDMENT DURATION ONE YEAR.
  - Enter/exit LCO for each power supply modification
  - 45 days work/testing per power supply
  - Approximately 2 weeks for surveillance testing and preventive maintenance

V. CBLA CONSIDERATIONS
(CONTINUED)

SHUTDOWN BOARD CONTROL POWER SUPPLY MODIFICATION
CONCEPTUAL SCHEDULE

Task Name	Start Date	Date Complete
UNIT 2 CYCLE 7 REFUEL OUTAGE	10/ 1/94	11/14/94
POWER SUPPLY 3EB MODIFICATION	10/ 1/94	11/14/94
TS APPROVAL NEED DATE	12/ 1/94	12/ 1/94
SURV. AND MAINT. PERIOD	12/15/94	12/31/94
POWER SUPPLY "A" MODIFICATION	1/ 1/95	2/15/95
SURV. AND MAINT. PERIOD	2/15/95	2/28/95
POWER SUPPLY "B" MODIFICATION	3/ 1/95	4/15/95
SURV. AND MAINT. PERIOD	4/15/95	4/30/95
POWER SUPPLY "C" MODIFICATION	5/ 1/95	6/15/95
SURV. AND MAINT. PERIOD	6/15/95	6/30/95
POWER SUPPLY "D" MODIFICATION	7/ 1/95	8/15/95



Baseline | Actual | Milestone

V. CBLA CONSIDERATIONS
(CONTINUED)

- OVERALL SAFETY BENEFIT

- HIGH PRIORITY APPROVAL REQUESTED

- AMMENDMENT REQUESTED BY DECEMBER 1, 1994.

ENCLOSURE

COST BENEFICIAL LICENSING ACTION

SHUTDOWN BOARD CONTROL POWER BATTERY REPLACEMENT

- PROPOSED CHANGE TO TECHNICAL SPECIFICATION 3.9.B.8
- BASES FOR TECHNICAL SPECIFICATION 3.9
- FSAR SECTION 8.6, "250-V DC POWER SUPPLY AND DISTRIBUTION"

ENCLOSURE

COST BENEFICIAL LICENSING ACTION

SHUTDOWN BOARD CONTROL POWER BATTERY REPLACEMENT

- PROPOSED CHANGE TO TECHNICAL SPECIFICATION 3.9.B.8

- BASES FOR TECHNICAL SPECIFICATION 3.9

- FSAR SECTION 8.6, "250-V DC POWER SUPPLY AND DISTRIBUTION"

PROPOSED CHANGE TO TECHNICAL SPECIFICATION 3.9.B.8

LIMITING CONDITIONS FOR OPERATION

3.9.B. Operation With Inoperable Equipment

5. When one of the shutdown buses is INOPERABLE, REACTOR POWER OPERATION is permissible for a period of 7 days.

6. When one of the 480-V diesel auxiliary boards becomes INOPERABLE, REACTOR POWER OPERATION is permissible for a period of 5 days.

7. From and after the date that one of the three 250-V unit batteries and/or its associated battery board is found to be INOPERABLE for any reason, continued REACTOR POWER OPERATION is permissible during the succeeding 7 days. Except for routine surveillance testing, NRC shall be notified within 24 hours of the situation, the precautions to be taken during this period, and the plans to return the failed component to an OPERABLE state.

SURVEILLANCE REQUIREMENTS

4.9.B. Operation With Inoperable Equipment

5. When a shutdown bus is found to be INOPERABLE, all 1 and 2 diesel generators shall be proven OPERABLE within 24 hours.

6. When one units 1 and 2 diesel auxiliary board is found to be INOPERABLE, each unit 1 and 2 diesel generator shall be proven OPERABLE within 24 hours, and power availability for the remaining diesel auxiliary board shall be verified within 1 hour and at least once per 8 hours thereafter.

LIMITING CONDITIONS FOR OPERATION | SURVEILLANCE REQUIREMENTS

3.9.B Operation With Inoperable Equipment

8. From and after the date that one of the 250-V shutdown board batteries and/or its associated battery board is found to be INOPERABLE for any reason, continued REACTOR POWER OPERATION is permissible during the succeeding five days in accordance with 3.9.B.7.

INSERT "AA"

9. When one division of the logic system is INOPERABLE, continued REACTOR POWER OPERATION is permissible under this condition for seven days, provided the CSCS requirements listed in Specification 3.9.B.3 are satisfied. The NRC shall be notified within 24 hours of the situation, the precautions to be taken during this period, and the plans to return the failed component to an OPERABLE state.

10. (deleted)

11. The following limiting conditions for operation exist for the undervoltage relays which start the diesel generators on the 4-kV shutdown boards.

INSERT "AA" -

8. From and after the date that one of the 250-V shutdown board batteries and/or its associated battery board is found to be INOPERABLE for any reason, continued REACTOR POWER OPERATION is permissible during the succeeding five days in accordance with 3.9.B.7 except as noted in 3.9.B.8.a below:

   a) For the purposes of Shutdown Board Battery and component replacement only, REACTOR POWER OPERATION is permissible for the succeeding forty-five (45) days providing:

      1) Only one shutdown board battery and associated components is being replaced at a time;

      2) All components normally supplied from the shutdown board battery which is replaced, are fed from its alternate source;

      3) Units 1 and 3 are defueled;

      4) NRC notification for 3.9.8.a is not required.

BASES FOR TECHNICAL SPECIFICATION 3.9

The objective of this specification is to assure an adequate source of electrical power to operate facilities to cool the plant during shutdown and to operate the engineered safeguards following an accident. There are three sources of alternating current electrical energy available, namely, the 161-kV transmission system, the 500-kV transmission system, and the diesel generators.

The unit station-service transformer B for unit 1 or the unit station-service transformer B for unit 2 provide noninterruptible sources of offsite power from the 500-kV transmission system to the units 1 and 2 shutdown boards. Auxiliary power can also be supplied from the 161-kV transmission system through the common station-service transformers or through the cooling tower transformers by way of the bus tie board. The 4-kV bus tie board may remain out of service indefinitely provided one of the required offsite power sources is not supplied from the 161-kV system through the bus tie board.

The minimum fuel oil requirement of 35,280 gallons for each diesel generator fuel tank assembly is sufficient for seven days of full load operation of each diesel and is conservatively based on availability of a replenishment supply. Each diesel generator has its own independent 7-day fuel oil storage tank assembly.

The degraded voltage sensing relays provide a start signal to the diesel generators in the event that a deteriorated voltage condition exists on a 4-kV shutdown board. This starting signal is independent of the starting signal generated by the complete loss of voltage relays and will continue to function and start the diesel generators on complete loss of voltage should the loss of voltage relays become inoperable. The 15-day inoperable time limit specified when one of the three phase-to-phase degraded voltage relays is inoperable is justified based on the two-out-of-three permissive logic scheme provided with these relays.

A 4-kV shutdown board is allowed to be out of operation for a brief period to allow for maintenance and testing, provided all remaining 4-kV shutdown boards and associated diesel generators, CS, RHR, (LPCI and containment cooling) systems supplied by the remaining 4-kV shutdown boards, and all emergency 480-V power boards are OPERABLE.

The 480-V diesel auxiliary board may be out of service for short periods for tests and maintenance.

There is a safety related 250-V dc unit battery located in each unit. Each 250-V dc unit battery system consists of a battery, a battery charger, and a distribution panel. There is also a backup charger which can be assigned to any one of the three unit batteries. The 250-V dc unit battery systems provide power for unit control functions, unit DC motor loads and alternate control power to the 4160 and 480-V ac shutdown boards. The primary control power supplies to the 3A, 3C and 3D 4160-V ac shutdown boards and the Unit 3 480-V ac shutdown boards are also provided by unit batteries. There are five safety related 250-V dc shutdown battery systems assigned as primary control power supplies to

4160-V ac shutdown boards A, B, C, D, and 3EB. Each of these shutdown battery systems has as 250-V dc battery, a charger, and a distribution panel. A portable spare charger can be used to supply any one of the five shutdown battery systems.

Each 250-V dc shutdown board control power supply can receive power from its own battery, battery charger, or from a spare charger. The chargers are powered from normal plant auxiliary power or from the standby diesel-driven generator system. Zero resistance short circuits between the control power supply and the shutdown board are cleared by fuses located in the respective control power supply. Each power supply is located in the reactor building near the shutdown board it supplies. Each battery is located in its own independently ventilated battery room.

The 250-V dc system is so arranged, and the batteries sized so that the loss of any one unit battery will not prevent the safe shutdown and cooldown of all three units in the event of the loss of offsite power and a design basis accident in any one unit. Loss of control power to any engineered safeguard control circuits is annunciated in the main control room of the unit affected. The loss of one 250-V shutdown board battery affects normal control power for the 480-V and 4,160-V shutdown boards which it supplies.

There are two 480-V ac RMOV boards that contain mg sets in their feeder lines. These 480-V ac RMOV boards have an automatic transfer from their normal to alternate power source (480-V ac shutdown boards). The mg sets act as electrical isolators to prevent a fault from propagating between electrical divisions due to an automatic transfer. The 480-V ac RMOV boards involved provide motive power to valves associated with the LPCI mode of the RHR system. Having an mg set out of service reduces the assurance that full RHR (LPCI) capacity will be available when required. Since sufficient equipment is available to maintain the minimum complement required for RHR (LPCI) operation, a 7-day servicing period is justified. Having two mg sets out of service can considerably reduce equipment availability; therefore, the affected unit shall be placed in Cold Shutdown within 24 hours.

The offsite power source requirements are based on the capacity of the respective lines. The Trinity line is limited to supplying two operating units because of the load limitations of CSST's A and B. The Athens line is limited to supplying one operating unit because of the load limitations of the Athens line. The limiting conditions are intended to prevent the 161-kV system from supplying more than two units in the event of a single failure in the offsite power system.

Specification 3.9.D provides the OPERABILITY requirements for the Unit 3 diesel generators when they serve as emergency power supplies to standby gas treatment train C and control room emergency ventilation train B when they are being considered OPERABLE for Unit 2 technical specifications. The allowable out of service time of 30 days is commensurate with the importance of the affected systems when Unit 3 is in cold shutdown, the low probability of a LOCA/Loss of offsite power and availability of onsite power to redundant trains.

FSAR SECTION 8.6
250-V DC POWER SUPPLY AND DISTRIBUTION

8.6 250-V DC POWER SUPPLY AND DISTRIBUTION

8.6.1 Safety Objective

The safety objective of the 250-V DC power system is to provide a highly reliable source of control power and motive power as required for the Engineered Safeguards System (ESS) so that no single credible event can disable the containment isolation and core standby cooling functions and their supporting control power sources and circuits.

8.6.2 Safety Design Basis

1. The ESS 250-V DC power system shall be designed with adequate independence and redundancy so that the failure of any single active component will not prevent the required ESS from functioning.

2. Battery capacity shall be adequate so that any two unit batteries can supply for 30 minutes, without chargers available, the DC power required to operate the ESS on any one reactor unit in the event of a design basis accident, as well as the DC power required for the safe shutdown and cooldown of the other two units with a final terminal voltage of 210-V.

3. The ESS that are supplied from the 250-V DC power system shall be designed to operate at the required minimum voltage for individual components.

4. The ESS 250-V DC power system, except for battery 4 and its associated charger, circuitry, switches, indicators and alarms, shall be capable of withstanding the Design Basis Earthquake without impairment of its function.

5. The ESS 250-V DC power system shall be designed so that any component, including battery charger, battery, distribution center, and interconnecting wiring, can be tested without disabling any required ESS.

8.6.3 Description

The 250-V DC power system is made up of two subsystems:

1. The 250-V plant DC system, which consists of four 120-cell lead-acid batteries (one Class 1E battery and battery charger per unit, one non-Class 1E station battery and battery charger, and one Class 1E spare battery charger), together with the associated chargers, circuitry, switches, indicators, and alarms (Figure 8.6-1a).

2. The 250-V DC control power supply system (250-V DC control power supplies A, B, C, D, and 3EB for 4160-V shutdown boards A, B, C, D, and 3EB, respectively and the 480V Shutdown Boards 1A, 1B, 2A and 2B), which consists of five 120-cell lead-acid batteries (one battery and battery charger for each shutdown board, and one spare battery charger), together with the associated chargers, circuitry, switches, indicators, and alarms (Figure 8.6-1a).

250-V Plant DC System

The battery chargers are of the solid-state, rectifier type, capable of working independently. Each charger is capable of automatically regulating output voltage within ± .5 percent of its rated value under the following conditions:

1. The load is between 0 percent and 100 percent with the AC power feeding the charger deviating from the rated voltage by 10 percent.

2. The battery is disconnected.

Each battery charger has the capacity to furnish floating, equalizing, and fast charge in accordance with the battery manufacturer's recommendations.

Each battery charger provides the 250-V DC supply during normal operations, keeps its associated battery fully charged at all times, and recharges the battery after a discharge. On loss of power to the charger, the battery supplies all required loads. Each battery is equipped with a low-voltage alarm which is actuated when battery voltage falls to 240-V.

The batteries for the 250-V unit and plant DC system are of the lead-calcium grid construction. The Unit 1 battery has a 1-minute rating of 2080 amperes and an 8-hour discharge rating of 2320 ampere-hours, Unit 2 and 3 batteries have a 1 minute rating of 1862 amperes and an 8-hour discharge rating of 2030 ampere-hours, both ratings to a terminal voltage of 210 volts at 77°F.

The three unit batteries have engineered safeguards control loads for the three units distributed among them so that redundant subsystems on each unit have separate normal and alternate power supplies. The battery board buses, motor-operated valve boards, and distribution panels supply nominal 250-V DC power to their loads without interruption unless the supply battery is discharged and power to the charger is lost. All transfers from normal to alternate sources are done manually, under administrative control procedures.

The major connected loads for the 250-V DC power system are listed in Table 8.6-1, Figure 8.6-5, and Figure 8.6-6. The batteries in the 250-V plant DC system have the capacity to carry all their required selected loads for 30 minutes without recharging. Each charger is sized to recharge its battery from a fully discharged condition in approximately 12 hours under normal load conditions.

A typical arrangement of the 250-V plant DC system for one unit is shown in Figure 8.6-2a; and the interconnection scheme for this same portion for all three units, illustrating separation requirements, is shown in Figure 8.6-3.

250-V DC Control Power Supply System (for shutdown boards)

The 250-V DC control power battery chargers have similar characteristics to the chargers of the plant system except for size.

The batteries for the 250-V control power supply system are of the lead-calcium grid construction. They have a one-minute rating of 148 amperes and an eight-hour discharge rating of 100 amperes hours, both ratings to a terminal voltage of 210-V at 77°F. Although the safety-design basis requirement for battery capacity is 30 minutes, the batteries have a greater capacity (25 amperes for three hours) to supply all required loads allowing ample time for corrective action if a charger malfunction occurs.

Normal 250-V DC control power for 4160-V shutdown boards A, B, C, D, and 3EB is supplied by one of the DC control power supplies with an alternate supply from one of the unit battery boards through a manual transfer switch. 250-V DC control power for 480-V shutdown boards 1A, 2A, 1B, and 2B is supplied by one of the DC control power supplies with an alternate supply from one of the battery boards through a manual transfer switch. 250-V DC control power for 4160-V shutdown boards 3EA, 3EC, and 3ED, 480-V shutdown boards 3A and 3B, the bus-tie board, and the cooling tower switchgear is from the unit battery boards. Alternate supplies have been provided through manual transfer switches. Separations between redundant control power circuits are maintained external to and within the switchgear.

The major connected loads for the 250-V DC control power system are listed in Table 8.6-1 and Figure 8.6-5.

The batteries in the 250-V DC control power supplies have the capacity to carry all their required loads for 30 minutes without recharging. Each charger is sized to recharge its battery from a fully discharged condition in approximately 12 hours under normal load conditions.

The typical arrangement for 250-V DC control power supplies A, B, C, D, and 3EB is shown in Figures 8.6-2b and 8.6-2c. The key diagrams for the boards are shown in Figures 8.6-1a, b, d, and e.

8.6.4 Safety Evaluation

8.6.4.1 General

The system is arranged and powered so that the probability of failure of power to any single battery board bus or shutdown board control bus is very low and that such a failure does not result in loss of any safeguards function. The system is designed to meet the intent of the IEEE criteria for nuclear power plant protection systems (IEEE-279).

Each battery, and its associated equipment, is easily accessible for inspection and testing. The DC system is ungrounded and has a ground detection alarm. The most probable mode of battery failure would be deterioration of a single cell which can be detected well in advance by standard, routine battery inspections and testing. The system is designed so that the batteries cannot be paralleled.

Each ESS battery and its associated earthquake-type racks and holddown bolts are designed as Class I equipment in accordance with Appendix C, "Structural Qualification of Subsystems and Components."

8.6.4.1.1 Plant DC System

Each ESS 250-V DC unit battery board bus can be supplied from its own battery charger or from the spare charger. The station battery board bus can be supplied from its own charger or from the spare charger. The charger switching is done manually and without normally paralleling the chargers; however, chargers are designed to operate in parallel if desired. The chargers can be powered from normal plant auxiliary power or from the standby diesel-driven generator system.

Zero-resistance short circuits at the battery board or any point downstream can be cleared by the breakers operating within their ratings. Each unit battery is located in the control building in its own ventilated, unit battery room. The station battery is located in the Turbine Building. It supplies loads that are not essential for safe shutdown and cooldown of the nuclear system. This battery is not considered in the accident load calculations.

8.6.4.1.2 Shutdown Board Control Power Supply

Each 250-V DC control power supply can receive power from its own battery, battery charger, or from a spare charger. The chargers are powered from normal plant auxiliary power or from the standby diesel-driven generator system. Zero-resistance short circuits between the control power supply and the shutdown board are cleared by fuses located in the respective control power supply A, B, C, D, or 3EB. Each power supply is located in the Reactor Building or Diesel Generator Building near the shutdown board it supplies. Each battery is located in its own independently ventilated battery room.

8.6.4.2 Loss of One 250-V DC Unit Battery

The ESS 250-V DC system is arranged, and the batteries sized, such that the loss of any one unit battery will not prevent the safe shutdown and cooldown of all three units in the event of the loss of offsite power and a design basis accident in any one unit. Loss of control power to any engineered safeguards control circuit is annunciated in the Main Control Room of the unit affected.

8.6.4.3 Loss of One 250-V DC Control Power Supply Battery

The loss of one battery affects normal control power for the 480-V and 4160-V shutdown board which it supplies. Complete loss of the control power to these shutdown boards results in loss of only those engineered safeguards supplied by these boards, which is acceptable.

8.6.5 Inspection and Testing

Routine service and testing are based upon the recommendations of the manufacturer and sound maintenance practices. Typical inspections include visual examinations for leaks and corrosion and a check of all batteries for uniformity, as well as values of cell voltage, specific gravity of electrolyte, and electrolyte level. Any one battery or battery charger may be removed from the system for testing or repair without loss of service to the system.

Table 8.6-1

250-V DC CONNECTED LOADS

Unit Battery Boards

1. Reactor Motor-Operated Valve Boards (3 per unit, A, B, and C)
2. Turbine Building Distribution Board (1 per unit)
3. Circuit Breaker Board 9-9 (1 per unit)
4. 480-V Shutdown Board Controls (Unit 3)
5. Emergency DC Lighting
6. Unit Preferred AC Motor Generator
7. 4160-V Shutdown Board Controls (Unit 3)
8. Bus-tie Board
9. Cooling Tower Switchgear

Station Battery Board

1. Main Turbine Emergency Bearing Oil Pumps
2. Main Generator Emergency Seal Oil Pumps
3. Plant Preferred AC Motor Generator
4. DC Emergency Lighting at Diesel Generator Building
5. Distribution Board 9-24
6. Diesel Generator Air Compressors
7. Cooling Tower Switchgear

Reactor MOV Board Loads

1. Autodepressurization Relief Valves (MOV Boards A, B and C)
2. Pressure Relief Valves (MOV Boards A, B and C)
3. Main Steam Isolation Valves Solenoids (MOV Boards A and B)
4. Recirculation MG Set Emergency Oil Pumps (MOV Boards A and B)
5. Backup Scram Valves (MOV Boards A, B and C)
6. RHR Shutdown Isolation Valves (MOV Board B)
7. Division I Engineered Safeguards Logic Power Supply (MOV Board B)
8. Reactor Building Emergency DC Lighting (MOV Board B)
9. HPCI Turbine Controls and Auxiliaries (MOV Board A)
10. HPCI Valves (MOV Board A)
11. RCIC Turbine Controls & Auxiliaries (MOV Board C)
12. RCIC Valves (MOV Boards B & C)
13. Division II Engineered Safeguards Logic Power Supply (MOV Board A)

250-V DC Control Power Supplies

1. 4160-V Shutdown Board Controls (Units 1 & 2), and 3EB on Unit 3
2. 480-V Shutdown Board Controls (Units 1 & 2)