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AREA CODE 409 838-6631

February 10, 1984
RBG- 17,003
File No. G9.5, G9.8.6.1

Mr. Harold R. Denton, Director
Office of Nuclear Reactor Regulation
U. S. Nuclear Regulatory Commission
Washington, D.C. 20555

Dear Mr. Denton:

River Bend Station Units 1 and 2
Docket Nos. 50-458/50-459

Enclosed for your review are Gulf States Utilities Company responses to Request for Additional Information identified by the Nuclear Regulatory Commission's Power Systems Branch (PSB). This letter supplements information contained in docketed correspondence from J. E. Booker to H. R. Denton dated December 30, 1983. Attachment 1 contains the actual written changes to the FSAR text including all tables and figures. These changes will be incorporated into the FSAR in a future amendment. Attachment 2 is provided as supplemental information to a previously docketed response for FSAR Question 430.20.

Sincerely,

J. E. Booker

J. E. Booker
Manager-Engineering
Nuclear Fuels & Licensing
River Bend Nuclear Group

JEB/WJR/ERG/JEP/je

Enclosures

B001
1/40

ATTACHMENT 1

QUESTION 430.21 (8.3)

BRANCH TECHNICAL POSITION PSB 1
ADEQUACY OF STATION ELECTRIC DISTRIBUTION SYSTEM VOLTAGES

A. BACKGROUND

Events at the Millstone station have shown that adverse effects on the Class 1E loads can be caused by sustained low grid voltage conditions when the Class 1E buses are connected to offsite power. These low voltage conditions will not be detected by the loss of voltage relays (loss of offsite power) whose low voltage pickup settings is generally in the range of .7 per unit voltage or less.

The above events also demonstrated that improper voltage protection logic can itself cause adverse effects on the Class 1E systems and equipment such as spurious load shedding of Class 1E loads from the standby diesel generators and spurious separation of Class 1E systems from offsite power due to normal motor starting transients.

A more recent event at Arkansas Nuclear One (ANO) station and the subsequent analysis performed disclosed the possibility of degraded voltage conditions existing on the Class 1E buses even with normal grid voltages, due to deficiencies in equipment between the grid and the Class 1E buses or by the starting transients experienced during certain accident events not originally considered in the sizing of these circuits.

B. BRANCH TECHNICAL POSITION

1. In addition to the undervoltage scheme provided to detect loss of offsite power at the Class 1E buses, a second level of undervoltage protection with time delay should also be provided to protect the Class 1E equipment; this second level of undervoltage protection shall satisfy the following criteria:

   (a) The selection of undervoltage and time delay setpoints shall be determined from an anlysis of the voltage requirements of the Class 1E loads at all onsite system distribution levels;

(b) Two separate time delays shall be selected for the second level of undervoltage protection based on the following conditions:

(1) The first time delay should be of a duration that establishes the existence of a sustained degraded voltage condition (i.e., something longer than a motor starting transient). Following this delay, an alarm in the control room should alert the operator to the degraded condition. The subsequent occurrence of a safety injection actuation signal (SIAS) should immediately separate the Class 1E distribution system from the offsite power system.

(2) The second time delay should be of a limited duration such that the permanently connected Class 1E loads will not be damaged. Following this delay, if the operator has failed to restore adequate voltages, the Class 1E distribution system should be automatically separated from the offsite power system. Bases and justification must be provided in support of the actual delay chosen.

(c) The voltage sensors shall be designed to satisfy the following applicable requirements derived from IEEE Std. 279-1971, "Criteria for Protection Systems for Nuclear Power Generating Stations":

(1) Class 1E equipment shall be utilized and shall be physically located at and electrically connected to the Class 1E switchgear.

(2) An independent scheme shall be provided for each division of the Class 1E power system.

(3) The undervoltage protection shall include coincidence logic on a per bus basis to preclude spurious trips of the offsite power source.

(4) The voltage sensors shall automatically initiate the disconnection of offsite power sources whenever the voltage setpoint and time delay limits (cited in item 1.b.2 above) have been exceeded.

(5) Capability for test and calibration during power operation shall be provided.

(6) Annunciation must be provided in the control room by any bypasses incorporated in the design.

(d) The Technical Specifications shall include limiting conditions for operations, surveillance requirements, trip setpoints with minimum and maximum limits, and allowable values for the second-level voltage protection sensors and associated time delay devices.

2. The Class 1E bus load shedding scheme should automatically prevent shedding during sequencing of the emergency loads to the bus. The load shedding feature should, however, be reinstated upon completion of the load sequencing action. The technical specifications must include a test requirement to demonstrate the operability of the automatic bypass and reinstatement features at least once per 18 months during shutdown.

In the event an adequate basis can be provided for retaining the load shed feature during the above transient conditions, the setpoint value in the Technical Specifications for the first level of undervoltage protection (loss of offsite power) must specify a value having maximum and minimum limits. The basis for the setpoints and limits selected must be documented.

3. The voltage levels at the safety-related buses should be optimized for the maximum and minimum load conditions that are expected throughout the anticipated range of voltage variations of the offsite power sources by appropriate adjustment of the voltage tap settings of the intervening transformers. The tap settings selected should be based on an analysis of the voltage at the terminals of the Class 1E loads. The analyses performed to determine minimum operating voltages should typically consider maximum unit steady state and transient loads for events such as a unit trip, loss of coolant

accident, startup or shutdown; with the offsite power supply (grid) at minimum anticipated voltage and only the offsite source being considered available. Maximum voltages should be analyzed with the offsite power supply (grid) at maximum expected voltage concurrent with minimum unit loads (e.g. cold shutdown, refueling). A separate set of the above analyses should be performed for each available connection to the offsite power supply.

4. The analytical techniques and assumptions used in the voltage analysis cited in item 3 above must be verified by actual measurement. The verification and test should be performed prior to initial full power reactor operation on all sources of offsite power by:

   (a) loading the station distribution buses, including all Class 1E buses down to the 120/208 v level, to at least 30%;

   (b) recording the existing grid and Class 1E bus voltages and bus loading down to the 120/208 volt level at steady state conditions and during the starting of both a large Class 1E and non-Class 1E motor (not concurrently);

   Note: To minimize the number of instrumented locations, (recorders) during the motor starting transient tests, the bus voltages and loading need only be recorded on that string of buses which previously showed the lowest analyzed voltages from item 3 above.

   (c) using the analytical techniques and assumptions of the previous voltage analysis cited in item 3 above, and the measured existing grid voltage and bus losing conditions recorded during conduct of the test, calculate a new set of voltages for all the Class 1E buses down to the 120/208 volt level;

   (d) compare the analytically derived voltage values against the test results.

With good correlation between the analytical results and the test results, the test verification requirement will be met. That is, the validity of the mathematical model used in performance of the analysis of item 3 will have been established; therefore, the validity of the results

of the analyses is also established. In general the test results should not be more than 3% lower than the analytical results; however, the difference between the two when subtracted from the voltage levels determined in the original analysis should never be less than the Class 1E equipment rated voltages.

RESPONSE

~~River Bend Station Unit 1 fully complies with NRC Branch Technical Position PSB 1, Adequacy of Station Electric Distribution System Voltages, except for the following:~~

REPLACE WITH INSERT

~~a) There is one time delay on the second level of undervoltage protection. A time delay, a time greater than a motor-starting transient, and subsequent alarm is not provided in the second level undervoltage protection scheme. Furthermore, the occurrence of a loss of coolant accident (LOCA) signal subsequent to actuation of the second level undervoltage time delay device, does not permit transfer of power to the onsite source until the time delay device has completed its cycle. The design will be revised to comply prior to fuel load.~~

~~b) The Class 1E bus load shedding scheme automatically prevents shedding during sequencing of emergency loads. The load shedding feature is reinstated upon completion of the load sequencing action only if offsite power was available prior to the load shedding/sequencing event. When load shedding/sequencing to the onsite source, the reinstatement of the load shedding feature is not permitted.~~

INSERT (For Pg. Q&R 8.3-10)

BRANCH TECHNICAL POSITION

1. Two completely seperate schemes of undervoltage protection are provided on the Class 1E buses. The selection of undervoltage and time delays setpoints have been determined from an analysis of the voltage requirements of the Class 1E loads. These setpoints will be verified during the actual system testing.

   (a) The first undervoltage scheme detects loss of power at the Class 1E buses. This undervoltage setpoint is set below any anticipated transient voltage condition, with a time delay of approximately 3 seconds.

   (b) The second level of undervoltage protection is set at approximately 90% and utilizes two seperate time delays based on the following conditions:

      (1) The first time delay is approximately 3 seconds which establishes a sustained degraded voltage condition. (i.e., something longer than a motor starting transient). Following this delay an alarm in the control room alerts the operator to the degraded condition. The subsequent occurence of a LOCA signal immediately seperates the Class 1E distribution system from the offsite power system, starts load shed logic and load sequence timers, starts the diesel generator, and permits auto-close of the diesel generator breaker.

      (2) The second time delay is approximately 50 seconds which ensures that permanently connected Class 1E loads will not be damaged. Following this time delay, if the operator has failed to restore adequate voltages, the Class 1E system is automatically seperated from the offsite power system, the load shed logic and load sequence timers start, the diesel generator starts, and permits auto-close of the diesel generator breaker.

   (c) The voltage sensors are designed to satisfy the following applicable requirements:

      (1) Class 1E equipment is utilized and is physically located at and electrically connected to the Class 1E switchgear.

      (2) An independent scheme is provided for each division of the Class 1E power system.

      (3) The undervoltage protection includes coincidence logic (2 out of 3) on a per bus basis to preclude spurious trips of the offsite power source.

(4) The voltage sensors automatically initiate the disconnection of offsite power sources whenever the voltage setpoint and time delay limits have been exceeded.

(5) Capability for test and calibration during power operation is provided.

(6) Annunciation is provided in the control room by any bypasses incorporated in the design.

2. The Class 1E bus load shedding scheme automatically prevents shedding during sequencing of the emergency loads to the bus. The load shedding feature is reinstated upon completion of the load sequencing action.

3. The voltage levels at the safety-related buses are optimized for the maximum and minimum load conditions that are expected throughout the anticipated range of voltage variations of the offsite power sources. The trip settings selected are based on an analysis of the voltage at the terminals of the Class 1E loads. The analyses performed to determine minimum operating voltages considers maximum unit steady state and transient loads for events such as a unit trip, loss of coolant accident, startup or shutdown; with the offsite power supply (grid) at minimum anticipated voltage and only the offsite source being considered available. Maximum voltages are analyzed with the offsite power supply at maximum expected voltage concurrent with minimum unit loads.

4. The analytical techniques and assumptions used in the voltage analysis cited in item 3 will be verified by actual measurement. The verification and test will be performed prior to initial full power reactor operation on all sources of offsite power by:

(a) loading the station distribution buses, including all Class 1E buses down to the 120/208 v level, to at least 30%;

(b) recording the existing grid and Class 1E bus voltages and bus loading down to the 120/208 volt level at steady state conditions and during the starting of both a large Class 1E and non-Class 1E motor (not concurrently);

(c) using the analytical techniques and assumptions of the previous voltage analysis cited in item 3 above, and the measured existing grid voltage and bus losing conditions recorded during conduct of the test, a new set of voltages for all the Class 1E buses down to the 120/208 volt level will be calculated.

(d) The analytically derived voltage values will be compared against the test results.

systems for the 500-kV bays: one to serve the 500-kV SF_6 circuit breakers and one to serve the 500-kV SF_6 buses, disconnecting switches, and air bushings. The initial ring bus configuration provides for the isolation of any faulted line without affecting the operation of any other line. It also provides for the isolation of any one breaker in the 500-kV SF_6 bus for inspection or maintenance without affecting the operation of any of the connecting lines or any other connections to the buses. The 500-kV SF_6 buses terminate at the 500-kV SF_6 air bushings. Connections are made to the 500-kV grid and to the 230-500-kV transformers via air-insulated, outdoor-constructed bus work and overhead lines from these air bushings.

The ac auxiliary power requirements of the 230-kV and 500-kV bays are provided by two 750-kVA, 13.8-kV to 480-V, oil-filled transformers supplied from onsite normal 13.8-kV buses 1NPS-SWG1A and 1NPS-SWG1B.

The dc power requirements for the Fancy Point Substation relay and control systems are provided by two redundant 125-V batteries and one 48-V battery. Each battery system is supported by its own charger which is provided power from the auxiliary ac power system and by an existing source external to River Bend Station.

Control functions between the plant and the substation are provided by two diverse methods. Control cables are routed in a concrete-encased duct bank to the substation control house. Routing within the substation between the various relay panels and control equipment is accomplished via a protected cable trench. An optic cable underbuilt on the reserve station service steel pole lines provides another diverse method of transmitting control functions and information between the plant and substation. The optical information is decoded at the substation and forwarded to the appropriate piece of equipment via control cables routed in a cable trench which is physically separated by five (5) feet or more from the other trench described herein. The routing separation is maintained over the route length except at termination points where the cables route to the same piece of equipment.

The 125-V battery systems furnish control power for circuit breakers in both the 500-kV and 230-kV switchyard bays. A complete loss of both 125-V battery systems including the battery chargers prevents the operation of all circuit breakers in the switchyard. The loss of the battery systems in conjunction with a fault in the switchyard or any incoming line would require the operation of backup relaying elsewhere within the grid to clear the fault. Offsite power will be manually restored by isolating one of the reserve station service lines to an unfaulted line in the event of severe battery damage. The estimated time to perform the subject operation is fifteen (15) minutes after personnel arrive at the switchyard.

The 48-V battery system provides operations voltage for the 500-kV static relaying.

The battery systems are monitored remotely using a SCADA (Supervisory Control And Data Aquisition) system which provides a low voltage alarm to the Baton Rouge operator in the event of malfunction. Additionally, the batteries receive a visual inspection weekly and a complete inspection for operability to manufacturer's specifications each six

months. The weekly inspection consists of checking the electrolyte levels, the battery voltage, and the charge rate. The six month inspection includes checking the voltage and specific gravity of each cell, cleaning and retorquing the battery connectors, and if needed, the application of an equalize charge for about 24 hours. A GSU form containing each of the above mentioned items is filled out for each inspection. Completed inspection forms are kept on file at the Baton Rouge Substation Department.

All 230-kV circuit breakers are equipped with two independent trip coils and breaker failure protection for redundant power circuit protection. All of the protective relay systems for the 230-kV bays are redundant. These systems are overlapping so that each high-voltage component is covered by at least two sets of protective relays. The primary and the backup relay systems are supplied from separate current inputs, separate dc circuits from each 125-V battery, and are connected to separate trip coils of the power circuit breakers. Cross tripping between the trip coils is used. The potentials for the primary and backup relay systems associated with the three 230-kV lines serving Unit 1 are provided from one set of potential transformers on the north 230-kV bus (primary) or one set of potential transformers on the south 230-kV bus (alternate). A potential transfer scheme is provided between the primary potentials and the alternate potentials. The potentials for the primary and backup relay systems associated with the other 230-kV lines are provided from one set of coupling capacitor voltage transformers on each line terminal. The potentials for the 500-230-kV transformer backup relaying (230 kV) are provided from one set of coupling capacitors on the 230-kV side of the transformer.

The primary relay system for each of the three 230-kV lines serving Unit 1 is an HCB pilot wire system over a primary pilot wire circuit. The backup relay system for each of the three 230-kV lines is a two-zone distance phase with directional overcurrent ground relay system over a backup pilot wire circuit. Additional transfer tripping of switchyard breakers for in-plant relay operations uses PM-type relays over either the primary or backup pilot wire circuits. The redundant pilot wire circuits are monitored with PM-type relays.

The primary relay system for each of the other 230-kV lines is a permissive, overreaching transfer trip system using a frequency shift audio tone, modulated on a microwave channel. The backup system for each of the other 230-kV lines is a three zone distance phase and ground relay system that initiates local tripping.

The north and south 230-kV buses are each protected with a common restraint bus differential system.

The 500-kV - 230-kV transformer is protected on the 230-kV side by single-zone distance phase with directional overcurrent ground relaying that initiates local tripping.

All 500-kV circuit breakers are equipped with two independent trip coils and breaker-failure protection for redundant power circuit protection. All of the protective relay systems for the 500-kV bays are redundant. These systems are overlapping so that each high-voltage component is covered by at least two sets of protective relays. The two primary static relay systems have separate current inputs and receive power from the 48-V battery system which acts as an isolated power supply. The electromechanical backup relay system has separate current inputs and receives its power from one of the redundant 125-V battery systems. Cross tripping between the trip coils is used. The potentials for the primary and backup relay systems associated with the 500-kV lines are provided from one set of coupling capacitor voltage on each line terminal. The secondary potentials are separted into two systems of junction boxes in the switchyard and are treated as redundant systems from this point. The potentials for the 500-kV - 230-kV transformer backup relaying (500 kV) are provided from one set of bushing potential devices on the 500-kV side of the transformer.

The primary relay systems for the two 500-kV lines are (1) phase comparison relaying over a CS26 power line carrier channel and (2) directional comparison tripping with phase and ground distance relays using a frequency shift audio tone, modulated on a microwave channel. The backup relay system for the two 500-kV lines is a three-zone distance phase and ground relay system that initiates local tripping.

The failure of all protective relaying cables between the plant and the substation disables the transfer trips and the primary relaying on the generator and reserve station service lines from the main control room. However, the Baton Rouge Dispatcher retains his control and monitoring capabilities. Faults in the switchyard or on the incoming 230-kV lines clear normally. Faults on the generator or reserve station service lines clear by backup impedance relaying. The transfer trips and primary relay circuits are monitored by the Baton Rouge Operator for indications of trouble. Loss of SCADA system cabling disables the remote control feature of the switchyard circuit breakers.

The primary relay system for the 500-kV line to the 500-kV to 230-kV transformer is a separate restraint bus differential system. The primary relay system for the 500-kV to 230-kV transformer is a separate restraint transformer differential system. The backup relay system (500 kV) for the 500-kV to 230-kV transformer is a single zone distance phase with directional overcurrent ground relaying that initiates local tripping.

The 230-kV and 500-kV circuit breakers can be operated either manually from the switchyard control house or remotely by either the Baton Rouge dispatcher or the River Bend Station operator. Those remotely operable by the Baton Rouge dispatcher are OCBs 20650, 20660, 20665, 20735, 20740, and 20745 and GCBs 20765, 20770, and 20775. Those remotely operable by the River Bend Station operator are OCBs 20610, 20620, 20635, 20640, 20670, and 20665.

1ENS*SWG1B. The HPCS system 2600-kW diesel generator 1E22*S001G1C supports standby 4.16-kV bus 1E22*S004. Each standby diesel generator is physically separated from the others and is located in the Seismic Category I diesel generator building. Failure of one diesel will not impede the operation of the other two diesel generators.

Standby 4.16 kV bus 1ENS*SWG1A and normal 4.16 kV bus 1NNS-SWG1A may be fed from the preferred station service transformer 1RTX-XSR1C simultaneously. If an undervoltage condition were to occur concurrently on both buses, a trip signal would be given to the normal supply breaker on 1NNS-SWG1A and to the motor feeder breakers on that bus. If proper voltage is not available, a trip signal would be given to the preferred supply breaker on 1ENS*SWG1A and the standby diesel generator would start and would energize the standby 4.16 kV bus. Division 2 equipment follows the same operation. Reference 1 provides a description of the standby bus transfers and tripping under loss of power conditions.

The standby 4.16-kV standby buses are electrically independent and physically isolated from one another. Their loads are redundant and consist of standby motors and standby 480-V load centers. DC control power for the standby 4.16-kV switchgear and for 1NNS-SWG1A, 1NNS-SWG1B, and 1NNS-SWG1C is supplied as shown in Table 8.3-8.

4.16-kV switchgear assemblies 1NNS-SWG2A and 1NNS-SWG2B at the circulating water pump area and 1NNS-SWG3A and 1NNS-SWG3B at the cooling tower makeup pump area and 1NNS-SWG4A and 1NNS-SWG4B at the radwaste building are of the split-bus design. Under normal conditions the supply breaker on each bus is closed and the bus tie breaker is open. No automatic closing of the tie breaker takes place after tripping either supply breaker. Closing all breakers is by manual control. When the supply breakers and bus tie breaker are to be closed to parallel two sources for a short period of time during throwover, closing of the last breaker is supervised by a synchronizing check relay. Closure of the three breakers initiates an alarm.

8.3.1.1.3.4 480-V Systems

All normal load centers for nonsafety-related service, except load center 1NJS-LDC1S and 1NJS-LDC1T, are of the split-bus design. Two load center transformers of each load center are energized from normal 13.8-kV buses 1NPS-SWG1A and 1NPS-SWG1B. In turn, load center transformers supply opposite sides of the split bus. These buses can be connected by closing the tie breaker. There is no automatic transfer between the two load center 480-V power sources. No interlocks are provided to prevent paralleling of the two load center 480-V power sources. Closing the two load center supply main breakers and the split-bus tie breaker is indicated in the main control room.

The standby 480-V load centers are single-ended and have circuit breakers with andinterrupting capability of not less than 30,000 amp symmetrical. These standby load centers are fed from the standby 4.16-kV buses. Standby 4.16-kV bus 1ENS*SWG1A provides power for standby 480-V load centers 1EJS*LDC1A and 1EJS*LDC2A. Standby 4.16-kV bus 1ENS*SWG1B provides power for standby 480-V load centers 1EJS*LDC1B and 1EJS*LDC2B. DC control

3. 4.16 KV Bus 1A Generator Supply
4. 4.16 KV Bus 1A Generator Neutral Breaker.
5. 480 V LDC 1A Supply
6. 480 V LDC 2A Supply

d. "4160 V STANDBY BUS DISTR. BREAKER AUTO TRIP" - This annunicator window is a common alarm actuated when the local or remote breaker control switch is in the AFTER START position and the breaker is automatically tripped open.

This condition also actuates the amber light associated with each breaker control switch. The 4160 V standby bus distribution breakers are listed in Section 8.3.1.1.4.1, Item 5c above.

e. "STBY DIESEL GEN. TROUBLE" - This annunciator windor is a common alarm actuated by the conditions listed in Section 8.3.1.1.4.1. Items 4.a.1 through 4.a.14, Item 4.b.2, Items 4.b.5 through 4.b.8, Items 4.c.1 through 4.c.8, Items 4.d.1 through 4.d.3, Items 4.e.1 through 4.e.4, plus items a, b, and e through m of the protective functions listed as annunciated individually.

f. "DIESEL FUEL OIL STORAGE TANK LEVEL HIGH/LOW"

g. "STBY GENERATOR TRIPPED" indicating light. This light is energized when any one of the conditions listed in Section 8.3.1.1.4.1,Items 2 and 3, exist.

6. Each standby diesel generator set is capable of being emergency started in the operational mode from the main control room as well as the standby diesel generator control room near the engines. These is no transfer scheme between these two locations, since the emergency start controls are in parallel. Normal start controls are on the local engine control panel only in the standby deisel generator control room near the engines (Fig. 8.3-11).

7. All standby diesel generator parameters that are bypassed under accident conditions are annunciated each standby diesel generator control room. These annunciators are located on the associated standby diesel engine control panel.

8. All conditions that render the standby diesel generator incapable of responding to an automatic start signal are annunciated in the main control room.

8.3.1.1.4.1.1 Qualification Testing

In accordance with Branch Technical Position EICSB-2, Diesel Generator Reliability Qualification Testing, the standby diesel generator manufacturer, Delaval Engine and Compressor Division, has performed a

c. Item c is indicated by means of breaker status light (RED).

3. The "HPCS SYSTEM NOT READY FOR AUTO START" alarm can also be annunciated by:

   a. Engine overspeed condition (can only occur while engine is running).

   b. Low oil pressure, high water temperature and overcrank; during non-LOCA condition only.

   c. Loss of DC power to 4160V switchgear.

4. The "DIESEL ENGINE TROUBLE" alarm can also be annunciated by:

   a. Engine failure to start/run
   b. Engine overspeed
   c. Low fuel level
   d. Crank case pressure high
   e. High lube oil temperature
   f. High water temperature
   g. Charger failure
   h. Engine tripped
   i. Main fuel pump failure
   j. Low lube oil temperature
   k. Low expansion tank water level
   l. High stator temperature
   m. Reserve fuel pump failure
   n. Low lube oil pressure
   o. Low cooling water pressure
   p. Low turbocharger lube oil pressure
   q. Restricted fuel oil filter
   r. Restricted lube oil filter

When the HPCS diesel generator is called upon to operate under accident conditions, the only protective devices used are the generator differential relays and engine overspeed trip device. The engine overspeed trip device is mechanical and trips the engine directly. The trips are annunciated in the main control room. Other protective relays, such as loss of excitation, anti-motoring (reverse power), overcurrent with voltage restraint, high jacket water temperature, and low lube oil pressure, are used to protect the machine when it is operating during periodic tests. These relays are automatically removed from the tripping circuits under accident conditions. In addition to these protective relays, a normal time delay overcurrent relay senses generator overload and causes an alarm in the main control room. The generator differential relays and overspeed trip device are retained under accident conditions to protect against what can be major faults which could cause significant damage. All the bypassed protective devices cause alarms in the main control room and the operator will have sufficient information to take necessary corrective action. Because during accident conditions the HPCS diesel generator is performing a safety-related function, these protective devices are insignificant so

Cable trays used for 13.8-kV service are identified as "J" trays and those for 4.16-kV are identified as "H" trays. The "J" and the "H" trays are separate from one another. Trays for 600-V or lower voltage large power cables are designated "L." Trays for 600-V or lower voltage small power cables are designated "K." Control cables of 120-V ac or 125-V dc, are run in "C" trays or conduit. Low level analog or digital instrumentation cables are run in "X" trays or in conduit. Segregation in conduit is in a comparable fashion to that employed for trays.

Cables of redundant safety-related systems are isolated from each other and from nonsafety-related cables.

There are no medium or high voltage (480V and above) power cables in the Control Building cable chases.

Electrical cables for the RPS and other safety-related systems located inside the containment structure are designed so that the cable is operable for the required period of usage during all postulated accident environments. Cables in hazardous environments are protected from the environment and against physical or fire damage to the extent required for the service either by selection of cable or by choice of raceway (e.g., cable trays with covers, metallic conduit).

Cables are derated for grouping and spacing in accordance with IPCEA recommendations. Medium voltage cable trays do not have more than a single layer of cables. Instrument and control cable trays may be filled up to the height of the cable tray siderails, assuming cable ampacity factors are not exceeded. Galvanized steel, nonconducting sleeves or blockouts in walls are used to transport cables through concrete walls.

Fire detection and protection systems, either manually or automatically initiated, are provided in those areas required to preserve the integrity of the circuits for safety-related services (Section 9.5.1).

The electrical penetrations, through the reactor containment vessel, are arranged in groups to maintain separation of electrical cables and to comply with the single-failure criteria. The design and fabrication of each type of penetration assembly is in accordance with IEEE-317 for Electrical Penetration Assemblies in Containment Structures for Nuclear Fueled Power Generating Stations. Each electrical penetration is designed to withstand the environment conditions at its location during all postulated DBAs.

Connections between field wires and penetration assembly conductors are made inside Seismic Category I termination cabinets designed to withstand the environmental conditions at its location during all postulated DBAs.

Wire splices are avoided and made only where necessary. All splices are qualified for their intended use as described in the Environemntal Qualification Document (EQD). All splices are made in accordance with the manufacturers recommended procedures and are tested after installation by continuity and insulation resistance measurements. There are no splices made in cable trays.

8.3.2.1.4 Support of Battery Systems

The facilities available for normal operation of the 125-V dc safety-related systems are shown in Fig. 8.3-6. Each system has its own battery charger for normal support, its battery for preferred support, and access to a backup battery charger.

Mechanical blocking devices prevent cross-connections between independent battery systems through the backup battery charger switchgear 1BYS-SWG01D. No single failure can jeopardize the safety of redundant loads.

The 125-V dc nonsafety-related systems are arranged similarly to the 125-V dc safety-related systems and are shown in Fig. 8.3-6.

8.3.2.1.5 Ventilation

Each battery is located in its own independently ventilated room to keep the gases produced due to the charging of batteries below an explosive concentration, and to keep the room temperature to a level at which the battery is specified to supply its rated current. The ratings of the batteries associated with the Division I and II standby diesels are based on a 24-hr average electrolyte temperature of 77°F.

8.3.2.1.6 Instrumentation and Alarm

Important system components are either alarmed on failure or capable of being tested during service to detect faults. Indicators are provided to monitor their status in the main control room. The station operating procedures provide for system status checks at every shift change which include the charging status of batteries in the unlikely event that a battery charger should fail without annunciating the condition in the control room.

Control of the battery chargers and the distribution switchgear is local. The dc power system includes the following monitors and alarms:

a. Main Control Room Annunciation

   1. Battery current (ammeter-charge/discharge)

   2. DC bus voltage (voltmeter)

   3. DC bus voltage low alarm (set at open circuit voltage)

   4. DC bus voltage low-low alarm

   5. DC bus ground fault alarm (for ungrounded systems)

   6. Battery breaker open alarm

   7. Battery charger output breaker open alarm

   8. Battery charger trouble alarm

   9. Back up charger breaker open alarm

10. Supply or distribution breaker overcurrent trip alarm

b. Local Annunciation

1. Battery charger output current (ammeter)

2. Battery current (ammeter-charger/discharger)

3. Battery voltage (voltmeter)

5. Battery charger output voltage (voltmeter)

6. Battery charger and overvoltage

7. Battery charger low AC supply voltage

8. Battery charger overcurrent

9. Battery charger temperature high

Uninterruptible power supplies have been specified to include protective circuitry which protected internal components from dc input voltage spikes which may have originated on the dc power system.

8.3.2.1.7 Maintenance and Testing

The station batteries and other equipment associated with the 125-V dc systems are easily accessible for maintenance and testing. The batteries are periodically checked for specific gravity and individual cell voltages. An equalizing (overvoltage) charge, where recommended by the battery manufacturer, is applied to bring all cells up to an equal voltage. Over a period of time, the above-mentioned tests will reveal a weak or weakening trend in any cell and replacement will be made if necessary. Periodically, the battery charger will be disconnected and the ability of the unit battery to maintain voltage and assume the dc load will be verified. This test will uncover any high-resistance connections or cell internal malfunctions. The normal station batteries and the standby batteries for Divisions I, II, and III have access to a battery load tester, as shown in Fig. 8.3-6. Testing will comply with IEEE-308, Criteria for Class 1E Electrical Systems for Nuclear Power Generating Stations. Periodic testing requirements of each battery system during normal or accident periods of operation are described in the Technical Specifications.

The battery chargers may be operated with the battery disconnected since the charger's stability is not load dependent. With the battery disconnected the charger's regulation is .5 percent from no load to full load and ripple does not exceed 105 millivolts (rms).

The only foreseen mode of electrical operation during which the battery chargers would supply power to the dc switchgear loads without the batteries also being connected to the dc switchgear load would occur during periodic battery discharge tests.

8.3.2.2.5 Battery Capacity

The ampere-hour capacity and short time rating of the battery is in accordance with criteria given in IEEE-308, and is adequate to supply all electrical loads required until ac power is restored for the operation of the battery chargers. The battery has sufficient stored energy to operate required connected essential loads for as long as each may be needed during a loss of the ac bus supplying the battery chargers under normal or emergency conditions. Capacity is large enough to cope with LOCA conditions or any other emergency shutdown. Each distribution circuit is capable of transmitting sufficient energy to start and operate all required loads in that circuit. The 125-V battery is sized in accordance with the principles set out in IEEE-308.

8.3.2.2.6 Charging

The Class 1E charger 1E22*S001CGR for the HPCS dc system is fed from the HPCS motor control center (MCC) and is capable of carrying the normal direct-current system load and, at the same time, keeping the battery in a fully charged condition. The sizing of the battery charger meets IEEE-308.

The maximum equalizing charge voltage for the HPCS battery is 137.4 VDC (2.29 VDC per cell). Performance of an equalizing charge at maximum voltage will result in no damage to connected equipment.

8.3.2.2.7 Ventilation

The battery room is independently ventilated to keep the gases produced due to the charging of the battery below an explosive concentration.

8.3.2.2.8 Maintenance and Testing

Design and installation of the 125-V dc system facilitates periodic maintenance tests to determine the condition of each individual cell. Testing includes the items listed below. Battery chargers are also periodically checked by visual inspection and performance tests.

Testing of the Division III 125-V dc batteries includes the following:

1. The specific gravity, voltage, and temperature of the pilot cell of each battery will be measured and logged once a month.

2. Every 3 months, voltage measurements of each cell to the nearest 0.01 V, specific gravity of each cell, and temperature of every fifth cell will be made. These measurements will be logged.

3. Once each refueling cycle, the batteries will be subjected to a service test. The specific gravity and voltage of each cell will be measured after discharge and logged.

8.3.2.2.9 Test Requirements of Station Batteries

Provisions are made in the dc power system so that surveillance and service tests can be performed in accordance with IEEE-450.

8.3.2.2.10 Instrumentation and Alarm

Important system functions are either alarmed on failure or capable of being tested during service to detect faults. Indicators for critical parameters are provided to monitor their status in the main control room. Additionally, station operating procedures provide for system status monitoring at every shift change which will include a check of the charging status of the battery in the unlikely event that the battery charger fails in a manner which is not alarmed in the control room.

Main control room instrumentation includes a voltmeter, and an ammeter for each dc system Control of the battery chargers and the distribution switchgear is local. The dc power system includes the following alarms and monitors:

1. "125V dc System Trouble" alarm located in the main control room annunciates in the event of:

    a. battery output breaker trip

    b. 125V dc bus ground, or

    c. 125V dc bus undervoltage.

2. "HPCS Battery Charger Trouble" alarm located in the main control room annunciates in the event of:

    a. battery charger output breaker trip

    b. battery charger high output voltage, or

    c. battery charger loss of AC power supply.

3. "Battery Trouble" alarm located on the local diesel-generator control panel annunciates in the event of:

    a. 125V dc bus ground, or

    b. 125V dc bus undervoltage.

4. The following voltmeters are provided to monitor 125V dc supply voltage:

    a. 125V dc voltmeter in the main control room

    b. 125V dc voltmeter in the main control room

    c. 125V dc voltmeter locally at battery charger

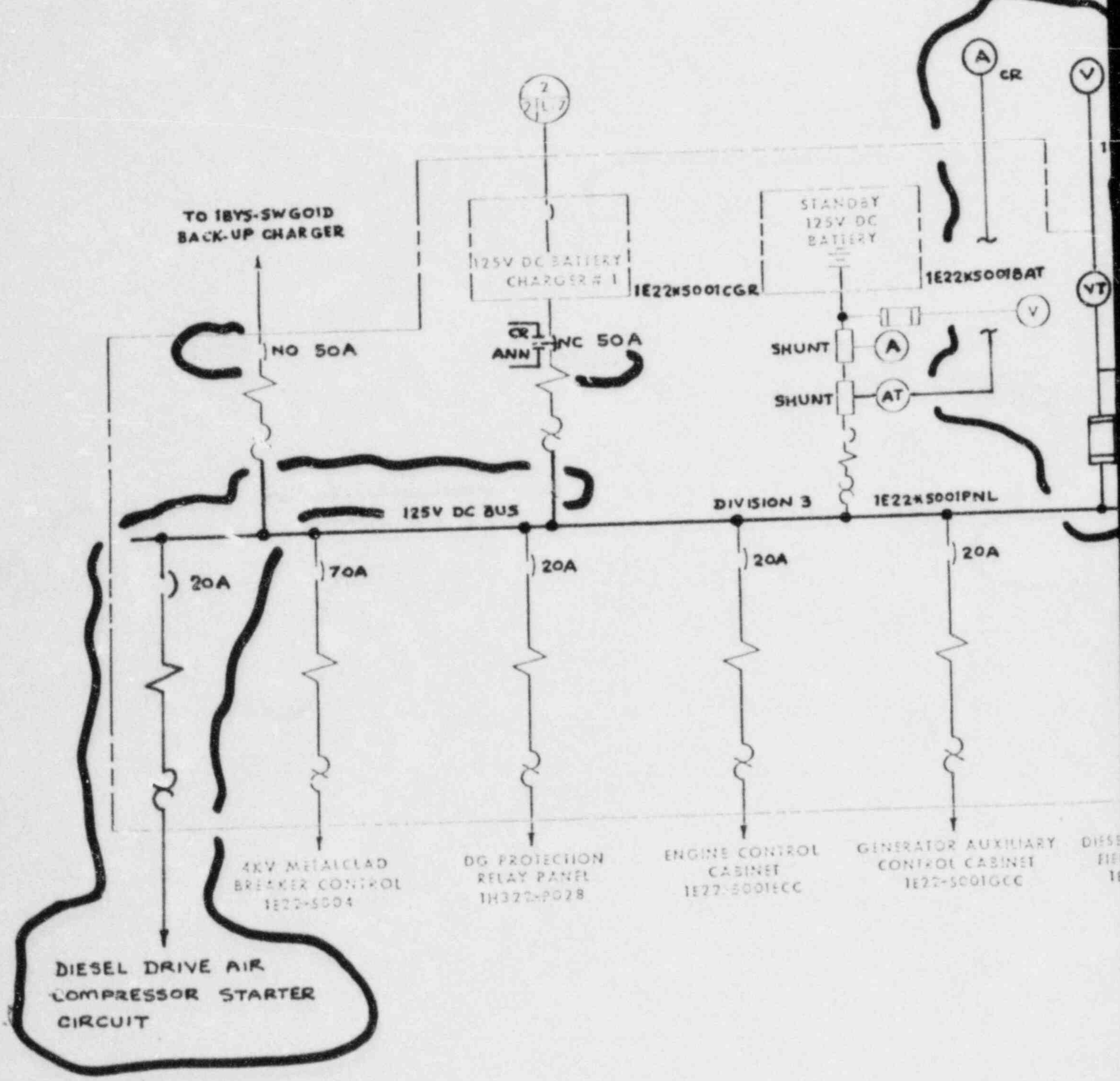
    d. 125V dc voltmeter at local diesel-generator control panel.

5. The following ammeters are provided to monitor 125V dc system load current:

    a. Ammeter in the main control room

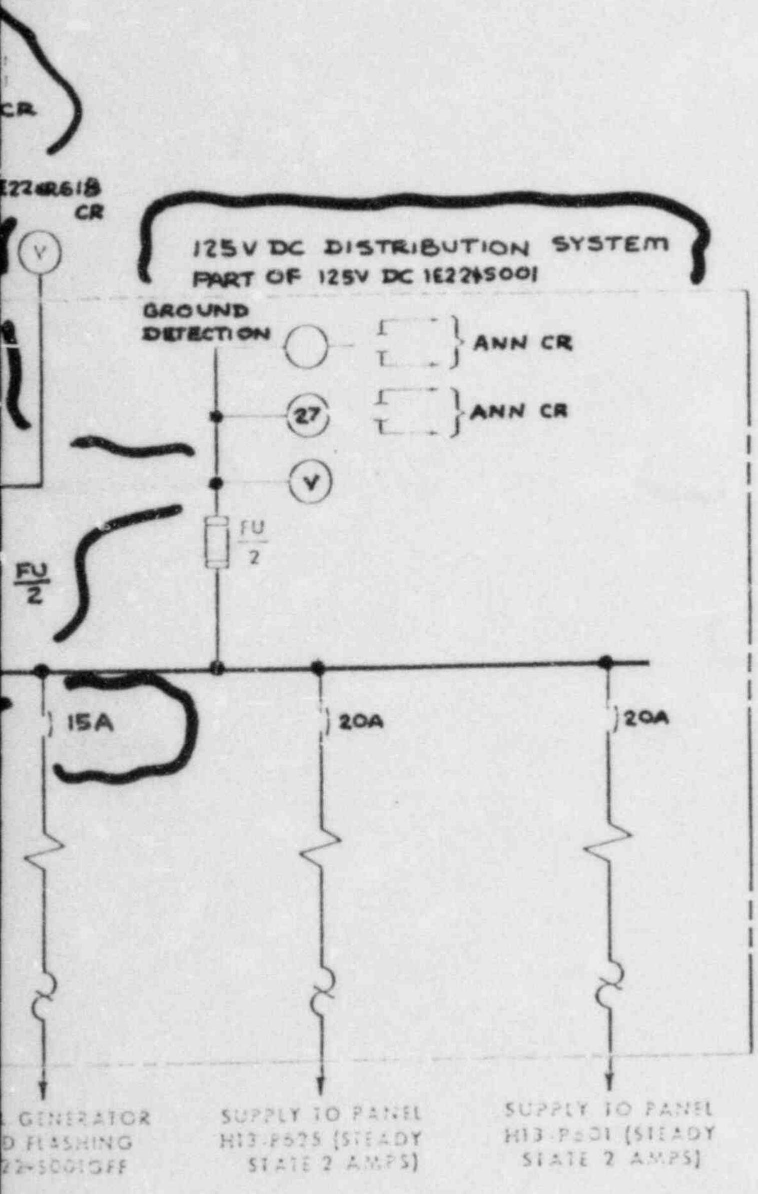
REFERENCES - 8.3

1. Letter from J. E. Booker, Gulf States Utilities Company, Beaumont, Texas, to H. R. Denton, U.S. Nuclear Regulatory Commission, Washington, D.C., February 10, 1984.



Also Available On
Aperture Card

8402210104-01

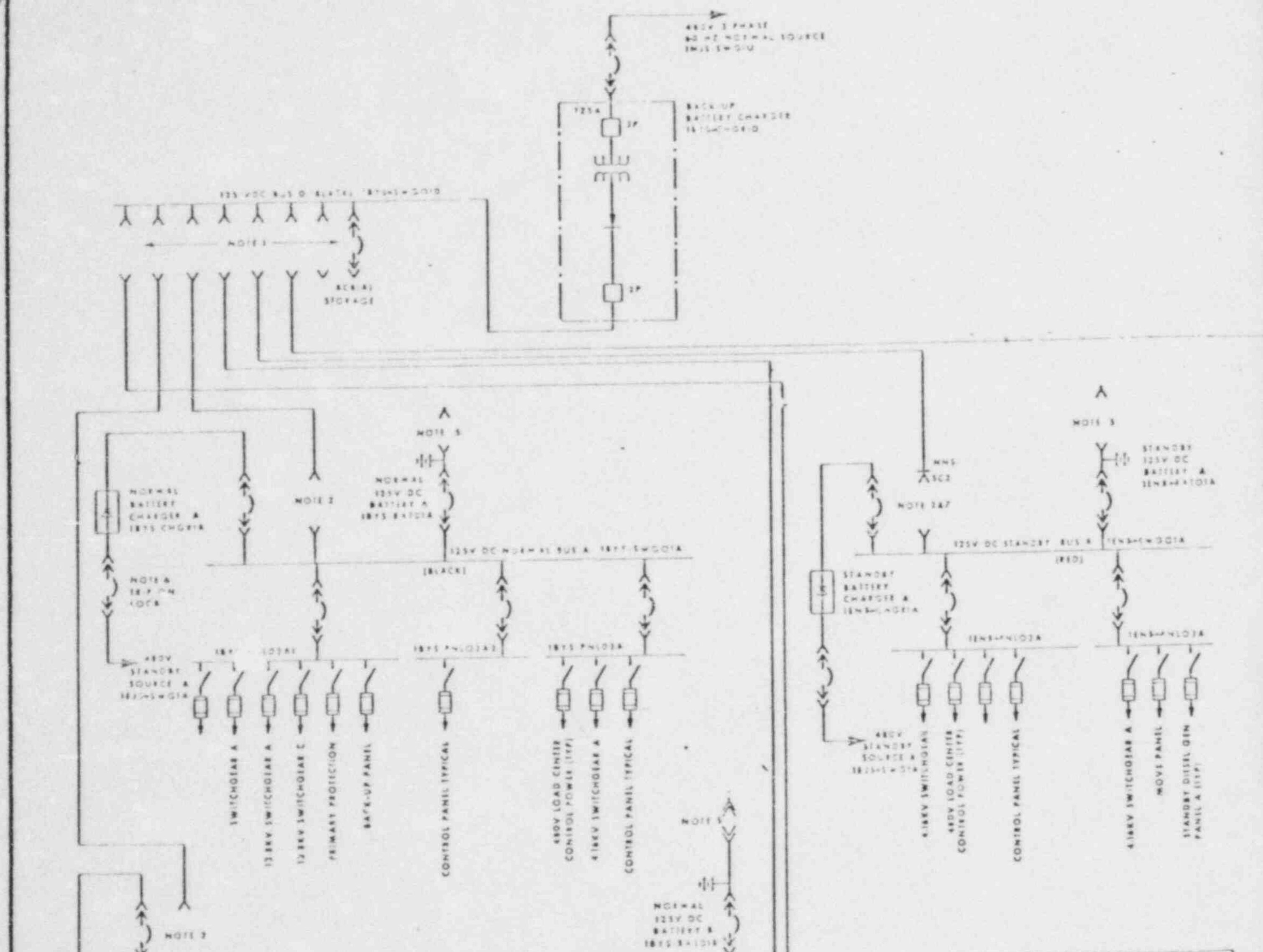


TI
APERTURE
CARD

FIGURE 8.3-3

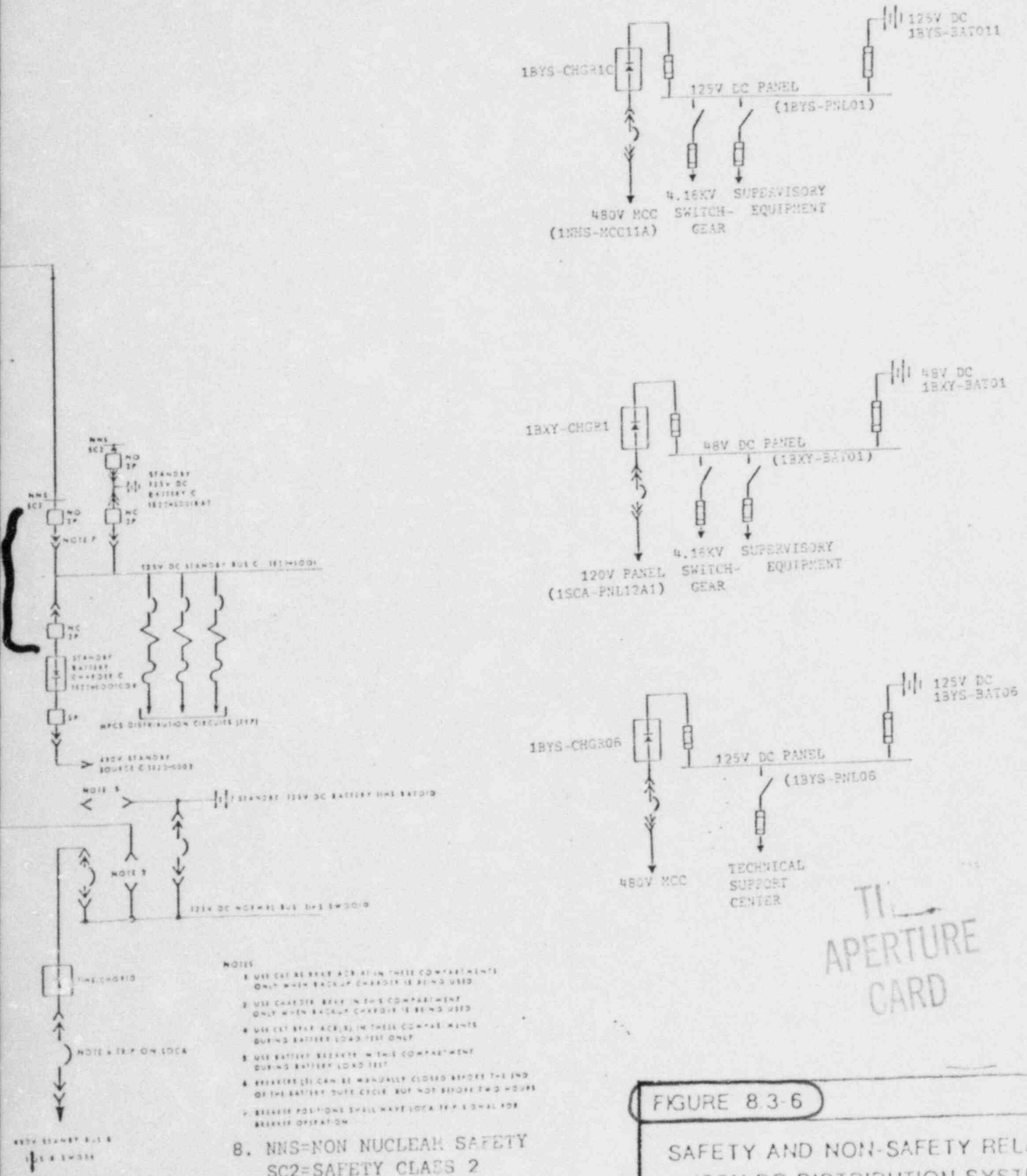
ONE LINE DIAGRAM
HIGH PRESSURE CORE SPRAY
SHT. 3 OF 3

RIVER BEND STATION
FINAL SAFETY ANALYSIS REPORT



Also Available On Aperture Card

8410221104-02



8. NNS=NON NUCLEAR SAFETY
SC2=SAFETY CLASS 2

TI APERTURE CARD

FIGURE 8.3-6

SAFETY AND NON-SAFETY RELATED
125V DC DISTRIBUTION SYSTEM

RIVER BEND STATION
FINAL SAFETY ANALYSIS REPORT

SOURCE 12210-EE-1ZJ

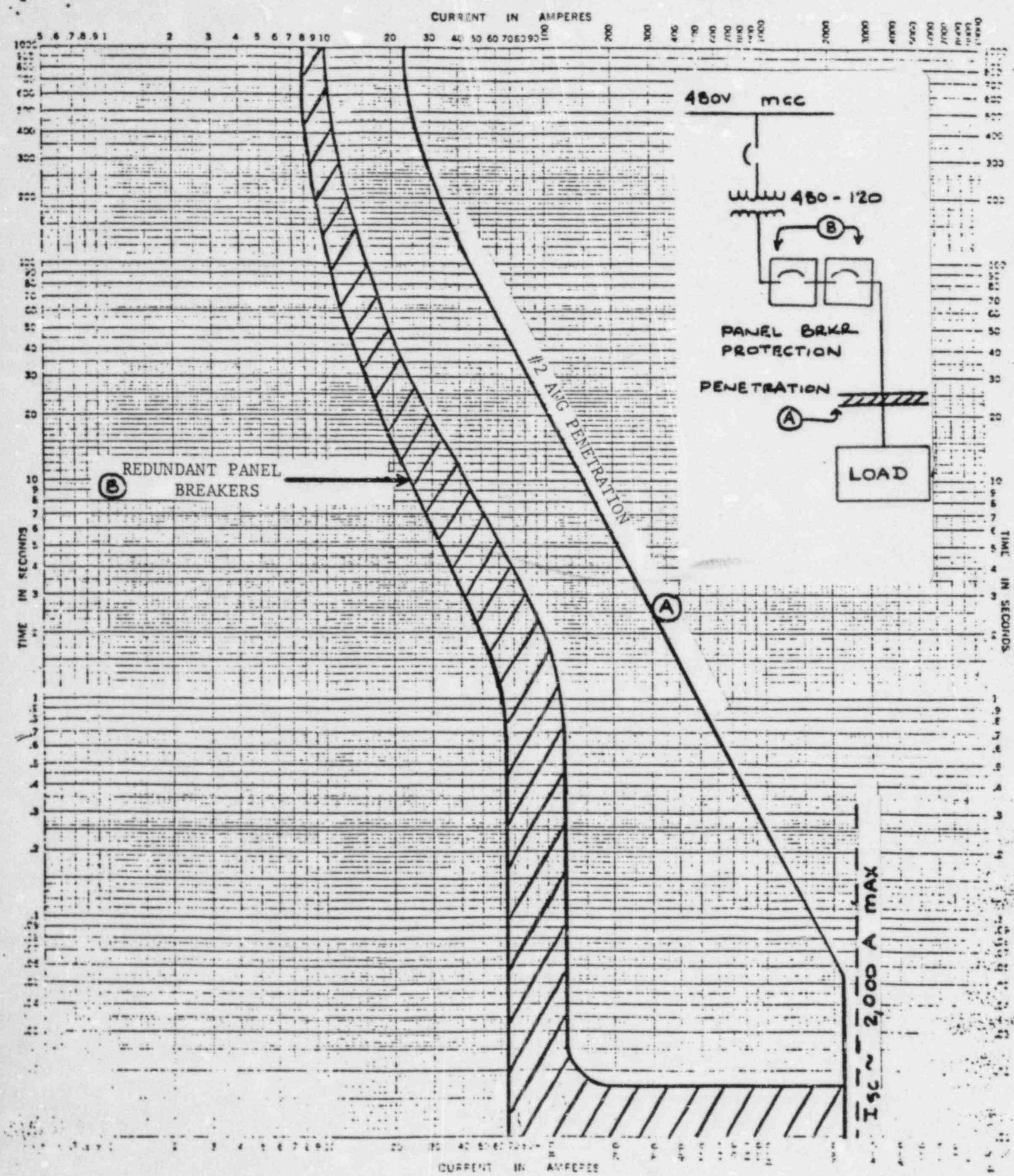


FIGURE 8.3-13a
TYPICAL PANEL FEED

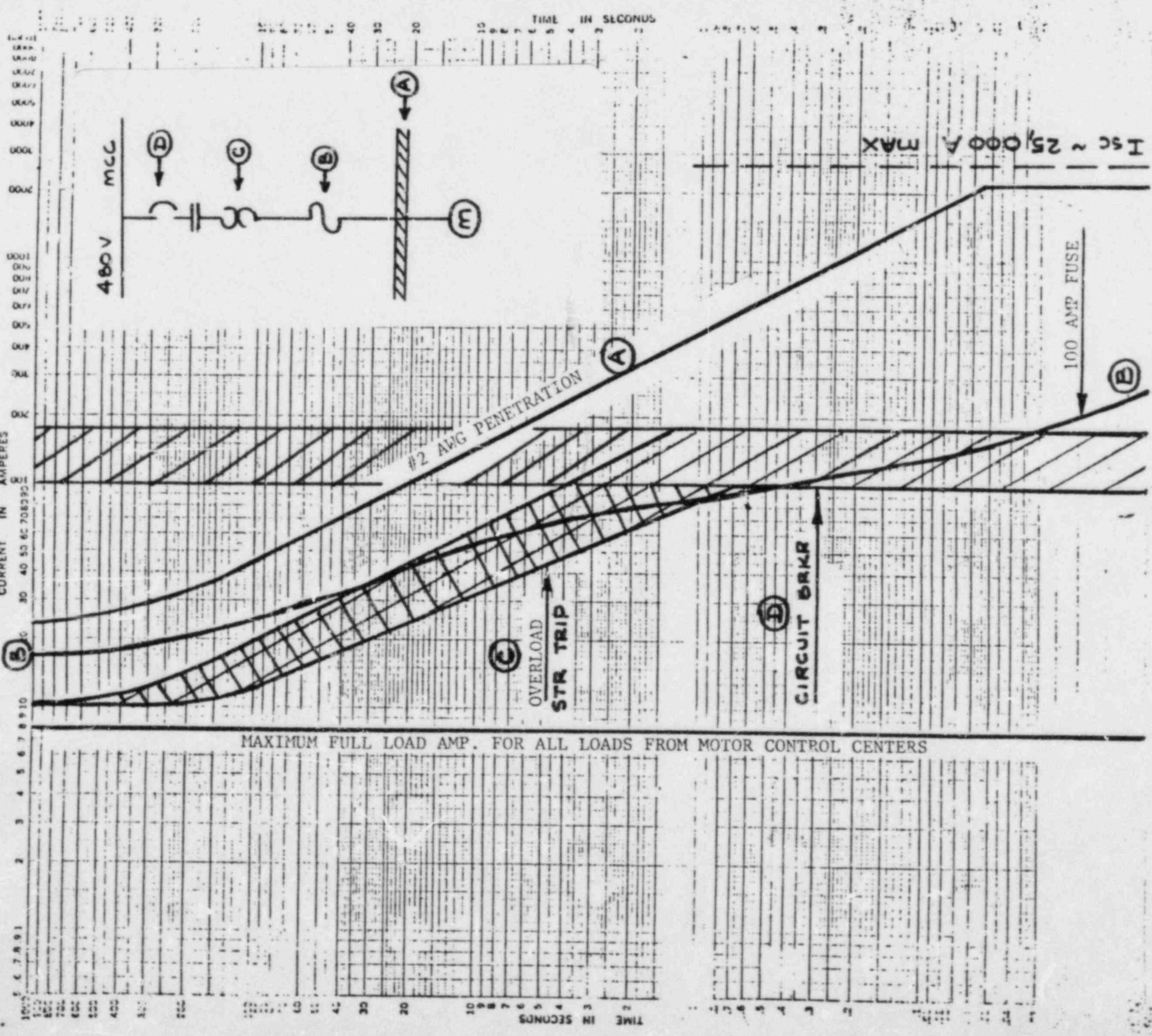


FIGURE 8.3-13b
480 V MCC LOADS
(LARGEST LOAD,
STARTER & FUSE)

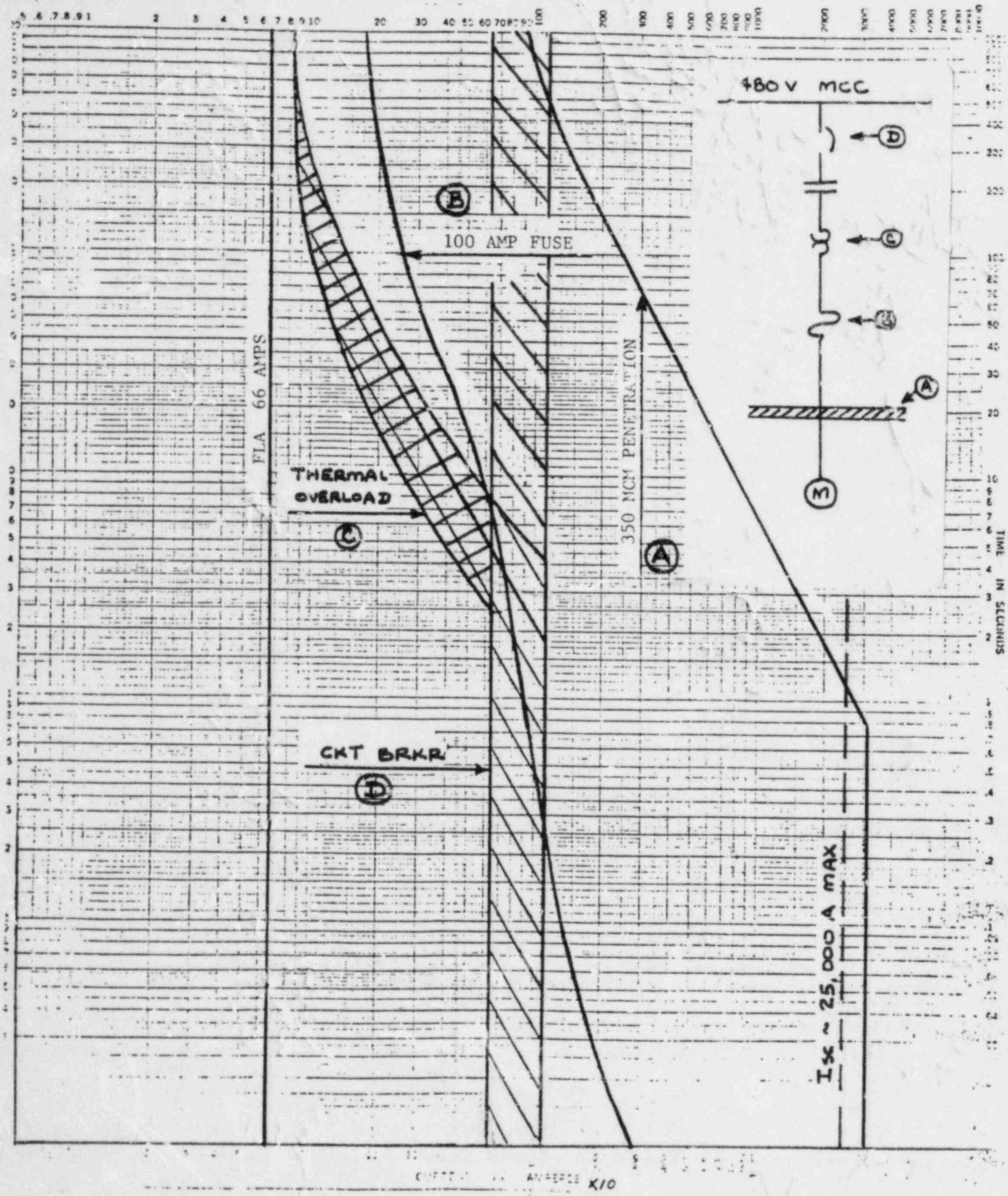


FIGURE 8.3-13c
TYPICAL 350 MCM
PENETRATION FOR
480 V MCC MOTOR LOAD

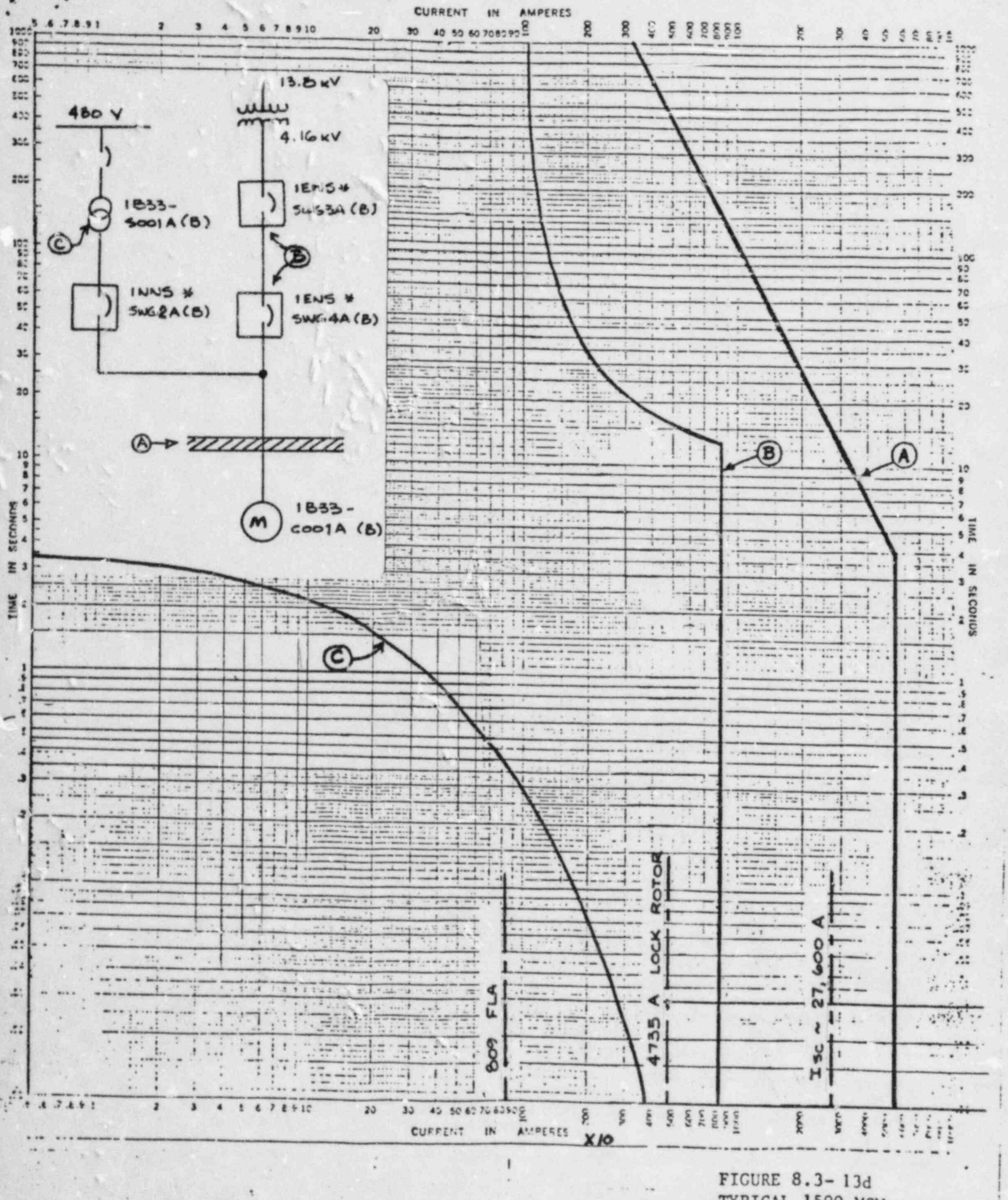
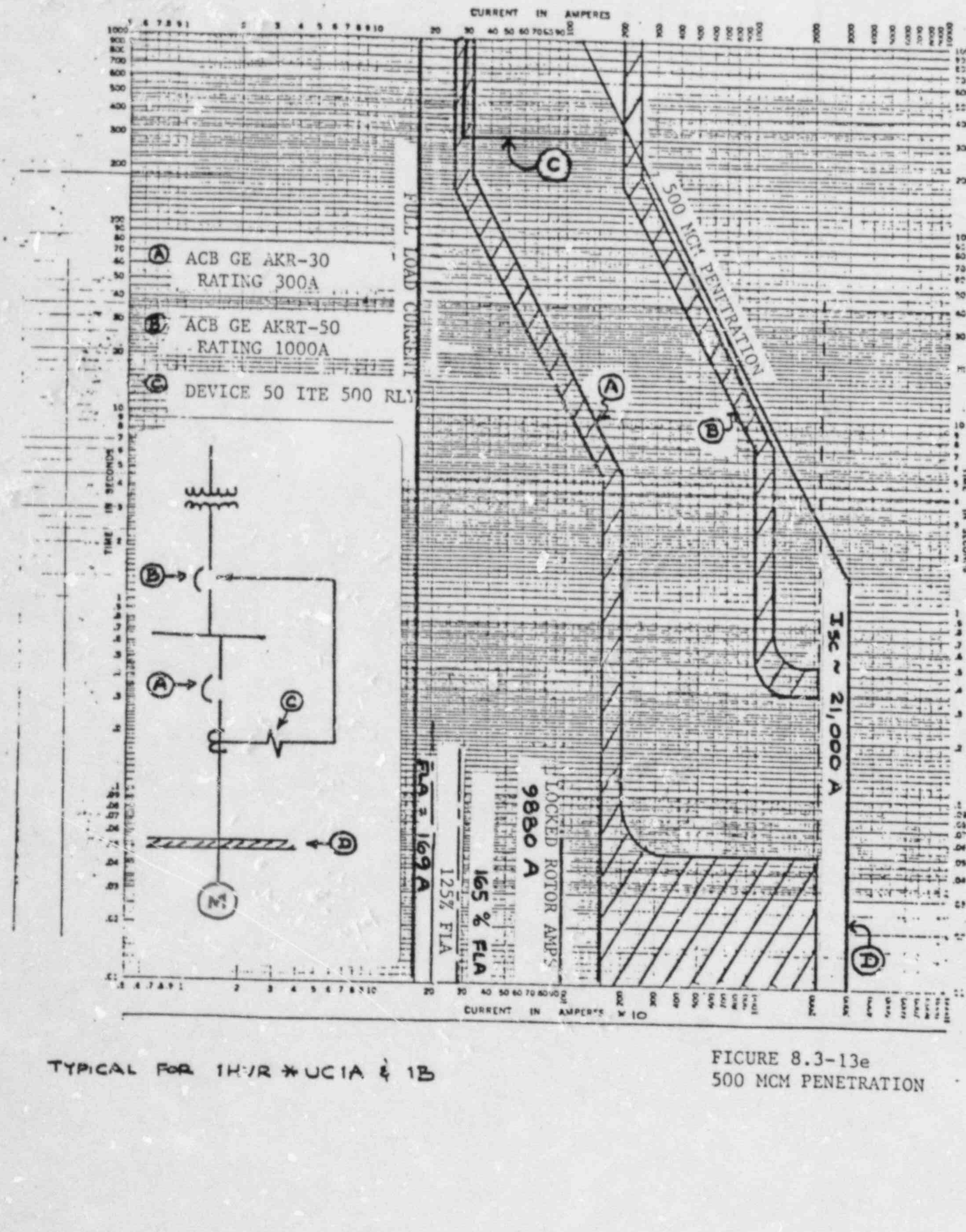


FIGURE 8.3- 13d
TYPICAL 1500 MCM
PENETRATION



TYPICAL FOR 1HVR * UC1A & 1B

FICURE 8.3-13e
500 MCM PENETRATION

ATTACHMENT 2

The following is a transfer scheme that analyzes the interaction of the diesel starting logic and normal bus transfer logic when the standby bus is fed through the normal bus and a common loss of power or undervoltage condition occurs (see Figures A, B and C).

I. Upon loss of power (i.e., generator trip), with emergency buses (1ENS*SWG1A and/or 1ENS*SWG1B) being fed through normal buses (1NNS-SWG1A and/or 1NNS-SWG1B), the following would occur:

1) 1NNS-SWG1A and 1NNS-SWG1B normal feeder breakers (No's 06 & 14) would trip.

2) If bus voltage on 1NNS-SWG1A and 1NNS-SWG1B is greater than 70 percent and other electrical permissives satisfied, fast transfer to preferred source (close preferred supply breakers 07 & 15) - no effect on emergency buses.

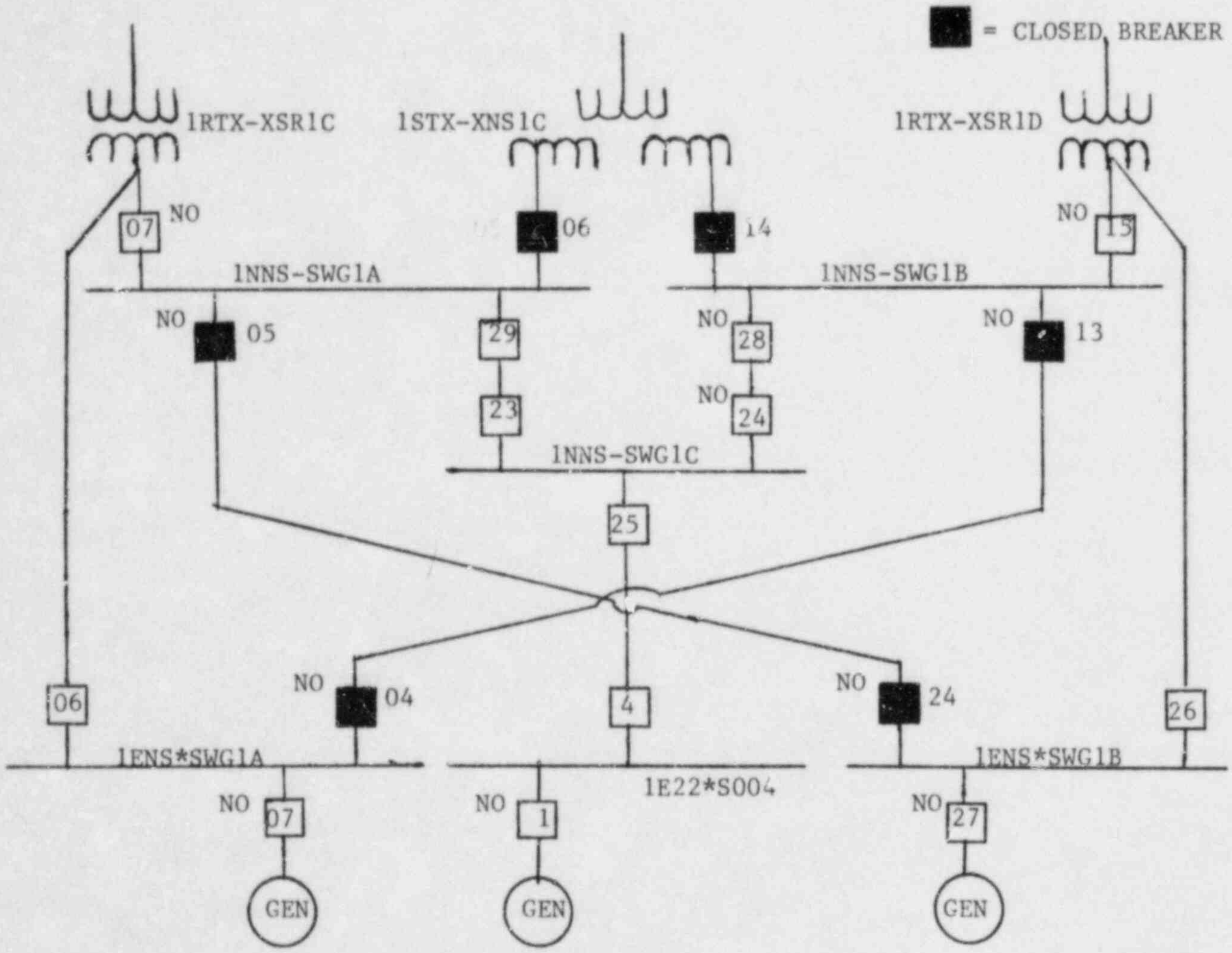
3) If fast transfer does not occur, residual bus voltage on 1NNS-SWG1A and 1NNS-SWG1B would have to drop below 25 percent to slow transfer.

4) If slow transfer occurs in less than 3 seconds there would be no effect on emergency buses.

5) If slow transfer takes more than 3 seconds emergency bus feeder breakers (No's 04 & 24) would trip on undervoltage, the diesel generator and load sequence timer would start.

II. On sustained undervoltage (80%) 1NNS-SWG1A and 1NNS-SWG1B feeder breakers (No's 06 & 14) would trip in 2 seconds, if fast transfer does not occur, and slow transfer takes longer than 1 second, the emergency bus feeder breakers (No's 04 & 24) would trip on undervoltage, the diesel generator and load sequence timer would start.

FIGURE A



CONDITION

Generator Trip (loss of power)

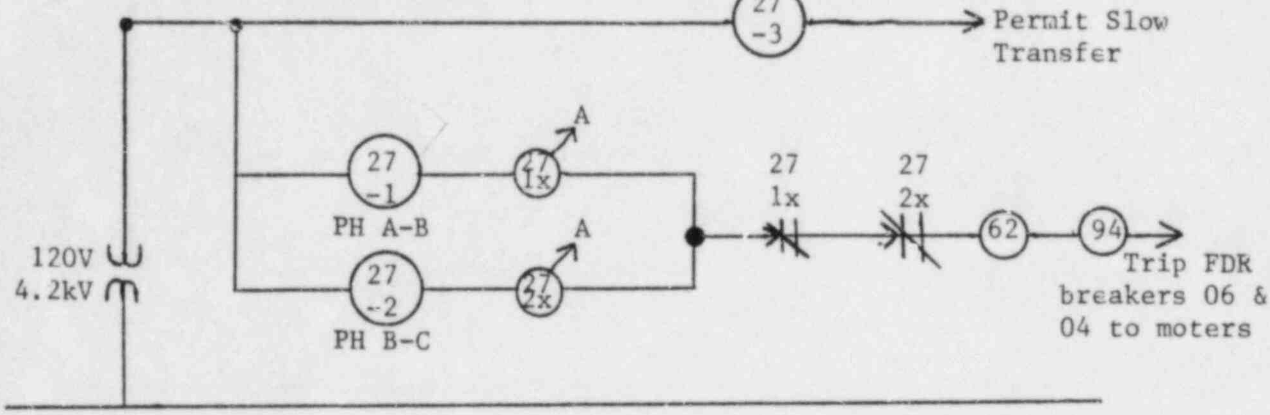
Circuit breakers 06 & 14 AUTO-TRIP
1NNS-SWG1A & 1NNS-SWG1B voltage is greater than 70% (Fast Transfer)
Residual bus voltage is less than 25% (Slow Transfer)
1ENS-SWG1A & 1ENS-SWG1B trip on undervoltage is less than 71% in three (3) seconds

Undervoltage

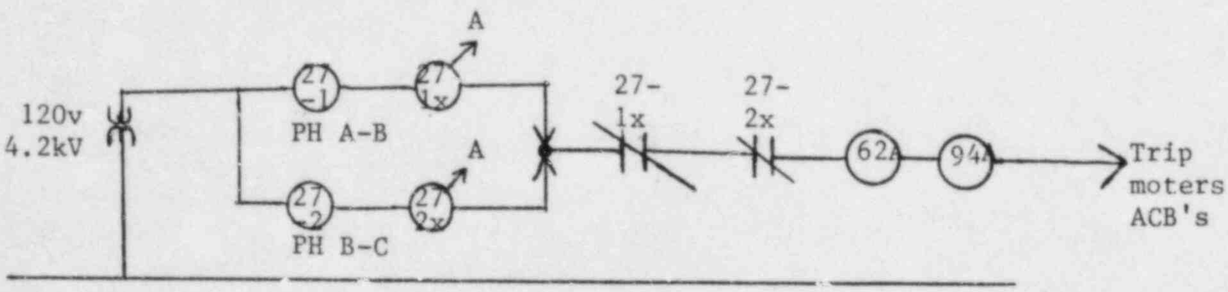
Circuit breakers 06 & 14 trip at 80% in two (2) seconds

FIGURE B

Undervoltage Trip Logic for NNS Buses:



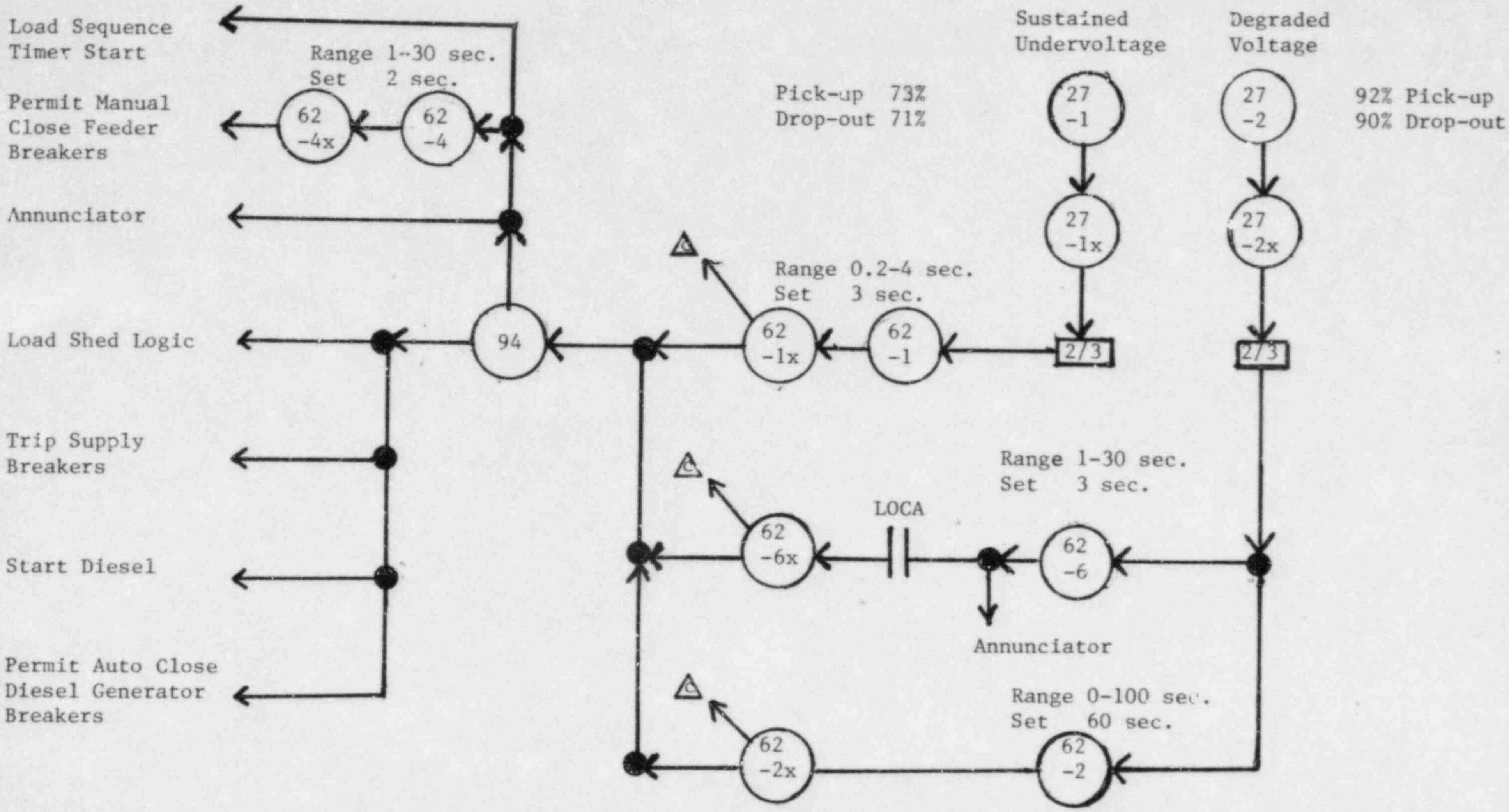
						Range	Set
1NNS-SWG1A & 1NNS-SWG1B	27-1&2	90-105v 0.0	96v 0.0	(80.77%)	62	0.2-4 sec.	2.0 sec.
	27-3	18-30v 0.0	30v 0.0	(25.24%)			
	59A	108-130v 0.0	108v 0.0	(90.86%)			
	25G&R	1.0 TD					



						Range	Set
1NNS-SWG1C	27-1&2	90-105v	96v	(80.77%)	62	0.2-4 sec.	2.0 sec.
	25	1.0 TD					

FIGURE C

Undervoltage Trip Logic for ENS Buses:



The following is a transfer scheme that analyzes the interaction of the diesel starting logic and normal bus transfer logic when the HPCS standby bus is fed through the normal bus and a common loss of power or undervoltage condition occurs (see Figures D and E).

I. Upon loss of power (i.e., generator trip), with emergency bus 1E22*S004 being fed from normal bus (1NNS-SWG1A or 1NNS-SWG1B) through 1NNS-SWG1C, the following would occur:

1) 1NNS-SWG1A and 1NNS-SWG1B normal feeder breakers (No's 06 & 14) would trip.

2) If bus voltage on 1NNS-SWG1A and 1NNS-SWG1B is greater than 70 percent and other electrical permissives satisfied, fast transfer to preferred source (close preferred supply breakers 07 & 15) - No effect on 1E22*S004 bus.

3) If fast transfer does not occur, residual bus voltage on 1NNS-SWG1A to 1NNS-SWG1B would have to drop below 25 percent to slow transfer.

a) If slow transfer occurs in less than 2 seconds there would be no effect on 1E22*S004 bus.

b) If slow transfer occurs after 2 seconds 1E22*S004 feeder breaker (No. 04) would trip on undervoltage, then after 2 more seconds the diesel generator would start and permit auto close of the diesel generator breaker (No. 1).

On concurrent undervoltage, 1NNS-SWG1A and 1NNS-SWG1B feeder breakers (No. 06 & 14) and 1E22*S004 feeder breaker (No. 04) would trip in 2 seconds. After 2 more seconds the diesel generator would start and permit to auto close diesel generator (No. 1).

FIGURE D

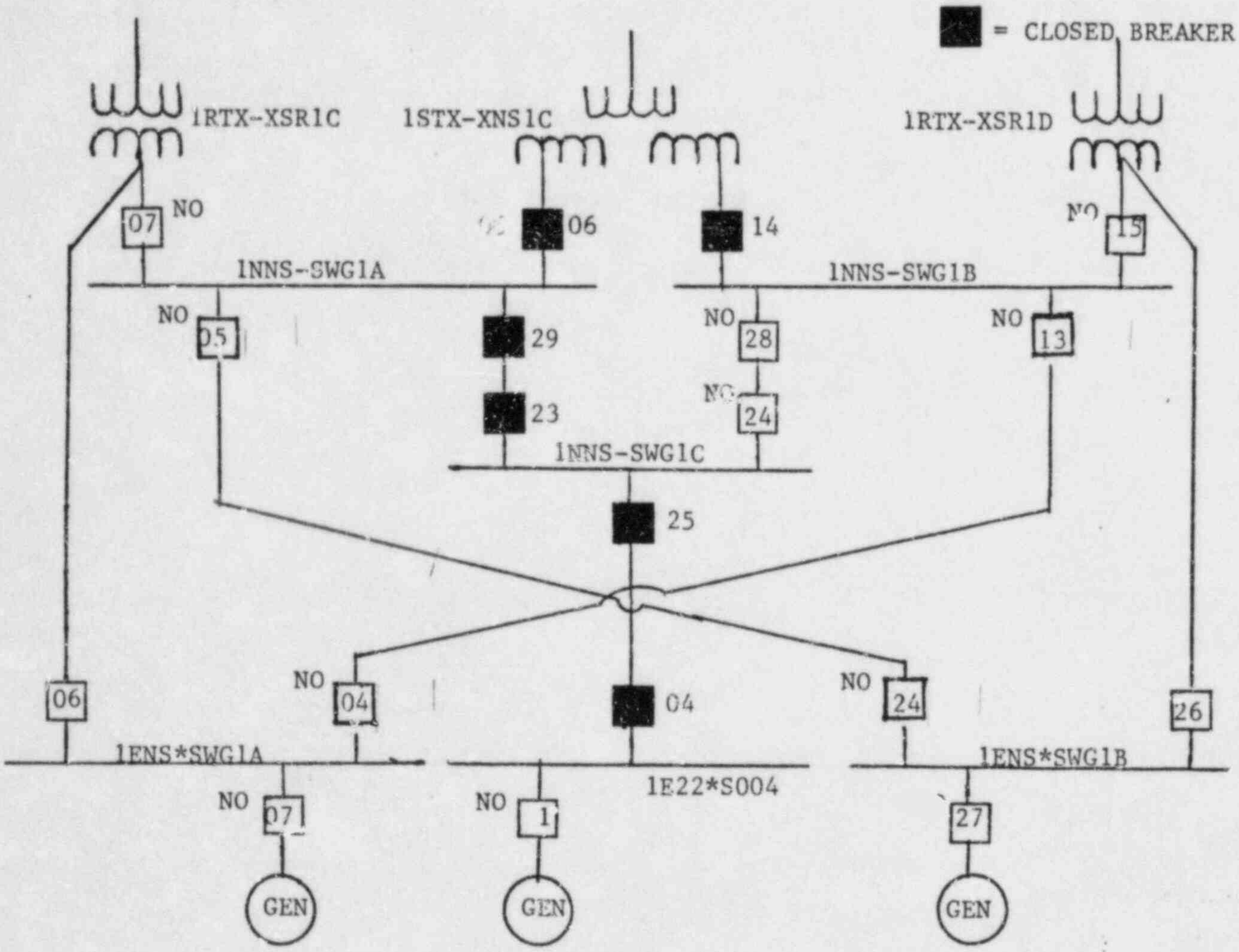

= CLOSED BREAKER
1RTX-XSR1C
1STX-XNS1C
1RTX-XSR1D
07
NO
06
14
NO
15
1NNS-SWG1A
1NNS-SWG1B
NO
05
29
NO
28
NO
13
23
NO
24
1NNS-SWG1C
25
NO
04
04
NO
24
06
26
1ENS*SWG1A
1E22*S004
1ENS*SWG1B
NO
07
NO
1
27
GEN
GEN
GEN

FIGURE E

Undervoltage Trip Logic for 1E22*S004 Bus: