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DUKE POWER

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

Subject: Catawba Nuclear Station
Docket Nos. 50-413 and 50-414
Response To Request For Additional Information
Regarding Breaker Coordination
(TAC Nos. M86367, M86368, M94847, M94848)

Attached is the response to the NRC Request For Additional Information, dated April 30, 1996, concerning breaker coordination issues at the Catawba Nuclear Station (Attachment A).

For your convenience, please refer to Attachment B for a list of Systems Designations used in the response and Attachment C for a simplified summary diagram of the 125 VDC Vital I & C Power System (EPL) Batteries, Battery Chargers and Distribution Centers. Attachment D identifies the interrupting ratings of various breakers used in the 600 VAC Essential Auxiliary Power System (EPE) and the 125 VDC Vital I & C Power System (EPL).

If there are any questions as a result of this review, please contact Jeff Lowery, Catawba Regulatory Compliance, at (803) 831-3414.

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Vice President
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Attachments

xc: S. D. Ebneter, Regional Administrator, Region II

P. S. Tam, ONRR

R. J. Freudenberger, Catawba Senior Resident Inspector

bxc:	ELL	EC050
	M. S. Kitlan	CN01RC
	J. E. Snyder	MG01RC
	J. E. Burchfield	ON03RC
	P. R. Newton	PB05E
	K. E. Nicholson	CN01RC
	J. E. Stoner	EC09N
	K. R. Caraway	EC09N
	P. M. Abraham	EC08I
	R. M. Glover	CN03CE
	J. W. Caldwell	CN03CE
	R. A. Dickard	CN03CE
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	J. L. Lowery	CN01RC
	SREC	
	NCMPA-1	
	NCEMC	
	PMPA	

ATTACHMENT A

DUKE POWER COMPANY

CATAWBA NUCLEAR STATION

RESPONSE TO REQUEST FOR ADDITIONAL INFORMATION

BREAKER COORDINATION

I. Probabilistic Safety Assessment Issues

In general the Licensee's PRA submittal for continued plant operation with uncoordinated circuit breakers in the 125 Volt DC EPL system and 600 Volt AC EPE system should address the impact of (1) initiating event (IE) frequency, (2) conditional impact of the IE on plant operation, (3) recovery of the plant mitigation capability, and (4) accident recovery via Safe Shutdown Facility (SSF). The Licensee's submittal should specifically address the following:

I.A 125 Volt DC Vital I&C Power System, EPL

1. Estimate initiating event frequency: The breaker coordination study provided with the letter dated March 2, 1994, from D.L. Rehn, Duke Power, excluded line-to-line cable faults in the outgoing feeders of the EPL load distribution centers. Based on the discussion presented in CNC-1535.00-00-0007, line-to-line cable faults appear rare. Using historical event data and estimated total number of cables from all of Duke's nuclear power facilities (i.e. Oconee, McGuire, and Catawba), and other industry data, e.g. IEEE Standard 500-1984, estimate the probability of a cable fault tripping any of the 125 Volt DC load groups (e.g. 1EDA, 1EDB, 1EDC, and 1EDD). Address the advantages in the use of the 2 kV rated interlocked armor cable. If no cable faults have occurred, assume one single line-to-line fault to estimate the EPL cable fault initiating event frequency. Also discuss any cable enhancement programs at Duke that would provide additional assurance that the probability of cable faults at Duke facilities will continue to remain small.

DUKE POWER COMPANY RESPONSE

The initiating event (IE) frequency for the T14 initiator (Loss of a Vital Instrumentation and Control Power Bus) used in the Catawba Integrated Plant Examination (IPE) and the breaker coordination study (December 29, 1994) is 0.05 based on one loss of a 125V DC Vital I&C Control Power distribution center in approximately twenty reactor-years (Catawba and McGuire) experience. The single incident was the result of an inadvertent manual tripping of the breaker, and not an electrical component failure or electrical fault. The initiator frequency derived from the McGuire and Catawba operational experience is in agreement with the fault tree solution (see Catawba PRA, Rev. 1, Appendix A.11) for failure of a control power distribution center.

In the 125V DC Vital I&C Power fault tree mentioned above, the various fault components are treated as a single bus fault on the distribution center or dc panelboard itself. Thus, the bus fault is a "black box" in which the distribution center or panelboard faults, faults on cables to the loads, and faults at terminals between the distribution points and the loads are implicitly included. A generic value for bus fault probability, 2.E-07/hr, is used in the fault tree for the distribution center fault. This converts to about 2E-03/yr. For comparison, IEEE Standard 500-1984 gives a composite cable failure rate of 7.54E-06/hr/plant for power, control, and signal cables combined. Therefore, if a typical plant has approximately 18,500 cables, and a typical distribution center has about 30 loads, then a single distribution center's failure rate due to cable fault is on the order of 1E-04/year. In our judgment the cable fault contribution is adequately covered by the distribution center fault value.

If a single line-to-line cable fault resulting in the loss of a distribution center or a power panelboard is assumed to have occurred at either Catawba or McGuire, then the EPL cable fault frequency can be determined from the single fault in now approximately 46 reactor years of experience. This is a cable fault frequency of approximately 2E-02. The probability of that fault causing the loss of a single distribution center is (2E-02)(30)/18,500 = 3E-05/year.

<u>Interlocked Armor Cable</u>

The cable has the same construction as non-armored cable, except that in addition, a steel armor covering is applied around the entire outer circumference of the cable. This interlocked steel outer covering provides protection to the cable from damage or degradation during loading and shipment from the factory to the plant, protection during unloading at the plant, protection during the cable pulling installation at the plant, as well as protection while in service.

Instead of being rated at only 600VAC, the cable was purchased with an insulation system rated at 2000VAC (2KV). The individual cable conductors are high potential tested under water and spark tested at the factory at the values required by the standards for 2KV cable. The individual conductors are then assembled into a multi-conductor cable with an interlocked armor covering.

The low voltage of 125VDC does not produce any internal ionization or corona that would cause an internal flashover or failure between conductors within the armored cable. The 2KV rated cable insulation system has a greater thickness than the insulation system of a standard 600V rated cable (which is adequate for this application), hence it provides a higher dielectric capability, better physical protection, and more margin for aging considerations.

Duke had an interlocked armor cable fault test performed at Westinghouse Electric Corporation's High Power Laboratory in East Pittsburgh, PA in which a short circuit was applied between conductors followed by energization of the cable. The test did not induce any additional shorts between conductors within the multi-conductor cable. The completed test results are documented in test report: MCM-1354.00-00-0029 titled "Cable Application - Fault Tests" and dated August 18-20, 1976.

Similar cable is used at Oconee Nuclear Station, where a cable monitoring program has been established. For the cable monitoring program, six cable samples were installed inside the Unit 2 containment building for this dedicated purpose. At five year intervals over the life of the plant, a five foot segment is removed from each cable sample for testing. The purpose of the test is to measure, document, and trend the mechanical and electrical properties of the cable. In general, the past test results collectively show that the cable samples are in good physical condition after 20 years in a reactor building environment. The cable used at Catawba is identical to or better than the cable used at Oconee, including the type of insulation material used, the insulation material formulation, and the overall cable construction. The environmental qualification requirements of Catawba are enveloped by the Oconee requirements; hence, the data obtained from the Oconee Condition Monitoring Program is directly applicable to the cable at Catawba.

Catawba Cable Failure Trending Program

A program to evaluate and trend plant cable problems was put into place in January 1995. The purpose of this program is to evaluate and record problems or malfunctions of plant cables and if an adverse trend develops, action is taken to address the problem. The kinds of deficiencies that would be reported in this program include short circuits, insulation damage, and problems with cable splices or terminations. Since cable of the same basic specifications and ratings is used in both safety and nonsafety applications at Catawba, all plant system cables are included in the scope of the trending program. This results in a total of approximately 37,400 cables for both units at Catawba.

A baseline failure goal is established for each equipment type in the trending program. This goal is established from analyzing typical industry experience and with a goal of supporting high plant reliability. Failure trends are evaluated across 18 month intervals and are classified in one of three color categories. Category GREEN means that the failure trend is below, or less than, the baseline goal. Category YELLOW means that the failure trend is below the baseline goal but is trending in a direction that will exceed the baseline failure goal if action is not taken, or the failure trend is above the baseline but is trending in a direction that shows improvement in performance such that the goal is almost obtained. Category RED means that the failure trend is above the baseline failure goal, showing no sign of immediate recovery, and requires action to improve performance. If a quarterly report shows equipment in the RED category, the equipment engineer submits an action plan addressing the significance, cause and corrective actions planned. An upcoming revision to the program will require submitting an action plan when equipment is in the YELLOW category.

Failure data is available from several different sources. The work management system is searched for all work orders written on the equipment type "CABLE". Word searches are also conducted in the Problem Investigation Process to find any reports that include discussion of cable in the problem description section. Finally the plant engineer who does the trending report also helps resolve many of the questions or problems with plant cables and that engineer will typically have direct knowledge of cable problems as they are investigated. Data on failures or problems with cables is collected at the end of each quarter and trend reports are published in the Failure Analysis And Trending System Quarterly Report along with reports on other types of equipment

Since the cable failure trending program began in January 1995 there has only been one failure reported. This failure in the second quarter of 1995 involved a single phase to ground short circuit of a vendor supplied wire in a motor control center. This wire connected the line side of a 600V breaker to it's bus and the short burned through without any breaker clearing. This failure was not specifically within the scope of the cable trending program but was reported as a failure for tracking purposes. When the cable trending program was put together in early 1995 a high level review of all available cable problem reports was conducted. This baseline review did not identify any short circuit type failures of Duke cables back to the 1983 time frame.

Some of the criteria and practices used in applying Duke cabling that will contribute to continued reliability are as follows. Duke does a minimal amount of cable splicing and does not allow any splices in raceways. Any safety related cables routed underground are installed in conduit or cable trenches. None of these cables are direct buried in the earth. Fire detection and/or protection is provided in all plant areas where cables are routed. Cable ampacities utilized for Duke cables are based on 70% of the standard industry ampacity ratings. Duke uses conservative conductor voltage ratings and uses the steel interlocked armor for additional physical protection.

Battery Output Circuit Breaker

Unlike some other plants where the battery is connected directly to the main dc distribution center bus with no automatic or manual disconnect means, Duke plants incorporate a battery source output circuit breaker between the battery and the bus. If no battery source output disconnect means was provided, a hypothesized fault on the main dc distribution center would unnecessarily deplete the battery of its entire capacity, rendering it unavailable as a source of dc power after the fault is cleared. The battery source output breaker is provided in Duke plants in order to maintain the integrity of the battery during any hypothesized dc system fault condition and retain the capacity of the battery source that would otherwise be depleted during the hypothesized fault. This isolation feature preserves the battery capability, making it available after the faulted equipment is isolated or repaired. Accordingly, there is an increased likelihood of fault recovery than otherwise.

It should be stressed that it is highly unlikely that a fault of the type and magnitude necessary to trip the battery source output breaker would occur since the dc battery system is ungrounded and is provided with a ground fault detection system.

2. Plant Response: Describe the plant response and conditional loss of mitigating equipment in the event of loss of each of the load group distribution centers.

DUKE POWER COMPANY RESPONSE

Note: At Catawba, the Unit 1 125VDC Vital I and C Power (EPL) System is essentially identical to the Unit 2 EPL System; and each is completely independent from the other. Therefore, in order to simplify the discussion, the following description is for Unit 1; however, it equally applies to Unit 2.

The effect of the loss of each of the load group distribution centers is as follows:

1EDA Loss of 125V DC Vital I&C Power Panelboard 1EPA, Auctioneering Diode Assembly 1EADA, and loss of Inverter 1EIA. The loss of 1EPA causes the loss of power to the control solenoids for the A-Train Main Steam Isolation Valves (MSIV), and the control solenoids for the A-Train Main Feedwater Control Valves resulting in secondary plant transients followed by a reactor trip. The loss of Auctioneering Diode Assembly 1EADA causes the loss of only one of two auctioneered sources of power to 125V DC Distribution Center 1EDE which is needed for control of Train-A Engineered Safety Features (ESF) equipment and Train-A Turbine Driven Auxiliary Feedwater (AFW) Pump control. The loss of Inverter 1EIA causes loss of 120V AC Vital I&C Power Panelboard 1ERPA. 1ERPA supplies SSPS Channel I power, ESFAS Train-A slave relay power and process control for the Train-A Pressurizer PORV.

1EDB Loss of 125V DC Vital I&C Power Panelboard 1EPB, and loss of Inverter 1EIB. The loss of Inverter 1EIB causes loss of 120V AC Vital I&C Power Panelboard 1ERPB. 1ERPB supplies SSPS Channel II power.

1EDC Loss of 125V DC Vital I&C Power Panelboard 1EPC, and loss of Inverter 1EIC. The loss of Inverter 1EIC causes loss of 120V AC Vital I&C Power Panelboard 1ERPC. 1ERPC supplies SSPS Channel III power.

1EDD Loss of 125V DC Vital I&C Power Panelboard 1EPD, Auctioneering Diode Assembly 1EADB, and loss of Inverter 1EID. The loss of 1EPD causes the loss of power to the control solenoids for the B-Train MSIVs, and the control solenoids for the B-Train Main Feedwater Control Valves resulting in secondary plant transients followed by a reactor trip. The loss of Auctioneering Diode Assembly 1EADB causes the loss of only one of two auctioneered sources of power to 125V DC Distribution Center 1EDF which is needed for control of Train-B ESF equipment and Train-B Turbine Driven AFW Pump control. The loss of Inverter 1EID causes loss of 120V AC Vital I&C Power Panelboard 1ERPD. 1ERPD supplies SSPS Channel IV power, ESFAS Train-B slave relay power and process control for the Train-B Pressurizer PORVs.

1EDE Loss of Train-A 4160V AC Essential Switchgear control power, loss of Train-A 600V AC Essential Load Center control power, loss of Diesel Generator Load Sequencer Panel A, loss of Train-A Turbine Driven AFW Pump Control, and loss of Train-A Auxiliary Shutdown Panel.

1EDF Loss of Train-B 4160V AC Essential Switchgear control power, loss of Train-B 600V AC Essential Load Center control power, loss of Diesel Generator Load Sequencer Panel B, loss of Train-B Turbine Driven AFW Pump Control, loss of Train-B PORV Solenoids Control Power and loss of Train-B Auxiliary Shutdown Panel.

In summary, a loss of power on 1EDA or 1EDD would result in a plant transient, but would not render the mitigating systems, except for the pressurizer PORV automatic control (one of three in Train A or two of three in Train B), inoperable. A loss of power on 1EDB or 1EDC simply results in one channel of the SSPS to be tripped. Loss of power on 1EDE or 1EDF would cause one train of safety systems to be without control power but would not result in a plant transient and, therefore, not result in an immediate need for a mitigating system.

When the loss of power on an EPL bus does not cause a plant trip, the affected dc bus would be considered inoperable, requiring resolution of the problem within the applicable Technical Specifications Action Statement specified time period. However, since in this situation there is no accident requiring the use of that equipment, continued power operation is not immediately affected.

3. Plant Recovery: For each of the cable faults that result in plant transients described in response to question 2 above, provide the conditional probability of mitigation failure, without taking credit for the safe shut down facility (SSF). Describe any credit taken for operator recovery actions.

DUKE POWER COMPANY RESPONSE

As stated in response to Question I.A.2, loss of power on 1EDA or 1EDD would result in a plant trip. In the existing analysis, one train of safety systems is also assumed to lose control power. The two resulting cut sets, which include the SSF capability, have a combined frequency of 6.7E-8/Reactor-Year. Without the SSF, the value becomes 1.2E-6/Reactor Year. Thus, the conditional probability of mitigation system failure without taking credit for the SSF is estimated to be 2.4E-5.

The existing PRA analysis of the T14 event did **not** take credit for recovering from the initiating bus fault.

4. Safe Shutdown Facility: For each scenario described in response to question 3, provide the credit that could be taken for the SSF, i.e. the conditional probability of failure of the SSF given each of the scenarios described in response to questions 2 and 3 above.

DUKE POWER COMPANY RESPONSE

If the plant systems that provide the reactor coolant system heat removal and the reactor coolant pump seal cooling functions are unavailable or are failed following the T14 event, the SSF could be used to maintain safe shutdown of the plant. The failure modes of the SSF include operator failure to utilize the SSF in a timely manner, maintenance unavailability, latent human error and hardware failures. Of these, the operator failure (0.03) and the maintenance unavailability (0.026) show up in cut sets above 1E-8.

5. Calculation CNC-1535.00-00-0007, page 5, considered the initiating event from the loss of Vital I&C bus, T14, only. Discuss the impact on CDF from loss of other Vital I&C buses in the EPL system. Specifically, provide the rationale for the following statements in paragraph 2, page 5 of the calculation:

   a. "The worst case faults result in a loss of one of four load distribution centers, 1EDA, 1EDB, 1EDC, or 1EDD. These load group distribution centers are important to normal operation but none are essential for plant shutdown."

   ## DUKE POWER COMPANY RESPONSE

   The four load distribution centers 1EDA, 1EDB, 1EDC, and 1EDD, are normally aligned and operated independent of one another and serve four independent load channels. Considering the independence of the channels, then a "worst case fault" can result in the loss of only one channel.

   The core damage frequency impact of the loss of power on an EPL bus is discussed in response to Question I.A.3.

   Loss of 1EDB or 1EDC results in a loss of a Vital I&C Power 120V ac Inverter and the loss of an SSPS channel, a nuclear instrumentation channel, and a process protection channel. Loss of 1EDA or 1EDD results in similar channel losses plus the loss of automatic control of one or two primary PORVs and loss of the power maintaining the main steam isolation valves open and the main feedwater control valves open. Loss of either of these load group distribution centers will result in a plant trip.

   Since a channel trip would occur on loss of power on any one of these channels, the load groups 1EDA, 1EDB, 1EDC, and 1EDD are "described" as "important to normal [power] operation". Further, in the event of power failure to one of these channels, 1EDE and 1EDF (which provide control power for the safety equipment needed for safe shutdown of the plant) continue to have power; therefore, the statement "but none are essential for shutdown" is made in the referenced calculation.

b. "None of the faults examined caused the complete loss of Auctioneered Distribution Center 1EDE, although power from one of the two auctioneered diode assemblies providing power to 1EDE would be lost when its associated load group distribution center fails by fault. The second of the auctioneered distribution center's power supplies is a train of the 125V dc Diesel Essential Auxiliary Power System which is unaffected by any of the documented breaker coordination problems."

DUKE POWER COMPANY RESPONSE

See response 5.a. above.

I.B 600 Volt AC Essential System, EPE

1. Estimate initiating event frequency: The breaker coordination study provided with the letter dated March 2, 1994, from D.L. Rehn, Duke Power, excluded cable faults in the outgoing feeders of the EPE system Motor Control Centers (MCCs). Using historical event data and estimated total number of cables from all of Duke's nuclear power facilities (i.e. Oconee, McGuire, and Catawba), and other industry data e.g. IEEE Standard 500-1984, estimate the probability of a cable fault tripping any one of the 11 EPE MCCs. Address the advantages in the use of the 2 kV rated interlocked armor cable. If no cable faults have occurred, assume one cable fault to estimate the EPE system cable fault initiating event frequency. Also discuss any cable enhancement programs at Duke that would provide additional assurance that the probability of cable faults at Duke facilities will continue to remain small.

DUKE POWER COMPANY RESPONSE

As indicated in the Duke submittal of December 29, 1994 many of the EPE MCCs are considered to be adequately coordinated when considering that cable faults are unlikely. To substantiate this assumption, the large body of Duke cable experience (Oconee, McGuire and Catawba) was considered with favorable results. The seven reactor Duke system has accumulated about 120 reactor years of experience as of December 31, 1995. Considering that a typical unit contains approximately 18,500 cables, this is a substantial experience base. Our examination of the Duke cable experience did not identify any failures of significance. Even allowing for one or two failures, this data suggests a very low probability of cable faults (of the order of 2E-3 cable failures per year per plant). Further, using the IEEE 500 data of 4.8 failures per million hours per plant for power cable failures and assuming approximately 18,500 cables per plant suggests an estimated cable failure rate of approximately 2.3E-06 per cable year. With approximately 30 cable terminations in a typical 600 V MCC, the resulting probability of MCC failures due to cable fault is very small (7E-05/yr.). Thus, neglecting the cable fault in the breaker coordination analysis is a reasonable assumption. In the Catawba PRA, Section 2.1 is devoted to identifying the internal initiating events for accident sequences. Loss of an individual MCC was not identified as an initiator of interest. However, the models for the individual 600 V MCCs are included in the system's analysis (Appendix A16) so as to include the effect of losing power to front-line equipment powered from the MCC, following the occurrence of an accident that requires the mitigative action by this equipment.

Interlocked Armor Cable

The discussion of interlocked armor cable in the response to question 1.A.1 also applies to the 600 VAC Essential Auxiliary Power System (EPE) as well.

Catawba Cable Failure Trending Program

See description of this program in response to question I.A.1 above.

2. Plant Response: Describe the plant response and conditional loss of mitigating equipment in the event of loss of each of the MCCs.

DUKE POWER COMPANY RESPONSE

A review of the loads on each of the essential 600 V MCCs indicates that loss of power to one of these MCCs would not directly result in a reactor transient. On the other hand, the power failure may render one train of safety systems inoperable (for example, inability to change the position of a MOV). The other train would not be affected. In this case the applicable Technical Specification would be entered and the problem resolved within the specified time. Loss of power to the MCC would be alarmed in the control room. Conditions involving a train of equipment being in maintenance at the time the postulated power failure occurs are considered infrequent and still may not result in a reactor trip, but may require a plant shutdown if the required Technical Specification allowable time limit (generally one hour) is not satisfied.

3. Plant Recovery: For each of the cable faults that result in plant transients described in response to question 2 above, provide the conditional probability of mitigation failure, without taking credit for the safe shut down facility (SSF). Describe any credit taken for operator recovery actions.

DUKE POWER COMPANY RESPONSE

The response is not necessary since a plant transient is not expected to occur for this condition.

4. Safe Shutdown Facility: For each scenario described in response to question 3, provide the credit that could be taken for the SSF, i.e. the conditional probability of failure of the SSF given each of the scenarios described in response to questions 2 and 3 above.

DUKE POWER COMPANY RESPONSE

No response is necessary since no scenarios are identified in question 3 above. It must be noted, however, that for conditions involving the loss of dc or a loss of ac power events, the SSF could b used to remove core decay heat and to provide reactor coolant pump seal protection, should the event lead to the loss off all plant-side safety systems.

5. Calculation CNC-1535.00-00-0007, page 6, only considered the failure probability of MCC 1EMXG from a fault in the Control Room Air Handling Unit (AHU) #1 only. Discuss the impact on CDF from loss of other loads in the EPE system.

DUKE POWER COMPANY RESPONSE

From the answer to question #1 above, the probability of failure of a MCC due to a cable fault is approximately 7E-05/yr. Thus, the probability of loss of a MCC due to a cable fault is less by over an order of magnitude than the probability of a T11 initiator, 2E-03. The T11 initiator causes the loss of an entire train and bounds the consequences of a MCC failure.

The 600V ac MCCs support safety related frontline equipment. Referring to the Catawba PRA Appendix A.16, the probability of loss of power on a 600V ac MCC is approximately 1.5E-04 for a 24 hr. mission time. The cable fault contribution to the mission time failure rate is about 5E-07; and, therefore, does not significantly affect the overall MCC failure probability calculated in the existing documentation.

6. It appears that the 600 Volt MCC incoming breakers may be rated for 10,000 IAC. Discuss the impact on the above results (I.B, 1-5) of having used 10,000 IAC breakers in circuits where the fault currents are higher than 10,000 Amperes.

DUKE POWER COMPANY RESPONSE

In Oct. 92 Duke completed a follow-up review in response to Deviation 413,414/92-01-06 and documented the results in a report. The background section of this report stated that non-automatic breakers were considered for local isolation at EPE motor control centers. This option was dropped the report says when Duke learned that the breaker was "rated for only 10,000 IAC". Since this was strictly a manual disconnect that would not open automatically it did not have an interrupting rating. Engineers who were involved with the original specification of this equipment say that the non-automatic switch would only withstand 10000 amps short circuit current. It was eliminated from consideration because the equipment was being designed for at least 18,000 amps short circuit current. Westinghouse who was the primary supplier of breakers for this equipment says that "IAC" is not a standard abbreviation in their technical literature. The context of the above report was short circuit withstand rating, and it appears the above mentioned report should have said the breaker was only rated for 10,000 amps rather than 10,000 IAC.

Regardless of why this term was used it had no bearing on the design of this equipment since the non-automatic switch was determined to be unsuitable for the application before the equipment was built. The wiring diagram (CNM-1314.01-64) that shows the Westinghouse Type MC instantaneous magnetic incoming breaker currently used in EPE motor control centers was approved and issued to the file in Nov. 1977. This was 7 years before Catawba began operation in 1985. The Westinghouse Type MC breaker which is rated 22,000 UL Listed Interrupting Rating rms Symmetrical Amperes was installed in the EPE motor control centers during original fabrication. All of the EPE motor control centers have a worst case fault current at the bus of less than 18,000 amps. Data sheets listing the interrupting ratings of various breakers used in the EPE and EPL systems are listed in Attachment D.

The trip element for the incoming breaker cannot be removed because the breaker manufacturer has told Duke that the 800 amp frame MC breaker without a trip element is not qualified for use in a system with fault current exceeding 10,000 amps.

I.C EPL and EPE Systems

1. Confirm that the cable and equipment discussed in response to I.A and I.B above, are not inside containment, or potentially exposed to harsh environments caused by design basis events that could cause a lack of breaker coordination in the EPE and EPL systems. In addition, confirm that no single breaker miscoordination in the EPE and EPL systems can cause simultaneous trip of both Units.

DUKE POWER COMPANY RESPONSE

There are no motor control centers, distribution centers or panelboards associated with the EPE or EPL systems located inside containment; therefore none of the main feeder cabling passes through containment or would be directly affected by degraded containment conditions. These buses are also not located in any other plant areas where they would be directly exposed to harsh environments caused by design basis events. Although a detailed analysis of the routes of all the downstream feeder circuits to evaluate harsh environment impact on breaker coordination has not been conducted, the criteria used for designing these circuits and some of the reviews that have been performed, reduce the potential that any design basis harsh environment conditions would cause a miscoordination problem.

Any circuits going to devices inside containment are provided with redundant penetration protective devices. Due to the conservative ampacity rating of the electrical penetrations, the protective devices will typically coordinate with the upstream breakers. Most load feeder breakers in the EPL system serve multiple loads, and the main feeder cable branches out through fuses to the various loads. The fuses are selected based on guidance in Design Criteria 2.04-1, "Rating Of Control Circuit Fuses And Resistors For Use At McGuire And Catawba Nuclear Stations". These guidelines address coordination with upstream devices, and their purpose is to maximize plant reliability for both normal and accident conditions.

All plant cabling potentially exposed to high energy design basis events such as steam line break, feedwater line break or LOCA has been covered by interaction reviews. These reviews tabulated all equipment within various break zones and evaluated the direct impact of disabling that equipment. The purpose of the reviews, which are documented in section 3.6 of the FSAR, was to determine if any equipment required to mitigate the break or any equipment required to achieve and maintain a cold shutdown was located within the zone. Any equipment within the zone required for these functions had to be moved out of the zone or protected. Acceptability reviews are required for any plant modification that could impact the earlier analysis.

The separation criteria (Design Criteria 1.02) governing routing of Catawba cables also reduces the impact of postulated harsh environment conditions. Redundant train cabling is separated by a minimum distance of three feet horizontally and 5 feet vertically. Furthermore, the Fire Protection Plan typically allows the cabling for only one shutdown train to be routed in a given plant area. The fire protection analysis addressed the need for protective devices in the analyzed circuits to coordinate with upstream devices.

The typical distances from bus locations to areas where harsh environments could exist minimize the potential for the environment to cause a miscoordination problem since the cable resistances and protective devices on the branch circuits enhance coordination. Given the separation of the cabling and reviews that have been performed it would not appear credible that a harsh environment condition would challenge coordination on more than one train.

The 125VDC Vital I and C Power (EPL) Systems for Units 1 and 2 are completely separate and independent from each other; therefore, in the unlikely event of a breaker miscoordination due to a fault, at most one train of one unit would be affected.

Unit 1 of the EPE system has one motor control center, 1EMXG, that feeds safety related loads such as HVAC and service water that support the operation of both units. Loss of power to this bus is not an accident initiator and does not cause either unit to trip. 1EMXG is capable of being powered from Unit 1 or Unit 2 but the incoming breakers are mechanically interlocked such that only one incoming breaker can be closed at a time. The other Unit 1 motor control centers in the EPE system serve loads related to Unit 1 only. Unit 2 of the EPE system is the same as described here for Unit 1 with one bus that supplies HVAC and service water to both units. Loss of power to an EPE motor control center is not expected to cause a unit trip and no scenario has been identified that could cause a simultaneous trip of both units.

II. Electrical Engineering Issues

1. On page 5 of Attachment 3 contained in the December 29, 1994 submittal, it is indicated that EPL load group distribution centers 1EDA, 1EDB, 1EDC, and 1EDD are important for normal plant operation but nor are essential for plant shutdown. Provide a discussion to address if this refers to a plant shutdown following a plant transient that may be caused by the loss of one of these distribution centers or if accident conditions are also being considered. In addition, for non-accident conditions, address if the plant can be safely shutdown with loads that are powered only from the two auctioneered distribution centers. The response should be applicable to both units.

DUKE POWER COMPANY RESPONSE

Note: Though the following discussion makes reference to the Unit 1 125VDC Vital I and C Power (EPL) System, it equally applies to Unit 2.

The discussion in the December 29, 1994 submittal refers to a plant shutdown following a fault-induced transient during normal plant operation. As discussed in question 2 of section I.A, the loss of 125VDC Vital I and C Power (EPL) System Distribution Center 1EDA or 1EDD would result in a plant secondary system transient and a subsequent reactor trip. The loss of either distribution center 1EDB or 1EDC would cause the associated Solid State Protection System (SSPS) channel to trip; however, the loss of one of these busses would not in itself cause a plant transient or reactor trip.

The loads fed from distribution centers 1EDA, 1EDB, 1EDC, and 1EDD are not required to be energized during non-accident conditions in order to accomplish a safe shutdown of the plant. Should a fault-induced transient occur, the plant could be safely shutdown using only the loads powered from either Auctioneered Distribution Center 1EDE or 1EDF.

Reference the responses to questions 2 and 5 in Section I.A for additional information.

2. The EPL system design includes tie breakers that may be used to connect load group distribution center EDA to EDC and load group distribution center EDB to EDD. Identify and discuss any condition for which the tie breakers are to be used to re-configure the EPL system in this manner. The response should also address existing measures to limit the time period that such a configuration can be maintained and return the system to its normal configuration of four electrically independent distribution centers.

DUKE POWER COMPANY RESPONSE

The EPL System may be placed in a tied configuration during normal plant operation when:

a. A battery parameter monitored under the Technical Specification required weekly and quarterly surveillance is below the administrative and/or Technical Specification limits. The parameters monitored include cell voltage, electrolyte level, and specific gravity,

b. Other weekly and quarterly Technical Specification surveillance requirements (with respect to battery float voltage, electrolyte leakage, etc.) are not satisfied,

c. The Technical Specification required battery charger capacity test is performed,

d. An equipment failure occurs.

The Technical Specifications limit the amount of time the EPL System can remain in a tied configuration. Each train of the EPL System is typically in a tied configuration less than 2% of the time during normal plant operation. In general, any Technical Specification mandated maintenance activity that requires placing the EPL System in a tied configuration is planned and scheduled to minimize the amount of time the system is left in this configuration. In rare cases, the EPL System may be placed in a tied configuration to accomplish a plant modification. In general, these activities would be implemented under the Critical Maintenance Process which employs probabilistic risk assessment and additional defense in depth measures during the planning, scheduling, and execution stages. An example of where this process was effectively used is the recent Unit 1 EPL System battery replacement modification. In this modification, each of four batteries in Unit 1 was replaced in less than half of the allowed Technical Specification action statement time period.

3. If an EPL distribution center is lost, discuss the provisions and measures taken to assure that the redundant load group distribution center loads are operable.

DUKE POWER COMPANY RESPONSE

In the event of the loss of an EPL System distribution center that did not cause a unit trip, Operations would immediately review the Technical Specification Action Items Log (TSAIL) to determine the appropriate Technical Specification action statement to enter. Subsequent actions would be directed toward investigating and resolving the problem within the specified time by utilizing Engineering and Maintenance resources as necessary.

4. Provide a discussion for all single line to ground faults that have occurred on the EPL system within the last five years. The discussion should address the nature of these faults including the length of time that the fault existed, any corrective actions taken to preclude recurrence of such faults, any inoperability period of the EPL ground fault detection system/alarm, and actions taken or to be taken if the fault detection system is inoperable.

DUKE POWER COMPANY RESPONSE

Neither unit at Catawba has ever experienced a single line-to-ground fault which caused the 125VDC Vital I and C Power (EPL) System to become inoperable. This is due in part to the ungrounded system design. A complete review of the EPL System work order history revealed that five ground faults have been experienced in the last five years. All of these faults resulted in alarms both locally and in the control room and were caused by solenoid valve problems. Three cases involved failed solenoid valve components, and the other two cases involved water intrusion which was subsequently corrected. Due to the intermittent nature and high resistance of these faults, and the lack of available equipment capable of reliably locating such faults, in the past, it sometimes took in excess of 6 months to correct the ground fault; however, it should be emphasized that none of these faults caused the EPL System to become inoperable at any time. Additional measures have now been implemented in an effort to aggressively locate and correct ground faults which may occur in the future. These include the procurement of an advanced ground locating device which will allow ground faults of a high-resistance nature to be located more readily. Also, a new Nuclear System Directive has been issued which establishes a ground response policy for both continuous and intermittent grounds. Finally, various health indicators are now monitored in the EPL System which will help identify any adverse ground fault trends.

The EPL System work order history search revealed that only one ground fault detector has failed over the last five years. Because the original ground detector was no longer available from the manufacturer, a substitute part had to be found and an evaluation performed to verify its acceptability for use in the application. As a result, it took longer than normal - approximately 1.5 years - to replace the unit; however, it should be emphasized that the EPL System is checked weekly per administrative procedure for ground faults via a method independent of the ground detector system. Therefore, in the unlikely event of a detector failure, a ground would most likely be detected via the alternate means before a fault-related problem developed.

5. Describe the post modification/maintenance testing used to verify that no detrimental conditions are induced in the 600 Vac essential auxiliary power system (EPE) equipment prior to returning this equipment to operation.

DUKE POWER COMPANY RESPONSE

All modification and maintenance work is controlled by station procedures. Catawba procedure "Inspection and Maintenance Procedure For Motor Control Center Breakers", (IP/0/A/3850/009), covers much of the work related to EPE motor control centers. This procedure, as well as other station procedures, provides strict controls on any changes from normal system configuration such as placement of grounding jumpers or test alignments. These types of configuration changes are documented on a Circuit Alteration / Restoration Log Sheet attached to the procedure. Before a change to the circuit is made the step is documented on the log sheet and verified to be correct by an independent technician. Before the work can be closed out and the equipment be re-energized, the proper steps in the restoration section of the procedure must be completed and also verified by an independent technician. Use of these controls throughout the work activity helps avoid problems that could otherwise be missed, such as leaving in temporary jumpers or wiring equipment incorrectly.

Since some spare equipment is held in the warehouse for long periods, some periodic inspections are performed to verify that the equipment is in a serviceable condition. An example of this is that meggar tests are performed every six months on many of the large safety related motors stored in the warehouse. This provides additional assurance that the motors are in good condition and allows for lead time to procure a replacement if a problem is found with a spare motor. Often when a replacement motor is to be installed, it will also be tested in the maintenance shop prior to taking it out to the field.

The Test Requirements section of the Inspection and Maintenance Procedure For Motor Control Center Breakers referred to above specifies that a meggar test of the load is to be performed if a fault is suspected. The Procedure Signoff Sheet includes a section for recording these meggar readings.

Typical restoration work performed at the completion of maintenance work on EPE motor control center feeders is as follows: All test equipment is verified to be removed. The motor control center compartment is verified to be wired per the latest compartment wiring diagram. Motor phase rotation testing, if required, is performed. Operations closes the breaker and verifies proper operation of the load. If a feeder breaker has been removed or replaced, a thermography test of the energized breaker is conducted. Any additional functional verification requirements specified by the engineer supporting the maintenance activity are also performed. This might include verifying proper full speed operation and verifying normal pressure and flow parameters, depending on what type equipment was worked on.

When modification work is performed the engineer provides a Post Modification Test Plan in the modification package. The purpose of this testing is to verify that the modification has been successfully implemented, that the modification accomplishes what it was intended to do and that no adverse effects are introduced to the plant. The Post Modification Test Plan receives a cross disciplinary review while it is being developed if the modification work involves multiple systems or disciplines.

6. Provide a clarifying discussion to explain the meaning of "10,000 IAC". In addition, include data sheets that provide the current interrupting ratings for the EPE MCC load breakers and incoming and load breakers for the EPL distribution centers.

DUKE POWER COMPANY RESPONSE

See response to question I.B.6 above.

ATTACHMENT B

DUKE POWER COMPANY

CATAWBA NUCLEAR STATION

SYSTEM DESIGNATIONS

CATAWBA NUCLEAR STATION
System Designator List

SYSTEM	DESCRIPTION
AD	SSF Diesel Generator
AM	Monitor Tank Bldg Vent
AS	Aux Steam
BB	S/G Blowdown Recycle
BW	S/G Wet Lay-up Recirc
CA	Aux Feedwater
CB	Aux Boiler Feedwater
CF	Feedwater - Pumps, I&C and Valves
CL	CF Pump Seal Water
CM	Condensate
CS	Condensate Storage
CT	Conventional Sampling
EBG	230KV S/Y Fire Protection
ECB	Normal Communications
ECD	Microwave (Dispatch)
ECE	Emergency Communication
ECF	Intercommunication
ECG	Fuel Handling Intercom
ECH	Test Department Intercom.
ECI	Inter-plant Telephone
ECM	Microwave
ECP	Public Address
EDA	Control Rod Position Indication
EEA	Environmental Instrumentation
EEB	Meteorological Instrumentation
EFA	Fire Detection
EGA	Generator Cooling
EGB	Generator Excitation
EGC	Generator I&C
EHM	Hydrogen Mitigation
EHT	Trace Heating
EIA	NSSS I&C (7330 PCS)
EIB	Balance of Plant Instr. (Heated Boxes)
EKA	Dispatch Control
ELA	Emergency Lighting AC
ELD	Emergency Lighting DC
ELN	Normal Lighting AC
EMA	ESF Bypass Ind. Sys.
EMB	Annunciation Alarm
EMC	Event Recorder
EMD	Loose Parts Monitoring
EME	Power Monitor - NC Pumps
EMF	Radiation Monitoring
EMG	Chart Recorders
EMH	Vibration Monitor - NC Pump
EMI	Vibration Monitor - CF Pump
EMJ	Closed Ckt. T.V. Monitor
EMK	Containment Evacuation Alarm
EML	Floor Drain Leak Detection
EMT	Equipment Monitoring

SYSTEM	DESCRIPTION
ENA	Incore System
ENB	Encore NIS
ENC	Boron Dilution Mitigation
ENS	Emergency Notification
EOA	Main Control Boards
EOC	SSF Control Board
EPA	Unit Main Power
EPB	6.9KV Normal Aux. Power
EPC	4.16KV Essential Aux. Power
EPD	600VAC Normal Aux. Power
EPE	600VAC Essential Aux. Power
EPF	240/120VAC Aux. Control Power
EPG	120VAC Vital I&C Power
EPH	208/120VAC Normal Aux. Power
EPI	208/120VAC Essential Power
EPJ	250VDC Aux. Power (Dead Plant Battery)
EPK	125VDC Aux. Control Power (Aux Battery)
EPL	125VDC Vital I&C Power (Vital Battery)
EPM	13.8KV Normal Aux. Power
EPQ	125VDC Diesel Aux. Power (EDG Battery)
EPR	240/120VAC Normal Aux. Power
EPW	600VAC Station Norm. Aux. Pwr.
EPX	NPD Power Supply Warehouse
EPY	240/120VAC Essential Aux. Power
EPZ	240/120 Station Norm. Aux. Power
EQB	EDG Load sequencer
EQC	EDG Controls
EQD	SSF Diesel Control
ERB	XFMR Station Cable Support
ERC	XFMR Station Grounding
ERD	Unit Mn. Power System Prot. Relaying
ERE	Unit Mn. Power System Cont. System
ERF	Unit Mn. Power System Meter & Monitoring
ERN	EDG Protective Relaying
ETA	208/120 Station Normal Aux. Power
ETB	4.16KV Blackout Aux. Power
ETC	600VAC Blackout Aux. Power
ETE	208/120VAC Blackout Aux. Power
ETF	600VAC Cooling Tower Aux. Power
ETH	208/120 Cooling Tower Aux. Power
ETL	600VAC SSF Aux. Power
ETM	250/125VDC SSF Power (SSF Battery)
EUC	Cathodic Protection
EVA	Station Grounding
EVB	Instrument Grounding
EVC	Computer Grounding
EVE	Electrical Reach Rods
EWA	Cable Room Cable Support
EWB	Equipment Room Cable Support

SYSTEM	DESCRIPTION
EWC	General Plant Cable Support
EXA	Plant Security
EXH	Elect. Cranes & Hoists
EXS	Misc. Electrical Systems
EZA	Electrical Penetrations
FC	Fuel Handling
FD	EDG Fuel Oil
FW	Refueling Water
GB	Hydrogen Blanket
GH	Generator Hydrogen
GN	Generator Nitrogen
GO	Oxygen
GP	CO2 Generator Purge
GS	Hydrogen Bulk Storage
HA	Bleed Steam To "A" Htrs.
HB	Bleed Steam To "B" Htrs.
HC	Bleed Steam To "C" Htrs.
HD	Bleed Steam To "D" Htrs.
HE	Bleed Steam To "E" Htrs.
HF	Bleed Steam To "F" Htrs.
HG	Bleed Steam To "G" Htrs.
HM	Moisture Separator/Reheaters
HS	Moisture Separator/Reheat Drains
HW	Heater Drain
IAE	Containment Airlock
ICCM	Inadequate Core Cooling Monitor
IDE	Steam Dump Control
IEE	Seismic Monitoring
IFE	Feedwater Control
IKE	Operator Aid Computer
ILE	PZR Pressure & Level Control
IPE	Reactor Protection Actuation
IRE	Rod Control System
ISE	ESF Actuation
ITE	Main Turbine I&C
ITM	Transient Monitor System
IWE	Feedwater Pump Turbine I&C
KC	Component Cooling
KD	EDG Engine Cooling Water
KF	Spent Fuel Cooling
KG	Generator Cooling Water
KR	Recirculated Cooling Water
LD	EDG Lube Oil
LF	Feedwater Pump Turbine Lube Oil
LG	Generator Seal Oil
LH	Main Turbine Hydraulic Oil
LP	Feedwater Pump Turbine Hydraulic Oil
LT	Main Turb Lube Oil
MI	Misc. Instruments
MSE	Misc. Electrical Systems
NB	Boron Recycle

SYSTEM	DESCRIPTION
NC	Reactor Coolant
ND	Residual Heat Removal
NF	Ice Condenser Refrigeration
NI	Safety Injection
NM	Nuclear Sampling
NR	Boron Thermal Regeneration
NS	Containment Spray
NV	Chemical and Volume Control
NW	Contain. Penetration Valve Injection
RA	Condenser Tube Cleaning
RC	Condenser Circulating H_20
RF	Fire Protection - Interior
RL	Low Pressure Service Water
RN	Nuclear Service Water
RS	RL Intake Screen Backwash
RY	Fire Protection - Exterior
SA	SM Supply to Aux. Equipment
SB	SM Bypass to Condenser
SC	Turbine Crossover
SM	Main Steam
SP	SM Supply to Feedwater Pump Turbine
SV	Main Steam Vent to Atmosphere
TE	CFPT Turbine Exhaust
TF	CFPT Turbine Steam Seal
TL	Main Turbine Steam Seal
TS	Turbine Exhaust Hood Spray
VA	Aux. Bldg. Ventilation
VB	Breathing Air
VC	Control Room Area Ventilation
VD	EDG Room Ventilation
VE	Annulus Ventilation
VF	Fuel Pool Ventilation
VG	EDG Starting Air
VH	TSC Ventilation
VI	Instrument Air
VJ	Computer Room Ventilation
VK	Relay House Ventilation
VM	Admin. Bldg. Ventilation
VN	EDG Air Intake & Exhaust
VO	Turbine Bldg. Ventilation
VP	Containment Purge Ventilation
VQ	Containment Air Addition/Release
VS	Station Air
VV	Containment Ventilation
VW	Service Bldg. & Warehouse Ventilation
VX	Containment Air Return & H2 Skimmer
VY	Containment H2 Sample & Purge
VZ	RN Pumphouse Ventilation
WB	Service Bldg. Sump
WC	Conventional Waste Water

SYSTEM	DESCRIPTION
WE	Equipment Decontamination
WG	Gaseous Waste Management
WL	Liquid Waste Recycle
WN	EDG Sump Pump
WP	Turb. Bldg. Sump Pump
WS	Nuclear Solid Waste Disposal
WT	Sanitation & Waste Treatment
WZ	Groundwater Drainage
YA	Conventional Chemical Add
YB	Admin. bldg. Chilled Water
YC	Control Area Chilled Water
YD	Drinking Water
YF	Filtered Water
YH	Heating Water
YJ	Computer Room Chilled Water
YK	NPD Office Area Chilled Water
YM	Make-up Demineralized Water
YN	Aux. Bldg. Chilled Water
YR	Aux. Bldg. Rad. Area Chilled Water
YT	Cooling Tower Water Treat
YV	Containment Chilled Water
YW	Service Bldg. Chilled Water
ZD	EDG Crankcase Vacuum
ZJ	Condensate Steam Air Ejectors
ZM	Main Vacuum
ZP	Vacuum Priming

ATTACHMENT C

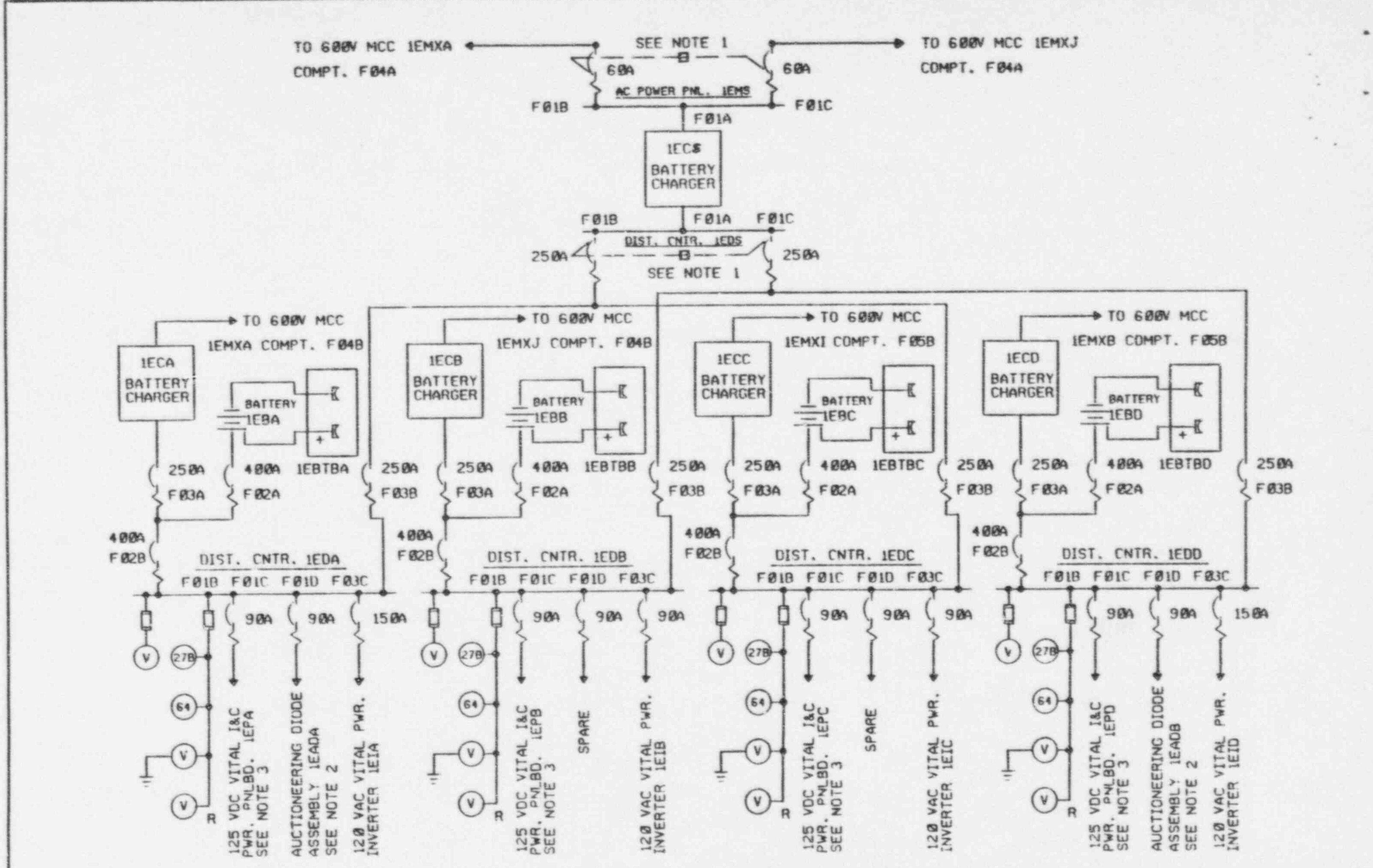
DUKE POWER COMPANY

CATAWBA NUCLEAR STATION

SUMMARY DIAGRAM OF THE 125 VDC VITAL I & C

POWER SYSTEM (EPL) BATTERIES, BATTERY CHARGERS AND

DISTRIBUTION CENTERS



LEGEND

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

NOTES:

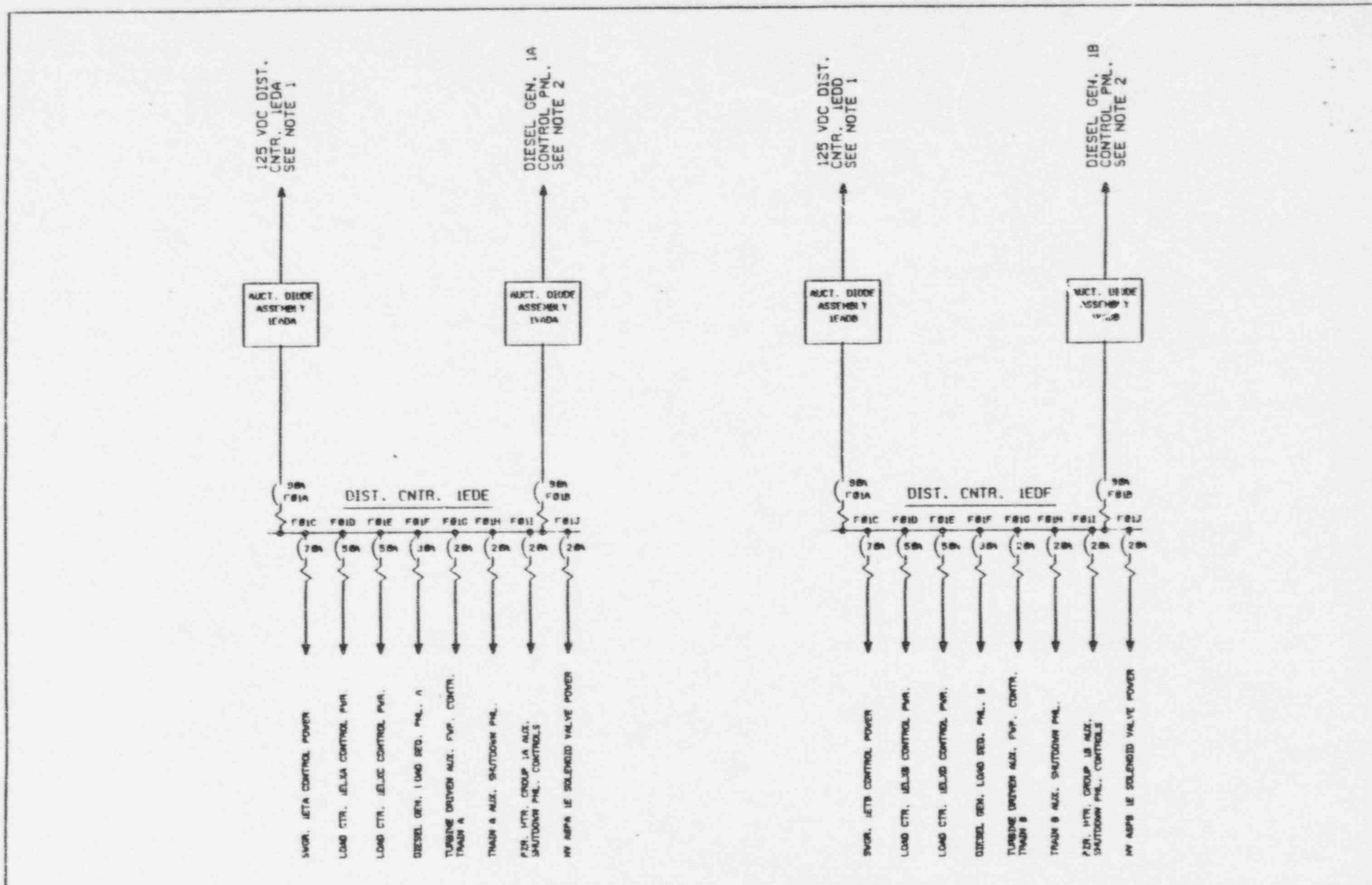
1. BREAKERS ARE KIRK KEY INTERLOCKED SUCH THAT ONLY ONE BREAKER CAN BE CLOSED AT ONE TIME.
2. SEE FIGURE 2 FOR AUCTIONEERING DIODE ASSEMBLIES.
3. SEE FIGURE 3 FOR POWER PANELBOARDS.

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

SPECIFICATION NO.: CNS-1O6.01-EPL-0001
DATE: DECEMBER 20, 1990
REVISION NUMBER: 0



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-1609.01-EPL-0001
DATE: DECEMBER 28, 1990
REVISION NUMBER: 0

ATTACHMENT D

DUKE POWER COMPANY

CATAWBA NUCLEAR STATION

INTERRUPTING RATINGS OF VARIOUS BREAKERS

USED IN THE 600 VAC ESSENTIAL AUXILIARY POWER SYSTEM (EPE)

AND THE 125 VDC VITAL I & C POWER SYSTEM (EPL)

Tables 1-4 list the types of molded-case circuit breakers used in the EPE and EPL Systems. The manufacturers' data sheets are provided on pages 2 and 3 of this attachment and are referenced accordingly.

Table 1: EPE System Motor Control Center Breakers

Breaker Application	Manufacturer	Type	Interrupting Rating RMS Symmetrical Amperes	Reference page of attachment
Incoming Breakers	Westinghouse	MC	22,000	2
Feeder Breakers	Westinghouse	HFB	18,000	2
Feeder Breakers	Westinghouse	LB	22,000	2

Table 2: EPL System Distribution Center (EDA, EDB, EDC, EDD) Breakers

Breaker Application/ Compartment	Manufacturer	Type	Interrupting Rating DC Amperes	Reference page of attachment
Battery Breaker/ F02A	Westinghouse	LB	20,000	2
Main Breaker/F02B	Westinghouse	LB	20,000	2
Battery Charger Breaker/F03A	Westinghouse	KB	10,000	2
Tie Breaker/F03B	Westinghouse	KB	10,000	2
Feeder Breakers	Westinghouse	HFB	20,000	2

Table 3: EPL System Auctioneered Distribution Center (EDE, EDF) Breakers

Breaker Application/ Compartment	Manufacturer	Type	Interrupting Rating DC Amperes	Reference page of attachment
Incoming Breakers	Westinghouse	HFB	20,000	2
Feeder Breakers	Westinghouse	HFB	20,000	2

Table 4: EPL System Power Panelboard (EPA, EPB, EPC, EPD) Breakers

Breaker Application/ Compartment	Manufacturer	Type	Interrupting Rating DC Amperes	Reference page of attachment
Feeder Breakers	General Electric	TED	10,000	3

ATTACHMENT D

SELECTION GUIDE

Circuit Breaker Type	Cont. Amp Rating At 40°C	No. Poles	Volts Ac	Volts Dc	Federal Spec. W-C-375b	UL Listed Interrupting Ratings rms Symmetrical Amperes: Ac Ratings Volts 120	120/240	240	277	480	600	Dc❷ 125	250	125/250	Additional Information: Reference Page No.	Pricing Page No.
INDUSTRIAL Circuit Breakers, *Continued*																
EB	15-100	1	120	125	11a	10,000	....	....	....	....	....	5,000	....	....	82	82
EB	15-100	2, 3	240	125/250	10b, 11b, 12b	....	....	10,000	....	....	....	....	....	5,000	82	82
EHB	15-100	1	277	125	13a	....	....	....	14,000	....	....	10,000	....	....	82	82
EHB	15-100	2	480	250	13b	....	....	....	....	14,000	....	....	10,000	....	82	82
EHB	15-100	3	480	....	13b	....	....	....	....	14,000	....	....	....	....	82	82
FB	15-150	2	600	250	18a	....	....	18,000	....	14,000	14,000	....	10,000	....	83	83
FB	15-150	3	600	....	18a	....	....	18,000	....	14,000	14,000	....	....	....	83	83
HFB	15-30	1	277	125	13a	....	....	....	65,000	....	....	10,000	....	....	83	83
HFB	40-100	1	277	125	13a	....	....	....	25,000	....	....	10,000	....	....	83	83
HFB	15-150	2, 3	600	250	22a	....	....	65,000	....	25,000	18,000	....	20,000	....	83	83
JA, KA	70-225	2, 3	600	250	19a, 20a	....	....	25,000	....	22,000	22,000	....	10,000	....	84	84
HKA	70-225	2, 3	600	250	19a, 20a	....	....	65,000	....	35,000	25,000	....	20,000	....	84	84
JB, KB	70-250	2, 3	600	250	19a, 20a	....	....	25,000	....	22,000	14,000	....	10,000	....	85	85
HKB	70-250	2, 3	600	250	❶	....	....	65,000	....	25,000	18,000	....	20,000	....	85	85
LB	70-400	2, 3	600	250	21a	....	....	42,000	....	30,000	22,000	....	20,000	....	86	86
LBB	125-400	2, 3	600	250	21a	....	....	42,000	....	30,000	22,000	....	20,000	....	86	86
HLB	125-400	2, 3	600	250	23a	....	....	65,000	....	35,000	25,000	....	20,000	....	86	86
DA	250-400	2, 3	240	250	14b	....	....	22,000	....	....	....	....	10,000	....	87	87
LA 400, LAB 400	70-400	2, 3	600	250	21a	....	....	42,000	....	30,000	22,000	....	20,000	....	88	88
HLA 400	125-400	2, 3	600	250	23a	....	....	65,000	....	35,000	25,000	....	20,000	....	88	88
LA 600	250-600	2, 3	600	250	21a	....	....	42,000	....	30,000	22,000	....	20,000	....	89	89
HLA 600	250-600	2, 3	600	250	23a	....	....	65,000	....	35,000	25,000	....	20,000	....	89	89
MA	125-800	2, 3	600	250	21a	....	....	42,000	....	30,000	22,000	....	20,000	....	90	90
HMA	125-800	2, 3	600	250	23a	....	....	65,000	....	35,000	25,000	....	20,000	....	90	90
NB	700-1200	2, 3	600	250	21a	....	....	42,000	....	30,000	22,000	....	20,000	....	91	91
HNB	700-1200	2, 3	600	250	23a	....	....	65,000	....	35,000	25,000	....	20,000	....	91	91
PB	600-2500	2, 3	600	250	25a	....	....	125,000	....	100,000	100,000	....	75,000	....	92	92
LC, LCC	75-600	2, 3	600	....	21a	....	....	42,000	....	30,000	22,000	....	....	....	93	93
HLC	75-600	2, 3	600	....	23a	....	....	65,000	....	35,000	25,000	....	....	....	93	93
MC, MCC	400-800	2, 3	600	....	21a	....	....	42,000	....	30,000	22,000	....	....	....	95	95
HMC	400-800	2, 3	600	....	23a	....	....	65,000	....	50,000	25,000	....	....	....	95	95
NC	600-1200	2, 3	600	....	21a	....	....	42,000	....	30,000	22,000	....	....	....	96	96
HNC	600-1200	2, 3	600	....	23a	....	....	65,000	....	50,000	25,000	....	....	....	96	96
PC, PCC	1000-3000	2, 3	600	....	25a	....	....	125,000	....	100,000	100,000	....	....	....	97	97
CURRENT LIMIT-R Current Limiting Circuit Breakers – Non-Fused Type																
FCL	15-100	2, 3	480	....	❶	....	....	200,000	....	150,000	....	....	....	....	99	99
LCL	125-400	2, 3	600	....	❶	....	....	200,000	....	200,000	100,000	....	....	....	99	99
TRI-PAC CURRENT LIMITING Current Limiting Circuit Breakers – Fused Type																
FB	15-100	2, 3	600	250	16a, 16b, 17a, 26a	....	....	200,000	....	200,000	200,000	....	100,000	....	101	101
LA	70-400	2, 3	600	250	16a, 16b, 17a, 26a	....	....	200,000	....	200,000	200,000	....	100,000	....	101	101
NB	300-800	2, 3	600	250	16b, 17a, 26a	....	....	200,000	....	200,000	200,000	....	100,000	....	102	102
PB	600-1600	2, 3	600	250	17a, 26a	....	....	200,000	....	200,000	200,000	....	100,000	....	102	102

❶ Not defined in W-C-375b.
❷ Two-pole circuit breaker, or two poles of three-pole circuit breaker at 250 VDc.