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ACCESSION NBR:9110170298 DOC.DATE: 91/10/09 NOTARIZED: NO DOCKET #
FACIL:50-269 Oconee Nuclear Station, Unit 1, Duke Power Co. 05000269
50-270 Oconee Nuclear Station, Unit 2, Duke Power Co. 05000270
50-287 Oconee Nuclear Station, Unit 3, Duke Power Co. 05000287
50-369 William B. McGuire Nuclear Station, Unit 1, Duke Powe 05000369
50-370 William B. McGuire Nuclear Station, Unit 2, Duke Powe 05000370
50-413 Catawba Nuclear Station, Unit 1, Duke Power Co. 05000413
50-414 Catawba Nuclear Station, Unit 2, Duke Power Co. 05000414
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SUBJECT: Responds to Generic Ltr 91-06, "Resolution of Generic Issue A-30 'Adequacy of Safety-Related DC Power Supplies.'"

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DUKE POWER

October 9, 1991

U.S. Nuclear Regulatory Commission
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Washington, D.C. 20555

Subject: Oconee Nuclear Station, Units 1, 2, and 3
Docket Nos. 50-269, -270, -287
McGuire Nuclear Station, Units 1 and 2
Docket Nos. 50-369, -370
Catawba Nuclear Station, Units 1 and 2
Docket Nos. 50-413, -414
Response to NRC Generic Letter 91-06 (Resolution of Generic Issue A-30, "Adequacy of Safety-Related DC Power Supplies," Pursuant to 10 CFR 50.54(f))

Gentlemen:

On April 29, 1991 the NRC issued the subject generic letter which requested utilities to provide answers to a series of questions regarding the design, operation, maintenance, surveillance, and testing of safety-related DC power systems.

The purpose of this request was to assess the adequacy of these systems, and in particular, whether maintenance, surveillance, and monitoring provisions are appropriate for these systems. NRC staff analysis indicated that inadequate maintenance and surveillance and the failure to detect battery unavailability are the main contributors to failure of these systems.

Accordingly, Attachments A, B, and C to this letter provide answers to the questions contained in the generic letter for Oconee, McGuire, and Catawba Nuclear Stations, respectively.

I declare under penalty of perjury that these statements are true and correct to the best of my knowledge.

Should you have any questions concerning the enclosed material, please call L.J. Rudy at (704) 373-3413.

A001
1/1

Very truly yours,

M.S. Tuckman

LJR/s

Attachments

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ATTACHMENT A

OCONEE NUCLEAR STATION RESPONSE TO GENERIC LETTER 91-06

1. Unit

Response
Oconee 1, 2, and 3. Unless so noted in conjunction with a specific response, the following responses are applicable to all three units.

2. a. The number of independent redundant divisions of Class 1E or safety-related dc power for this plant is (Include any separate Class 1E or safety-related dc, such as any dc dedicated to the diesel generators.)

Response
There are four separate Class 1E dc power systems at Oconee. These systems are: 1) 125Vdc Instrumentation and Control Power System, which provides a source of reliable continuous power for control and instrumentation for normal operation and orderly shutdown for each unit; 2) 125Vdc Keowee Station Power System, which assures a source of reliable continuous power for normal and emergency operation of Keowee Hydro Station (which is the source of emergency ac power for Oconee); 3) Switching Station 125Vdc Power System, which provides dc power for protective relaying and control in the 230kV switchyard; and 4) Standby Shutdown Facility 125Vdc Power System (the Standby Shutdown Facility is used to achieve and maintain hot shutdown of one or more Oconee units following a control room fire, turbine building flood, or physical security event). Each system is described below:

SYSTEM/DIVISIONS
Vital I&C 125Vdc -
Battery 1CA/Charger 1CA/Distribution Center 1DCA
Battery 1CB/Charger 1CB/Distribution Center 1DCB
Battery 2CA/Charger 2CA/Distribution Center 2DCA
Battery 2CB/Charger 2CB/Distribution Center 2DCB
Battery 3CA/Charger 3CA/Distribution Center 3DCA
Battery 3CB/Charger 3CB/Distribution Center 3DCB

The system consists of two batteries, three battery chargers (two normal and one standby), and two I&C distribution centers per unit. All reactor protection and engineered safety features loads on this system can be powered from either the Unit 1 and Unit 2 or Unit 2 and Unit 3 or Unit 3 and Unit 1 125Vdc I&C distribution centers. The 125Vdc I&C distribution centers are normally supplied from their associated battery and charger. For one unit, in the event that only one of its batteries and associated chargers are operable, both I&C distribution centers will be tied together allowing operation of the dc loads from the unit's operable battery and charger. One I&C battery can supply both I&C distribution centers and their associated panelboard loads. Also, one of the three battery chargers for each unit can supply all connected ESF and reactor protection loads.

Keowee Hydro 125Vdc (serves all three Oconee units) -
Battery No. 1/Charger No. 1/Distribution Center 1DA (for Keowee 1)
Battery No. 2/Charger No. 2/Distribution Center 2DA (for Keowee 2)

There are essentially two independent physically separated seismic Category I subsystems, each complete with an ac/dc power supply (charger), a battery bank, a battery/charger bus, and a dc distribution center. Each subsystem provides the necessary power to automatically or manually start, control, and protect one of the hydro units. A failure of any one battery, charger, or dc distribution center cannot cause loss of both hydro units.

230kV Switchyard 125Vdc -
Battery SY-1/Charger SY-1/Distribution Center SY-DC1 (supplies Unit 1 motor-operated disconnect switch)
Battery SY-2/Charger SY-2/Distribution Center SY-DC2 (supplies Unit 2 motor-operated disconnect switch)

There are two essentially independent subsystems each complete with an ac/dc power supply (battery charger), a battery bank, a battery/charger bus, and motor control center (distribution panel). All safety-related equipment and the relay house in which it is located are seismic Category I design. Each subsystem provides the necessary dc power to continuously monitor operations of the protective relaying, isolate Oconee (including Keowee) from all external 230kV grid faults, connect onsite power to Oconee from a Keowee hydro unit, or restore offsite power to Oconee from non-faulted portions of the external 230kV grid. Provisions are included to manually connect a standby battery charger to either battery/charger bus.

SSF 125Vdc (serves all three Oconee units) -
Battery DCSF/Charger CSF/Distribution Center DCSF
Battery DCSFS/Charger CSFS/Distribution Center DCSF

b. The number of functional safety-related divisions of dc power necessary to attain safe shutdown for this unit is

Response
Vital I&C 125Vdc - one dc division

Keowee Hydro 125Vdc - one dc division

230kV Switchyard 125Vdc - one dc division

SSF 125Vdc - one dc division (when SSF is required for shutdown)

3. Does the control room at this unit have the following separate, independently annunciated alarms and indications for each division of dc power?

a. Alarms

1. Battery disconnect or circuit breaker open?

2. Battery charger disconnect or circuit breaker open (both input ac and output dc)?

3. **dc system ground?**

4. **dc bus undervoltage?**

5. **dc bus overvoltage?**

6. **Battery charger failure?**

7. **Battery discharge?**

Response

The following separate and independently annunciated alarms are provided for each unit in each control room for the 125V vital I&C system (Units 1 and 2 share a common control room; Unit 3 has a separate control room):

"DC System Trouble" - Alarms in the control room for the following conditions: 1) positive leg ground 2) negative leg ground 3) charger trouble (includes both low ac input voltage and low dc output voltage) 4) charger output breaker tripped 5) bus voltage low

"Battery Breaker Open"

"Standby Battery Charger Trouble" - Alarms in the control room for the following conditions: 1) low ac input voltage 2) low dc output voltage

DC bus overvoltage (question 3.a.5) is not annunciated in the control room for vital I&C distribution centers. During operator rounds (conducted every 12 hours), the vital I&C dc power system is inspected according to a check sheet that includes verifying proper dc bus voltage. These rounds would detect an overvoltage condition.

Normal battery charger (i.e., not the standby charger) failure (question 3.a.6) is not annunciated in the control room. All battery charger failures except a failure that causes a dc output overvoltage would be detected by the "DC System Trouble" alarm above. If the charger failed in a way that caused an overvoltage condition, this would be detected during operator rounds (every 12 hours) that inspect the system, which include verifying proper dc bus voltage. These rounds would detect an overvoltage condition.

Although battery discharge (question 3.a.7) is not directly measured, it would be detected by the low voltage alarms that are annunciated in the control room. The low voltage setpoint is above the system requirements.

The following separate and independently annunciated alarms are provided in the Unit 1/2 control room (on a Unit 2 panel) for the Keowee hydro 125V system:

"Unit Battery Trouble" - Alarms in the control room for the following conditions: 1) battery charger input and output low voltage 2) positive and negative leg ground

"Unit DC Supply Failure" - Alarms in the control room on loss of dc control voltage to equipment

"Unit Battery Charger Trouble" - Alarms in the control room for the following conditions: 1) low ac input voltage 2) low dc output voltage

"Standby Battery Charger Trouble" - Alarms in the control room for the following conditions: 1) low ac input voltage 2) low dc output voltage

Although dc bus overvoltage (question 3.a.5) is not annunciated in the control room, during operator rounds, the system is inspected every 4 hours and this inspection includes verifying proper dc bus voltage.

Although battery discharge (question 3.a.7) is not directly measured, it would be detected by the low voltage alarms that are annunciated in the Keowee Hydro control room, which is staffed full-time. The low voltage setpoint is above the system requirements.

The following alarm is provided in the Unit 1/2 control room for the 230kV switchyard 125V system:

"Battery Trouble" - Alarms in the control room for the following conditions: 1) positive leg ground 2) negative leg ground 3) charger low ac input voltage 4) charger low dc output voltage 5) distribution center low voltage

For this system, local indication is provided in the switchyard relay house. Once the above annunciator is received in the Unit 1/2 control room, an operator would be dispatched to the relay house to investigate. Also, normal 12-hour operator rounds would detect dc bus overvoltage, for which separate indication is not provided.

For the SSF 125V system, no alarms are provided in the Oconee control rooms. In the SSF control room there are two - on the diesel generator control board panel there are "DC System Trouble" and "Battery Charger Trouble" alarms. Also, the SSF equipment room contains "DC System Undervoltage", "DC System Ground", "DC Panelboard Power Lost", and "DC Distribution Center Power Lost" alarms.

Operator rounds of the SSF (conducted every 12 hours) would detect any abnormal condition. These rounds include inspecting breaker alignment and normal voltage ranges.

b. Indications

1. Battery float charge current?

Response
Vital I&C 125Vdc - No
Keowee Hydro 125Vdc - No
230kV Switchyard 125Vdc - No
SSF 125Vdc - No
For the above systems, battery float charge current is not provided on an indicator in the control room. However, existing battery charger and

bus voltage alarms and indications in conjunction with surveillance and maintenance activities performed on these systems ensure that the systems remain reliable and capable of performing their intended functions.

2. Battery circuit output current?

Response
Vital I&C 125Vdc - No
Keowee Hydro 125Vdc - No
230kV Switchyard 125Vdc - No
SSF 125Vdc - No
For the above systems, battery circuit output current is not provided on an indicator in the control room. Normally, dc current would be coming from the battery charger and not from the battery. If there is battery output current, then the battery charger is not working properly. Problems with the battery charger that cause the battery to output current would be detected and alarmed by the low voltage relays on the battery charger and dc distribution center. The absence of this indication in the control room does not jeopardize the reliability of the systems or the ability of these systems to perform their intended functions.

3. Battery discharge?

Response
Vital I&C 125Vdc - No
Keowee Hydro 125Vdc - No
230kV Switchyard 125Vdc - No
SSF 125Vdc - No
For the above systems, battery discharge is not provided on an indicator in the control room. Normally, the battery is not discharging. If the battery is discharging, the battery charger is not working properly. Problems with the battery charger that cause the battery to discharge would be detected and alarmed by the low voltage relays on the battery charger and dc distribution center. The absence of this indication in the control room does not jeopardize the reliability of the systems or the ability of these systems to perform their intended functions.

4. Bus voltage?

Response
Vital I&C 125Vdc - Yes

Keowee Hydro 125Vdc - Yes

230kV Switchyard 125Vdc - No
Bus voltage is not provided on an indicator in the control room. This information is provided locally on each dc distribution center. Bus voltage is noted during operator rounds and the reading is compared to the checksheet limits. Operator rounds are conducted every 12 hours. Low voltage alarms are provided on the system to alert the operators of abnormal voltage. The absence of this indication in the control room

does not jeopardize the reliability of the system or the ability of the system to perform its intended function.

SSF 125Vdc - No
Bus voltage is not provided on an indicator in the control room. This information is provided locally on each dc distribution center and low bus voltage is alarmed in the SSF control room. Bus voltage is noted during operator rounds and the reading is compared to the checksheet limits. Operator rounds are conducted every 12 hours. The absence of this indication in the control room does not jeopardize the reliability of the system or the ability of the system to perform its intended function.

c. Does the unit have written procedures for response to the above alarms and indications?

Response
For those alarms identified for Oconee, written response procedures exist.

4. Does this unit have indication of bypassed and inoperable status of circuit breakers or other devices that can be used to disconnect the battery and battery charger from its dc bus and the battery charger from its ac power source during maintenance or testing?

Response
Vital I&C 125Vdc - Yes

Keowee Hydro 125Vdc - Yes

230kV Switchyard 125Vdc - Yes

SSF 125Vdc - Yes

5. If the answer to any part of question 3 or 4 is no, then provide information justifying the existing design features of the facility's safety-related dc systems.

Response
Justification for all "no" answers has been provided with each question above. Regarding question 3 concerning alarms and indications, it should be noted that a review of control room alarms and indications was conducted as part of Duke Power Company's response to Supplement 1 to NUREG-0737, "Requirements for Emergency Response Capability", which demonstrated the acceptability of existing alarms and indications.

6. (1) Have you conducted a review of maintenance and testing activities to minimize the potential for human error causing more than one dc division to be unavailable? and (2) Do plant procedures prohibit maintenance or testing on redundant dc divisions at the same time?

Response
(1) No. One supervisor handles the work requests for maintenance and testing. He knows when a dc division is unavailable. Also, maintenance and/or testing must be approved by the operations supervisor on duty. Therefore, the likelihood of taking more than one dc division out of service at the same time is minimal. (2) Procedures prohibit conducting maintenance or testing, or otherwise removing from service more divisions than are allowed by plant technical specifications.

7. Are maintenance, surveillance and test procedures regarding station batteries conducted routinely at this plant? Specifically:

a. At least once per 7 days are the following verified to be within acceptable limits:

1. Pilot cell electrolyte level?

Response
Yes. Procedure IP/0/A/3000/01, 125VDC Instrumentation and Control Battery Daily Surveillance, governs this activity. (All procedures referenced in question 7 pertain to the vital I&C batteries. Other procedures exist for the Keowee hydro, 230kV switchyard, and SSF batteries.)

2. Specific gravity or charging current?

Response
Yes. (IP/0/A/3000/01)

3. Float voltage?

Response
Yes. (IP/0/A/3000/01)

4. Total bus voltage on float charge?

Response
Yes. (IP/0/A/3000/01)

5. Physical condition of all cells?

Response
Yes. (IP/0/A/3000/01)

b. At least once per 92 days, or within 7 days after a battery discharge, overcharge, or if the pilot cell readings are outside the 7-day surveillance requirements are the following verified to be within acceptable limits:

1. Electrolyte level of each cell?

Response

Yes. Procedure IP/0/A/3000/11, 125VDC Instrumentation and Control Battery Quarterly Surveillance, governs this activity.

2. The average specific gravity of all cells?

Response
Yes. (IP/0/A/3000/11)

3. The specific gravity of each cell?

Response
Yes. (IP/0/A/3000/11)

4. The average electrolyte temperature of a representative number of cells?

Response
No. The average is not taken. Normally, temperature is taken on all cells quarterly during specific gravity readings. Also, it is verified that all cell temperatures are within a 5F band.

5. The float voltage of each cell?

Response
Yes. (IP/0/A/3000/11)

6. Visually inspect or measure resistance of terminals and connectors (including the connectors at the dc bus)?

Response
Yes, except for the bus connection. The bus connection is located in a motor control center and would require the removal of panels to inspect.

c. At least every 18 months are the following verified:

1. Low resistance of each connection (by test)?

Response
Yes. Procedure IP/0/A/3000/03, 125VDC Instrument and Control Battery Service Test and Annual Surveillance, governs this activity.

2. Physical condition of the battery?

Response
Yes. (IP/0/A/3000/03)

3. Battery charger capability to deliver rated ampere output to the dc bus?

Response
No. Although the chargers are safety-related, Oconee does not perform this test because backup chargers are available in the event of a failure. Also, calculations containing load information were compared

with the manufacturer's nameplate rating and indicate that the charger is capable of feeding required loads.

4. The capability of the battery to deliver its design duty cycle to the dc bus?

Response
Yes. (IP/0/A/3000/03)

5. Each individual cell voltage is within acceptable limits during the service test?

Response
Yes. (IP/0/A/3000/03)

d. At least every 60 months, is capacity of each battery verified by performance of a discharge test?

Response
No. Oconee has not performed this test in the past; however, this test will be performed beginning in 1992.

e. At least annually, is the battery capacity verified by performance discharge test, if the battery shows signs of degradation or has reached 85% of the expected service life?

Response
Once the 60-month discharge test of question 7.d is begun, this test will be performed if the above conditions are met.

8. Does this plant have operational features such that following loss of one safety-related dc power supply or bus:

a. Capability is maintained for ensuring continued and adequate reactor cooling?

b. Reactor coolant system integrity and isolation capability are maintained?

c. Operating procedures, instrumentation (including indicators and annunciators), and control functions are adequate to initiate systems as required to maintain adequate core cooling?

Response
Two vital I&C class 1E dc divisions are provided for each unit. The vital I&C dc loads for each unit are powered from the dc divisions through an auctioneering network of two isolating diode assemblies. One assembly is supplied power from one of the unit dc divisions while the other assembly is supplied from a different unit (backup unit) dc division. The functions of the diode assemblies are to permit the two distribution systems to supply current to the vital I&C panelboard connected to the output of the diode assemblies and to block flow of current from one dc distribution system to the other. There are six I&C

battery divisions; only four are needed. There are four inverter backed busses; only three are needed. Technical specifications allow for one of these to be out of service for a limited amount of time to ensure the above three concerns are covered. Therefore, as demonstrated by the redundancies mentioned above, following the loss of one safety-related dc power supply or bus capability is maintained for ensuring continued and adequate reactor cooling, reactor coolant system integrity and isolation capability are maintained, and operating procedures, instrumentation, and control functions are adequate to initiate systems as required to maintain adequate core cooling.

9. If the answer to any part of question 6, 7 or 8 is no, then provide your basis for not performing the maintenance, surveillance and test procedures described and/or the bases for not including the operational features cited.

Response

Justification for all "no" answers has been provided with each question above.

ATTACHMENT B

MCGUIRE NUCLEAR STATION RESPONSE TO GENERIC LETTER 91-06

1. Unit

Response
McGuire 1 and 2. The following responses are applicable to both units.

2. a. The number of independent redundant divisions of Class 1E or safety-related dc power for this plant is (Include any separate Class 1E or safety-related dc, such as any dc dedicated to the diesel generators.)

Response
McGuire Nuclear Station has four channels (A, B, C, and D) of Class 1E dc power shared between two units (see Figure B-1). These four channels are paired to form two independent and redundant trains, A and B. Train A is comprised of both Channels A and C. Channel A powers Train A equipment necessary for safe shutdown. Channel C is associated with Train A and mainly supplies power required for the third channel of the Nuclear Instrumentation System (NIS) and Solid State Protection System (SSPS) instrumentation/control. Train B is comprised of both Channels B and D. Channel D supplies the Train B loads necessary for safe shutdown. Channel B is the associated channel and provides power for the second channel of the NIS and SSPS instrumentation/control.

There is one Train A and one Train B diesel generator per unit (plant total of four); each diesel generator has a 125V battery system.

b. The number of functional safety-related divisions of dc power necessary to attain safe shutdown for this unit is

Response
The number of functional safety-related trains (divisions) of dc power necessary to attain safe shutdown for each unit is one. Channels A and D are the Train A and Train B channels, respectively and one of these must be operable for safe shutdown. In the normal operating configuration, Channels B and C cannot shut the plant down by themselves because they mainly supply the NIS and SSPS system loads.

3. Does the control room at this unit have the following separate, independently annunciated alarms and indications for each division of dc power?

a. Alarms

1. Battery disconnect or circuit breaker open?

2. Battery charger disconnect or circuit breaker open (both input ac and output dc)?

3. dc system ground?

4. dc bus undervoltage?

5. dc bus overvoltage?

6. Battery charger failure?

7. Battery discharge?

Response

The following separate and independently annunciated alarms are provided in the control room for the 125V vital I&C system:

"Battery Ground"

"Battery Undervoltage" - Alarms in control room if: 1) undervoltage device senses undervoltage condition due to open bus breaker 2) battery charger malfunction

"Standby Charger Trouble" - Alarms in control room if: 1) ac power failure 2) low voltage dc output 3) high voltage dc output

"125V DC Essential Power Channel Trouble" - Alarms in control room if: 1) battery charger trouble 2) charger connection box breakers open (charger ac input breakers from motor control center) 3) charger breakers open 4) battery breaker open 5) bus breaker open 6) tie breaker between two busses closed 7) undervoltage on dc panelboards fed from vital dc busses

Although there is no alarm for dc bus overvoltage (question 3.a.5), analog dc bus voltage is provided in the control room for each of the four channels. Also, the charger has circuits which in an overvoltage condition activate a channel trouble annunciator and alarm and log on the computer at 160V. If the voltage reaches 167V, the charger will shut down.

Although there is no alarm for battery discharge (question 3.a.7), battery discharge indication is provided by an undervoltage relay on each channel which will alarm at 115V. The alarm is indicated on the computer and by an annunciator. This alarm will indicate that the battery voltage has dropped below the open circuit voltage which would only occur when the battery is being discharged.

Should any of the above alarms be activated, an operator would be dispatched to investigate the cause and would obtain further information from a local panel.

The following alarm is provided in the control room for the 125V emergency diesel generator battery system:

"125V DC D/G Control Power System Trouble" - Alarms in control room for any of the following conditions: 1) battery charger breaker open 2) battery breaker open 3) battery charger trouble 4) battery ground 5) dc bus undervoltage 6) battery charger blown fuses 7) D/G dc control power undervoltage

b. Indications

1. **Battery float charge current?**

2. **Battery circuit output current?**

3. **Battery discharge?**

4. **Bus voltage?**

Response
Of the four indications listed above, only bus voltage is provided. With the charger on the bus at float potential and the breakers in the normal configuration, the battery will be float charged. As stated earlier, the bus voltage is given in the control room for each channel. Breaker alignment for each channel can be determined at any time in the control room. The position of the charger, incoming, and tie circuit breakers are logged and alarmed on the computer and activate an annunciator when they change from their normal position. The battery breaker is logged on the computer and activates an annunciator when it changes from its normal position. The condition of charge for the battery is also determined during routine surveillances.

The dc system output current is only provided locally on the charger. The current from the battery itself is not metered. When the breakers are aligned such that the charger is connected to the bus and the bus voltage is above open circuit potential, then it is logical to determine that the battery is not discharging. If the bus voltage is at or below the open circuit voltage, then this indicates the battery is being discharged.

As stated previously, battery discharge indication is provided by an undervoltage relay on each channel.

c. **Does the unit have written procedures for response to the above alarms and indications?**

Response
For those alarms identified for McGuire, written response procedures exist.

4. **Does this unit have indication of bypassed and inoperable status of circuit breakers or other devices that can be used to disconnect the battery and battery charger from its dc bus and the battery charger from its ac power source during maintenance or testing?**

Response
Yes

5. **If the answer to any part of question 3 or 4 is no, then provide information justifying the existing design features of the facility's safety-related dc systems.**

Response

Justification for all "no" answers has been provided with each question above. Regarding question 3 concerning alarms and indications, it should be noted that a review of control room alarms and indications was conducted as part of Duke Power Company's response to Supplement 1 to NUREG-0737, "Requirements for Emergency Response Capability", which demonstrated the acceptability of existing alarms and indications.

6. (1) Have you conducted a review of maintenance and testing activities to minimize the potential for human error causing more than one dc division to be unavailable? and (2) Do plant procedures prohibit maintenance or testing on redundant dc divisions at the same time?

Response

(1) No. One supervisor handles the work requests for maintenance and testing. He knows when a dc division is unavailable. Also, maintenance and/or testing must be approved by the operations supervisor on duty. Therefore, the likelihood of taking more than one dc division out of service at the same time is minimal. (2) Yes. Procedures prohibit removing redundant trains.

7. Are maintenance, surveillance and test procedures regarding station batteries conducted routinely at this plant? Specifically:

a. At least once per 7 days are the following verified to be within acceptable limits:

1. Pilot cell electrolyte level?

2. Specific gravity or charging current?

3. Float voltage?

4. Total bus voltage on float charge?

5. Physical condition of all cells?

b. At least once per 92 days, or within 7 days after a battery discharge, overcharge, or if the pilot cell readings are outside the 7-day surveillance requirements are the following verified to be within acceptable limits:

1. Electrolyte level of each cell?

2. The average specific gravity of all cells?

3. The specific gravity of each cell?

4. The average electrolyte temperature of a representative number of cells?

5. The float voltage of each cell?

6. Visually inspect or measure resistance of terminals and connectors (including the connectors at the dc bus)?

c. At least every 18 months are the following verified:

1. Low resistance of each connection (by test)?

2. Physical condition of the battery?

3. Battery charger capability to deliver rated ampere output to the dc bus?

4. The capability of the battery to deliver its design duty cycle to the dc bus?

5. Each individual cell voltage is within acceptable limits during the service test?

d. At least every 60 months, is capacity of each battery verified by performance of a discharge test?

e. At least annually, is the battery capacity verified by performance discharge test, if the battery shows signs of degradation or has reached 85% of the expected service life?

Response

The McGuire Technical Specifications have provisions equivalent to those found in the Westinghouse Standard Technical Specifications for maintenance and surveillance. The answer to all parts of question 7 is yes, except for inspecting or measuring resistance of the connectors at the dc bus (question 7.b.6). These connectors are located in a distribution center and would require the removal of panels to inspect.

Applicable procedures governing the above activities for the vital I&C system (other procedures exist for the diesel generator dc system) are as follows:

PT/0/A/4350/28A, 125 Volt Vital Battery Weekly Inspection (question 7.a.1-5)
PT/0/A/4350/28B, 125 Volt Vital Battery Quarterly Inspection (question 7.b.1-6)
IP/0/A/3061/07, Vital Battery and Terminal Post Inspection (question 7.c.1&2)
PT/0/A/4350/08E, 125VDC Vital Charger Performance Test (question 7.c.3)
PT/0/A/4350/38, 125VDC Vital Instrumentation and Control Battery Service Test (question 7.c.4&5)
PT/0/A/4350/40, 125VDC Battery Performance Test Using Alber BCT 1000 Discharge System (question 7.d&e)

8. Does this plant have operational features such that following loss of one safety-related dc power supply or bus:

a. Capability is maintained for ensuring continued and adequate

reactor cooling?

b. Reactor coolant system integrity and isolation capability are maintained?

c. Operating procedures, instrumentation (including indicators and annunciators), and control functions are adequate to initiate systems as required to maintain adequate core cooling?

Response
Following the loss of one safety-related dc power supply or bus, capability is maintained (1) for ensuring continued and adequate reactor cooling and (2) for reactor coolant system integrity and isolation. As described in the response to question 2.a, McGuire has two independent and redundant trains. This ensures that the capabilities above exist and that the instrumentation and control functions are available.

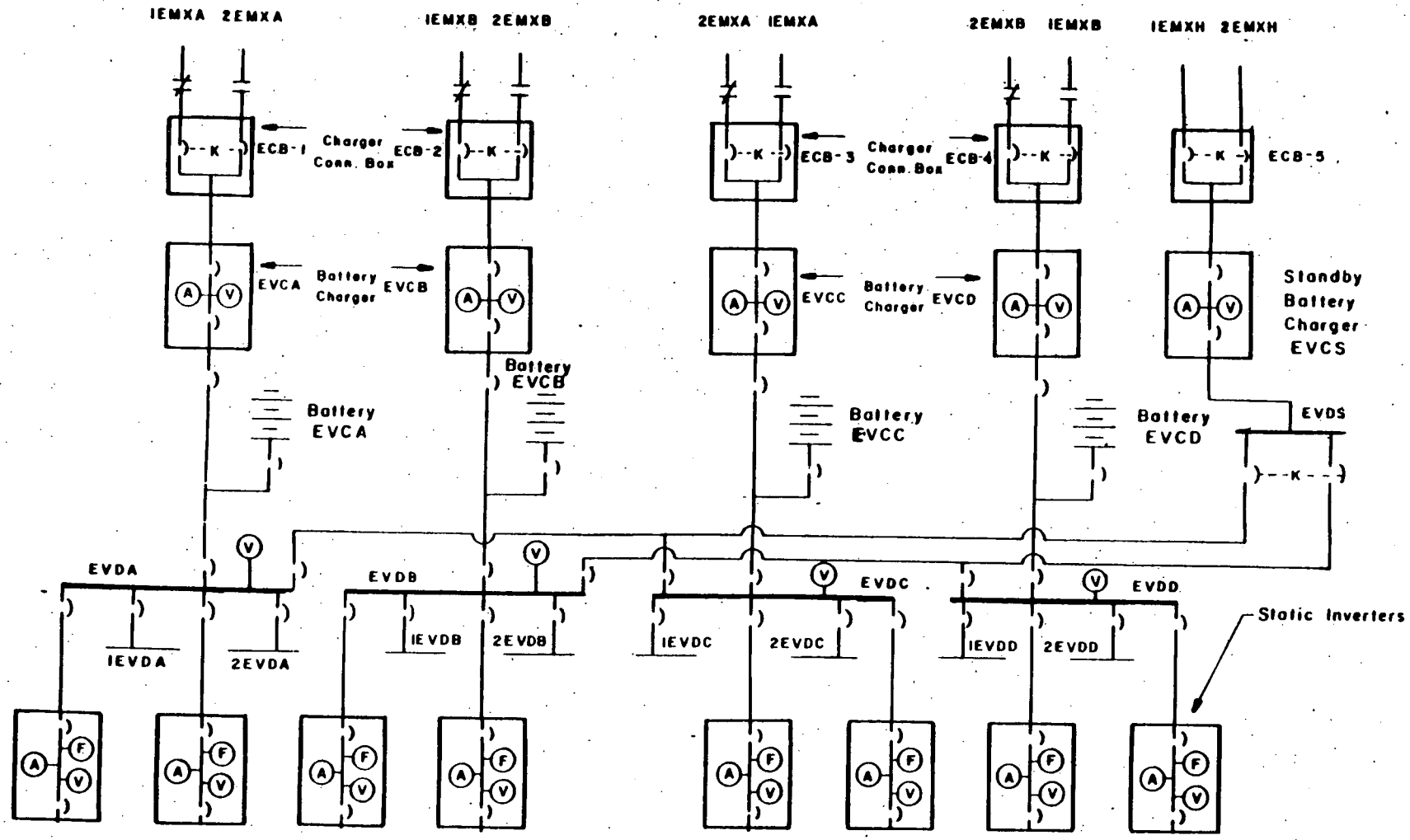
McGuire also has other features to ensure the system is available to perform its intended function. In the event of a charger failure, there is a standby charger which can be aligned to any one channel. In addition, Channels A and C can be cross-tied in the event either battery becomes inoperable. Channels B and D have the same capability. The vital batteries are sized such that each battery can carry the emergency loads of its channel plus those of its associated channel for a period of one hour.

The station has the necessary operating procedures to ensure safe shutdown with the loss of a dc power supply or bus.

9. If the answer to any part of question 6, 7 or 8 is no, then provide your basis for not performing the maintenance, surveillance and test procedures described and/or the bases for not including the operational features cited.

Response
Justification for all "no" answers has been provided with each question above.

Figure B-1 - McGuire Vital I&C DC Power Arrangement



ATTACHMENT C

CATAWBA NUCLEAR STATION RESPONSE TO GENERIC LETTER 91-06

1. Unit

Response
Catawba 1 and 2. The following responses are applicable to both units.

2. a. The number of independent redundant divisions of Class 1E or safety-related dc power for this plant is (Include any separate Class 1E or safety-related dc, such as any dc dedicated to the diesel generators.)

Response
Each unit at Catawba has two safety-related dc power systems. The 125V DC Vital Instrumentation and Control Power System (EPL) has two independent redundant trains (divisions) with each train consisting of two load channels (for a total of four). The major components comprising a load channel are a battery, battery charger, distribution center, and power panelboard (see Figures C-1, C-2, and C-3). The 125V DC Essential Diesel Auxiliary Power System (EPQ) also has two independent redundant trains (divisions). The major components comprising a train (division) in the EPQ system are a battery, battery charger, and distribution center (see Figure C-4). Both the EPL system and EPQ system feed two auctioneered distribution centers by way of auctioneering diode assemblies. The two auctioneered distribution centers for each unit are independent and redundant.

b. The number of functional safety-related divisions of dc power necessary to attain safe shutdown for this unit is

Response
The number of functional safety-related trains (divisions) of dc power necessary to attain safe shutdown for each unit at Catawba is two - one train (division) of the EPL system and one train (division) of the EPQ system. One train of the EPL system is needed to supply the dc vital instrumentation and control loads as well as the 120V AC Vital Instrumentation and Control static inverters which supply the ac vital instrumentation and control loads. One train of the EPQ system is needed to supply the loads required to start and operate the associated emergency diesel generator.

3. Does the control room at this unit have the following separate, independently annunciated alarms and indications for each division of dc power?

a. alarms

1. Battery disconnect or circuit breaker open?

2. Battery charger disconnect or circuit breaker open (both input ac and output dc)?

3. dc system ground?

4. dc bus undervoltage?

5. dc bus overvoltage?

6. Battery charger failure?

7. Battery discharge?

Response

The following separate and independently annunciated alarms are provided in the control room for the 125V vital I&C system:

"125 VDC Essential Power Channel Trouble" - Alarms in control room if: 1) battery breaker open 2) battery charger trouble 3) distribution center undervoltage 4) distribution center ground fault 5) battery charger breaker open 6) panelboard undervoltage 7) bus tie breaker closed 8) auctioneering diode assembly input undervoltage

"125 VDC Essential Power Standby Charger Trouble" - Alarms in control room if: 1) ac power failure 2) low dc volts 3) high dc volts 4) dc output breaker open

Although Catawba does not have an alarm for dc bus overvoltage (question 3.a.5), Catawba's method of detecting a safety-related dc bus overvoltage condition is via battery charger overvoltage sensing circuitry. This method is effective since the battery charger is the only device normally connected to the dc bus which could induce a sustained overvoltage condition. Both an annunciator alarm as well as a computer alarm are provided in the control room for each load channel to alert the operator of an overvoltage condition. Each load channel also includes a reflash alarm located in the Battery and Equipment Room, as well as a pilot lamp on each of the battery chargers themselves. Should an overvoltage condition occur on one of the dc busses, the operator will be alerted by an annunciator that a particular 125V dc essential power channel is having trouble. More specifically, both the computer and the associated reflash module will indicate that the channel's respective charger is malfunctioning. Ultimately, the pilot lamps located on the charger will indicate that a charger overvoltage condition is occurring.

Although Catawba does not have an alarm for battery discharge (question 3.a.7), a dual undervoltage relaying scheme is utilized to detect battery discharge for each load channel. One relay is connected to the distribution center bus (see Figure C-1), while the other relay is connected to the supply side of the battery charger output breaker. The battery charger relay is set to drop out at 127V dc while the distribution center relay is set to drop out at 115V dc. Consequently, should a charger fail or its output voltage go low, the charger undervoltage relay will drop out first triggering a control room annunciator and computer alarm, a local reflash alarm, and a pilot lamp on the charger. The annunciator will indicate 125V dc essential power channel trouble, while both the computer and reflash module will more specifically indicate battery charger trouble. The pilot lamp will indicate a low charger output voltage. Should the battery voltage drop

further, the distribution center undervoltage relay will drop out triggering both a control room alarm (annunciator and computer) as well as a local reflash alarm. Once again the annunciator will indicate 125V dc essential power channel trouble, while both the computer and reflash module will more specifically indicate battery charger trouble.

The following alarm is provided in the control room for the 125V essential diesel auxiliary power system:

"125 VDC Diesel Generator Control Power System Trouble" - Alarms in control room if: 1) battery charger breaker open 2) battery breaker open 3) battery charger trouble 4) battery ground fault 5) battery undervoltage 6) auctioneering diode assembly input undervoltage 7) charger supply to D/G control panel open

Once again, Catawba does not have an alarm for dc bus overvoltage (question 3.a.5). Catawba's method of detecting a safety-related dc bus overvoltage condition is via battery charger overvoltage sensing circuitry. This method is effective since the battery charger is the only device normally connected to the dc bus which could induce a sustained overvoltage condition. Both an annunciator alarm as well as a computer alarm are provided in the control room for each train (division) to alert the operator of an overvoltage condition. Also provided for each train (division) is a reflash alarm located in the Electrical Penetration Room. Should an overvoltage condition occur on one of the dc busses, the operator will be alerted by an annunciator that a particular 125V dc diesel generator control power system train (division) is having trouble. More specifically, both the computer and the associated reflash module will indicate that the train's (division's) respective charger is malfunctioning.

Again, Catawba does not have an alarm for battery discharge (question 3.a.7). A dual undervoltage relaying scheme is utilized to detect battery discharge for each load channel. One relay is connected to the distribution bus (load side of the charger output breaker), while the other relay is connected to the battery charger output (supply side of the charger output breaker). The battery charger relay is set to drop out at 125V dc while the distribution center relay is set to drop out at 107V dc. Consequently, should a charger fail or its output voltage go low, the charger undervoltage relay will drop out first triggering a control room annunciator and computer alarm and a local reflash alarm. The annunciator will indicate that a particular 125V dc diesel generator control power system train (division) is having trouble, while both the computer and reflash module will more specifically indicate battery charger trouble. Should the battery voltage drop further, the distribution bus undervoltage relay will drop out triggering both a control room alarm (annunciator and computer) as well as a local reflash alarm. Once again the annunciator will indicate that a particular 125V dc diesel generator control power system train (division) is having trouble, while both the computer and reflash module will more specifically indicate low battery voltage.

b. Indications

1. **Battery float charge current?**

2. **Battery circuit output current?**

3. **Battery discharge?**

4. **Bus voltage?**

Response

Of the four indications listed above, only bus voltage is provided. The existing control room alarms and indications in conjunction with the surveillance and maintenance activities performed on the safety-related dc power systems at Catawba assure that the systems remain reliable and capable of performing their design basis functions. The absence of battery float charge indication or battery circuit output current indication in the control room does not jeopardize the systems' reliability or capability to perform their design basis functions. Independent and redundant bus voltage indication is provided in the control room as well as locally for each load channel in the EPL system and each train (division) in the EPQ system. Bus voltage indication provides a highly effective means of monitoring system availability and assuring system reliability. System reliability is further enhanced by surveillance and maintenance activities which include a periodic check (once every 7 days per technical specification requirements) of overall battery float charge voltage and individual cell float charge voltage, as well as verification of proper electrolyte level and specific gravity (for lead acid cells only).

Battery discharge indication is unnecessary given the dual undervoltage relaying scheme employed at Catawba as described above. This scheme provides a very reliable and rapid means of alerting the control room operator of a potential battery discharge condition in either of the safety-related dc power systems (EPL and EPQ). In addition, the bus voltmeters described above provide a reliable means of monitoring battery discharge.

It should also be noted that during periods of maintenance and testing, additional local indications are provided and are monitored by technicians to ensure all parameters are within specification.

c. **Does the unit have written procedures for response to the above alarms and indications?**

Response

For those alarms identified for Catawba, written response procedures exist.

4. **Does this unit have indication of bypassed and inoperable status of circuit breakers or other devices that can be used to disconnect the battery and battery charger from its dc bus and the battery charger from its ac power source during maintenance or testing?**

Response

Yes

5. If the answer to any part of question 3 or 4 is no, then provide information justifying the existing design features of the facility's safety-related dc systems.

Response
Justification for all "no" answers has been provided with each question above. Regarding question 3 concerning alarms and indications, it should be noted that a review of control room alarms and indications was conducted as part of Duke Power Company's response to Supplement 1 to NUREG-0737, "Requirements for Emergency Response Capability", which demonstrated the acceptability of existing alarms and indications.

6. (1) Have you conducted a review of maintenance and testing activities to minimize the potential for human error causing more than one dc division to be unavailable? and (2) Do plant procedures prohibit maintenance or testing on redundant dc divisions at the same time?

Response
(1) No. One supervisor handles the work requests for maintenance and testing. He knows when a dc division is unavailable. Also, maintenance and/or testing must be approved by the operations supervisor on duty. Therefore, the likelihood of taking more than one dc division out of service at the same time is minimal. (2) Yes. Procedures prohibit removing redundant trains.

7. Are maintenance, surveillance and test procedures regarding station batteries conducted routinely at this plant? Specifically:

a. At least once per 7 days are the following verified to be within acceptable limits:

1. Pilot cell electrolyte level?

2. Specific gravity or charging current?

3. Float Voltage?

4. Total bus voltage on float charge?

5. Physical condition of all cells?

b. At least once per 92 days, or within 7 days after a battery discharge, overcharge, or if the pilot cell readings are outside the 7-day surveillance requirements are the following verified to be within acceptable limits:

1. Electrolyte level of each cell?

2. **The average specific gravity of all cells?**

3. **The specific gravity of each cell?**

4. **The average electrolyte temperature of a representative number of cells?**

5. **The float voltage of each cell?**

6. **Visually inspect or measure resistance of terminals and connectors (including the connectors at the dc bus)?**

c. **At least every 18 months are the following verified:**

1. **Low resistance of each connection (by test)?**

2. **Physical condition of the battery?**

3. **Battery charger capability to deliver rated ampere output to the dc bus?**

4. **The capability of the battery to deliver its design duty cycle to the dc bus?**

5. **Each individual cell voltage is within acceptable limits during the service test?**

d. **At least every 60 months, is capacity of each battery verified by performance of a discharge test?**

e. **At least annually, is the battery capacity verified by performance discharge test, if the battery shows signs of degradation or has reached 85% of the expected service life?**

Response

The Catawba Technical Specifications have provisions equivalent to those found in the Westinghouse Standard Technical Specifications for maintenance and surveillance. The answer to all parts of question 7 is yes, except for inspecting or measuring resistance of the connectors at the dc bus (question 7.b.6). These connectors are located in a distribution center and would require the removal of panels to inspect.

Applicable procedures governing the above activities for the vital I&C system (other procedures exist for the diesel generator dc system) are as follows:

IP/0/A/3710/15, Batteries Periodic Inspection (question 7.a.1-5 and 7.b.1-6)
IP/0/A/3710/08F, Vital Battery and Terminal Inspection (question 7.c.1&2)
IP/0/A/3710/08E, Vital Battery and Terminal Inspection (question 7.c.3)
IP/0/A/3710/10, Vital Batteries Service Test (question 7.c.4&5)
IP/0/A/3710/19, 125VDC Vital Instrumentation and Control Power System Battery Capacity Test (question 7.d&e)

8. Does this plant have operational features such that following loss of one safety-related dc power supply or bus:

a. Capability is maintained for ensuring continued and adequate reactor cooling?

b. Reactor coolant system integrity and isolation capability are maintained?

c. Operating procedures, instrumentation (including indicators and annunciators), and control functions are adequate to initiate systems as required to maintain adequate core cooling?

Response

Yes. Both the EPL system and EPQ system are designed with two independent and redundant trains (divisions) of power. Each train (division) of the EPL system consists of two independent load channels (for a total of four load channels per unit) as described previously. Should one load channel be lost, the other three will continue to supply their loads. Should two channels in the same train (division) be lost, the redundant load channels in the opposite train (division) will continue to supply their loads. Should one train (division) of the EPQ system be lost, the redundant train will continue to supply its loads.

Should a train (division) be lost in either the EPL or EPQ systems, control room annunciators, computer alarms, and local alarms would be triggered. Since all control room annunciators, computer alarms, and local alarms are independent and redundant for each load channel in the EPL system and each train (division) in the EPQ system, the loss of one train of safety-related dc power would not affect the alarms on the remaining load channels or trains. Also, each load channel in the EPL system as well as each train (division) in the EPQ system has a dedicated bus voltmeter mounted in the control room as well as locally. These would be available to continuously monitor dc bus voltage. Operating procedures, which include annunciator response procedures, would be consulted to guide the operator to the applicable technical specification section(s) so that appropriate action could be taken to maintain adequate core cooling and safely shut the unit down. In addition, should the unit trip due to loss of an entire train of dc power from the EPL system, appropriate emergency procedures would be invoked to maintain adequate core cooling and safely shut down the unit.

9. If the answer to any part of question 6, 7 or 8 is no, then provide your basis for not performing the maintenance, surveillance and test procedures described and/or the bases for not including the operational features cited.

Response

Justification for all "no" answers has been provided with each question above.

Figure C-1 -
Catawba Vital I&C DC Power Arrangement

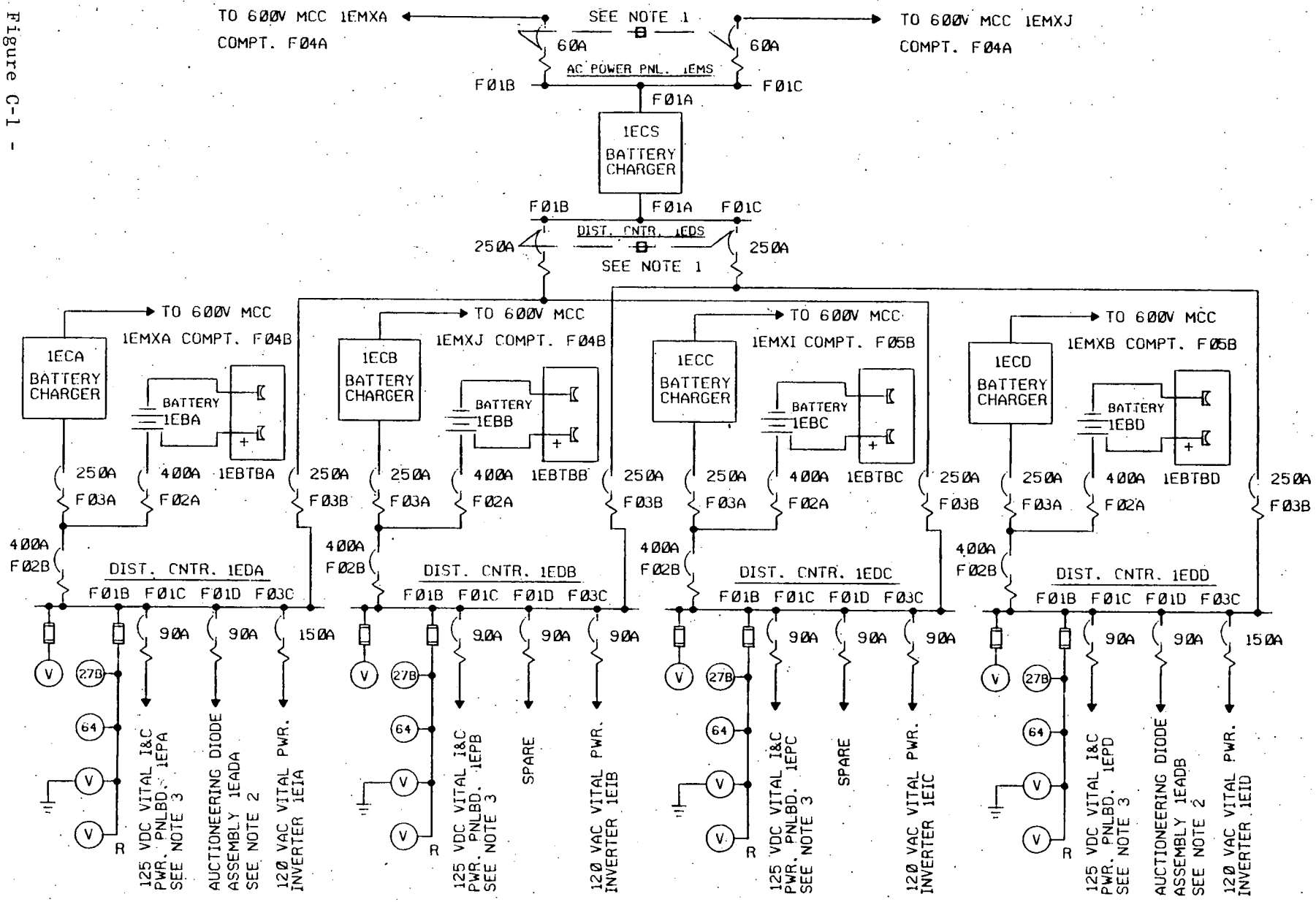


FIGURE 1

LEGEND

- TEST SET/CONSTANT CURR. CHARGER CONNECTION
- BATTERY
- FUSE
- BREAKER
- VOLTMETER
- 27B UNDERVOLTAGE RELAY
- 64 GROUND DETECTOR RELAY
- R - REMOTE DEVICE

NOTES:

1. BREAKERS ARE KIRK KEY INTERLOCKED SUCH THAT ONLY ONE BREAKER CAN BE CLOSED AT ONE TIME.
2. SEE FIGURE 2 FOR AUCTIONEERING DIODE ASSEMBLIES.
3. SEE FIGURE 3 FOR POWER PANELBOARDS.

THIS DRAWING IS A SUMMARY ONE-LINE DIAGRAM. IT IS TYPICAL FOR BOTH UNITS. UNIT 1 IS SHOWN. EQUIPMENT DESIGNATIONS CHANGE ACCORDINGLY FOR UNIT 2. UNUSED COMPARTMENTS (NO INSTALLED BREAKERS) ARE NOT SHOWN. FOR COMPLETE SYSTEM INFORMATION, REFER TO DESIGN DOCUMENTS.

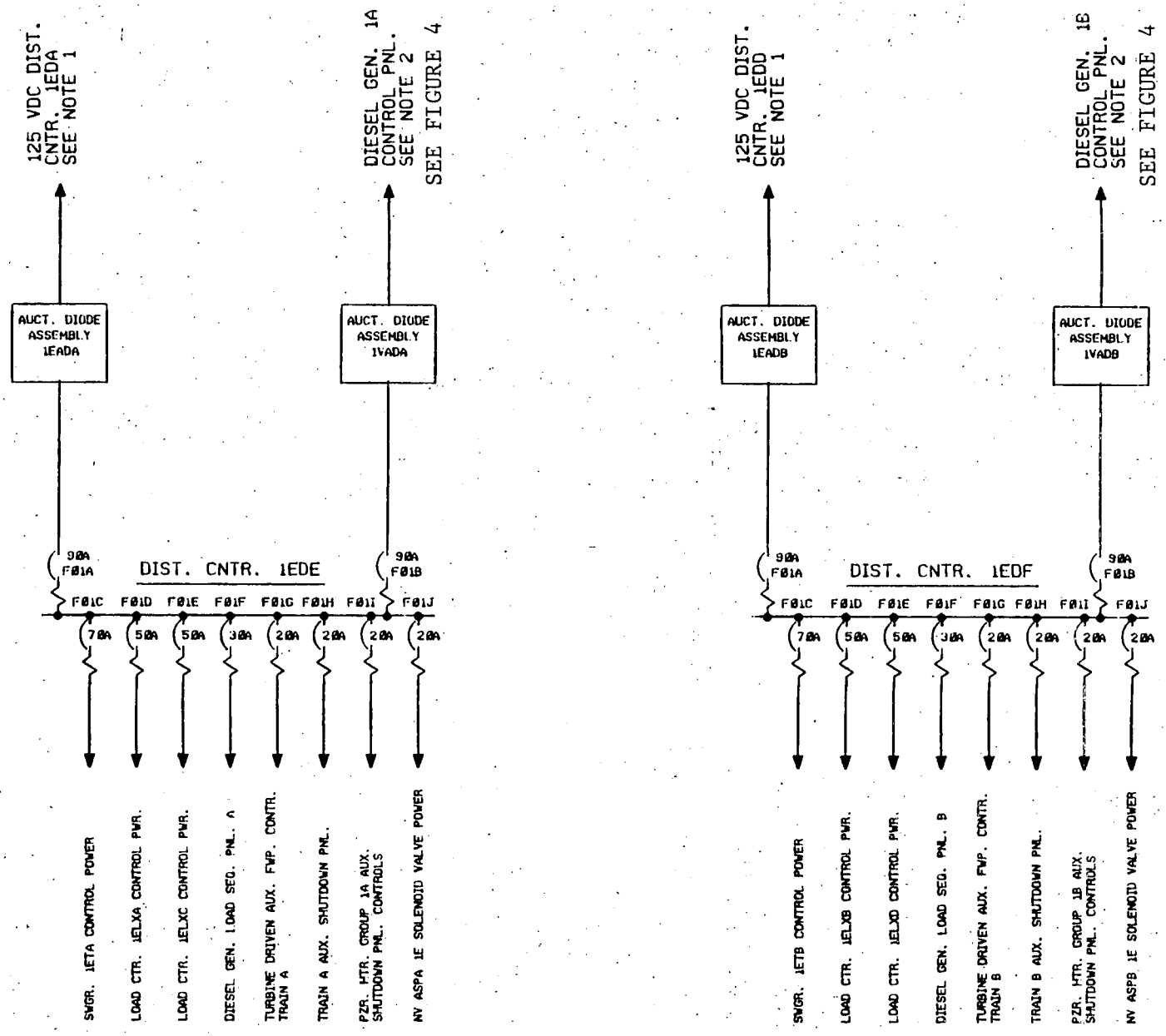
FIGURE 1

SUMMARY DIAGRAM FOR THE 125 VDC VITAL I AND C POWER SYSTEM (EPL)- BATTERIES, BATTERY CHARGERS AND DISTRIBUTION CENTERS

1991 CATAWBA SITA AUDIT
DATE: AUGUST 19, 1991

Figure C-2 -
Catawba Vital I&C DC Power Arrangement

FIGURE 2



LEGEND

BREAKER

NOTES:

1. 125 VDC VITAL I & C DISTRIBUTION CENTERS 1EDA AND 1EDD ARE SHOWN ON FIGURE 1.
2. THE DIESEL GENERATOR CONTROL PANELS ARE PART OF THE 125 VDC ESSEN. DIESEL AUXILIARY POWER SYSTEM (EPQ).

THIS DRAWING IS A SUMMARY ONE-LINE DIAGRAM. IT IS TYPICAL FOR BOTH UNITS. UNIT 1 IS SHOWN. EQUIPMENT DESIGNATIONS CHANGE ACCORDINGLY FOR UNIT 2. UNUSED COMPARTMENTS (NO INSTALLED BREAKERS) ARE NOT SHOWN. FOR COMPLETE SYSTEM INFORMATION, REFER TO DESIGN DOCUMENTS.

FIGURE 2

SUMMARY DIAGRAM FOR THE 125 VDC VITAL I AND C POWER SYSTEM (EPL)- AUCTIONEERING DIODE ASSEMBLIES AND ASSOCIATED DISTRIBUTION CENTERS

SPECIFICATION NO.: CNS-1106.01-EPL-0001
DATE: DECEMBER 20, 1990
REVISION NUMBER: 0

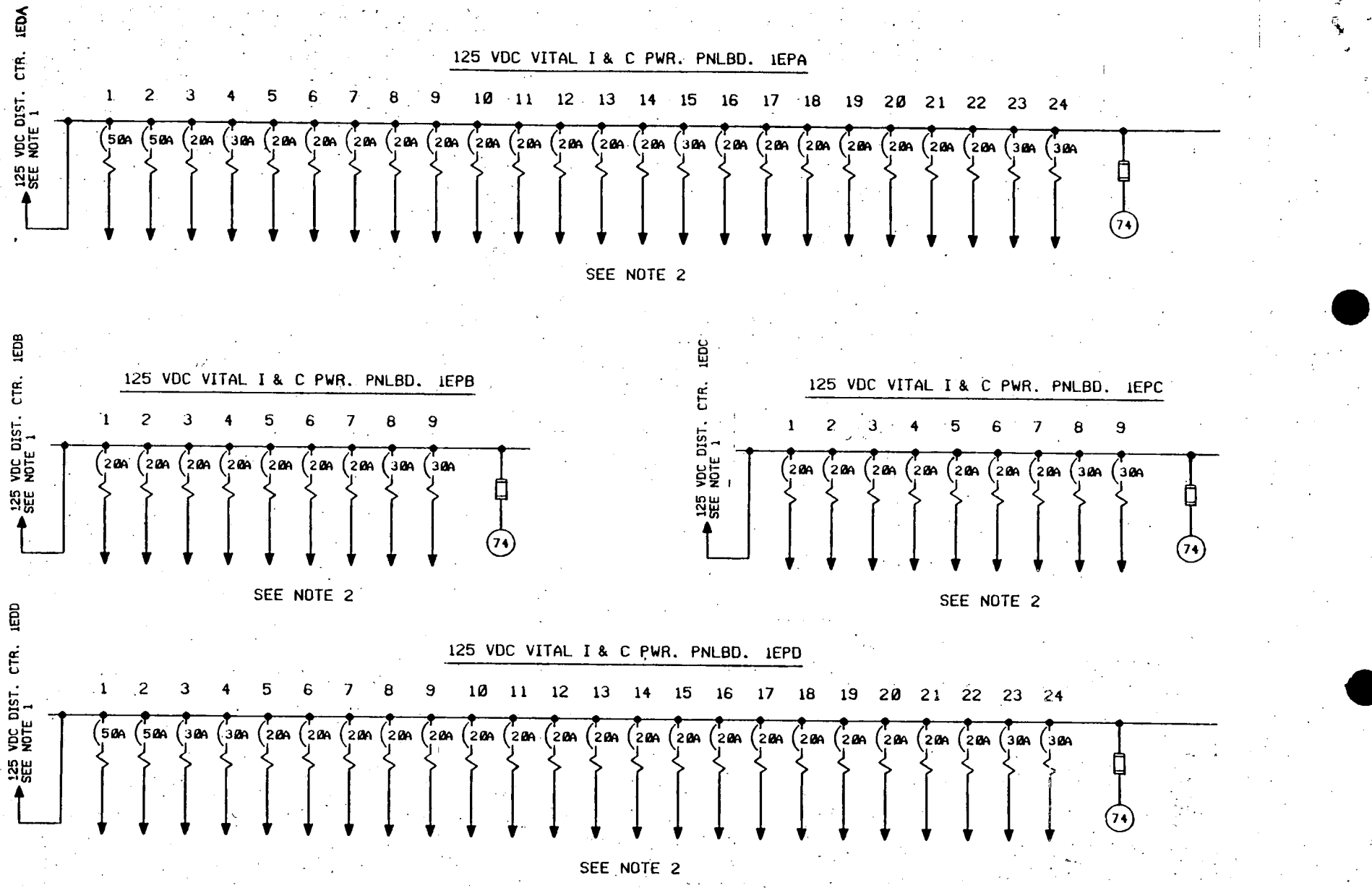


Figure C-3 - Catawba Vital I&C DC Power Arrangement FIGURE 3

LEGEND

BREAKER

74 UNDERVOLTAGE ALARM

FUSE

NOTES:

1. 125 VDC VITAL I & C DISTRIBUTION CENTERS 1EDA, 1EDB, 1EDC, AND 1EDD ARE SHOWN ON FIGURE 1.
2. SEE DESIGN DOCUMENTS FOR DETAILED LOAD INFORMATION.

THIS DRAWING IS A SUMMARY ONE-LINE DIAGRAM. IT IS TYPICAL FOR BOTH UNITS. UNIT 1 IS SHOWN. EQUIPMENT DESIGNATIONS CHANGE ACCORDINGLY FOR UNIT 2. UNUSED BREAKER SLOTS ARE NOT SHOWN. FOR COMPLETE INFORMATION, REFER TO DESIGN DOCUMENTS.

FIGURE 3

SUMMARY DIAGRAM FOR THE 125 VDC VITAL I AND C POWER SYSTEM (EPL)-POWER PANELBOARDS

SPECIFICATION NO.: CNS-1206.01-EPL-0001
DATE: DECEMBER 20, 1990
REVISION NUMBER: 0

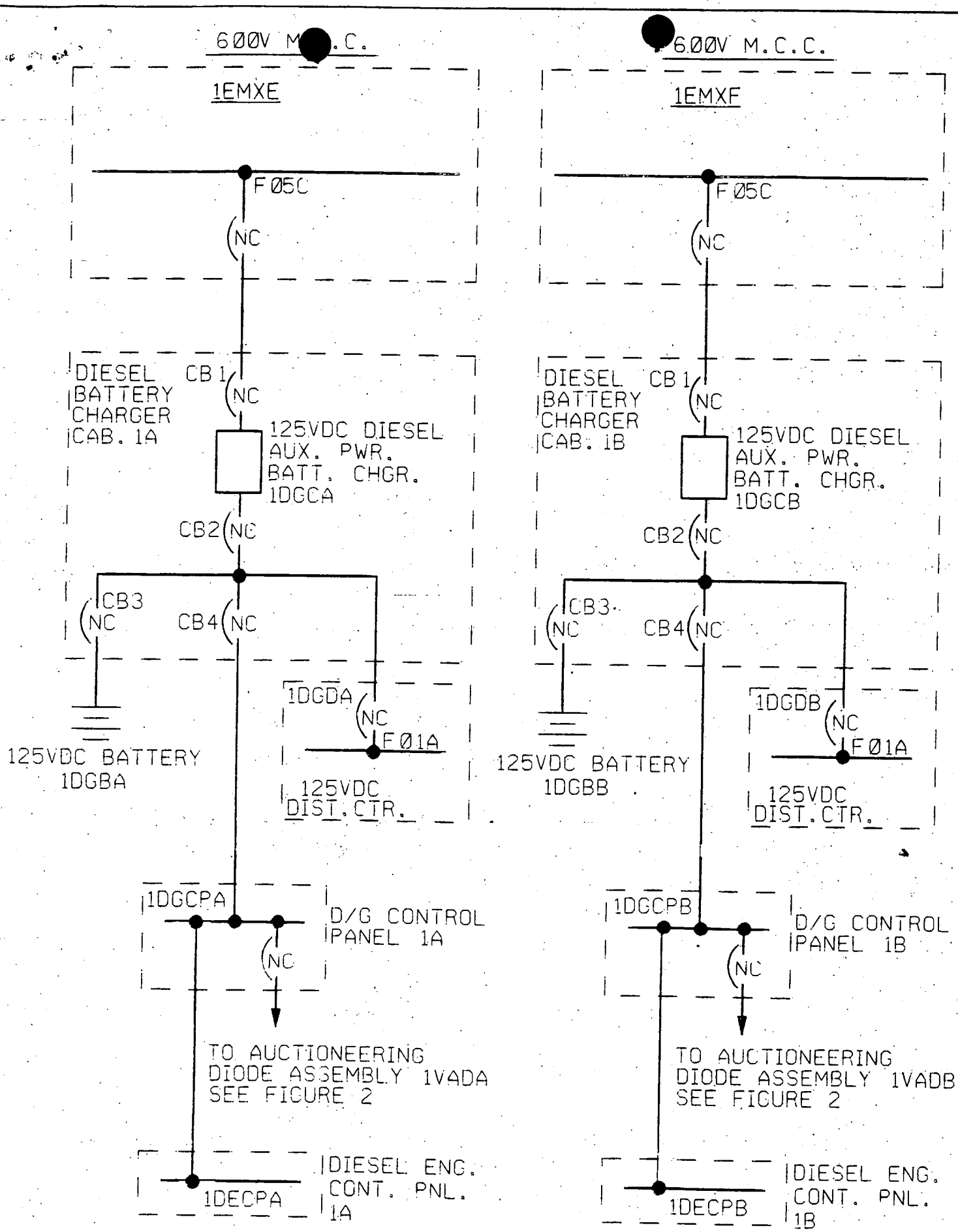


Figure C-4 -
Catawba Essential Diesel DC Auxiliary Power Arrangement

FIGURE 4

SUMMARY DIAGRAM FOR THE 125VDC ESSENTIAL DIESEL AUXILIARY POWER SYSTEM (EPQ)