REGULATORY INFORMATION DISTRIBUTION SYSTEM (RIDS)

ACCESSION NBR:8210060223 DOC.DATE: 82/09/22 NOTARIZED: NO DOCKET #
FACIL:50-397 WPPSS Nuclear Project, Unit 2, Washington Public Powe 05000397
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SUBJECT: Forwards corrections & clarifications to Amend 23 to FSAR Section 8.3 re onsite power sys.Next FSAR amend will be revised to include encl corrections.

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September 22, 1982
G02-82-800

Docket No. 50-397

Mr. A. Schwencer, Chief
Licensing Branch No. 2
Division of Licensing
U.S. Nuclear Regulatory Commission
Washington, D.C. 20555

Dear Mr. Schwencer:

Subject: NUCLEAR PROJECT NO. 2
FINAL SAFETY ANALYSIS REPORT
SECTION 8.3 CORRECTIONS

Amendment 23 of the WNP-2 FSAR provided a revision to Section 8.3 in May, 1982. In subsequent meetings between Supply System personnel and the NRC, it has been noted that typographical errors in the text and figures exist and some clarification is required. The attached Amendment 23 marked up pages are provided to correct those errors and provide clarification. The Supply System does not consider these corrections and clarifications to represent changes in the WNP-2 separation criteria as discussed in previous meetings and communications. The next FSAR amendment will be revised to include these corrections.

Should you have any questions with regard to these corrections, please contact Mr. R. M. Nelson, Manager, WNP-2 Project Licensing.

Very truly yours,

G D Bouchey

G. D. Bouchey
Manager, Nuclear Safety and Licensing

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cc: R Auluck - NRC
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8.3 ONSITE POWER SYSTEMS

8.3.1 AC POWER SYSTEMS

8.3.1.1 Description

Principal elements of the WNP-2 auxiliary AC electrical systems are illustrated in Figures 8.1-9a through 8.1-9d. Four (4) auxiliary transformers are provided.

Normal auxiliary power is provided by two (2) normal auxiliary transformers fed from the main generator 25 kV isolated phase bus. The startup transformer is connected to the BPA 230 kV H. J. Ashe Switchyard. These auxiliary systems each have the capacity to carry the full plant auxiliary load. A backup transformer is provided to supply all Division 1 and 2 plant ESF loads. This transformer is supplied from the BPA Benton Switchyard via a 115 kV line to the plant. The transformer steps down the 115 kV supply to 4.16 kV and is connected by cables through circuit breakers to the 4.16 kV Class 1E switchgear buses SM-7 and SM-8.

8.3.1.1.1 4.16 kV and 6.9 kV Distribution System

The auxiliary transformers step down the available voltage as required to supply the 4.16 kV and 6.9 kV auxiliary switchgear buses. During normal operation, all load is carried by the normal auxiliary transformers. The startup transformer is used while the 25 kV main generator is being started and synchronized with the system. When this is acomplished, all auxiliary load is transferred (live load transfer) to the normal auxiliary transformers. The startup transformer remains energized from the 230 kV offsite powerline to permit the auxiliary load to be automatically transferred back to it if power from either normal auxiliary transformer is lost. It is possible to operate the plant with auxiliary loads carried by the startup transformer. C

The 4.16 kV non-Class 1E switchgear buses SM-1, SM-2, and SM-3 are fed from the secondary windings of the dual secondary winding normal auxiliary transformer (TR-N1) or from the 4.16 kV "Y" winding of the dual secondary winding startup transformer (TR-S). These buses supply the large non-Class 1E auxiliary motors and substations, and the Class 1E switchgear buses SM-4, SM-7, and SM-8.

The 6.9 kV non-Class 1E switchgear buses are fed from the single secondary winding normal auxiliary transformer (TR-N2) or from the 6.9 kV "X" winding of the dual secondary winding startup transformer (TR-S). These buses supply the non-Class 1E reactor recirculation pumps, cooling tower substations and auxiliary substations.

The 6.9 kV and 4.16 kV auxiliary switchgear buses are arranged for distribution of power through a switchgear assembly of air circuit breakers. The switchgear is of metal-clad, indoor design and has 3-pole air circuit breakers (draw-out type) with stored energy mechanisms fed from the plant DC systems.

Normal source power failure is detected by relays in the unit trip protective system and by undervoltage relays. Automatic transfer facilities are provided so that failure of normal supply causes immediate tripping of the normal supply circuit breakers and simultaneous closing of the startup transformer supply circuit breakers. The startup transformer circuit breakers are interlocked to close only after the normal source circuit ~~curcuit~~ breakers have opened, thus preventing closing into a fault; this provides virtually continuous feed to the Class 1E and non-Class 1E switchgear buses of all divisions.

Upon loss of both normal and startup sources, or if the startup source is lost when the main generator is out of service, the tie breakers between the 4.16 kV Class 1E and the 4.16 kV non-Class 1E switchgear buses are automatically opened, thereby shedding all loads supplied via the 4.16 kV non-Class 1E buses. The 4.16 kV Class 1E bus undervoltage signals cause trip of all 4.16 kV feeder breakers except those breakers supplying 480 V substations. The Division 1 and 2 4.16 kV Class 1E buses (SM-7,8) are then automatically transferred to the 115/4.16 kV backup transformer for supply of load. In the event this source is also unavailable, these buses would be automatically transferred to the onsite standby sources (Division 1 and 2 diesel generators). Reapplication of load is on a time priority basis. The loading sequence for buses SM-7 and SM-8, as shown in Tables 8.3-1 and 8.3-2 and Figures 8.3-16c and 8.3-17c, is accomplished through the use of electro-mechanical time delay relays. The Division 3 (HPCS) 4.16 kV Class 1E bus (SM-4) cannot be connected to the backup source; loss of the normal/startup sources causes automatic transfer of this load to the Division 3 onsite standby source (Division 3 diesel generator). Load shedding and load sequencing are not required in this division.

The 4.16 kV Class 1E buses SM-7 and SM-8 provide power to the 4.16 kV emergency core cooling system (ECCS) loads, control rod drive pumps and (via stepdown transformers) the 480 V Class 1E buses SL-71, SL-73, SL-81, and SL-83. The 4.16 kV Class 1E bus SM-4 provides power to the 4.16 kV high pressure core spray (HPCS) pump and (via stepdown transformer) the 480 V Class 1E motor control center MC-4A (HPCS auxiliaries). Buses SM-7 and SM-8 can be fed from any of three sources, namely (1) normal auxiliary switchgear which receives power from either the normal auxiliary transformers or the startup transformer, (2) the backup transformer or, (3) standby diesel generators. Bus SM-4 can be fed from either of two sources, namely, (1) normal auxiliary switchgear which receives power from either the normal auxiliary transformers or the startup transformer or, (2) a standby diesel generator.

The Division 1 and 2 4.16 kV Class 1E buses have been arranged to allow both ESF and non-ESF loads to be supplied by the onsite power sources on loss of offsite power as shown in Figure 8.1-9b. Division 1 4.16 kV ESF loads are connected to bus SM-7 while 4.16 kV non-ESF loads are connected to sub-bus SM-75. The isolating circuit breaker (7-75) feeding sub-bus SM-75 is automatically tripped by a LOCA signal to shed these loads. Division 2 loads are treated in a similar manner on buses SM-8 and SM-85. The plant service water pumps are automatically started on loss of offsite power to provide water to drywell cooling units for orderly shutdown, but on loss-of-coolant accident they are automatically tripped from the standby AC power system.

Manual live transfer of power between normal auxiliary and startup sources is possible either way by the main control room operator on the 4.16 kV non-Class 1E switchgear buses SM-1, 2, and 3. Likewise, manual live transfer of power between normal/startup and backup transformer sources is possible on the 4.16 kV Class 1E switchgear buses SM-7 or 8, although the startup source is the preferred offsite power source. Manual live transfer of power between the normal/start or the backup power source and the Division 1 or 2 standby power source is possible. This facilitates diesel generator testing without dropping loads, or the return of loads from the diesel generator to the offsite power source upon recovery of the offsite source following a total loss. However, synchronizing of any diesel generator with the normal auxiliary transformer is avoided by administrative procedures.

The primary undervoltage sensing scheme for the 4.16 kV Class 1E distribution system utilizes instantaneous under-voltage relays to start the Division 1, 2 and/or 3 standby diesel-generators immediately upon loss of voltage at their associated 4.16 kV Class 1E switchgear buses. These relays also energize two-second timers which allow the system to attempt to establish supply from the startup source (if the plant is operating from the normal source at the time) or verify that voltage loss is maintained (if the plant is operating from the startup source initially).

In the event that voltage loss is maintained for two seconds, the Division 1 and/or 2 timers trip the Class 1E bus normal/startup source breakers, institute load shedding, and energize additional two-second and five-second timers. The second two-second timer are utilized to attempt closing of the backup source breakers; backup transformer undervoltage relays will inhibit breaker closure in the event of backup source undervoltage. The five-second timers are used to inhibit closure of the diesel generator breakers until the system has had time to attempt re-establishment of supply via the backup source.

Since there is no provision for the Division 3 4.16 kV Class 1E bus transfer to the backup source, its diesel generator breaker closes via signals from the single Division 3 three-second timer, which is energized by the bus undervoltage relay.

Refer to 8.3.1.1.8.1.7 and 8.3.1.1.8.2.7 for additional discussion of the standby diesel generator starting and loading systems.

A second level of undervoltage protection is provided to protect against the effects of prolonged degraded voltage which could adversely affect the operation of Class 1E electric motors requiring at least 90% of the rated nameplate volts for continuous operation. (See Table 8.3-13.) For this reason, Class 1E bus SM-4, SM-7, and SM-8 voltages are monitored by an additional set of Class 1E undervoltage relays. Three static type undervoltage relays are provided for each bus and are connected in such a manner as to monitor all three line voltages (i.e., phases AB, BC, & CA). The arrangement utilizes a 2-out-of-3 logic to preclude the possibility of spurious voltage loss signal and facilitate testing.

In the event of sustained bus undervoltage (87.3% of nominal bus voltage lasting more than 8 seconds), the second level of undervoltage protection automatically trips the feeder breaker connecting the normal/startup sources to their respective 4.16 kV Class 1E buses. For Divisions 1 and 2 this action results in loss of bus voltage, thereby starting the diesel generators, initiating load shedding and energizing the three bus transfer timers mentioned in the primary undervoltage scheme above. In this case, however, the first two-second timer is bypassed. The second two-second timer permits closing of the backup source breaker and the five-second timer permits closing of the diesel generator ~~breker~~ breaker, assuming a failure of the backup source breaker to close. Closure of the backup source and diesel generator breakers is permitted if the source voltage is at least 94% of normal.

Should the degraded voltage condition exist on the backup power source while the source is supplying the load, the second level undervoltage relays would then isolate that source, again initiating the sequence of events described for the secondary undervoltage sensing scheme above. However, closing of backup feeder breakers, as part of that sequence of events, is blocked.

~~From~~ For Division 3, the second level of undervoltage protection trips the normal/startup source breaker, thereby causing a loss of bus voltage. From this point on, the primary undervoltage relay takes over and the ensuing sequence of events will be the same as in the case of the loss of offsite power discussed above.

When the Class 1E buses SM-7 and SM-8 are being fed from the turbine generator, the possibility of sustained undervoltage is not considered credible due to response characteristics of the voltage regulator and protection equipment for the unit.

The scheme described assures a power source within the acceptable voltage limits for the Class 1E loads at all times. Circuit design allows for testing of the individual relays, one at a time, without disrupting the protective function.

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8.3.1.1.2 480 Volt Distribution System

Power for 480 V auxiliaries is supplied from unit substations consisting of 6.9 kV/480 V or 4.16 kV/480 V transformers and associated metal clad switchgear. Non-Class 1E 4.16 kV buses SM-1, 2 and 3, supply separate 480 V substations, each with its own power transformer and switchgear.

Class 1E 480 V substations supplying ESF loads are arranged as independent radial systems with each 480 V bus fed by its own power transformer. Each 480 V Class 1E bus is independent of the other 480 V buses; there are no crossties. The 480 V auxiliaries required during emergency conditions are supplied from 480 V Class 1E buses SL-71 and SL-73 (Division 1) and SL-81 and SL-83 (Division 2). The HPCS 480 V auxiliaries are supplied from an independent transformer and Class 1E bus MC-4A (Division 3). Power supplies to all Class 1E auxiliary systems are arranged so that alternate or redundant auxiliary systems are supplied from 4.16 kV switchgear buses of separate Class 1E divisions.

The 480 V substations supply 460 V motor loads larger than 100 HP and all motor control center loads. Switchgear for 480 V substations is of the indoor metal clad type with draw-out circuit breakers operated from the plant DC system. Phase to ground fault currents are limited to a maximum of 10 amperes by use of neutral ground resistors in all substation transformer neutral ground connections. All substation transformer neutral ground connections and switchgear branch feeder circuits are equipped with ground detection devices and alarms.

The 480 V motor control centers feed motors 100 HP and less (in general), control power transformers, heaters, motor-operated valves, all other small electrically operated auxiliaries and all lighting. Control centers are isolated in separate load groups corresponding to divisions established by the 480 V substation units. Branch circuit protection for all loads is provided by fused disconnect switches equipped with current limiting fuses, with the exception of subfeeders to other small motor control centers and all HPCS motor control center (MC-4A) branch circuits. Molded case circuit breakers are utilized for these feeders to other MCCs and for all loads fed by MC-4A. Class 1E motor control centers are shown on the auxiliary one-line diagram (Figures 8.3-1a through 8.3-1f).

8.3.1.1.3 120/240 Volt (Non-Class 1E) Plant Uninterruptible Power System

The non-Class 1E plant uninterruptible power system supplies 120/240 V AC to station services where uninterruptible power is required, such as for plant, computer and plant instrumentation (e.g., DEH cabinet). This source of power is necessary for plant operational loads, but does not supply ESF loads. Power is distributed via a single phase, three wire, grounded neutral system.

Failure of the non-Class 1E uninterruptible power system has no adverse effect on station safety since no ESF loads are supplied from this system.

The plant uninterruptible power system receives its power from a static inverter-static switch arrangement fed both from a 250 V DC station battery (float source) and from a 480 V AC Class 1E MCC (preferred source) as shown on Figure 8.3-2. During faults on the uninterruptible power system the static switch will automatically transfer loads to a regulated alternate source, which supplies sufficient fault current to blow the circuit fuse and clear the fault.

A manual bypass switch is also provided to bypass the entire plant uninterruptible power system and transfer load to an unregulated bypass source. This will allow for maintenance and inspection of the system.

8.3.1.1.4 120/208 Volt Non-Class 1E Instrumentation Power System

Power is supplied to non-Class 1E plant instrumentation at 120/208 V AC via a three phase, four wire, grounded neutral distribution system. This distribution system supplies power to the 115 V AC transversing incore probe (TIP) of the neutron monitoring system and other non-Class 1E instrumentation loads.

Failure of the noncritical instrumentation power system has no adverse effect on station safety since no ESF loads are supplied from this system.

Alarm and fault detection equipment is provided to alert the operator of possible trouble. All equipment associated with the 120/208 V non-Class 1E instrumentation power system is readily accessible for inspection and maintenance on a routine basis in accordance with the manufacturer's recommendation.

a. Each diesel generator starts immediately upon recipt of a 4.16 kV Class 1E bus (SM-7, 8) primary undervoltage relay signal or LOCA signals (reactor low water level and/or high drywell pressure).

b. Upon sustained loss of 4.16 kV Class 1E bus voltage, the bus is automatically isolated from the upstream non-Class 1E system. All loads on the bus are tripped, except for those small loads shown in Tables 8.3-1 and 8.3-2 as part of the initial load block fed by the 480 V unit substation.

c. After each diesel generator has attained approximately normal frequency and voltage, its breaker closes (if 4.16 kV Class 1E bus voltage has not been re-established via the offsite system sources) thus immediately starting all loads belonging to the first block for which "starting required" signals are available for engineered safety feature actuation signals.

d. The starting of subsequent load blocks are delayed by time relays in accordance with Tables 8.3-1 and 8.3-2. Diesel generator capacity is such that units are capable of maintaining all required loads established by the loading schedules.

e. Limitation of diesel generator loading is maintained during the entire period the units are required to operate, since the Class 1E loads capable of being connected to the units exceed unit capability. However, as indicated in the loading schedules (Tables 8.3-1 and 8.3-2), the maximum loads automatically connected to the Division 1 and Division 2 diesel generating units (3860kW and 3382kW, respectively) do not exceed unit ratings (4400kw each). Loading beyond these values would require positive operator action to manually apply loads.

f. Maximum voltage dip projected to occur on the Class 1E buses (SM-7,8) as a result of motor starting during periods when emergency plant

load is being supplied by the diesel generators is 85 percent of nominal bus voltage. The duration of voltage dip is expected to be very short lived - in the order of 2 to 5 seconds. Since the Class 1E bus primary undervoltage relays are set at 69 percent of nominal bus voltage, initiation of load shedding as a result of voltage dip due to motor starting will not occur. Since the Class 1E bus secondary undervoltage relays are set at 87.3 percent of nominal bus voltage (90.8 percent of motor nominal voltage) with a definite time delay of 8 seconds, they will not initiate any undesirable tripping action.

c. Incomplete sequence

d. Emergency stop pushbutton

e. Generator loss of excitation

f. Reverse current

g. Generator overcurrent

h. Generator overvoltage

i. High jacket water temperature

j. Low lube oil pressure

During a synchronizing test, the diesel generator is protected from overcurrent resulting from the non-Class 1E loads connected to the upstream buses, in the event of a loss of startup transformer power. The overcurrent protection results in isolation of the diesel generator emergency bus from the upstream non-Class 1E loads without disconnecting the diesel generator from the emergency bus.

The Division 1 and 2 standby diesel generator control circuits are detailed in Figures 8.3-25a through 8.3-25d (general DC control), 8.3-26a and 8.3-26b (excitation control) and 8.3-27 (governor control).

The diesel generator incomplete sequence (fail to start) relay (K4) indicated in Figure 8.3-25b is designed to shut the generating unit down and lock it out in the event the normal starting cycle is not completed within a predetermined time. The relay is actuated if speed sensing instrumentation indicates that the unit requires in excess of fifty (50) seconds to accelerate to 150 rpm (regardless of the cause), or upon failure of the cranking motors to disconnect when the unit is running.

8.3.1.1.8.1.9 Surveillance

Surveillance instrumentation is provided to monitor the status of the standby diesel generating system. Provisions for surveillance are an essential requirement in the design, manufacturing, installation, testing, operation, and maintenance of the diesel generators. Such surveillance not only provides continuous monitoring of the status of the standby diesel generating system, so as to indicate readiness to perform intended functions, but also serves to facilitate testing and maintenance of the equipment. Periodic surveillance

procedures are also implemented to check setpoints of protective relays to ensure a reliable operation. Annunciation is provided both locally (diesel generator control panels) and in the main control room. Table 8.3-11 indicates the annunciation furnished for the Divisions 1 and 2 diesel generating systems.

When operating in the standby mode, conditions rendering the diesel generating units incapable of responding to emergency start signals are intentionally limited, as indicated in 8.3.1.1.8.1.8. Table 8.3-11, items 1 through 7 (inclusive), indicates all conditions which render the units incapable of responding, including both diesel generating unit and distribution system problems. Local, disabling diesel generator incomplete sequence and differential current conditions are annunciated indirectly (and distinctly from any nondisabling alarms) via the unit lockout (item 6) and fail to start (item 9) alarms. Item 21 indicates that the unit has been started automatically upon receipt of emergency start signals. The remaining items indicate nondisabling diesel generator problems which do not cause unit trip.

During test mode operation, an expanded set of disabling conditions are permitted to prevent unit start or initiate unit trip as indicated on 8.3.1.1.8.1.8. However, in the event of receipt of emergency start signals while the units are in the test mode, automatic control circuitry transfers the diesel generators to the standby mode, starts (if not operating at the time) the diesel generators and eliminates from the trip circuitry those signals not permitted to disable the unit in the standby mode.

Main control room annunciation is designed to permit the control room operator to accurately monitor the status of the standby diesel generating system at all times and during all modes of operation. Any condition which renders the diesel generators incapable of operation is annunciated via Table 8.3-11 Items 1-9. The difference between the standby mode and all other modes is that the number of unit tripping signals permitted to actually operate (via the unit lockout relay) is limited in the standby mode.

Diesel generating unit controls reset automatically (time delayed) following nonemergency manual stops initiated at the local control stations.

8.3.1.1.8.1.10 Instrumentation and Control Systems

Power supply source for the instrumentation and control systems for each diesel generator is independent in accordance with the divisional separation criteria detailed in 8.3.1.4 and 8.3.2.4. Each diesel generator set includes the following instrumentation:

8.3.1.2 Analysis

8.3.1.2.1 Compliance to Criteria

8.3.1.2.1.1 General

Compliance with General Design Criterion 17 is assured for the onsite power systems by having sufficient independence, redundancy and testability to perform the required safety functions assuming a single failure. Independence is discussed in 8.3.1.4 and testability is covered in 8.3.1.2.2. Redundancy in the onsite auxiliary AC power system is provided via the formation of redundant safety-related (Class 1E) electrical load groups (Division 1 and 2) in conformance with General Design Criterion 17, IEEE Std. 308-1974 and NRC Regulatory Guide 1.6 (Rev. 0). This redundancy extends from the onsite standby power sources through 4.16 kV buses, station service transformers, 480 V buses, MCC's, distribution cables, switchgear and protective devices.

The Division 3 power system is a separate and independent safety-related (Class 1E) power system serving the only HPCS system.

No essential electrical component of one Class 1E electrical division is dependent for its emergency power supply on electrical equipment or devices which are common to the power supply of another division. The onsite auxiliary AC power system standby sources consist of three diesel generator sets. Each of the diesel generators feeds one of the Class 1E divisions. The onsite auxiliary power system redundancy is based on the capability of either of the two redundant (Division 1 and 2) onsite power sources and their associated load groups, in conjunction with the Division 3 onsite power source and associated load group, to bring the reactor to a safe cold shutdown condition and/or to mitigate the consequences of a design basis accident.

8.3.1.2.1.2 Reactor Protection System (RPS) Power System

The RPS Power System is not an Engineered Safety Feature, component, or system. The system itself fails in a failsafe mode. That is, it de-energizes and thus causes a shutdown action. In addition, redundant electrical protection devices are utilized for isolation as indicated in 8.3.1.1.6. However, design considerations are taken to ensure power supply availability commensurate with the needs of the equipment serviced by it. Redundancy of equipment ensures a high degree of availability.

8.3.1.2.1.3 Redundant (Division 1 and Division 2) Standby AC Power Supplies

Upon loss of normal and offsite sources of power to the 4.16 kV switchgear buses, the 4.16 kV Class 1E portion of the auxiliary AC power system is automatically isolated. All 4.0 kV motor and selected 460 V motor loads are automatically shed from their respective buses to allow for the sequential loading of the standby diesel generators. See 8.3.1.1.1.

The diesel generators start automatically and are automatically connected to the Class 1E 4.16 kV buses. Electrical loads necessary for an emergency reactor shutdown or shutdown in the event of a LOCA, are automatically and sequentially reconnected to these safety-related buses. The automatic diesel starting and loading sequence is designed to provide power to engineered safety feature (ESF) components required in the event of a design basis accident within the time period specified for their operation in Chapter 15.

The two diesel generators supplying power to Division 1 and Division 2 ESF components are sized and designed in accordance with NRC Regulatory Guide 1.9, Revision 0. Their ratings are based upon continuous load rating greater than the sum of the loads requiring power at any one time.

The sequencing of large loads at five (or more) second intervals ensures that diesel generator voltage and frequency limits (80 percent and 95 percent respectively) are maintained. Also, engine overspeed settings and other design parameters remain in accordance with NRC Regulatory Guide 1.9, Revision 0, as discussed in 8.3.1.1.8.1.

The Division 1 and 2 portions of the onsite AC power system also satisfy Regulatory Guide 1.32, Revision 2, not only in their adherence to IEEE Standard 308-1974, but also as follows:

a. Offsite power is available from either offsite source within a few seconds if the plant main generator source is lost.

b. Electrical and physical independence of standby power sources is in accordance with Regulatory Guide 1.6 as described in 8.3.1.1.8.1.

c. The selection of the diesel generator capacities has been made in accordance with Regulatory Guide 1.9 as further described in 8.3.1.1.8.1.

8.3.1.2.1.4 HPCS (Division 3) Standby AC Power Supply

8.3.1.2.1.4.1 Compliance with Criterion GDC 17

The HPCS AC power supply is Class 1E and is designed with sufficient capacity and independence to ensure that core cooling, containment integrity, and other vital functions are maintained in the event of a postulated accident. The design of the onsite and offsite electrical power systems provides compatible independence and redundancy to ensure high availability of power supply to the emergency core cooling system, even assuming a single failure.

Electrical power from the transmission network to the HPCS bus SM-4 is provided via the 230 kV startup auxiliary transformer. A loss of normal voltage at 4.16 kV bus SM-4 results in automatic starting of the HPCS diesel generator, tripping of the normal supply breaker and closing of the generator breaker as described in 8.3.1.1.8.2.7.

8.3.1.2.1.4.2 Compliance with Criterion GDC 18

The auxiliary electrical system is designed to permit inspection and testing of all important areas and features, especailly those that have a safety function and whose operation is not normally required. As detailed in Chapter 16, periodic component tests will be supplemented by extensive functional

c. The start and load reliability test satisfies the following requirements: A total of sixty-nine (69) valid start and loading tests with no failure or one hundred and twenty eight (128) valid start and loading tests with a single failure is to be performed. Failure of the unit to succesfully complete this series of tests as prescribed requires a review of the system design adequacy, the cause of the failure to be corrected, and the tests continued until 128 valid tests are achieved without exceeding the one failure. The start and load test is conducted as follows:

1. Engine ~~craking~~ cranking is started upon receipt of the start signal, and the diesel generator set accelerates to specified frequency and voltage within the required time interval.

2. Immediately following, the diesel generator set accepts a single step load consisting of the main HPCS pump motor load (fully loaded) or larger motor load (fully loaded) and additional loads (inductive and/or resistive) as required to total at least 100% of the continuous rating of the diesel generator unit.

3. At least 90% of these tests are performed with the diesel generator set initially at "warm standby", based on jacket water and lube oil temperatures at or below values recommended by the engine manufacturer. After load is applied the diesel generator set continue to operate until jacket water and lube oil temperatures are within plus or minus 10°F (5-1/2°C) of the normal engine operating temperatures for the corresponding load.

4. The other 10% of these tests are performed with the engine initially at normal operating temperature equilibrium (defined as jacket water and lube oil temperature within +10°F (5-1/2°C) of normal operating temperatures as established by the engine manufacturer for the corresponding load).

If the cause for failure to start or accept load in accordance with the preceding sequence falls under any of the categories listed below, that particular test is disregarded, and the test sequence resumed without penalty following identification of the cause for the unsuccessful attempt.

1. Unsuccessful start attempts which can definitely be attributed to operator error including setting of alignment control switches, rheostats, potentiometers, or other adjustments that may have been changed inadvertently prior to that particular start test.

2. A starting and/or loading test performed for verification of a schedule maintenance procedure required during this series of tests. This maintenance procedure is defined prior to conducting the start and load acceptance qualification tests and then becomes part of the normal maintenance schedule after installation.

3. Failure of any of the temporary service systems such as DC power source, output circuit breaker, load, interconnecting piping and any other temporary setup which is not part of the permanent installation.

4. Failure to carry load which is definitely attributed to loadings in excess of required loading.

8.3.1.2.1.4.5 Conformance With Regulatory Guide 1.9 (Revision 0)

The HPCS system diesel generating unit conforms to the requriements of Regulatory Guide 1.9 (Revision 0), with the exception of voltage and frequency limits, as described below.

The unit conforms to Position 1 of the guide in that the continuous rating of the diesel generator is greater than the maximum coincidental steady-state loads requiring power at any time (see Table 8.3-3). Intermittent loads such as motor-operated valves are not considered for long-term loads.

The unit conforms to Position 2 of the guide in that the 2000-hour (2850 kW) and 90% of the 30-minute (2727 kW) ratings both exceed the maximum coincidental load indicated in Table 8.3-3.

The unit conforms to Position 3 of the guide in that the load requirements will be verified by preoperational tests.

The HPCS diesel generator unit is considered as a justifiable departure from strict conformance to Position 4 of the guide regarding voltage and frequency limits during the initial loading transient. The HPCS system consists of one large pump and motor combination which represents more than 90% of the total load; consequently, limiting the momentary voltage drop to 25% and the momentary frequency drop to 5% would not significantly enhance the reliability of HPCS operation. To meet these regulatory guide requirements, a diesel generator unit approximately two to three times as large as that required to carry the continuous rated load would be necessary. However, the frequency and voltage overshoot requirements of Regulatory Guide 1.9 (Revision 0) are met. A prototype testing program on an installed unit, as described in 8.3.1.2.1.4.4, has verified the following functions:

a. System fast-start capabilities

b. Load carrying capability

c. Load rejection capability

d. Ability of the system to accept and carry the required loads

e. The mechanical integrity of the diesel engine generator unit and all of the major system auxiliaries

The above ~~engine~~ diesel generator capabilities will be further verified by preoperational testing in conformance with Regulatory Guide ~~1.106~~ 1.108, Revision 1, including errata. At least 5 of the 69 start and loading tests will be made using the actual generator loads.

The design of the HPCS diesel generator conforms with the applicable sections of IEEE criteria for Class 1E "Electrical Systems for Nuclear Power Generation Station," IEEE Standard 308-1971.

The generator has the capability of providing power to start the required loads with operationally acceptable voltage and frequency recovery characteritics. A partial or complete load rejection will not cause the diesel engine to trip on overspeed.

The HPCS Power Supply Topical Report (NEDO-10905-3) decribes the prototype and reliability test requirements.

The calculated HPCS diesel generator transient response is indicated in Figure 8.3-28. NEDO-10905-3 provides an analysis showing the conservatism of calculated response compared to that obtained from actual tests.

8.3.1.2.1.4.6 Conformance with Regulatory Guide 1.29

The HPCS power supply system is capable of performing its function when subjected to the effects of design bases natural phenomena at its location. In particular, it is designed in accordance with the Seismic Category I criteria and housed in a safty class structure.

8.3.1.2.1.4.7 Conformance With Regulatory Guide 1.32

The design of the HPCS diesel generator conforms with the applicable sections of IEEE criteria for Class 1E, "Electrical Systems for Nuclear Power Generation Stations," IEEE Standard 308-1971.

8.3.1.2.1.4.8 Conformance With Regulatory Guide 1.47

See 7.1.

8.3.1.2.1.4.9 Conformance With Regulatory Guide 1.62

Manual controls are provided to permit the operator to select the most suitable distribution path from the power supply to the load. An automatic start signal will override the test mode. Provision is made for control of the system from the control room as well as from an external location.

All Class 1E cables external except for upgraded cables as noted in section 8.3.1.4.2.3. to the power generation control complex (PGCC) prefixed by 1, 2, 3, 4, 5, 6, or 7 are tagged every 15 feet and at their terminations with a unique identifying ~~number~~ {cable number}. Non-Class 1E cables, as well as cables associated by proximity to Class 1E cables, are identified with a unique cable number at their terminations, pullpoints, entrance and exit to raceways, and every 100 feet. Non-Class 1E cables that are powered from Class 1E are identified every 15 feet (except in conduit). In addition to the cable numbers, color coded division identifiers are provided either as part of the cable marker or as a separate marker (except for upgraded cables as noted in section 8.3.1.4.2.3). See Table 8.3-25.

Prior to cable installation, conduit is similarly tagged with a unique conduit number, in addition to the division marking characters shown in Table 8.3-25, at 15 foot intervals, at discontinuities, at pull boxes, at points of entrance and exit of rooms, and at origin and destination equipment. Conduits containing cables operating above 600 volts are also tagged to indicate the operating voltage.

Trays are tagged prior to cable installation with unique tray node identification numbers, and the division marking characters indicated in Table 8.3-25, supplemented by another character (H, P, C, S, R) which indicates the voltage level (6.9 kV, 4.16 kV, Control, Signal, RPS) of the cables contained in the tray. Non-Class 1E tray sections (a tray section is defined by two adjacent nodes) that contain prime cables (see 8.3.1.4.1.13.c) are identified with an additional prime marker. Trays containing cables operating above 600 volts are tagged to indicate the operating voltage level.

Switchgear, transformers, distribution panels, batteries, chargers, and other electrical equipment are tagged with the equipment number indicated on the single line diagrams (e.g., SM-8-85, MC-8A, etc.) as well as the division marking characters indicated in Table 8.3-25.

Safety-related cables within the power generation control complex (PGCC) and under floor PGCC raceways are tagged with identification numbers every 10 feet, and division markers every 5 feet. The tagging characteristics are shown in Table 8.3-26.

Cable routing information is provided in Tables 8.3-8, 8.3-20, 8.3-21, and 8.3-22. This illustrates the computer program used for identification and routing of cables in trays. Routing information for cables in conduits is provided in raceway layout drawings. Table 8.3-9 indicates sample cable routing schedules. Actual cable tray drawings for the

reactor, control and radwaste buildings are shown in Figures 8.3-9 through 8.3-14, inclusive.

A list of Class 1E components and equipment (see 8.3.1.4.1.1 for definition) is provided to facilitate identification of safety-related components and their circuits.

Class 1E circuits and associated circuits within equipment enclosures are not uniquely identified. They are identified with the same division as the equipment except that all intruding divisional circuits and prime circuits are identified by an additional ~~checkered~~ striped marker as shown in Tables 8.3-25 and 8.3-26.

8.3.1.4 Independence of Redundant Systems

The physical independence of electrical systems complies with the requirements of IEEE Standard 279-1971, IEEE Standard 308-1974 (IEEE Standard 308-1971 for the HPCS system), General Design Critria 3 and 17, and Regulatory Guide 1.6, Revision D. See Table 7.1-3 for a matrix of the applicability of codes and standards to the various safety-related systems. The physical separation of mechanical equipment including piping and instrumentation tubing is not included in this section. However, sufficient separation between redundant plant protection system equipment is provided such that the capability of the protection systems to mitigate the consequences of any design basis accident and bring the reactor to a cold shutdown condition is assured. See 3.1.

8.3.1.4.1 Definitions

8.3.1.4.1.1 Class 1E

Class 1E is defined as the safety classification of the electrical equipment and systems that are essential to emergency reactor shutdown, containment isolation, reactor core cooling, and containment and reactor heat removal, or are otherwise essential in preventing significant release of radioactive material to the environment.

8.3.1.4.1.2 Safety-Related Electrical and Instrumentation Systems and Equipment

These items are those electrical and instrumentation systems and equipment which are relied upon to prevent or mitigate the consequences of accidents and malfunctions originating within the reactor coolant pressure boundary. Safety systems from an electrical aspect consist of those electrical and instrumentation circuits and components designated as Class 1E that are necessary for the systems listed in Table 7.1-1 to perform their safety function, and include the Reactor Protection System, the Nuclear Steam Supply Shutoff System, and the Engineered Safeguards Systems. The Class 1E cables within the NSSS Power Generation Control Complex (PGCC) are defined by codes as listed on Table 8.3-21 and Figure 8.3-30.

8.3.1.4.1.3 Reactor Protection System (RPS)

The reactor protection system is the overall complex of instrument channels, trip system and trip actuators, and wiring which generates a reactor trip (scram) signal to initiate a reactor trip when a monitored parameter (or group of parameters) exceeds a setpoint value indicating the approach

8.3.1.4.1.13 Associated Circuits

Associated circuits are defined as follows:

a. Non-Class 1E cables/wires that share raceways with Class 1E cables/wires and are not physically separated from Class 1E cables/wires.

b. Non-Class 1E cables/wires carrying non-Class 1E power that share enclosures and are not physically separated from Class 1E cables/wires.

c. Non-Class 1E cables/wire for loads which are supplied from a Class 1E power source. These are referred to as prime circuits.

8.3.1.4.1.14 Raceway

A raceway is any channel that is designed and used expressly for supporting wire, cables, or bus bars. Raceways consist primarily of, but not restricted to, cable trays, wireways, and conduits.

8.3.1.4.1.15 Power Generation Control Complex (PGCC)

The power generation control complex (PGCC) located in the main control room is a modular assembly of termination cabinets interconnected by floor sections comprised of multiple separate cable ducts on which are mounted control panels (see 8.3.1.4.3.6).

8.3.1.4.16 Intruding Circuits

Intruding circuits are Class 1E or prime circuits which enter an enclosure with residing equipment assigned to a redundant division.

8.3.1.4.2 General Separation Criteria

The criteria in this section provides sufficient physical independence of Class 1E electrical systems so safety-related systems can perform their engineered safety function during any design basis accident and bring the reactor to a cold shutdown condition.

8.3.1.4.2.1 Cable Separation

Cable separation is achieved by segregating electrical circuits by voltage level and service it performs (such as power, control, or signal) by engineered system designations, by power supply and divisional separation categories, and by routing (see Tables 8.3-8, 8.3-20 and 8.3-21).

8.3.1.4.2.1.1 Cable Segregation by Voltage Level and Service

Cables are assigned to one of three groups (power, control, or instrumentation) depending upon the voltage level, and service.

8.3.1.4.2.1.1.1 Power Cable

Power cables are defined as those cables that provide electrical energy for equipment motive power and heating requiring 14.4 kV, 6.9 kV, 4.16 kV, 480 volts, 240 volts, 120/208 V AC, 250 and 125 V DC (see Tables 8.3-20 and 8.3-24).

Power cables of different voltage ratings are routed in different cable trays except as follows: (a) Common tray is permitted for 480 volt, 120/208 V AC, 125 V and 250 V DC of compatible divisions; (b) Common tray is permitted for 4160 and 6900 V power cables of compatible divisions; 480, 4160 and 6900 V power cables are not to be installed in cable trays in the spreading area beneath the control room. If a run through this area is unavoidable, the power cable is installed in conduit.

Power cables are installed in raceways separate from control cables and low level signal cables and where vertically stacked, the power cables are placed in the tray with the highest position in the tray tier. Stacking of multiple power trays are such that the voltage levels decrease sequentially from the top to the bottom tray in the stack.

8.3.1.4.2.1.1.2 Control Cable

Control cables are those cables using 120 V AC (or below) or 125 V DC (or below), with normal current not in excess of 30

amperes, whose circuits are designed to supply control power for the plant systems. Included in the category of control cables are those cables used for intermittent operation to change the operating status of a utilization device of the plant system. Control cables include all cables which have any of the following functions (see Tables 8.3-20, 8.3-21, and 8.3-24):

a. 125 V DC or 120 V AC control ~~feeds~~ to switchgear, and control room ~~panel~~ and local panels ~~control buses. Wire types are to be power cable, type G2.~~

b. 125 V DC or 120 V AC control power ~~feeds~~ to solenoids.

c. 125 V DC or 120 V AC control and interlock circuits.

d. Annunciator circuits.

8.3.1.4.2.1.1.3 Instrument Cable ~~(Low Level Signals)~~

Instrumentation cables are those cables used to carry low level analog or digital signals. Low level signal cables require a specific degree of separation or segregation to perserve the accuracy of the transmitted signal. Low level signal cables are run in raceways separate from all power and control cables, except within the control room Power Generation and Control Complex (PGCC) and as noted below. Instrument (signal) trays are of the enclosed (solid bottom and covers) type.

Analog and digital signal input cables are routed as follows:

a. Digital computer signals in the reactor building are run in divisional control trays as applicable by the device being served. Non-Class 1E digital signals in other areas are run in instrumentation trays of Division B, unless they are routed through the reactor building.

b. Analog computer signals in the reactor building are run in divisional instrumentation trays as applicable by the device being served. Non-Class 1E analog signals in other areas are run in instrumentation trays of Division A, unless they are routed through the reactor building.

8.3.1.4.2.1.2 Cable Segregation by Engineered System Designation

Cables are assigned to circuits within an engineered system as shown on Tables 8.3-8 and 8.3-21. A cable will contain only circuits of the same functional system except for annunciator or computer circuits.

8.3.1.4.2.1.3 Cable/Circuit Segregation by Power Supply and Divisional Separation Categories

Each cable is assigned to a division depending upon its safety function and its power supply (see the PGCC power supply classification on Table 8.3-21). Class 1E cables originating from Class 1E power supplies assume the same divisional classification as the power supply. The system is the same for non-Class 1E power and control cables (except annunciator cables). Each cable number is assigned to one of three general separation classes; Class 1E, Associated or non-Class 1E. Some cables have more than one consecutive cable number (see Note 4 on Table 8.3-8).

8.3.1.4.2.1.3.1 Class 1E Cables

Class 1E cables are purchased to IEEE Standard 383-1974 and are designed to withstand normal and accident environmental conditions and perform their safety function during a design basis event following a 40-year life. Cables outside the PGCC that perform a safety-related function are assigned divisional designation by cable numbers prefixed by the numbers 1 through 7. The prefix number corresponds to a segregated safety divisional system of cables and raceways of the same number (see Table 8.3-20). Within the PGCC the correlating divisional categories are shown on Table 8.3-21. Class 1E cables are identified in accordance with 8.3.1.3.

8.3.1.4.2.1.3.2 Associated Circuits

Any non-Class 1E cable that is routed into a Class 1E raceway is an associated cable and is not routed into a redundant Class 1E raceway. Associated cable numbers external to the PGCC are prefixed by an "A" or "B" and denoted in computerized cable schedules with Note 5 as shown in Table 8.3-8. Associated cables are procured to the same requirements as Class 1E and are identified as indicated in 8.3.1.3 and Tables 8.3-25 and 8.3-26. These circuits are defined in accordance with the three part definition in 8.3.1.4.1.13 and comply with at least one of the following requirements:

a. Where installed in cable trays, raceways, and PGCC floor ducts (see definition (a), 8.3.1.4.1.13).

1. They are uniquely identified as associated or as Class 1E circuits and remain with, or are physically separated the same as, those Class 1E circuits with which they are associated.

2. They are identified in accordance with item 1 above from the Class 1E equipment up to and including an isolation device. Beyond the isolation device, such a circuit is not considered an associated circuit and does not conform to item 1 above, provided it does not again become associated with a Class 1E system.

3. They are analyzed or tested to demonstrate that Class 1E circuits are not degraded below an acceptable level.

b. Where installed in cabinets and equipment, external to trays, raceways, and ~~flow~~ PGCC floor ducts, (item (a) above) see definitions b and c, 8.3.1.4.1.13.

1. Associated Circuit Definition b - Circuits which become associated due to sharing of enclosures with Class 1E circuits are not separated; they are analyzed to show that the Class 1E circuits are not degraded below an acceptable level.

2. Associated Circuit Definition c (prime circuits) - Non-Class 1E circuits which receive power from Class 1E power sources comply with the same separation requirements placed on Class 1E circuits. For example, a Division A non-Class 1E circuit whose power source is a Division 1 bus, is separated from a Division 2 Class 1E circuit or a Division B non-Class 1E circuit whose power source is a Division 2 bus.

8.3.1.4.2.1.3.3 Non-Class 1E Cables/Circuits

Non-Class 1E cables are assigned numbers prefixed by "A" or "B" and are routed in non-Class 1E raceways. They are procured to the same requirements as Class 1E cables, except for a few vendor supplied cables designated in the

computerized cable schedule as type Z. These non-Class 1E cables are tagged in accordance with Tables 8.3-25 and 8.3-26.

The isolation of non-Class 1E circuits from Class 1E circuits or associated circuits is achieved by complying with at least one of the following requirements.

a. Non-Class 1E circuits are physically separated from Class 1E circuits and associated circuits by the minimum separation requirements specified for redundant Class 1E divisions or they become associated circuits.

b. Non-Class 1E circuits are electrically isolated from Class 1E circuits and associated circuits by the use of isolation devices, shielding and wiring techniques, physical separation, or an appropriate combination, or they become associated circuits.

c. The effects of lesser separation or the absence of isolation between the non-Class 1E circuits and the Class 1E circuits or associated circuits are analyzed to demonstrate that Class 1E circuits are not degraded below an acceptable level or they become associated circuits.

Non-Class 1E low energy (Instrumentation and control circuits)

d. ~~Low energy~~ ^ ~~(see 8.3.1.4.2.1.1.3) non-Class 1E instrumentation and control circuits~~ are not required to be physically separated or isolated from associated circuits provided: (1) the non-Class 1E circuits are not routed with associated cables of a redundant division; or (2) they are analyzed to demonstrate that Class 1E circuits are not degraded below an acceptable level. As part of the analysis, consideration is given to potential energy and identification of the circuits involved.

see attached insert >

8.3.1.4.2.1.4 Cable Segregation by Routing

The physical separaton distances required between raceways external to the PGCC are identified in 8.3.1.4.3.8. The physical arrangement of the PGCC raceways are described in 8.3.1.4.3.6.3. Outside the PGCC thirty-four independent raceway systems are provided for cabling. These include dedicated raceways assigned to each of the Class 1E divisions. The raceways for Divisions 1, 2, and 3 utilize open-type ladder trays for power and control. Trays for instrumentation raceways for Divisions 4, 5, 6, and 7 are totally enclosed. Raceways exist for non-Class 1E cabling crossovers between

Insert Page 8.3-57a
(8.3.1.4.2.1.3.3.d)

Since power cables (see 8.3.1.4.2.1.1.1) are not considered to be low energy circuits, the analysis applied to non-Class 1E-to-Class 1E/associated separation described above does not apply. Non-Class 1E power cables routed in open raceways (trays) are separated from all Class 1E/associated cables (see 8.3.1.4.1.13) with the same requirements specified for separation of redundant Class 1E cables. For other than open raceways, additional information is provided in 8.3.1.4.4.

b. Where Class 1E equipment or cabling is located or routed in areas where there is a potential for internally generated missiles, pipe whip, or flood, a protective barrier is provided or an analysis is performed to assure that a loss of plant capability to mitigate the consequences of an accident or to bring it to a safe shutdown condition cannot occur.

c. Fire barriers are provided between redundant electrical equipment including raceways whenever the physical separation distances in 8.3.1.4 are not met. Raceways penetrating fire-rated walls, floors or ceilings, or pressure boundries are sealed with a fire-rated fire stop.

d. Refer to Appendix F for compliance with 10CFR50 Appendix R.

8.3.1.4.2.3 Administrative Controls for Ensuring Separation Criteria

The quality assurance procedures described in IEEE Standard 336-1971 are employed during the design and installation of the cable system to ensure compliance with the design criteria. Design drawings and cable lists are prepared, reviewed, and approved for construction and updated in the field. Each cable and raceway is identified in the computer program, and the identification includes the applicable separation classification. Cable routing programs ensure that cables of particular separation groups are routed through the appropriate raceways. Cables are installed in accordance with written procedures which specify quality requirements, inspection, and documentation requirements for all cable pulls. Upon completion of Class 1E cable pulling, an electrical quality control inspector initials the cable pull slip and verifies that the cables have been installed in accordance with the design documents.

See attached insert

Post cable installation procedures exist to upgrade the classification of various cables to ensure that adequate quality has been provided. These cables have been evaluated on an individual basis to be acceptable deviations from the normal installation procedures.

8.3.1.4.2.4 System Separation Criteria

8.3.1.4.2.4.1 Fail-Safe Cabling

Fail-safe (de-energized to operate) wiring outside of the main

(Insert Page 8.3-57d, 8.3.1.4.2.3)

In some cases it has been necessary to upgrade certain cables from a non-Class 1E status to either a Class 1E or prime cable status. Post installation procedures exist to upgrade such cables. These cables are evaluated on an individual basis and allowed to deviate from the normal installation procedures.

The following briefly describes the upgrading procedure for various categories of cables:

1. Non-Class 1E cables upgraded to Class 1E:

   a. Cable identification tags are revised at all terminations, pullpoints, entrance and exits to raceways.

   b. Cable installation records are reviewed to provide assurance that these cables are routed in Class 1E raceways and installed to Class 1E requirements. Otherwise, megger and continuity tests are performed, termination and routing is reinspected to Class 1E requirements, and documentation is prepared verifying the upgrade.

2. Non-Class 1E cables upgraded to prime cables:

   a. Same upgrade as 1.a above.

   b. Routing and termination is reinspected to Class 1E requirements and documentation is prepared verifying the upgrade.

guide. Independence between equipment and circuits of redundant Class 1E electrical divisions is provided to satisfy 10CFR50 requirements.

Deviations to the guide are listed below:

a. Paragraph ~~3.8 Appendix (1) to~~ C.1 of Regulatory Guide 1.75 Rev.1 excludes the use of fault current actuated circuit interrupting devices as an isolation device. WNP-2 uses overcurrent actuated circuit breakers and fuses. Justification for this deviation is provided in 8.3.1.4.1.12 and 8.3.2.2.1.1.

b. ~~Paragraph 4.5(a) Appendix (1) to Regulatory Guide 1.75 implies that associated circuits should be routed in Class 1E raceways. Some of the WNP-2 associated circuits are partially routed in non-Class 1E raceways. The non-Class 1E cables and raceways are divisionalized, BOP Division A and B. Routing criteria ensures that cables associated with one BOP division are separated from cables associated with the redundant BOP division and from Class 1E cables of the associated safety division. Justification for this design is provided in 8.3.1.4.4.1 and 8.3.1.4.4.2.~~ See attached insert

c. ~~Paragraphs 4.6.1 and 4.6.2 Appendix (1) to Regulatory Guide 1.75 require that non-Class 1E circuits be separated from Class 1E circuits by the same minimum separation required between redundant Class 1E circuits, unless the non-Class 1E circuits are treated as associated. As discussed in (b) above, some associated circuits in WNP-2 are partially routed in non-Class 1E raceways and are therefore not separated from non-Class 1E circuits. This deviation is covered by the justification of item (b).~~ See attached insert

d. ~~Sections~~ Paragraphs 5.1.3 and 5.1.4 ~~Appendix (1) to~~ of IEEE 384 as endorsed by Regulatory Guide 1.75 Rev.1 required a minimum separation of 1-inch between enclosed raceways of redundant divisions. This requirement is not met in WNP-2 though ~~, generally, some air space exists between the above raceways~~ the raceways are not physically touching. Justification for this deviation is based on Wyle Lab tests No. 56719 and No. 56669 for the Susquehanna Steam Electric Station. These tests demonstrate that rigid steel conduits and some specific heat-

resistant sleeving materials qualify as barriers against potential damage due to an electrical fault in one of the circuits requiring separation.

e. Paragraph ~~Section~~ 5.6.3 of IEEE 384 as endorsed by ~~Appendix (1) to~~ Regulatory Guide 1.75 rev. 1 requires identification of internal wiring to distinguish between redundant Class 1E wiring and between Class 1E and non-Class 1E wiring. At WNP-2 the panel or enclosure is assigned to a given Class 1E division if the majority of the contained wiring belongs to this division. Circuits associated to this division and non-Class 1E wiring in the panel are not identified. However, if Class 1E wiring for a redundant division or wiring associated by connection to the redundant division are also present in the same panel, then these wires are identified by color coded tags as shown in Tables 8.3-25 and 8.3-26.

8.3.1.4.2.6.b Paragraph 4.5 of IEEE 384 as endorsed by Regulatory Guide 1.75, Rev. 1, Paragraph C.4, states that associated circuits should meet all the same requirements as those placed upon Class 1E circuits. Some WNP-2 cables, which are associated by the IEEE 384 definition, may be partially routed in non-Class 1E raceways as well as Class 1E raceways. These cables when routed in the non-Class 1E trays are not considered associated based on analysis. They meet all the pull/termination documentation requirements placed upon Class 1E cables when they are bulk pulled with Class 1E cables. When they are not bulk pulled, they are installed to the same installation parameters as Class 1E by procedure, except that verification documentation for sidewall pressure, pulling tension, and minimum bend radius may not be available.

8.3.1.4.2.6.c Paragraphs 4.6.1 and 4.6.2 of IEEE 384 as endorsed by Regulatory Guide 1.75, Rev. 1, require that non-Class 1E circuits be separated from Class 1E/associated circuits by the same minimum separation required between redundant Class 1E circuits, unless the non-Class 1E circuits are classified as associated. As discussed in b above, some circuits that would be classified as "associated", by the IEEE 384 definition, are partially routed in non-Class 1E raceways and therefore are not separated from non-Class 1E circuits. Class 1E physical separation is not necessarily maintained between the non-Class 1E and Class 1E raceways, except as noted in 8.3.1.4.2.1.3.3.d.

Inside enclosures, non-Class 1E circuits are not separated from Class 1E circuits and thus would be termed "associated" by Regulatory Guide 1.75. These circuits are category 1C and treated as non-Class 1E, except for prime circuits which do meet Class 1E separation requirements. Justification for this deviation is described in 8.3.1.4.4.1.3.

8.3.1.4.3 Physical And Spatial Separation Details

Each Class 1E component is assigned to one of seven Class 1E divisions. Class 1E components of one division are separated from Class 1E components of the other divisions except as noted in Table 8.3-21 for the NSSS PGCC. Class 1E components are physically separated and protected from non-Class 1E high-energy components such that loss of Class 1E redundancy cannot result from a design basis event.

Structures are designed to provide protection from the effects of wind loadings, tornadoes, external missiles, flooding, and earthquakes. All Class 1E equipment, components, and raceways, and their supports, are designed to Seismic Category I requirements (refer to 3.10 for discussion of seismic capability).

8.3.1.4.3.1 Standby Generating Units and Auxiliaries

The standby diesel generator sets are located in separate equipment rooms in the diesel generator building. Auxiliaries and local controls for each diesel generator set, separated the same as the units themselves, are also located in this building. Each unit is provided with an independent air supply.

8.3.1.4.3.2 DC Power Systems

The Class 1E DC power systems include batteries, chargers, and associated equipment. Equipment for redundant systems is located in separate rooms. For further description see 8.3.2.

8.3.1.4.3.3 Switchgear

Separate electrical equipment rooms are provided in the radwaste/control building for redundant 4.16 kV and 480 V Class 1E Division 1 and 2 switchgear as shown on Figure 8.1-7. The Division 3 4.16 kV Class 1E switchgear and 480 V Class 1E MCC are located in the diesel generator building.

8.3.1.4.3.4 Motor Control Centers and Distribution Panels

Motor control centers, distribution panels, and miscellaneous electrical equipment of redundant divisions are either spatially separated or are located in separate rooms of safety class structures.

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8.3.1.4.3.6.3 PGCC Cable Assembly and Routing

The cable assembly within the power generation control complex is designed around the following variables: engineered system designation, circuit signal classification, PGCC separation classification based on power supply, and finally, the origination/destination which provides the routing and length (see Table 8.3-21). Each PGCC cable is precut, assembled (with lugs and connectors at either end as required) and installed in the panel/floor module shipping section. Special cable and routing requirements are shown on Table 8.3-22. The cable jacket and conductor insulation for the cables within the PGCC is either Raychem Flamtrol, General Electric Vulkene/Geoprene, or Tefzel. The fire suppression system has been provided to limit any off-gasing/smoke that could result from a cable fire.

Cable routing consists of two categories: field interface terminations (fits) and system interface terminations (sits). Fits cables are routed between termination cabinets and PGCC control panels, while sits cables are routed between PGCC control panels and do not interface with BOP field cable (see Figure 8.3-30).

8.3.1.4.3.7 Separation Within Panels

Separation of wiring in panels and instrument racks for redundant divisions of Class 1E circuits is accomplished by mounting redundant equipment on physically separated panels or control boards wherever practicable. Where locating control devices on separate panels is considered prohibitive for manual operation of equipment for optimum equipment arrangement, and where no single credible event in a single panel could disable two sets of redundant control circuits, both devices are located in the same panel. Where control devices of redundant systems are mounted in the same panel, physical separation (six inches), barriers, or isolation devices are provided. Wherever wiring of two redundant divisions exists in a single panel section, separated or isolated terminal boards and wiring preclude the possibility of fire propagation from one division of wiring to another. This separation is adequate since the material used in the construction of panel board, devices, and wiring are of a fire retardant nature.

In a few instances it is necessary for a single device such as a relay to be connected to wiring from redundant safety divisions. In such cases the intruding division wiring is routed immediately away from the device to attain the required 6" separation or to the extent where a barrier can be installed.

8.3.1.4.3.8 Spatial Separation Details for Raceways

The minimum separation distances for trays and conduits in general and specific areas are described in this section.

8.3.1.4.3.8.1 General Plant Areas

Raceways of redundant divisions are separated by physical distance. Figures 8.3-29a through 8.3-29d indicate the minimum separation distances for parallel runs of trays and conduits of redundant divisions. In general areas the minimum separation distance between open cable trays of redundant divisions or between an open tray of one division and a conduit or enclosed raceway of a redundant division routed above the tray is three feet free air space (horizontally) and five feet free air space (vertically). However, if no automatic area fire detection and extinguishing system exists, and the lower tray is the highest tray in a tier of three or more, the minimum vertical free air space for separation is eight feet. The minimum separation distance between an open cable tray of one division and a conduit of a redundant division where the conduit is routed below the open tray is one inch. Where equipment arrangement precludes maintaining the minimum separation distance, covers or barriers are provided between trays of redundant divisions. Circuits of redundant divisions can also be run in solid enclosed raceways, such as totally enclosed trays or rigid steel conduit, where the minimum established distance for open trays is not maintained.

In cases of crossover of one open tray over another of a redundant division where the minimum vertical separation criteria established in the above is not maintained, barriers consisting of solid steel covers on bottom trays and solid bottom in top trays are provided. These covers extend to each side of both tray edges by a minimum distance equal to three times the width of the widest tray involved in either division. The length of the protective covers is taken along the tray centerline. See Figure 8.3-29d. At crossovers, a minimum vertical separation of one inch is provided between the top of the bottom tray and the bottom of the top tray.

In the cases of ~~crossovers of~~ enclosed raceways ~~and~~ open trays of a redundant division, the minimum separation distance is one inch ~~if the enclosed raceway is below the open tray. If~~ the enclosed raceway is above the open tray, a one-inch vertical separation and a tray cover extending 12 inches beyond the sides of the ~~conduit~~ is required. See Figure 8.3-29d.

c. Some sensing equipment for the reactor protection system and the nuclear steam supply shutoff system are located in the turbine building which is a non-Category I structure. The sensors, cables, and raceways are Class 1E. Failure of the sensors due to seismic effects on the non-Category I structure in which the sensors are mounted does not prevent the system from performing its intended function. This is accomplished by the use of backup sensing devices which are mounted in Category I structures.

8.3.1.4.4 Associated Circuit Analysis

Non-Class 1E control and instrumentation cables as depicted in Table 8.3-27 illustrate the various circuit configurations that result in associated circuits within the designed cable and raceway systems (see Table 8.3-20). These non-Class 1E cables which become associated by connection or proximity to a Class 1E circuit are representative of the three part definition of associated circuits in 8.3.1.4.1.13. Associated cables as depicted in Tables 8.3-20 and 8.3-27 are routed in compatible divisional trays. These cables are uniquely identified and remain with or are physically separated the same as those Class 1E circuits with which they are associated except at cable end points inside enclosures.

8.3.1.4.4.1 Categories of Associated Circuits Treated as Non-Class 1E

The following categories of circuits are treated as non-Class 1E circuits. Justification is provided in 8.3.1.4.4.1.1 to 8.3.1.4.4.1.8.

Category 1A: Non-Class 1E instrumentation and control cables/wires that are not supplied Class 1E power and are routed in non-Class 1E raceways but have a continuing section in Class 1E raceways or enclosures. See Figure 8.3-43a.

Category 1B: Non-Class 1E instrumentation and control cables/wires that are supplied Class 1E power and are routed in non-Class 1E raceways but have a continuing section in Class 1E raceways or enclosures. See Figure 8.3-43a.

Category 1C: Non-Class 1E instrumentation and control cables/wires that are not supplied Class 1E power

but are associated by proximity inside an enclosure. ~~or become associated with a noncompatible Class 1E division in a downstream raceway or enclosure~~. See Figure 8.3-43a.

Category 2A: Non-Class 1E power cables/wires that are not supplied Class 1E power and are routed in non-Class 1E raceways, but have a continuing section in Class 1E raceways or enclosures. See Figure 8.3-43b.

Category 2B: Non-Class 1E power cables/wires that are connected to Class 1E power and are routed in non-Class 1E raceways, but have a continuing section in Class 1E raceways or enclosures. See Figure 8.3-43b.

Category 3A: Non-Class 1E instrumentation circuits that are connected to Class 1E circuits and utilize current limiting isolation devices. See Figure 8.3-43c.

Category 3B: Non-Class 1E power cables/wires that are connectd to Class 1E power through a series of two Class 1E circuit breakers or fuses. ~~See Figure 8.3-43d.~~

Category 3C: Non-Class 1E power cables/wires that are supplied Class 1E power through an inverter. ~~See Figure 8.3-43d~~.

8.3.1.4.4.1.1 Analysis for Category 1A Circuits

The postulated events for this category of non-Class 1E instrumentation and control cables (non-Class 1E powered but a continuing section associated by proximity with Class 1E cables/wires) are mechanical, structural, or electrical failures in the non-Class 1E raceway or equipment. These failures eventually manifest as overcurrents in the non-Class 1E cable and the continuing associated section of the cable. The design features that minimize the effects of this hazard on the Class 1E circuits are the following:

a. The cables in instrumentation and control raceways are low energy circuits ~~(see Table 8.3-20)~~.

b. The cable insulation and jacketing are fire retardant per IEEE Standard 383-1974 (see 8.3.3). Cable types are selected and routed according to their voltage level and application per Table 8.3-20.

8.3.1.4.4.1.4 Analysis for Category 2A Non-Class 1E Circuits

This category of non-Class 1E cables consists of power cables that are not supplied Class 1E power and are routed in non-Class 1E raceways but have a continuing section in Class 1E raceways or enclosures. The analysis for this category is identical to Category 1A except that these circuits are not low energy circuits. Refer to 8.3.1.4.4.1.1. The justifications for these circuits are as follows:

a. Justification b, c, d, e, f, and g as listed under Category 1A

b. The 480 V system is high resistance grounded to limit ground fault currents to 10 amperes maximum (see 8.3.1.1.10).

c. The 6.9 kV and 4.16 kV systems are high resistance grounded to limit ground fault currents to 12.5 amperes maximum.

d. The cable loading in power trays is limited to 2" fill and cable ampacities are taken from NEMAWC51-1972. Ambient temperature correction is made for temperatures above 40°C. In addition, a group derating factor is applied to further guarantee that cable overheating will not occur.

e. Non-Class 1E 480 V combination motor starters in motor control centers are provided current limiting fuses and thermal overload relays which are designed to operate at 1.25 times full load current.

8.3.1.4.4.1.5 Analysis for Category 2B Non-Class 1E Circuits

These circuits are non-Class 1E cables that are Class 1E powered and routed in non-Class 1E raceways. A continuing portion of these cables are routed in Class 1E raceways or enclosures. Justification for these circuits are as follows:

a. All the justifications listed under Category 2A.

b. Those justifications listed under Category 1B-b, c, and d.

8.3.1.4.4.1.6 Analysis for Category 3A Non-Class 1E Circuits

The cables in this category consist of data logging type instrumentation circuits such as inputs to the analog process computer. These circuits are low energy circuits and are connected to Class 1E signal circuits through Class 1E current limiting resistance units such that a fault in the non-Class 1E circuit does not affect operation of the Class 1E circuit.

8.3.1.4.4.1.7 Analysis for Category 3B Non-Class 1E Circuits

The non-Class 1E cables in this category are connected to Class 1E power and supply important to non-Class 1E loads (such as emergency lighting) and are not identified or separated as prime circuits. The justification for this Category is similar to Category 2B. Additional protection is provided by isolating the circuit through two Class E overcurrent devices in series. See 8.3.1.2.1.1

8.3.1.4.4.1.8 Analysis for Category 3C Non-Class 1E Circuits

The non-Class 1E cables in this category connect to non-Class 1E loads and are powered by inverters (1N-1 and 1N-2) which are fed from Class 1E batteries. The cables of this category are not designated as prime circuits and are not separated as associated circuits. Protection of the Class 1E power supply feeding the inverter is provided by Class 1E overcurrent devices (see 8.3.1.2.1.1 and 8.3.2.2.1.1) and the current limiting characteristic of the inverter.

8.3.1.4.4.2 Categories of Associated Circuits Treated as Class 1E

The following categories of associated circuits exist and are illustrated in Figures 8.3-43D and 8.3-43E.

Category 4A: Associated instrumentation and control circuits that are connected to non-Class 1E power and routed in Class 1E raceways and/or enclosures and may have a continuing section in a non-Class 1E raceway (Category 1A).

Category 4B: Associated power circuits that are connected to non-Class 1E power and routed in Class 1E raceways and/or enclosures and may have a continuing section in a non-Class 1E raceway (Category 2A).

Category 4C: Associated instrumentation and control circuits that are supplied Class 1E power are routed in Class 1E raceways, are not isolated on accident

signal, and may have a continuing section in a non-Class 1E raceway (Category 1B).

Category 4D: Associated power circuits that are connected to Class 1E power, are routed in Class 1E raceways, are not isolated on accident signal and have a continuing section in a non-Class 1E raceway (Category 2B). may

The design features of all associated circuits are in accordance with 8.3.1.4.2.1.3.2. The non-associated circuit portions of the cable routes are analyzed in 8.3.1.4.4.1.

8.3.1.4.4.3 Specific Deviations to Separation Criteria

8.3.1.4.4.3.1 RPS Power Supply

The Reactor Protection System Power Supply System consists of two non-Class 1E buses designated RPS-BUSA and RPS-BUSB which provide the failsafe power supply to the reactor trip logic circuits and to the neutron monitoring circuits (see 8.3.1.1.6). The non-Class 1E neutral of the RPS power supply bridges the various essential circuits; however, the postulated failure modes result in loss of power to various portions of the circuit. Since the systems are provided with failsafe logic circuits, power loss will not prevent them from performing their safety function. Fire barriers have been provided between redundant divisions. In areas where four-channel separation is required, the four-channel separation is maintained up to the relay. The relays in these instances do not have coil to contact separation. The assignment of RPS-bus power supply to the various RPS trip logic circuits and isolation valves circuits is consistent with the single failure criteria. The reactor protection system scram solenoid cabling at the scram solenoid units utilizes flexible conduit because of space limitations. The raceways entering these units do not meet WNP-2 cable separation criteria; however, it is in accordance with the design requirements shown on Figure 8.3-41.

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TABLE 8.3-8 (Continued)

(12) REF./S.

FIRST LINE WILL INDICATE THE REFERENCE NOTE NUMBER IF APPLICABLE. SECOND LINE WILL INDICATE THE REVISION, I.E., REF. 1, 2 AND REV. A OR REV. 1 ETC. REVISION IDENTIFIED ALPHABETICALLY INDICATE CHANGES PRIOR TO THE CABLE AND CONDUIT SCHEDULE BEING FORMALLY APPROVED FOR CONSTRUCTION. THE NUMBER ZERO "0" IS USED TO DENOTE THE FIRST ISSUE OF CABLE AND CONDUIT SCHEDULE AS APPROVED FOR CONSTRUCTION. SUBSEQUENT REVISED ISSUES WILL BE IDENTIFIED USING THE NUMERICAL SYSTEM. EXCEPT FOR REV. 0 THE REVISED ITEMS WILL BE IDENTIFIED BY AN ASTERISK IN CABLE AND CONDUIT SCHEDULE.

(13) REFERENCE NOTES

1. FOR ELECTRICAL DRAWING INDEX AND ELECTRICAL SYMBOL LIST SEE DRAWINGS E500 and E501.
   CABLE SCHEDULE OUTPUT SHEETS ARE PRINTED WITH A MINIMUM OF FOUR LINES FOR EACH CABLE NUMBER. THE FIRST LINE IS HEADING INFORMATION, THE SECOND LINE IS CABLE ENTRY X, Y AND Z COORDINATES, THE THIRD LINE IS CABLE ROUTING NODES, AND THE FOURTH LINE IS CABLE EXIT X, Y, Z COORDINATES.

2. "HOLD" INDICATES CABLE IS NOT RELEASED FOR CONSTRUCTION. CABLE SPEC HEADING IN SCHEDULE INDICATES CABLE TYPE AND QUANTITY. EXAMPLE: G1 1 INDICATES TYPE G1 CABLE, SINGLE CONDUCTOR.

3. CABLES DESIGNATED BY "CABLES NOT ROUTED" ARE NOT RELEASED FOR INSTALLATION. ROUTING TO BE DETERMINED AND WILL BE RELEASED IN A SUBSEQUENT ISSUE.
   AN ASTERISK UNDER THE COLUMN HEADING RV INDICATES THIS CABLE IS APPROVED FOR CONSTRUCTION.

TABLE 8.3-20

CABLE ROUTING CRITERIA

SIGNAL

POWER RACEWAYS: Raceway Types	Raceway Divisions	A	B	A	B	1	2	3	A	B	1	2	3	A	B
POWER CABLES															
Cable Application		14.4KV POWER		6.9KV POWER		4.16KV POWER					480/240/208/120VAC 250/125VDC PWR				
Cable Insulation Voltage/Type		15KV C		8KV A		5KV B					1000V/600V G				
Cable Divisions		A	B	A	B	1	2	3	A	B	1	2	3	A	B
H	A	X													
H	B		X												
H	A			X					X						
H	B				X					X					
H	1					0			A						
H	2						0			A					
H	3							●							
P	A								X					X	
P	B									X					X
P	1										0			A	
P	2											0			A
P	3												0		

SIGNAL RACEWAYS		1	2	3	4	5	6	7	A	B	A	B
SIGNAL (INSTRUMENTATION) CABLES												
Cable Application		ANALOG		NMS & RPS TRIP LOGIC CABLES					Analog*	Digital*	DIGITAL CABLES IN RB	
Cable Insulation Voltage/Type		600V/1000V L,K,M,J										
Cable Divisions		1	2	3	4	5	6	7	A	B	A	B
S	1	0							A			
S	2		0							A		
S	3			●								
S	4				0							
S	5					0						
S	6						0					
S	7							0				
S	A								X			
S	B									X		
C	1										A	
C	2											A

*Analog-Digital Cable Separation Outside Reactor Building

C

SEE TABLE 8.3-21 & TABLE 8.3-27,22

CONTROL RACEWAYS		1	2	3	4	5	6	7	A	B	4	5	6	7
CONTROL CABLES														
Cable Application		Control Indication & Annun.			RPS Trip Logic Cables				Contr Ind & Ann		RPS Scram SOV Ckt Only			
Cable Insulation Voltage/Type		600/1000V L,K,H			600V K				600V 1000V H,K,G*		600V H,G*			
Cable Divisions		1	2	3	4	5	6	7	A	B	4	5	6	7
C	1	0							A					
C	2		0							A				
C	3			●										
C	4				0									
C	5					0								
C	6						0							
C	7							0						
C	A								X					
C	B									X				
R_C	4										0			
R_C	5											0		
R_C	6												0	
R_C	7													0

*#4AWG "G"(1000V) Is Used For RMC(C12A), #6AWG "G" (1000V) Is Used For Scram Return And "G" (1000V) IS Used For RPS Power

INTERFACE BOP/P CA DIV.	NSSS PGCC CABLE DIV.	BOP PGCC CABLE DIV.	PGCC RACEWAY DIVISION 1	2	3	NON IE	
1	ESS1	Div 1	0				
2	ESS2	Div 2		0			
3	ESS3	Div 3			●		
4	A1		0				See Figure 8.3-41
6	B1		0				
5	A2			0			~~See Figure~~
7	B2			0			~~8.3-41~~
1	NSS1		0				See Figure 8.3-42
2	NSS2			0			
4	DIV1A		0				See Figure 8.3-41
6	DIV1B		0				
5	DIV2A			0			~~See Figure~~
7	DIV2B			0			~~8.3-41~~
A	XXX1	Div A	A			X	
B	XXX1	Div A	A			X	
A	XXX2	Div B		A		X	
B	XXX2	Div B		A		X	
3	XXX3	Div 3			A		

LEGEND: X-NON-IE, A-Associated, 0-Class 1E, R_C- The Subscript "C" Refer To CND.
RB-Reactor Building ●-HPCS (Only)

TABLE 8.3-21
POWER GENERATION CONTROL COMPLEX (PGCC) CABLE DESIGN INFORMATION

Example 1: NSSS PGCC Cable Information Obtained from the GE system cable

Summary:	Cable No. 8708/C51B-002,
From:	H13-P687
To:	H13-P608
System:	C51B
Signal:	GE/MAC
Separation:	E2
Cable Type:	SP4

Example 1: BOP PGCC Cable Information Obtained from the B&R BOP cable routing

Summary:	Cable No. CH-C2-1.10
From:	H13-P091
To:	H13-P811
Signal & Separation:	C2
Cable Type:	GE-1
Raceway:	Div 2

INDEX OF SYSTEMS

SEPARATION CODE

- B22A Nuclear Boiler Process Instrumentation
- B22E Auto Depressurization (ADS)
- B22F Jet Pump Instrumentation
- B22H Nuclear Steam Supply Shutoff (NSSS)
- B33A -35A Reactor Recirc. (Reval)
- C12A Reactor Manual Control (RMC)
- C12B Control Rod Drive Hydraulic (CRD HYD)
- C34A Feedwater Control
- C41A Standby Liquid Control
- C51A Startup Range Neutron Monitoring
- C51B Power Range Neutron Monitoring
- C51C Startup Drive Control
- C51D Traversing In-Core Probe Calib (TIP)
- C61A Remote Shutdown
- C72A Reactor Protection System (RPS)
- C72B RPS Motor Generator Set Control
- C91A Computer Interconnection
- D17A Process Radiation Monitoring
- D21A Area Radiation Monitoring (ARM)
- E12A Residual Heat Removal (RHR)
- E21A Low Pressure Core Spray (LPCS)
- E22A High Pressure Core Spray (HPCS)
- E22B HPCS Power Supply
- E31A Leak Detection
- E51A Reactor Core Isolation Cooling (RCIC)
- G11A Radwaste
- G33A Reactor Water Cleanup
- H13A Annunciator System
- N64A Off Gas System - Low Temp.

PGCC POWER SUPPLY CLASSIFICATION

POWER SOURCE DESCRIPTION AS SHOWN ON ELEMENTARY	NON CLASS 1E			PRIME			CLASS 1E	
120VAC INST BUS	X	X	X					
125VDC INST BUS	X	X	X					
24VDC INST BUS	X	X	X					
48VDC INST BUS	X	X	X					
120VAC INST BUS A				X		X		
120VAC INST BUS B					X		X	
125VDC INST BUS A				X		X		
125VDC INST BUS B					X		X	
24VDC INST BUS A				X		X		
24VDC INST BUS B					X		X	
120VAC UPS BUS	X	X	X					
120VAC UPS BUS A				X		X		
120VAC UPS BUS B					X		X	
120VAC RPS BUS A	X	X						
120VAC RPS BUS B	X	X						
120VAC INST BUS C					X			X
125VDC INST BUS C					X			X
24VDC INST BUS C					X			X

PGCC SIGNAL DESCRIPTION

NSSS CODE	BOP CODE (1)	DESCRIPTION
GE/MAC	S	Milliamp Process Signal
Low A	S	Low Level Analog Signal
Low D	S	Low Level Digital Signal
Comp A	S	160 MV Computer Analog Signal
Comp D	S	Computer Digital Signal
M/R IN	S	Meter/Recorder Input
ANN IN	C/S	Annunciator Input
28 VDC	C	28 Volt DC Power
120 VAC	C	120 Volt AC Power
125 VDC	C	125 Volt DC Power
CI 120A	C	120 Volt AC Control & Indication Signal
CI 125D	C	125 Volt DC Control & Indication Signal
CI 28D	C/S	28 Volt DC Control & Indication Signal
24 VDC	C	24 Volt DC Power
CT 5A	C	5 Amp. Current Transformer Circuit
ARM IN	S	Area Radiation Monitor Input

PGCC CABLE SEPARATION CATEGORIES

NSSS CODE	BOP CODE	DESCRIPTION
ESS1	Div 1	Core Standby Cooling System Division 1
ESS2	Div 2	Core Standby Cooling System Division 2
ESS3	Div 3	Core Standby Cooling System Division 3
A1	Div 4	Reactor Protection System Channel A Division 1
B1	Div 6	Reactor Protection System Channel B Division 1
A2	Div 5	Reactor Protection System Channel A Division 2
B2	Div 7	Reactor Protection System Channel B Division 2
NSSI	Div 1	Nuclear Steam Supply Shutoff System Division 1
NSSII	Div 2	Nuclear Steam Supply Shutoff System Division 2
DIV 1A	DIV 4	Neutron Monitoring System Trip Logic A1 Division 1A
DIV 1B	DIV 6	Neutron Monitoring System Trip Logic B1 Division 1B
DIV 2A	DIV 5	Neutron Monitoring System Trip Logic A2 Division 2A
DIV 2B	DIV 7	Neutron Monitoring System Trip Logic B2 Division 2B
XXXI	DIV A or DIV B	All other non-safety functions routed IN Division 1 or non-Class 1E (XXXI cable in DIV1 raceway is associated.)
XXXII	DIV A or DIV B	All other non-safety functions routed IN Division 2 or non-Class 1E (XXXII Cable in Div 2 raceway is associated.)
XXXIII	DIV 3	All other non-safety functions routed with Division 3

Safety-Related Systems (NSSS)

PGCC RACEWAYS

PGCC CABLE TYPES
(Supplied by General Electric)

NSSS CODE	BOP CODE	DESCRIPTION
SP1 AWG 20		1 Twisted Shielded Pair of #20 wire
SP4 AWG 20	GE-7A	4 Twisted Shielded Pairs of #20 wire
SP7 AWG 20	GE-5A	7 Twisted Shielded Pairs of #20 wire
SP15 AWG 20		15 Twisted Shielded Pairs of #20 wire
	GE-5	7 Twisted Shielded Pairs of #16 wire
TC4 Cu/Cn		4 Shielded Pairs of Copper Constantan Thermocouple wire
TC8 Cu/Cn	GE-6	8 Shielded Pairs of Copper Constantan Thermocouple wire
TC8 Chr/Cn		8 Shielded Pairs of Chrome Constantan Thermocouple Wire
	GE-7	4 Twisted Shielded Pairs of #16 wire
ST/1 AWG 20		Twisted Shielded Triple Conductors of #20 Wire
	GE-4	12 Conductors of #14 wire With Overall Shield
	GE-3	7 Conductors of #14 wire
MC7 AWG 14		
	GE-1	19 Conductors of #14 Wire
MC19 AWG 14		
		8 Conductors of #16 Wire
MC8 AWG 16		
		12 Conductors of #16 Wire
MC12 AWG 16	GE-2	19 Conductors of #16 Wire
MC19 AWG 16		27 Conductors of #16 Wire
MC27 AWG 16		37 Conductors of #16 Wire
MC37 AWG 16		7 Conductors of #20 Wire
MC7 AWG 20		12 Conductors of #20 Wire
MC12 AWG 20		19 Conductors of #20 Wire
MC19 AWG 20		27 Conductors of #20 Wire
MC27 AWG 20		37 Conductors of #20 Wire
MC37 AWG 20		48 Conductors of #20 Wire
MC48 AWG 20		
7/C AWG 14		7 Separate Conductors of #14 Wire Routed In Conduit
12/C AWG 14		12 Separate Conductors of #14 Wire Routed In Conduit
2 COND PWR		2 Power Conductors Routed In Conduit
3 COND PWR		3 Power Conductors Routed In Conduit
COAX RG-6		Coaxial Cable Type RG-6
COAX RG-22		Coaxial Cable Type RG-22
COAX RG-59		Coaxial Cable Type RG-59
COAX RG-59AM		Coaxial Cable Type RG-59AM
	GE-8	6 3/c #16 Individually Shielded
	GE-9	2 1/c #10
	GE-10	2 1/c #12
	GE-12	2 1/c #14
	GE-13	4 4/c #16 Individually Shielded
	GE-14	7/c #16 Overall Shield

1) This BOP code corresponds to BOP cable signal classification for BOP PGCC Cables and for those cables that interface with the NSSS PGCC cables.

2) This BOP code corresponds to the BOP cable separation classification that interfaces with the NSSS separation code. This code is also used in combination with the BOP PGCC signal code to describe BOP PGCC cable signal/separation classification, i.e., "C1" indicates Control, Division 1. Balance of plant Div B cables can interface with XXXI PGCC cables providing "bridging" between essential raceways does not occur. Similar for XXXII/DIV A interface cables. Note that "Bridging" between essential raceways is acceptable in the following cases: Case 1 Div 1 PGCC duct can interface with Div 4 or Div 6 BOP raceway. Case 2 Div 2 PGCC duct can interface with Div 5 or Div 7 BOP raceway.

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February 1982

TABLE 8.3-22
SYSTEM CABLES AND ROUTING CRITERIA

DESCRIPTION	FIELD: NON-CLASS IE	FIELD: CLASS IE	FIELD: CABLE TYPE	FIELD: RACEWAY TYPE/DIV	IN PGCC MODULAR FLOOR DUCTS: RACEWAY DIV	IN PGCC MODULAR FLOOR DUCTS: PGCC SEPARATION CATEGORY	IN PGCC MODULAR FLOOR DUCTS: PGCC SIGNAL CLASS	IN PGCC MODULAR FLOOR DUCTS: PGCC CABLE TYPE	NSSS SPECIAL CABLE REQ.: IMP (OHMS)	NSSS SPECIAL CABLE REQ.: CAPAC (pF/ft)	NSSS SPECIAL CABLE REQ.: MAX VOLTS (V kms)	NSSS SPECIAL CABLE REQ.: SPECIAL REQUIR.	REMARKS
RPS TRIP LOGIC CONTROL CABLES		X	K1	C4	Div 1	A1	C1120A	12/C#14					Failsafe cables routed in GRDD. flex CND within PGCC
		X	K1	C6	Div 1	B1	C1120A	12/C#14	NA				
		X	K1	C5	Div 2	A2	C1120A	12/C#14					
		X	K1	C7	Div 2	B2	C1120A	12/C#14					
RPS SCRAM SOLENOIDS CABLES		X	H2	R4	Div 1	A1	C1120A	2CONDPWR				SCRAM SOV CKT NEUTRAL TO BE #6AWG FROM MAIN CONTROL PANEL TO SCRAM GROUP PULL BOX AT SOVS	RPS scram SOV cables trip logic A1 & B1 and LPRM group 1 & 3 cables are routed in separate PGCC Division 1 ducts, similarly for RPS scram SOV cables trip logic A2 & B2 and LPRM group 2&4 cables.
		X	H2	R6	Div 1	B1	C1120A	2CONDPWR					
		X	H2	R5	Div 2	A2	C1120A	2CONDPWR					
		X	H2	R7	Div 2	B2	C1120A	2CONDPWR					
RPS TRIP LOGIC SIGNAL CABLES		X	L2	S4	Div 1	A1	GEMAC	SP4					
		X	L2	S6	Div 1	B1	GEMAC	SP4	.NA				
		X	L2	S5	Div 2	A2	GEMAC	SP4					
		X	L2	S7	Div 2	B2	GEMAC	SP4					
NEUTRON MON SYS CABLES (INCLUD. MAIN STEAM RAD) – C51A – SRM – SENSOR CA		↑	M7	↑	↑	↑	-	-	75	20.5	1000	COAX 3 SHLD HI RAD, TEMP	NEUTRON MONITORING SYS. GROUP 1
PREAMP SIG.CA.			M1				LOWA	COAX RG6	75	20.0	1500	COAX STD	
PREAMP HV. CA.			L4				LOWA	COAX RG59	47	37.3	2000	SHLD	
PREAMP LV. CA.			L4				C1 28D	COAX RG59	47	37.3	2000	SHLD	
C51A – IRM – SENSOR CA.			M6				-	-	130	9.8	1000	COAX 3 SHLD.	
PREAMP SIG.CA.			M1				LOWA	COAX RG6	75	20.0	1500	COAX STD	
PREAMP HV. CA.			L4				LOWA	COAX RG59	47	37.3	2000	SHLD	
PREAMP LV. CA.		X	L4	S4	Div 1	Div1A	C1 28D	COAX RG59	47	37.3	2000	SHLD	
RANGE SW CA.			-				C1 28D	MC19	NA				
C51B – LPRM – SENSOR/EPA.CA.			M5				-	-	62	25.7	2300	COAX HI RAD TEMP.	
EPA/PGCC CA.			L4				LOWA	COAX RG59	47	37.3	2000	SHLD	
D17A – EXCESS RAD M – SENSOR CA.			M1						75	20.5	1000	COAX 3 SHLD HI RAD, TEMP	
PREAMP SIG. CA			M1				LOWA	COAX RG6	75	20.0	1500	COAX STD	
PREAMP HV CA.			L4				LOWA	COAX RG59	47	37.3	2000	SHLD	
PREAMP LV. CA.		↓	L4	↓	↓	↓	LOWA	COAX RG59	47	37.3	2000	SHLD	
SAME AS NMS GRP.I		X	SEE C51A	S6	Div 1	Div 1B	← SAME AS NMS GROUP 1 →						NMS GROUP III
SAME AS NMS GRP.I		X		S5	Div 2	Div 2A	← SAME AS NMS GROUP 1 →						NMS GROUP II
SAME AS NMS GRP.I		X		S7	Div 2	Div 2B	← SAME AS NMS GROUP 1 →						NMS GROUP IV
PROCESS RADIATION MONITORING (D17A)	X			S2	Div 2	XXX2	← SAME AS D17A IN NMS (ABOVE)						
	X		↓	SB	Div 2	XXX2	← SAME AS D17A IN NMS (ABOVE)						
AREA RADIATION MONITORING (D21A)	X		L3	S2	Div 2	XXX2	ARM-1N	MC8	NA				
	X		L3	SA	Div 2	XXX2	ARM-1N	MC8	NA				
TIP (C51D) – INDEX MECH CABLE	X		L3	C2	-	-	-	-				27/C SHLD	
DRIVE MECH POS IND	X		L3	C2	Div 2	XXX2	LOWD	MC48				48/C SHLD	
DRIVE MECH CONTRCA	X		L3	C2	Div 2	XXX2	LOWD	MC37				37/C SHLD	
DRIVE MECH ANALOG POS	X		L1	S2	Div 2	XXX2	LOWA	ST1					
DRIVE MECH DET SIG	X		L4	S2	Div 2	XXX2	LOWA	COAX RG59	47	37.3	2000	SHLD	
DRIVE MECH CHAMBER	X		L3	C2	-	-	-	-				4/C SHLD	
DRIVE MECH BALL VACA	X		K1	C2	-	-	-	-				2/C#16	
SHEAR VA ASSY CA.	X		L3	C2	-	-	-	-				14/C SHLD	
REAC MAN CONTR (C12A) – ROD POSTION CABINET – LEFT/RIGHT BRANCH JUNCTION MODULES	X		G1	CA	Div 1	XXX1	C1120A	2CONDPWR	NA				
	X		M8	SA	Div 1	XXX1	LOWD	COAX RG22					
CRD PROBE/EPA CAB.	X		K2	S1					RAYCHEM 60/7180 OR EQUAL			13/C	
EPA/RPIS CABLE	X		L3	S1	Div 1	XXX1	LOWA	MC48					
EPA/H22-P007	X		J2	S1	-	-	-	-				28 PAIR OA SHLD.	
RPS POWER SUPPLY (C72B)	X		H2	C1	Div 1	XXX1	C1120A	2CONDPWR					Failsafe Power Cables Routed In Grounded Flexible Conduit Within PGCC
	X		G2	PA	Div 1	XXX1	C1120A	2CONDPWR					
	X		G2	C2	Div 2	XXX2	C1120A	2CONDPWR					
	X		G2	P2	Div 2	XXX2	C1120A	2CONDPWR					
	X		H2	C2	Div 2	XXX2	C1120A	2CONDPWR					
	X		G2	PB	Div 2	XXX2	C1120A	2CONDPWR					
	X		H2	C1	Div 1	XXX1	C1120A	2CONDPWR					

see NMS1

The LPRM cables are subdivided into four groups as follows:
Group 1 (Div 1A) APRM CHE
Group 2 (Div 2A) APRM CHC+D
Group 3 (Div 1B) APRM CHA+B
Group 4 (Div 2B) APRM CHF

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TABLE 8.3-24

POWER/CONTROL CABLE CLASSIFICATION

1	2	3	4	5	6	7	8	9	10	11	12
		LOAD TYPE									
CABLE SIZE (AWG)	SERVICE VOLTAGE (VOLTS)	MOTORS ALL EXCEPT COL. 11	MOTOR-OPERATED VALVES	SOLENOID VALVES	SPACE HEATER (INC. MOTOR HEATER)	PROCESS HEATER	TRANS (INC. PWR. AND LIGHT'G.)	FDR'S TO SWG'R & LOC. CONT. P.	METERING, PROTECTION & CONTROL CKTS.	SMALL MOTORS (* *)	
#10 AND SMALLER	120 VAC 125 VDC	P	P	C	(See Note 2) C (up to 900W)	P	P	(See Note 2) C (up to 30A circuits)	C	C	
LARGER THAN #10	120 VAC 125 VDC	P	P	C	P	P	P	P	C	NA	
ANY	ABOVE 120 VAC 125 VDC	P	P	NA	P	P	P	P	C	NA	

NOTES:

1. (* *) INCLUDED ARE: ELECTRO HYDRAULIC OPERATORS (EHO'S), HVAC DAMPERS, REACTOR STARTUP RANGE DETECTOR DRIVE MOTOR, MOTORS UP TO 1/3 HP.

2. CONTROL DESIGNATION IS TO BE RETAINED FOR CABLES REQUIRING SIZES LARGER THAN #10 AWG FOR VOLTAGE DROP REDUCTION.

LEGEND:

P - POWER
C - CONTROL
NA - NOT APPLICABLE

TABLE 8.3-25

DIVISION MARKERS FOR EQUIPMENT, RACEWAYS, & CABLES EXTERNAL TO PGCC

DIVISIONAL SEPARATION CLASS	SAFETY CLASS: CLASS 1E	SAFETY CLASS: ASSOCIATED	SAFETY CLASS: NON CLASS 1E	REPRESENTATIVE CABLE NUMBER	CABLE DIVISION MARKING CHARACTER	RACEWAY TYPE (CABLE COMPATABILITY FROM E550/E551 DRAWINGS)	REPRESENTATIVE TRAY DIVISION MARKING CHARACTERS	RACEWAY/ EQUIP. MARKER BACKGROUND COLOR	REPRESENTATIVE CABLE MARKER BACKGROUND COLOR	CHARACTER COLOR	PRIME CABLES (NON-CLASS 1E CABLES POWERED FROM CLASS 1E SOURCES) HAVE AN ADDITIONAL ~~CHECKED~~ checkered MARKER ALSO ON RACEWAYS USED.	PRIME CABLES ARE IDENTIFIED IN THE SFTY CLR FLD OF DWG E550/ E551	CLASS 1E OR PRIME CABLES THAT "INTRUDE" IN PANELS ARE IDENTIFIED (1)
1	X			1LPCS-5	DIV. 1	H,P,C,S	CDIV1	YELLOW	YELLOW	BLACK	NA	NA	YEL./WHITE
		X		A1LPCS-9001	DIV. 1				SILVER/YELLOW		RED/WHITE	A'1	YEL./WHITE
2	X			2RHR-10	DIV. 2	H,P,C,S	CDIV2	ORANGE	ORANGE	BLACK	NA	NA	BL./WHITE
		X		BRHR-9001	DIV. 2				GOLD/ORANGE		GREEN/WHITE	B'2	BL./WHITE
3	X			3HPCS-14	DIV. 3	P,C,S	CDIV3	RED	RED	BLACK	NA	NA	GN/WHITE
4	X			4RPS-17	CHA1	R,C,S	RCHA1	LT. BLUE	LIGHT BLUE	RED	NA	NA	YEL./WHITE
5	X			5RPS-17	CHA2	R,C,S	RCHA2	GREEN	GREEN	RED	NA	NA	BL./WHITE
6	X			6RPS-17	CHB1	R,C,S	RCHB1	DRK.BLUE	DARK BLUE	RED	NA	NA	YEL./WHITE
7	X			7RPS-17	CHB2	R,C,S	RCHB2	BROWN	BROWN	RED	NA	NA	BL./WHITE
A			X	AMIA-402	DIV. A	H,P,C,S	CDIVA	SILVER	SILVER	BLACK	RED/WHITE	A'1 (NOTE 1)	YEL./WHITE
			X	ASLS3-9075	DIV. A				SILVER/YELLOW				
B			X	BO12C-105	DIV. B	H,P,C,S	CDIVB	GOLD	GOLD	BLACK	GREEN/WHITE	B'2 (NOTE 1)	BL./WHITE.
			X	BSH7-9126	DIV. B				GOLD/ORANGE				

RACEWAY TYPES NOTE: THE RACEWAY TYPE CORRESPONDS TO THE CABLE COMPATIBILITY ON THE E550/E551 DRAWINGS.

H - POWER 6.9/4.16 KV
P - POWER 1000/600 V AC
 250 VDC, 125 V DC/20/208/240 V AC
C - CONTROL 120 V AC/125 V DC
S - SIGNAL
R - RPS SCRAM SOV RACEWAY

CABLE MARKER

THE CABLE MARKER INCLUDES BOTH THE CABLE NUMBER AND THE DIVISION MARKING CHARACTERS

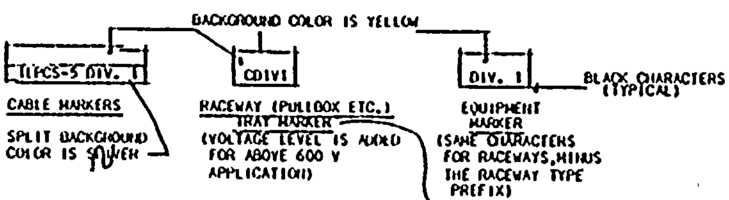
PRIME CABLES:

A'1 SIGNIFIES DIV. 1 POWER/DIVA NON-CLASS 1E FUNCTION
B'2 SIGNIFIES DIV. 2 POWER/DIVB NON-CLASS 1E FUNCTION
A'2 & B'1 ARE PROHIBITED

NON-1E 9000 SERIES CABLE NUMBER

A NON-CLASS 1E CABLE IDENTIFIED BY A CABLE NUMBER BETWEEN 9000 & 9999 AND IS ROUTED PARTIALLY OR WHOLLY IN A DIVISIONALIZED RACEWAY OR IS NOT PHYSICALLY SEPARATED FROM A CLASS 1E CABLE WITHIN ITS EQUIPMENT OF ORIGIN OR DESTINATION.

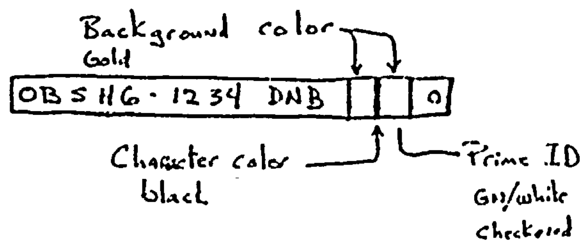
TYPICAL DIVISION MARKERS



(1) INTERNAL PANEL WIREMARKERS

NOTE 1: AN A'1 OR B'2 CABLE SECTION MAY BE TREATED AS NON-CLASS 1E. SEE CATEGORY 1B, FIGURE 8.3-43A AND CATEGORY 2B, FIGURE 8.3-43B.

(+ rigid conduit)



Metal Tag Conduit Marker (when required)

TABLE 8.3-26

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DIVISION MARKERS FOR EQUIPMENT, RACEWAYS, CABLES, & WIRES IN PGCC

PGCC DIV. SEP. CLASSES	SAFETY CLASS: CLASS 1E	SAFETY CLASS: ASSOCIATED	SAFETY CLASS: NON CLASS 1E	CABLE MARKERS: CABLE SEP. CATEGORY AS SHOWN ON CABLE ID MARKER	CABLE MARKERS: CABLE SEPARATION MARKER: LETTERING	CABLE MARKERS: CABLE SEPARATION MARKER: LETTERING COLOR	CABLE MARKERS: PRIME CABLES (NON-CLASS 1E CABLES PWRED FROM CLASS 1E SOURCES) HAVE AN ADDITIONAL CHECKERED MARKER	PGCC RACEWAY/ EQUIP. MARKER-LETTERING COLOR IS BLACK	PGCC RACEWAY/ EQUIP./ CABLE MARKER BACKGROUND COLOR	EXTERNAL TO PGCC INTERFACES WITH DIVISIONAL SEPARATION CLASS SHOWN ON TABLE 8.3-25	WIRE MARKERS (1): IF CABLE INTRUDES INTO A PANEL (IN PGCC) OF A DIFFERENT DIV. THEN THE INTERNAL PANEL WIRING, WHICH IS ELECTRICALLY CONNECTED, SHALL BE IDENTIFIED WITH STRIPED MARKER TAPE
	X			RPS-A1	RPS-I	Red					
ESS	X			Div-1A	Div I	Black				4	
	X			RPS-B1	RPS-I	Red					
	X			Div-1B	Div I	Black	N/A			6	Yellow/White
1	X			ESS1	~~Div~~ I	Black		Div 1	Yellow		
NSS	~~X~~			~~NSS1~~	~~Div~~ I	Black				1	
	X			Div 1	Div I	Black					
		X		XXX1	N/A	N/A	Red/White				For Prime Cables Only
		X		Div A	N/A	N/A	Red/White			A,B, 1	Yellow/White
		~~X~~		~~Div B~~	~~N/A~~	~~N/A~~	~~N/A~~				~~N/A~~
	X			RPS-A2	~~RB~~-II	Red					
RPS	X			Div 2A	Div II	~~Black~~ white				5	
	X			RPS-B2	RPS II	Red					
	X			Div 2B	Div II	~~Black~~ white				7	Blue/White
ESS	X			ESS2	~~Div~~ II	~~Black~~	N/A				
2 NSS	X			NSS2	~~Div~~ II	~~Black~~		Div 2	Blue	2	
	X			Div 2	Div II	~~Black~~					
		X		XXX2	N/A	N/A	Green/White				For Prime Cables Only
		X		Div B	N/A	N/A	Green/White			A,B, 2	Blue/White
		~~X~~		~~Div A~~	~~N/A~~	~~N/A~~	~~N/A~~				~~N/A~~
	X			ESSIII	ESSIII	White	N/A				
3		X		XXXIII	N/A	N/A	Blue/Yellow	Div 3	Green	3	Green/White
	X			Div 3	ESSIII	White	N/A				
NON-			X	XXX1							
CLASS			X	XXX11	N/A	N/A	N/A	N/A	White	A,B,1,2	N/A
1E			X	Div A							
DUCT			X	Div B							

(1) Each panel or bay shall be identified with the appropriate divisional marker to show the residing Division of the internal wires. Note that the internal wires in a Division 1 panel that are compatible with the various Division 1 cable separation categories will not be identified. Similarly for Division 2 & 3 panels.

TABLE 8.3-27

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NON-CLASS 1E ASSOCIATED CIRCUITS[3] (CONTROL & INSTRUMENTATION)

	PGCC PANEL: ASSOCIATED WITH CABLES OF PGCC CLASS 1E DIV.	FIRE-STOP	PGCC RACEWAY: ASSOC-IATED CABLE (2)	PGCC RACEWAY: NON-CLASS 1E CABLE (BY ANALYSIS)	FIRE-STOP	PGCC TERM. CAB: ASSOC-IATED WITH CABLES OF CLASS 1E DIV.	FIRE-STOP	BOP RACEWAYS: ASSO-CIATED CABLE	FIRE-STOP	BOP RACEWAYS: NON-CLASS 1E CABLE (BY ANALYSIS)	FIRE-STOP	BOP EQUIP.: CAN BE ASSO-CIATED WITH CABLES COMPAT. WITH CLASS 1E DIV.
CABLE DIVISION	X,1		XXX1			1,X		A		A		1,X
RACEWAY DIVISION			1					1		A		
CABLE DIVISION	X,1			XXX1		1,X				A		1,X
RACEWAY DIVISION				NON-CLASS 1E						A		
CABLE DIVISION	X			XXX2		X				B(1)		1,X
RACEWAY DIVISION				NON-CLASS 1E						B		

CATEGORY 4,A, 4C (TYPICAL) — CATEGORY 1A, 1B (TYPICAL) — CATEGORY 1C (TYPICAL)

	PGCC PANEL	FIRE-STOP	PGCC RACEWAY: ASSOCIATED CABLE	PGCC RACEWAY: NON-CLASS 1E CABLE	FIRE-STOP	PGCC TERM. CAB	FIRE-STOP	BOP RACEWAYS: ASSOCIATED CABLE	FIRE-STOP	BOP RACEWAYS: NON-CLASS 1E CABLE	FIRE-STOP	BOP EQUIP.
CABLE DIVISION	X,2		XXX2			2,X		B		B		2,X
RACEWAY DIVISION			2					2		B(1)		
CABLE DIVISION	X,2			XXX2		2,X				B		2,X
RACEWAY DIVISION				NON-CLASS 1E						B(1)		
CABLE DIVISION	X			XXX1		X				A(1)		
RACEWAY DIVISION				NON-CLASS 1E						A(1)		2,X

X - For Non-Class 1E Powered Cables only. These cables are not treated as associated (Category 1C).

1. Design control is provided to not allow these circuits in redundant Class 1E raceways downstream of equipment of origin/destination. These cables are not prime cables.

2. All XXX ~~111~~ 3 cables are associated and routed only in Division 3 raceways and enclosure inside the PGCC. External to the PGCC they interface only with Division 3 cables and are routed in Division 3 Raceways and Enclosures.

3. Associated circuits includes both prime and non-prime circuits. This table can be generalized by replacing PGCC with BOP, XXX1 with DIV A and XXX2 with DIV B.

~~4. Non-Class 1E powered cables contained in raceways that are routed into Division 2 raceways are isolated by over current protective devices.~~

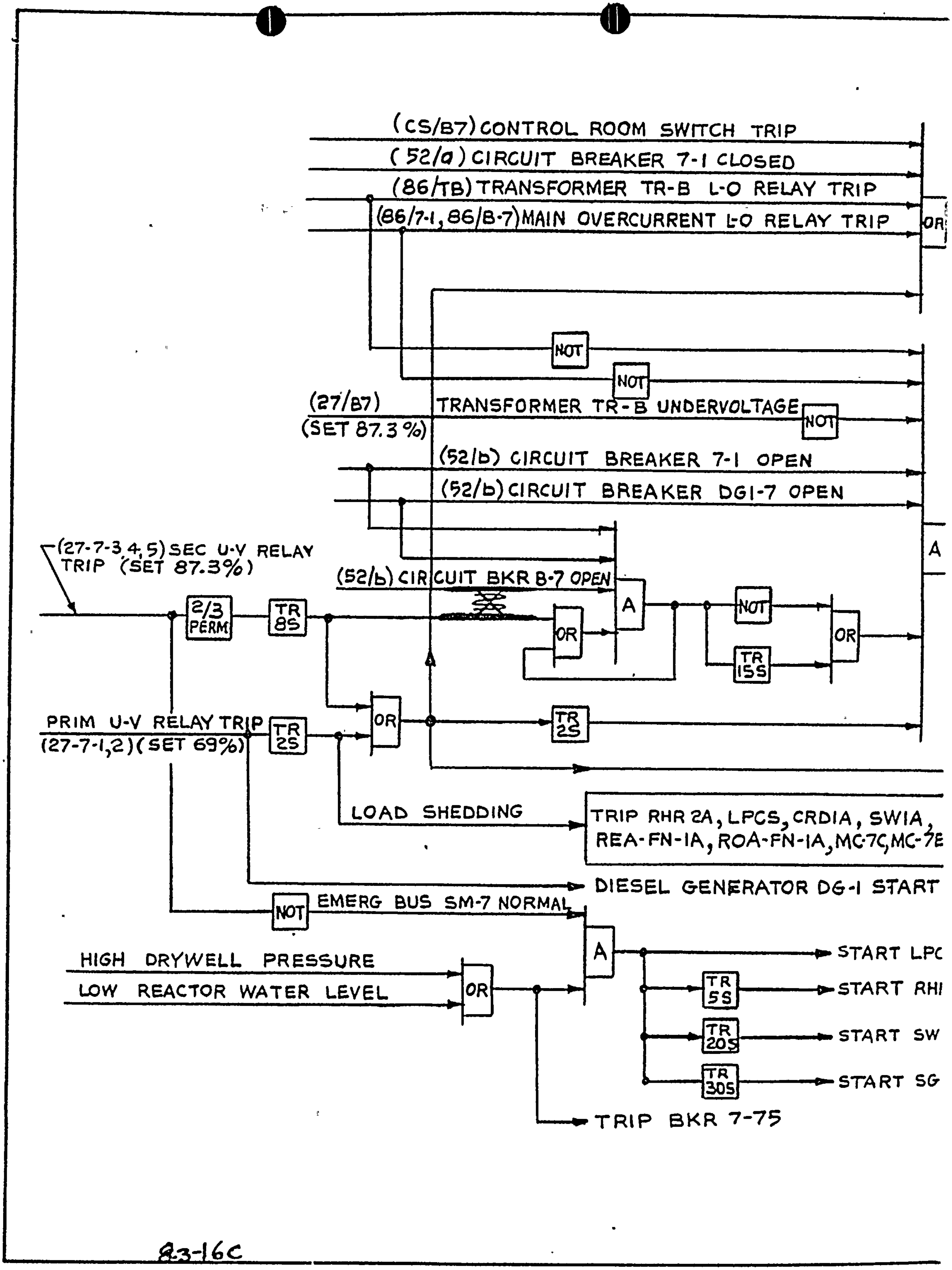
NON-CLASS 1E CIRCUITS (POWER)

BOP EQUIP — CATEGORY 2A, 2B (TYPICAL)

BOP EQUIP					
	A		(A)		1
1	1		(A)		
NON-			(1)B		1
1E			B		

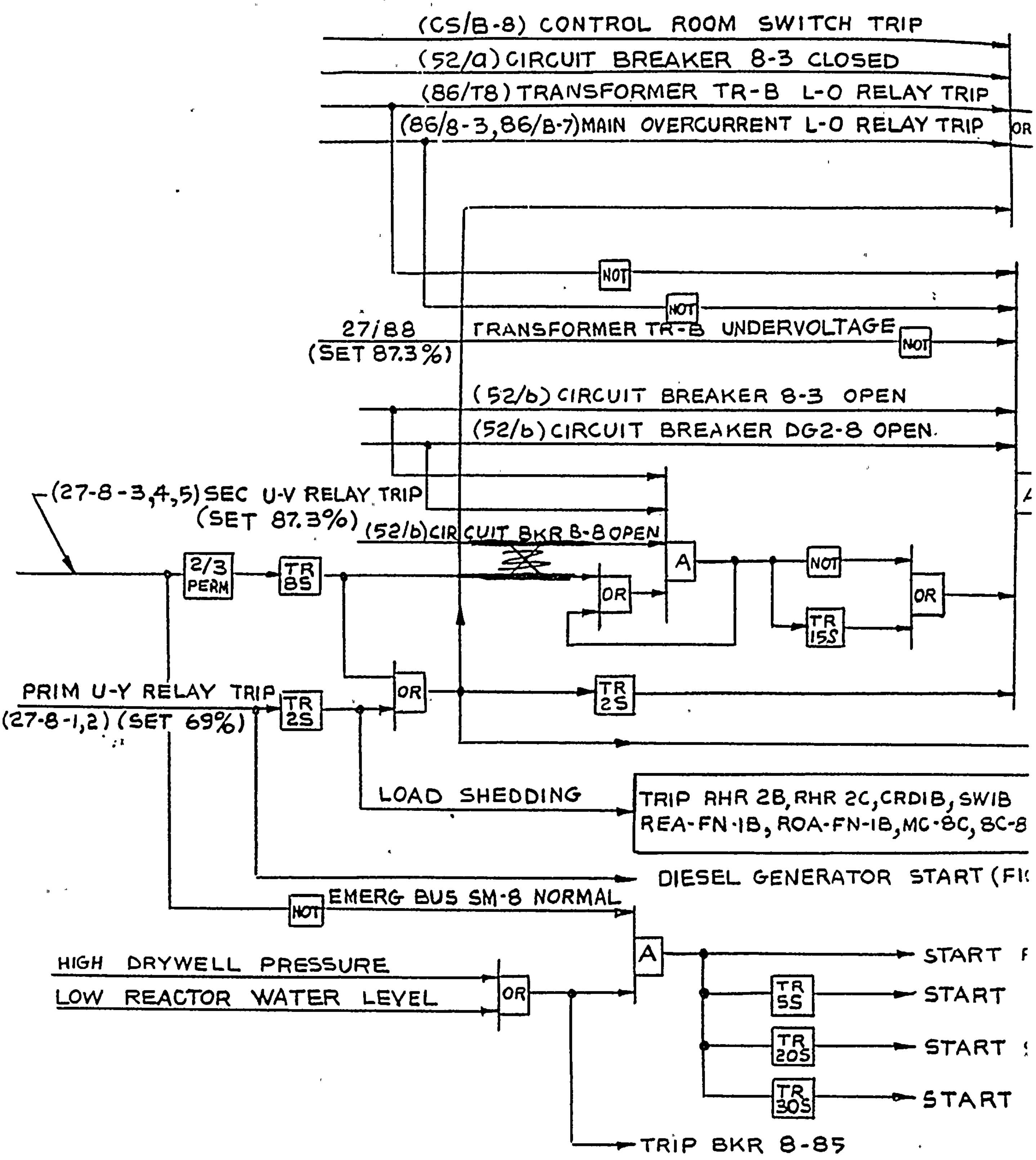
CATEGORY 4B, 4D (TYPICAL)

	(B)		B		2
2	(2)		(4)B		
NON-			(1)A		2
1E			A		

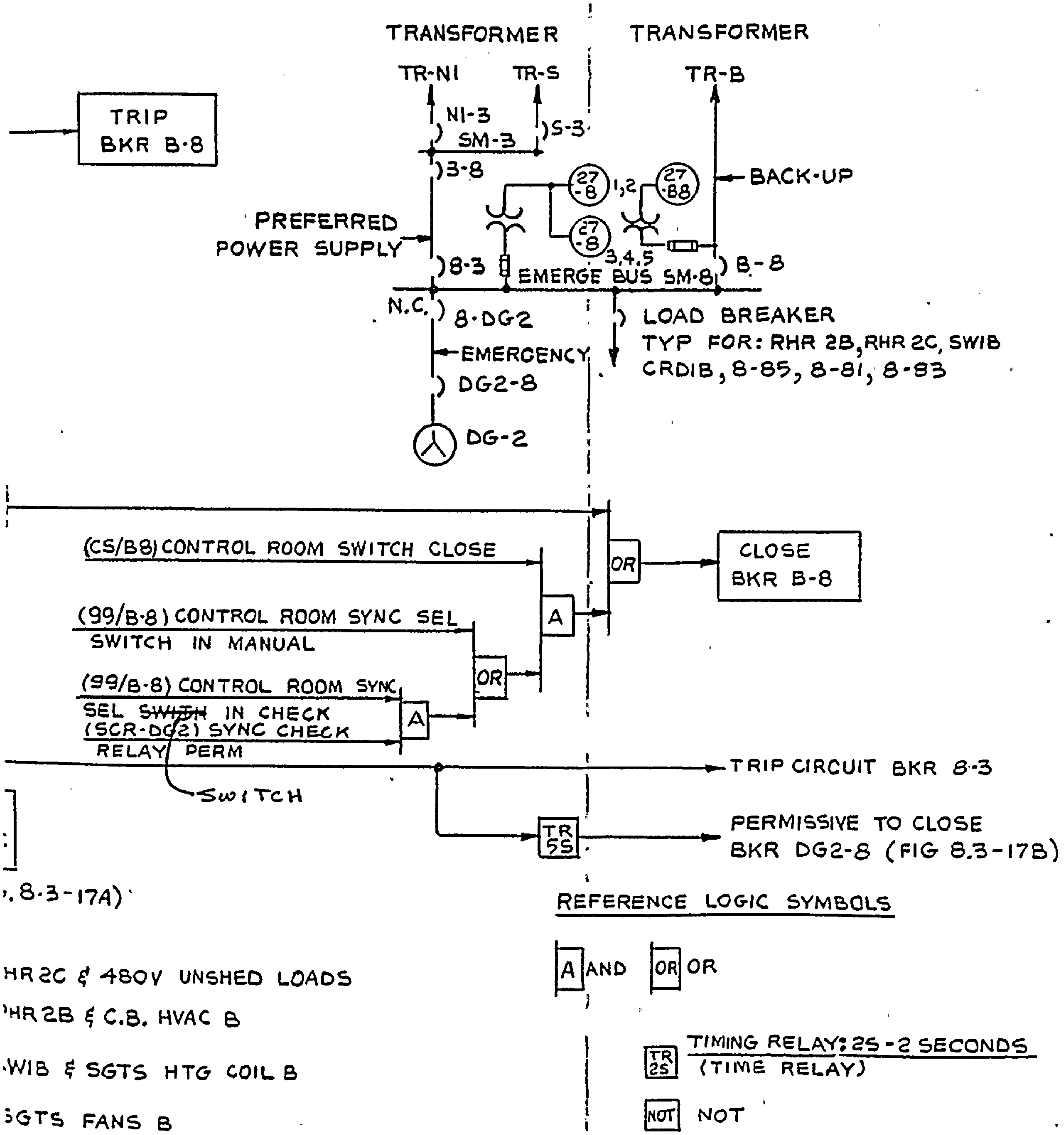


(CS/B7) CONTROL ROOM SWITCH TRIP
(52/a) CIRCUIT BREAKER 7-1 CLOSED
(86/TB) TRANSFORMER TR-B L-O RELAY TRIP
(86/7-1, 86/B-7) MAIN OVERCURRENT L-O RELAY TRIP
OR
NOT
NOT
(27/B7)
(SET 87.3 %)
TRANSFORMER TR-B UNDERVOLTAGE
NOT
(52/b) CIRCUIT BREAKER 7-1 OPEN
(52/b) CIRCUIT BREAKER DG1-7 OPEN
A
(27-7-3,4,5) SEC U-V RELAY TRIP (SET 87.3%)
(52/b) CIRCUIT BKR B-7 OPEN
2/3 PERM
TR 8S
OR
A
NOT
OR
TR 15S
PRIM U-V RELAY TRIP
(27-7-1,2) (SET 69%)
TR 2S
OR
TR 2S
LOAD SHEDDING
TRIP RHR 2A, LPCS, CRDIA, SWIA, REA-FN-1A, ROA-FN-1A, MC-7C, MC-7E
DIESEL GENERATOR DG-1 START
NOT
EMERG BUS SM-7 NORMAL
A
HIGH DRYWELL PRESSURE
LOW REACTOR WATER LEVEL
OR
START LPC
TR 5S
START RHI
TR 20S
START SW
TR 30S
START SG
TRIP BKR 7-75

83-16C


(CS/B-8) CONTROL ROOM SWITCH TRIP
(52/a) CIRCUIT BREAKER 8-3 CLOSED
(86/T8) TRANSFORMER TR-B L-O RELAY TRIP
(86/8-3, 86/B-7) MAIN OVERCURRENT L-O RELAY TRIP
OR
NOT
NOT
27/88
(SET 87.3%)
TRANSFORMER TR-B UNDERVOLTAGE
NOT
(52/b) CIRCUIT BREAKER 8-3 OPEN
(52/b) CIRCUIT BREAKER DG2-8 OPEN.
(27-8-3,4,5) SEC U-V RELAY TRIP
(SET 87.3%)
(52/b) CIRCUIT BKR B-8 OPEN
2/3 PERM
TR 8S
A
OR
NOT
TR 15S
OR
PRIM U-Y RELAY TRIP
(27-8-1,2) (SET 69%)
TR 2S
OR
TR 2S
LOAD SHEDDING
TRIP RHR 2B, RHR 2C, CRD1B, SW1B
REA-FN-1B, ROA-FN-1B, MC-8C, 8C-8
DIESEL GENERATOR START (FI
NOT
EMERG BUS SM-8 NORMAL
HIGH DRYWELL PRESSURE
LOW REACTOR WATER LEVEL
OR
A
START
START
START
START
TR 5S
TR 20S
TR 30S
TRIP BKR 8-85

8.3-17c



WASHINGTON PUBLIC POWER SUPPLY SYSTEM NUCLEAR PROJECT NO. 2	EMERGENCY BUS SM-8 UNDERVOLTAGE PROTECTION, BUS TRANSFER, AND LOAD SEQUENCING	FIGURE 8.3-17c

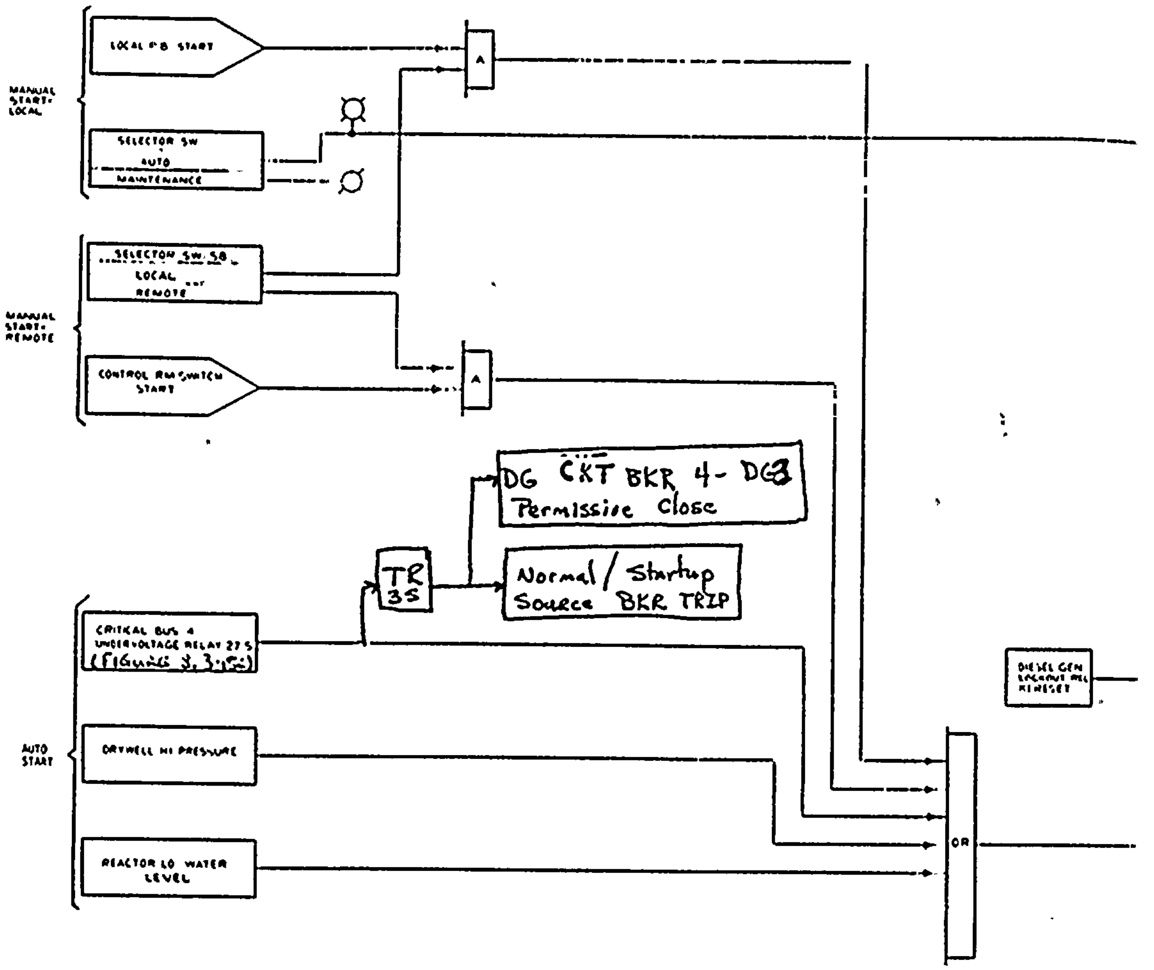

LOCAL P.B. START
A
MANUAL START-LOCAL
SELECTOR SW
AUTO
MAINTENANCE
SELECTOR SW. 58
LOCAL
REMOTE
MANUAL START-REMOTE
CONTROL RM SWITCH START
A
DG CKT BKR 4-DG3
Permissive Close
TR 3S
Normal / Startup Source BKR TRIP
CRITICAL BUS 4 UNDERVOLTAGE RELAY 27 S
DIESEL GEN
AUTO START
DRYWELL HI PRESSURE
REACTOR LO WATER LEVEL
OR

Fig. 8.3-18a

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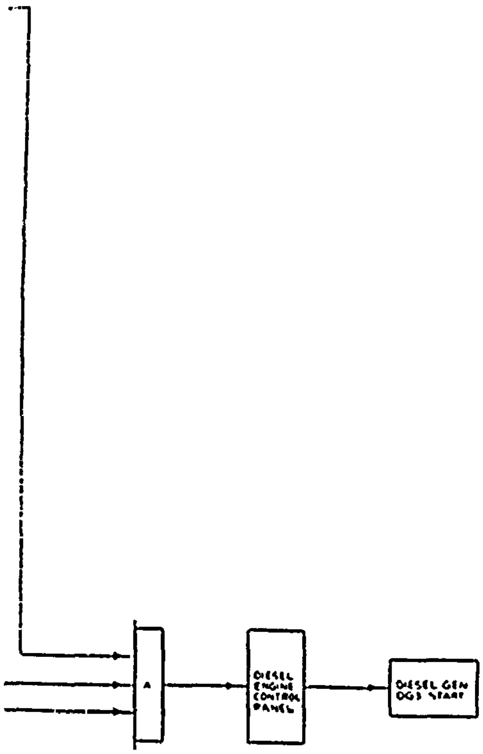
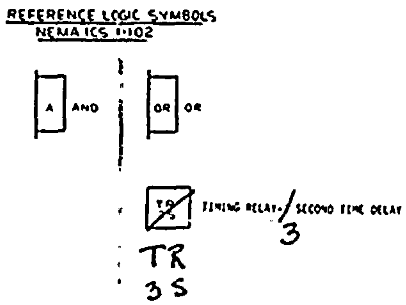
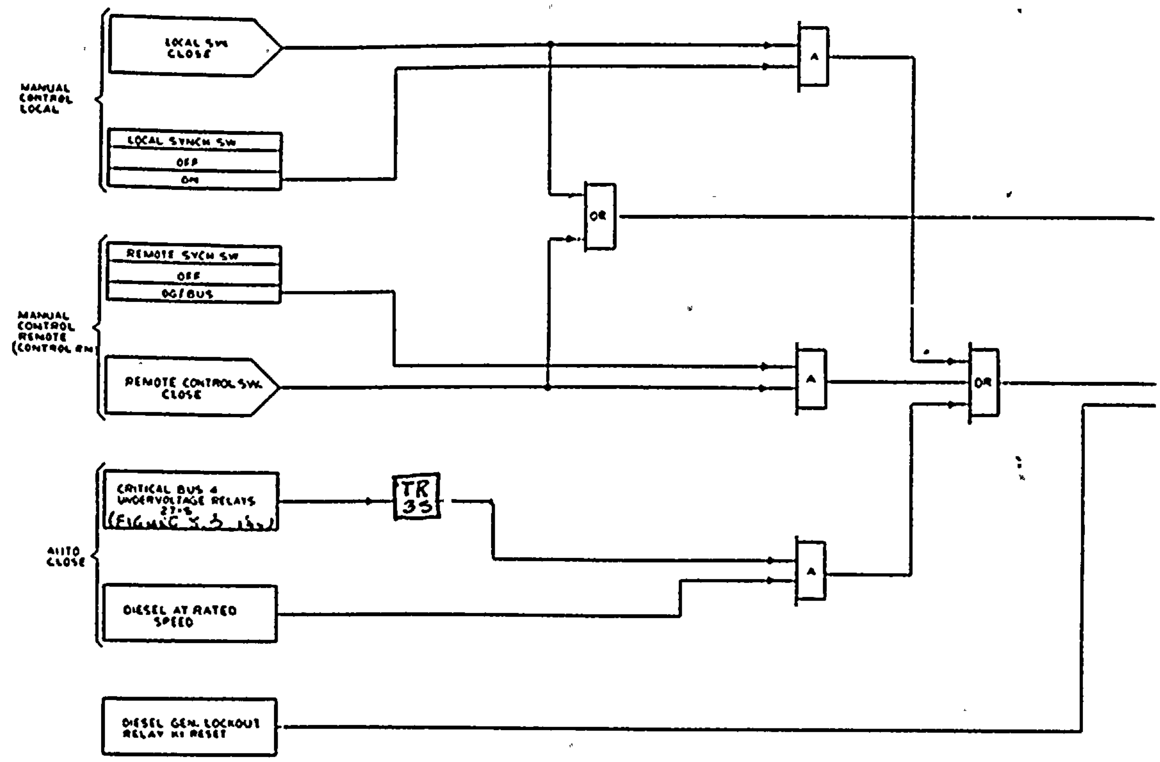
SEE FIGURE 8.3-18b





WASHINGTON PUBLIC POWER SUPPLY SYSTEM NUCLEAR PROJECT NO. 2	DIESEL GENERATOR LOGIC DIAGRAM - DIVISION 3 (HPCS), ENGINE START	FIGURE 8.3-18a



MANUAL CONTROL LOCAL
LOCAL SW CLOSE
LOCAL SYNCH SW
OFF
ON
OR
MANUAL CONTROL REMOTE (CONTROL RM)
REMOTE SYCH SW
OFF
DG/BUS
REMOTE CONTROL SW. CLOSE
A
A
OR
AUTO CLOSE
CRITICAL BUS 4 UNDERVOLTAGE RELAYS 27-5
TR 3S
A
DIESEL AT RATED SPEED
DIESEL GEN. LOCKOUT RELAY K1 RESET

Fig. 8.3-18b

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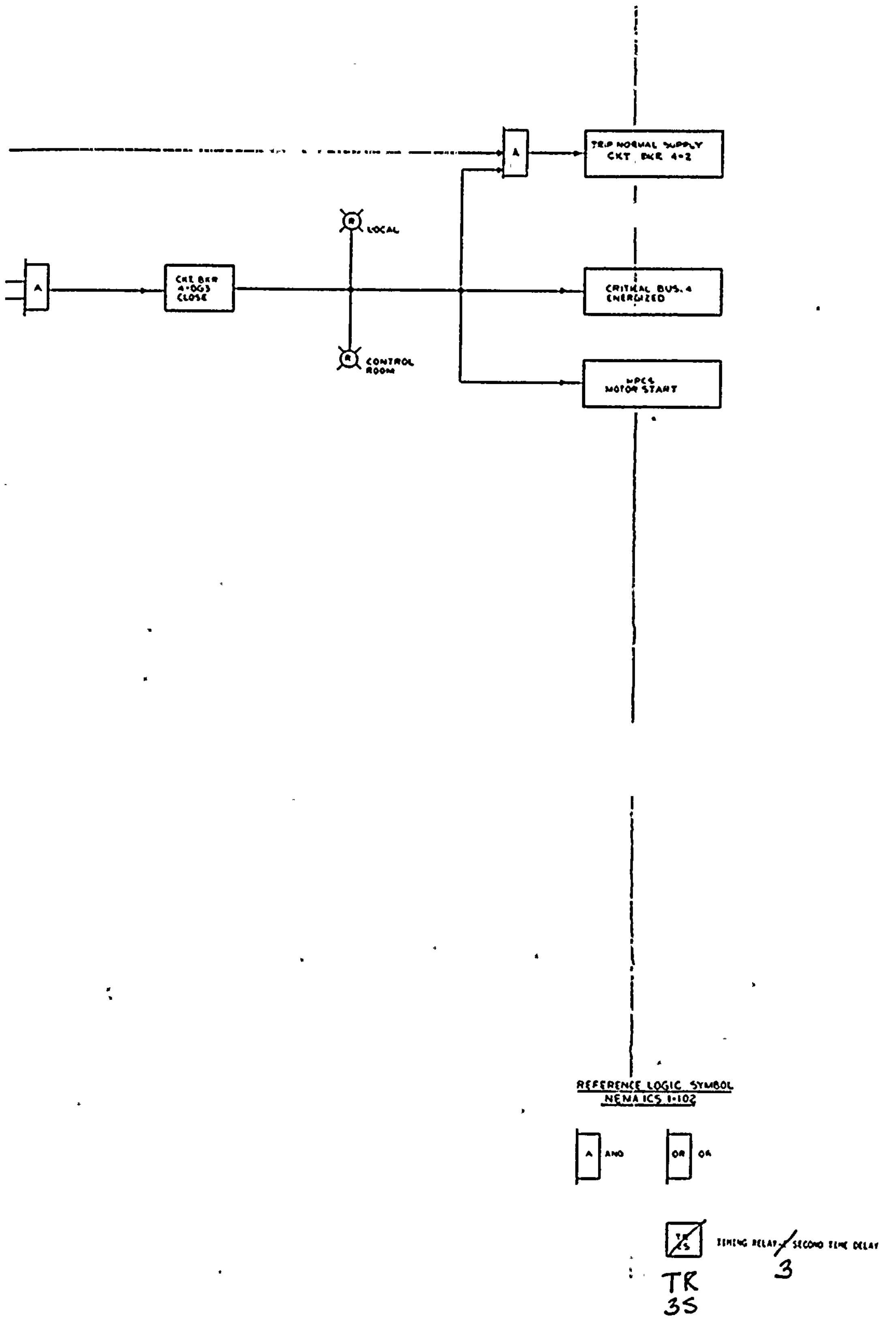
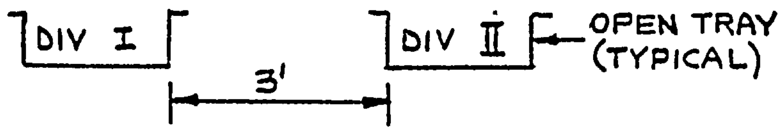
SEE FIGURE 8.3-18a



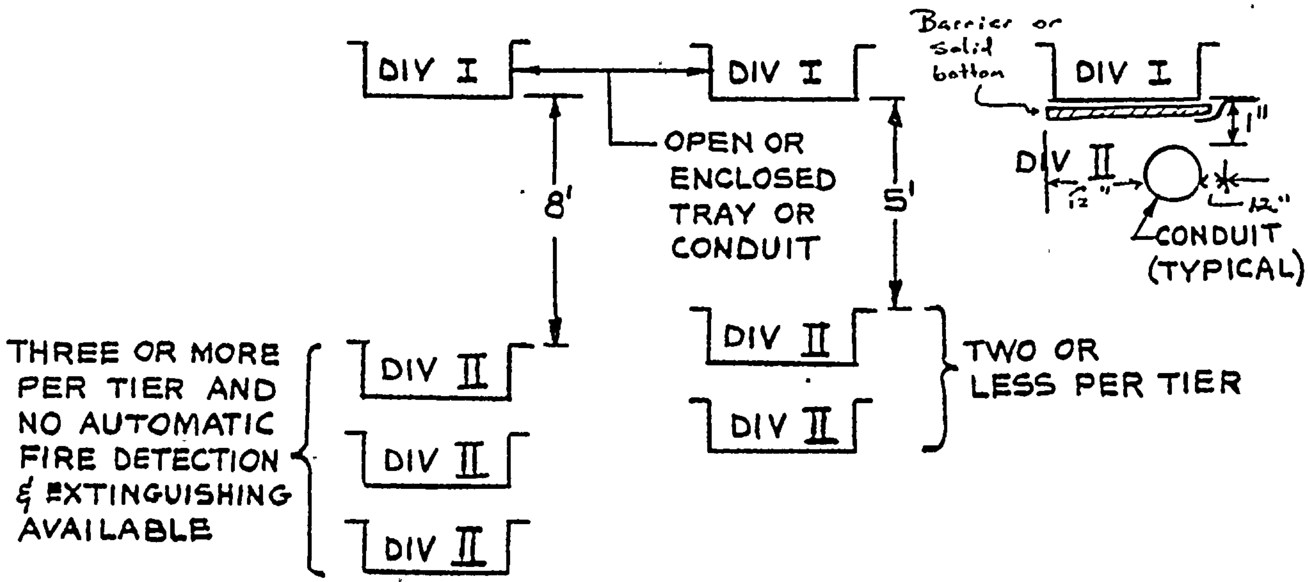
WASHINGTON PUBLIC POWER SUPPLY SYSTEM NUCLEAR PROJECT NO. 2	DIESEL GENERATOR LOGIC DIAGRAM - DIVISION 3 (HPCS), GENERATOR BREAKER CLOSE	FIGURE 8.3-18b

GENERAL AREAS

A. MINIMUM HORIZONTAL SEPARATION REQUIRMENT BETWEEN ANY TWO REDUNDANT DIVISIONS. THIS IS ALSO APPLICABLE IF ONE RACEWAY IS ENCLOSED AND THE ENCLOSED RACEWAY IS NOT LOWER THAN THE OPEN TRAY OR RACEWAY.



B. MINIMUM VERTICAL SEPARATION REQUIREMENTS BETWEEN ANY TWO REDUNDANT DIVISIONS.



NOTE:

DISTANCES SHOWN CONSIDER THE IDEAL ARRANGEMENT OF TWO (2) RACEWAYS ONLY. IF MORE THAN TWO (2) TRAYS EXIST IN ANY PARTICULAR ARRANGEMENT, PHYSICAL SEPARATION DISTANCES CHOSEN MUST BE BASED ON THE COMPLETE CONFIGURATION.

WASHINGTON PUBLIC POWER SUPPLY SYSTEM NUCLEAR PROJECT NO. 2	CABLE SEPARATION REQUIREMENTS GENERAL AREAS/OPEN TRAYS - PARALLEL ROUTING	FIGURE 8.3- 29a

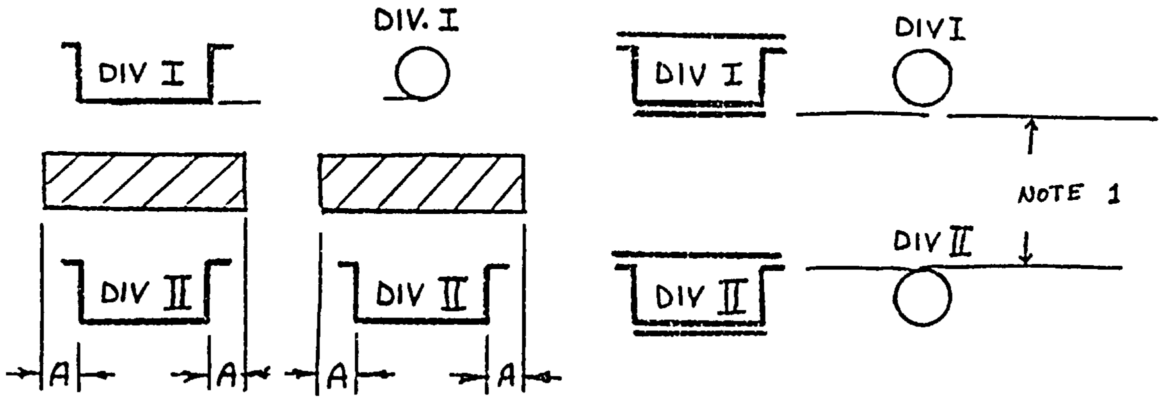
AMENDMENT NO. 2[illegible]
February 1982

C. CONT'D

GENERAL AREAS

VERTICAL
(SEE NOTE ON FIGURE 8.3-29a)

WHERE VERTICAL SEPARATION REQUIRMENTS ARE NOT MET THE USE OF BARRIERS, TRAY COVERS OR CONDUITS MAY BE USED WITH NO SPECIFIC DIMENSIONAL REQUIREMENTS EXCEPT AS INDICATED BELOW:



A= 12" MINIMUM OR FLUSH TO WALL.

NOTE 1. No minimum separation distance is required between redundant division conduits or enclosed trays but they must not physically touch.

WASHINGTON PUBLIC POWER SUPPLY SYSTEM NUCLEAR PROJECT NO. 2	CABLE SEPARATION REQUIREMENTS GENERAL AREAS/OPEN TRAYS - PARALLEL ROUTING	FIGURE 8.[illegible]- 2[illegible]

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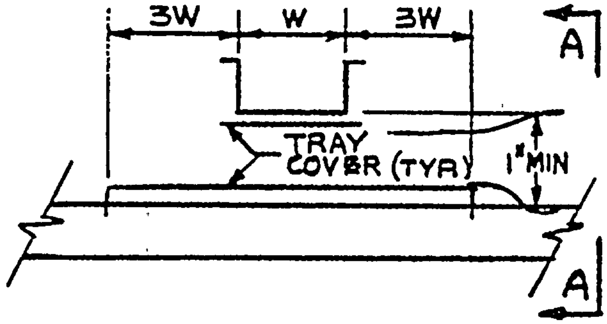
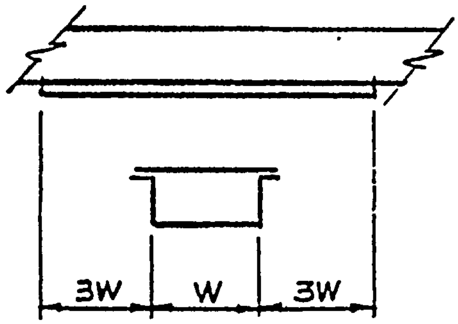
GENERAL AREAS

CROSSOVERS

(SEE NOTE ON FIGURE 8.3-29a)

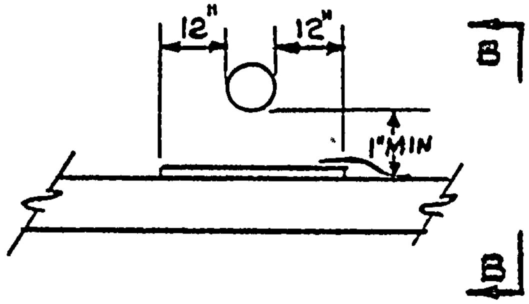
TRAY COVERS SHALL BE USED FOR ALL CROSSOVERS OF REDUNDANT DIVISION RACEWAY SYSTEMS, EXCEPT WHEN THE BOTTOM RACEWAY IS A CONDUIT. THE SCHEMES SHOWN BELOW SHALL BE USED REGARDLESS OF THE VOLTAGE LEVEL OF THE CABLES IN A CROSSOVER RACEWAY SYSTEM.

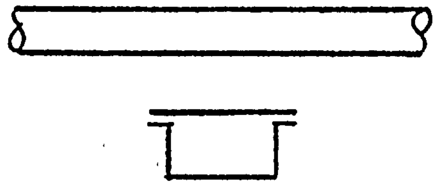




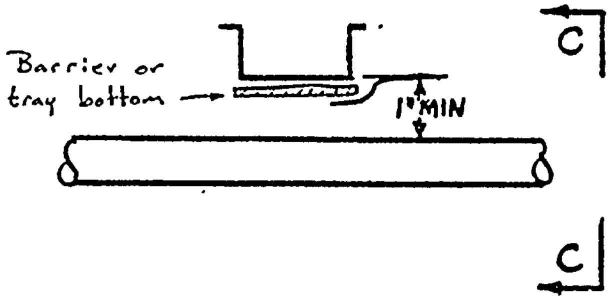
"W" IS DEFINED AS THE NOMINAL TRAY WIDTH AT THE WIDEST TRAY INVOLVED.
3W = 3 TIMES THE NOMINAL TRAY WIDTH OR FLUSH TO A WALL.

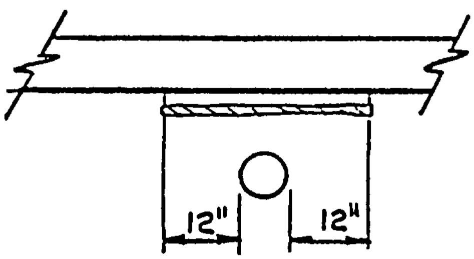
SECTION A-A





SECTION B-B

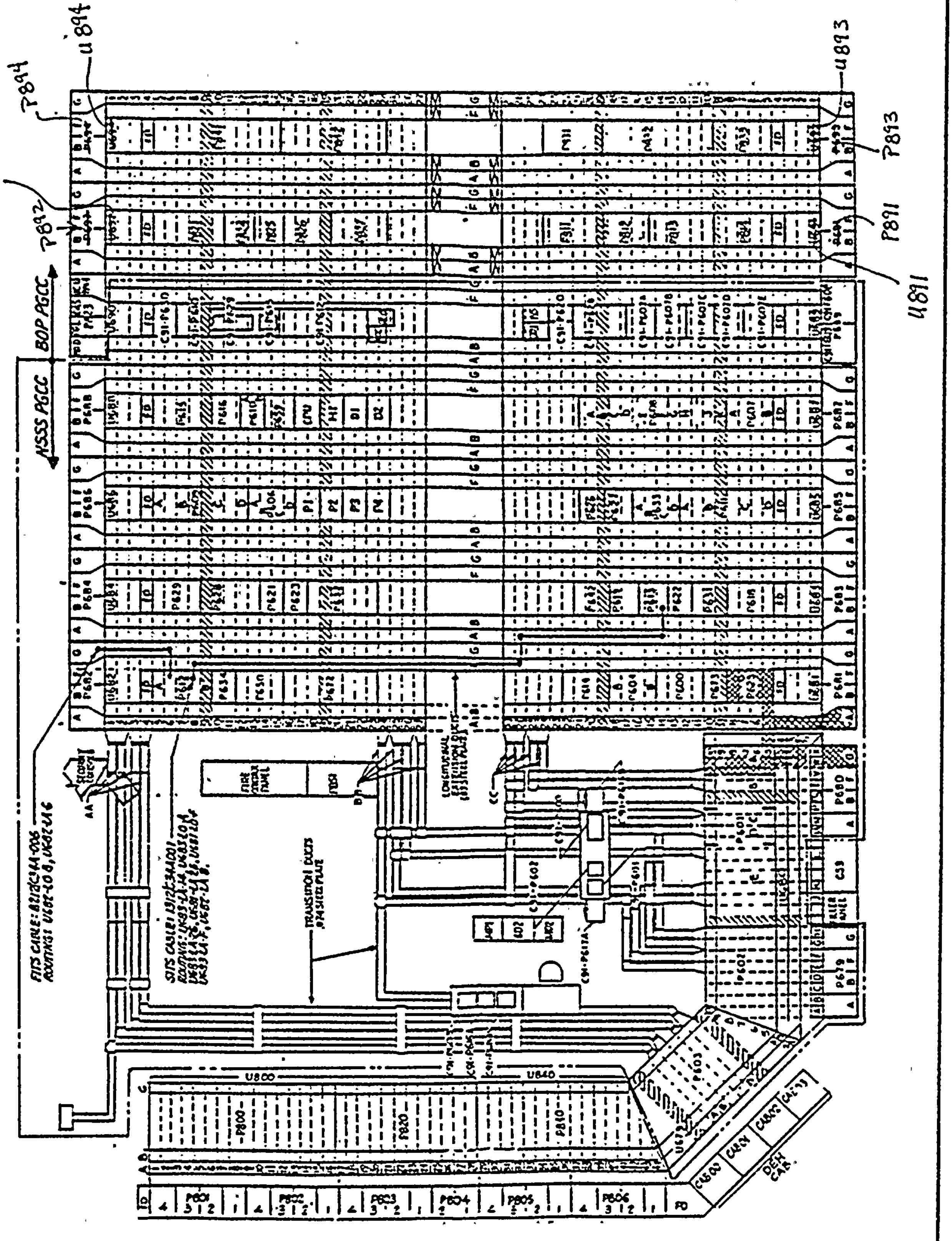




SECTION C-C

WASHINGTON PUBLIC POWER SUPPLY SYSTEM NUCLEAR PROJECT NO. 2	CABLE SEPARATION REQUIREMENTS GENERAL AREAS/OPEN TRAYS-CROSSOVERS	FIGURE 8.3-29d

AMENDMENT NO. 23
February 1982



WASHINGTON PUBLIC POWER SUPPLY SYSTEM NUCLEAR PROJECT NO. 2	POWER GENERATION CONTROL COMPLEX PLAN - CABLE ROUTING DETAIL	FIGURE 8.3-30

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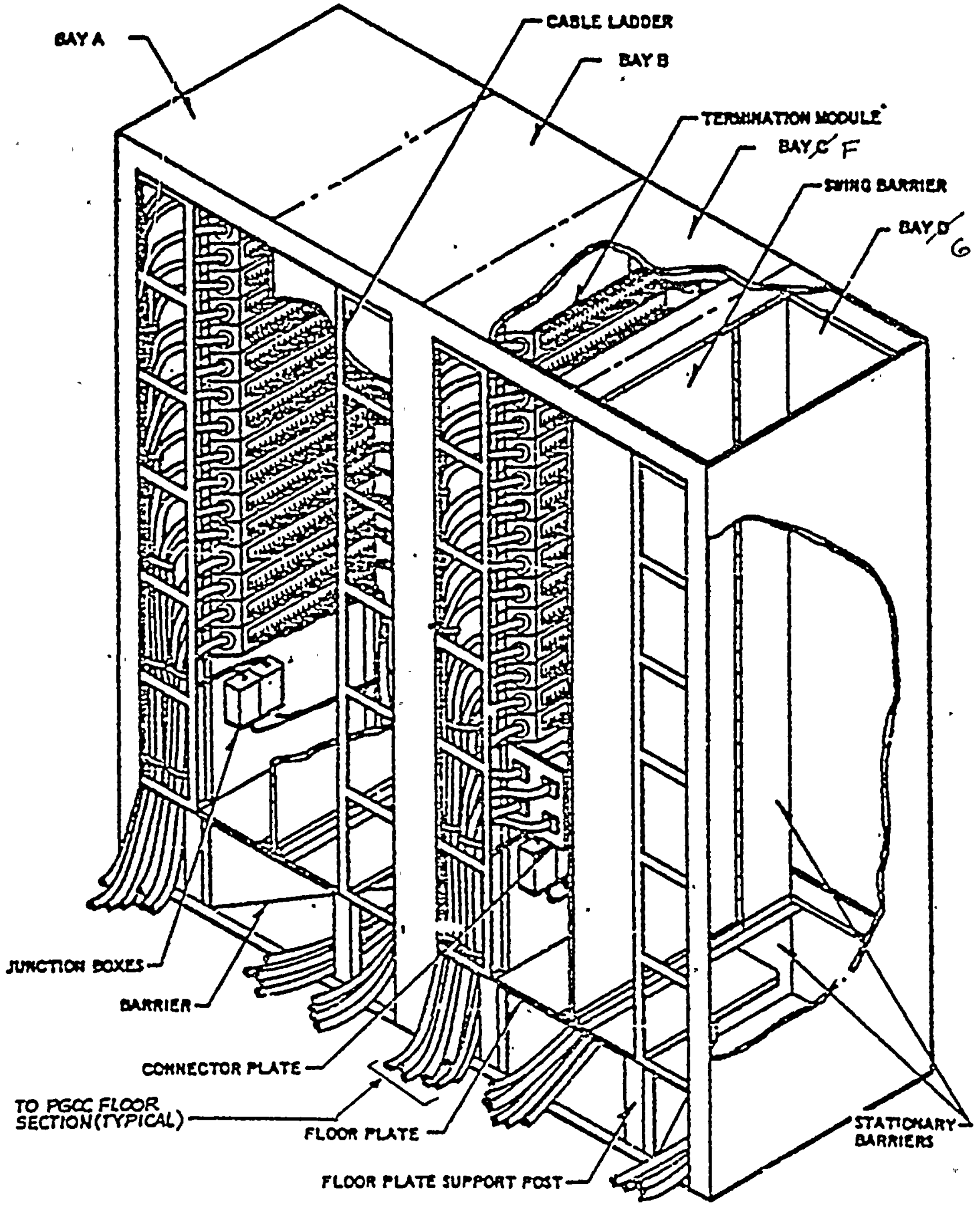
February 1982



ASSEMBLED TERMINATION CABINET (DOOR REMOVED FOR CLARITY)

WASHINGTON PUBLIC POWER SUPPLY SYSTEM NUCLEAR PROJECT NO. 2	POWER GENERATION CONTROL COMPLEX TERMINATION CABINET ASSEMBLY	FIGURE 8.3-32

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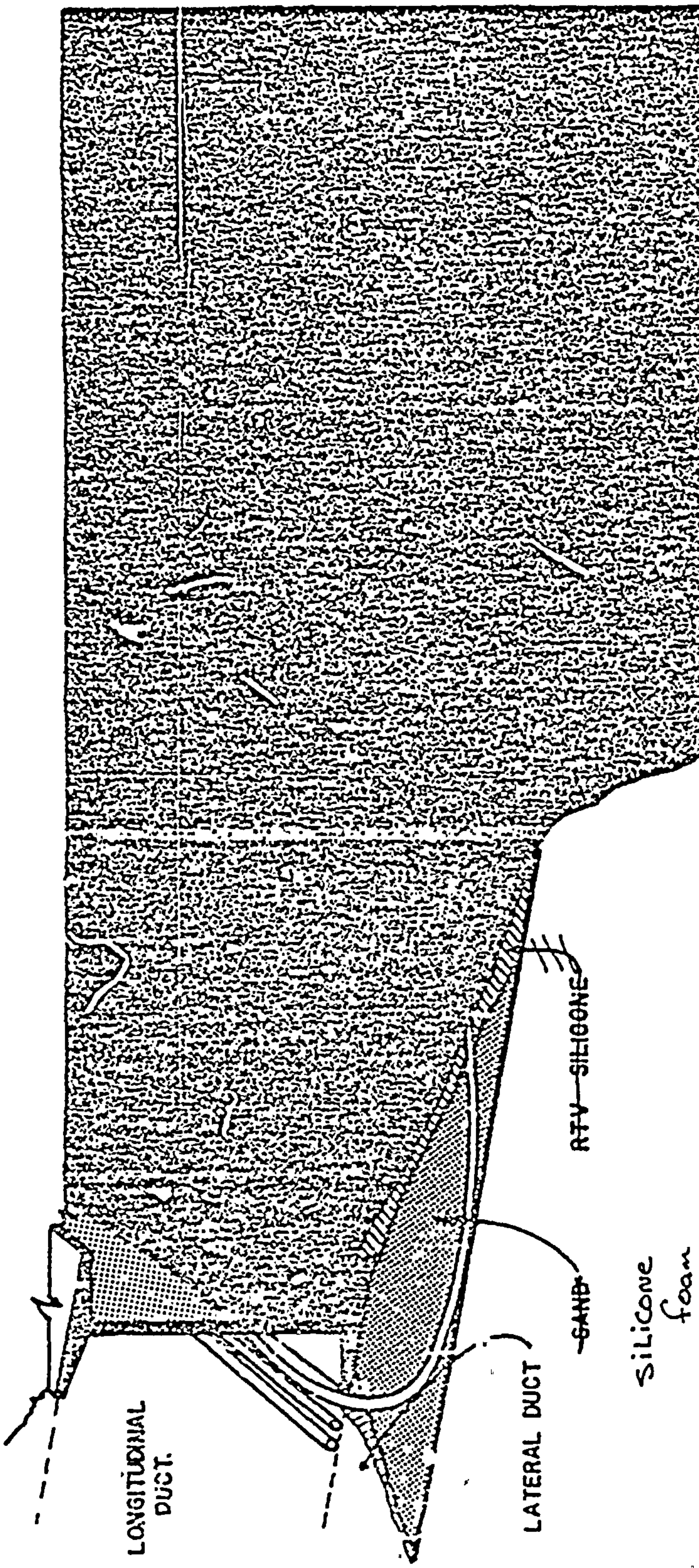

FIRESTOPPING DETAIL

WASHINGTON PUBLIC POWER SUPPLY SYSTEM NUCLEAR PROJECT NO. 2	POWER GENERATION CONTROL COMPLEX FIRESTOPPING DETAIL	FIGURE 8.3-37

[illegible]

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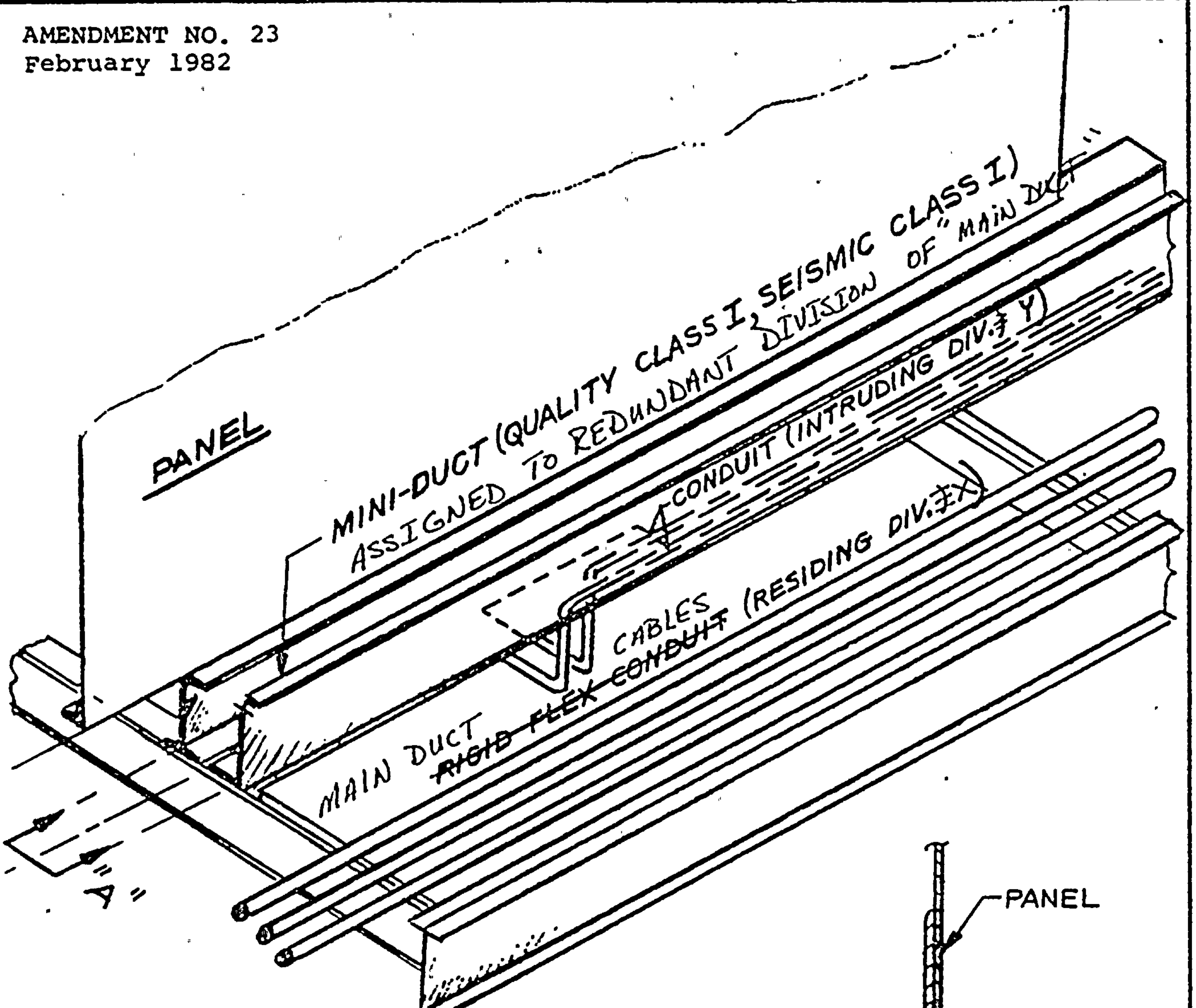
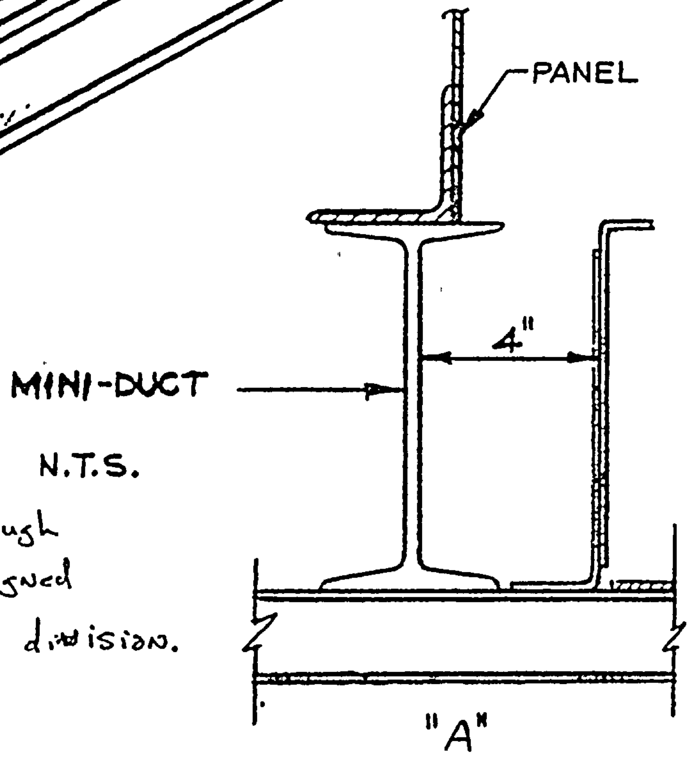


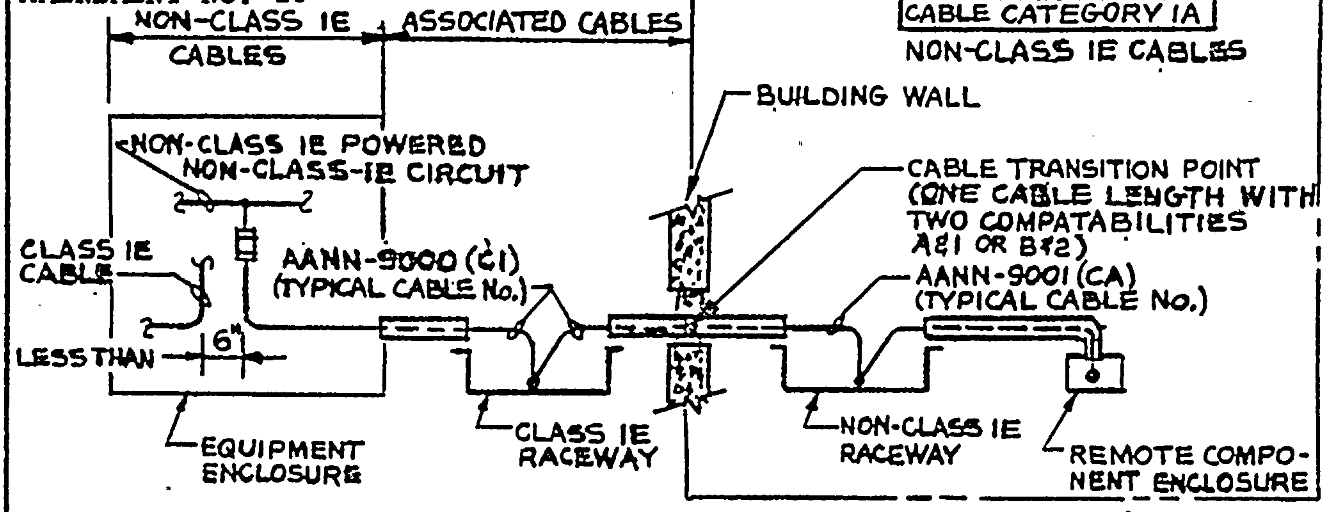


N.T.S.

Note: The Mini-Duct is used to route cables of one division through a main-duct assigned to a redundant division.

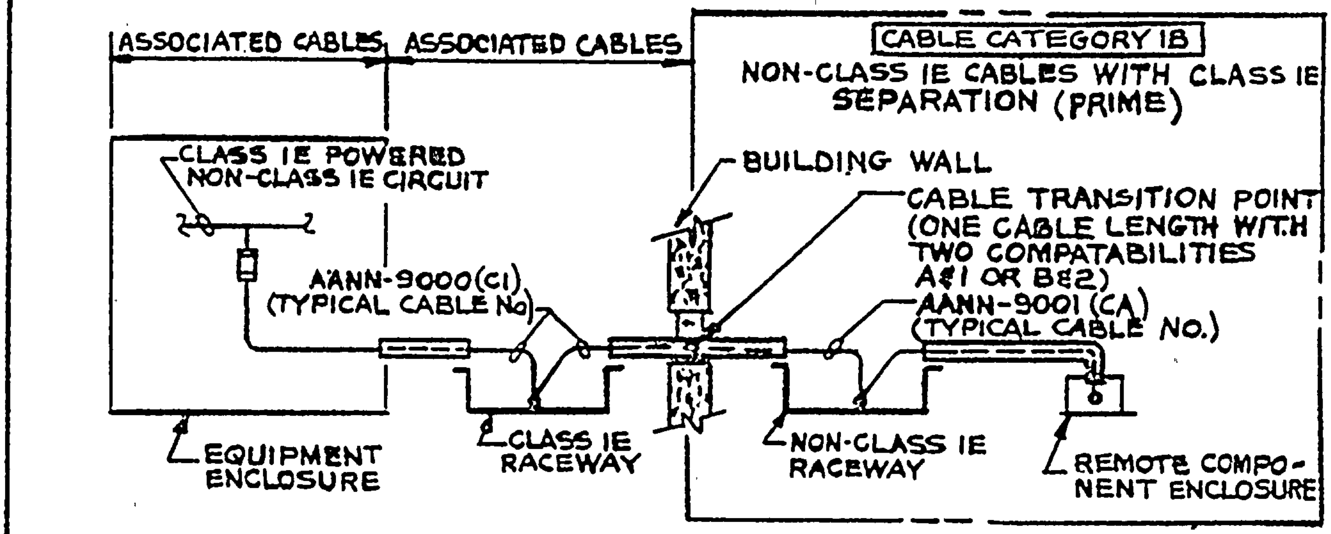
WASHINGTON PUBLIC POWER SUPPLY SYSTEM NUCLEAR PROJECT NO. 2	POWER GENERATION CONTROL COMPLEX MINI DUCT DETAIL	FIGURE 8.3-40

AMENDMENT NO. 23



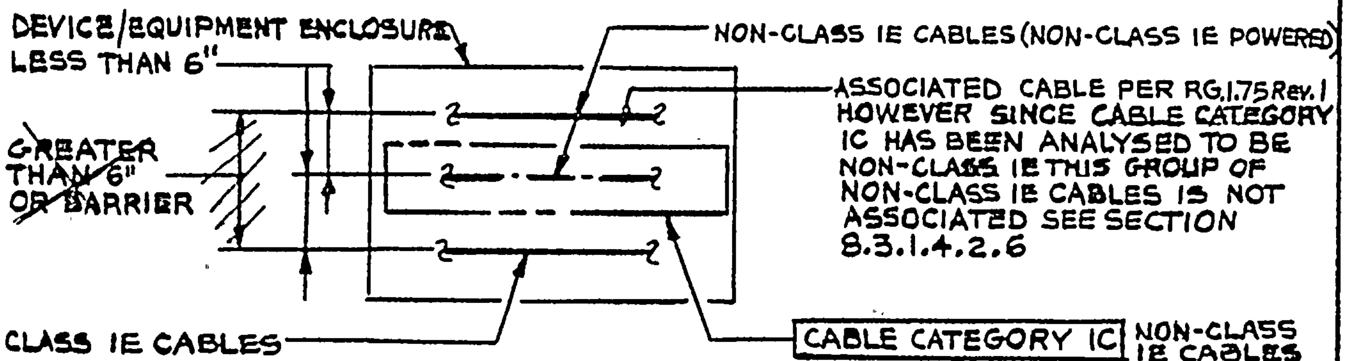
NON-CLASS IE (NON-CLASS IE POWERED) INSTRUMENTATION & CONTROL CABLES

CABLE CATEGORY IA (RACEWAYS)



NON-CLASS IE (CLASS IE POWERED) INSTRUMENTATION & CONTROL CABLES

CABLE CATEGORY IB (RACEWAYS)

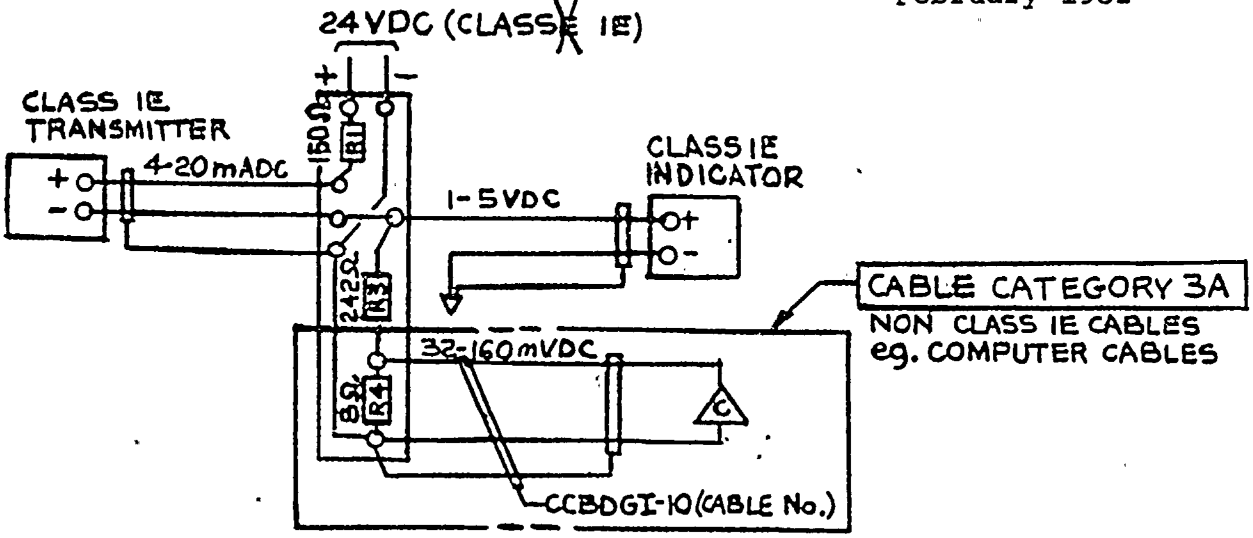


NON-CLASS IE (NON-CLASS IE POWERED) INSTRUMENTATION & CONTROL CIRCUITS

CABLE CATEGORY IC (ENCLOSURES)

WASHINGTON PUBLIC POWER SUPPLY SYSTEM NUCLEAR PROJECT NO. 2	NON-CLASS 1E CIRCUIT CATEGORIES REQUIRING ANALYSIS	FIGURE 8.3-43a

AMENDMENT NO. 23
February 1982

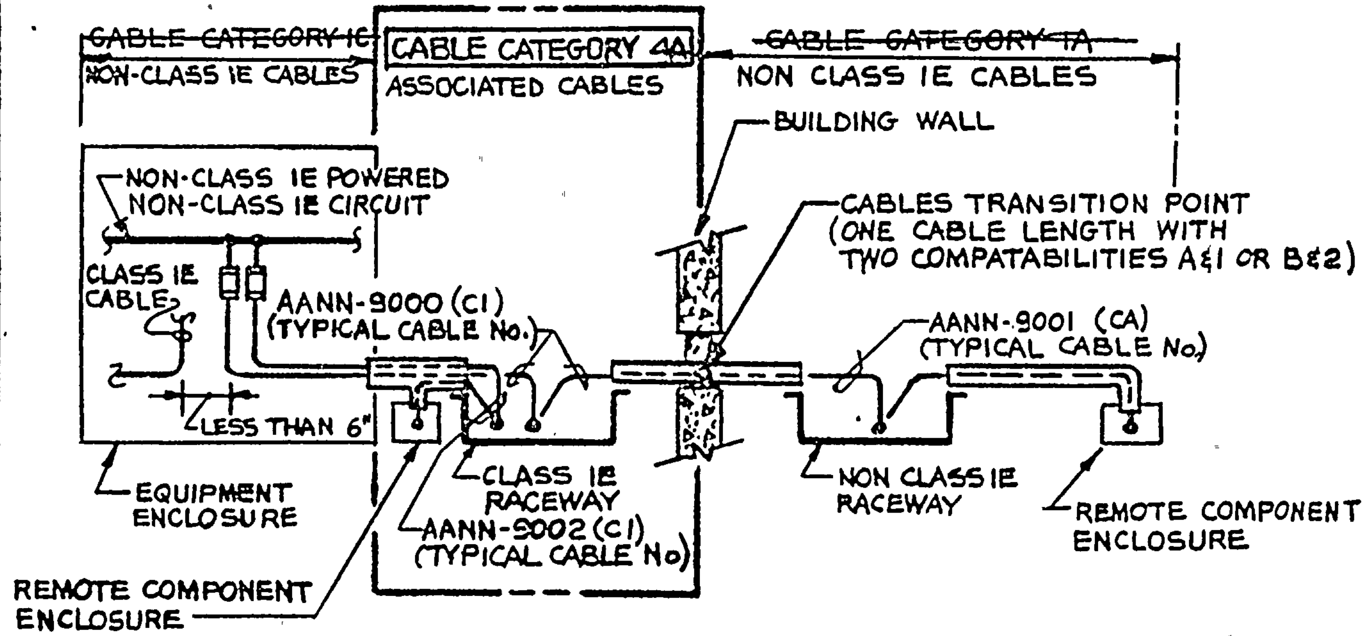


NON CLASS IE INSTRUMENTATION CIRCUITS POWERED FROM CLASS IE THROUGH CURRENT LIMITING DEVICES-CABLE CATEGORY 3A

WASHINGTON PUBLIC POWER SUPPLY SYSTEM NUCLEAR PROJECT NO. 2	NON-CLASS iE CIRCUIT CATEGORIES REQUIRING ANALYSIS	FIGURE 8.3-43

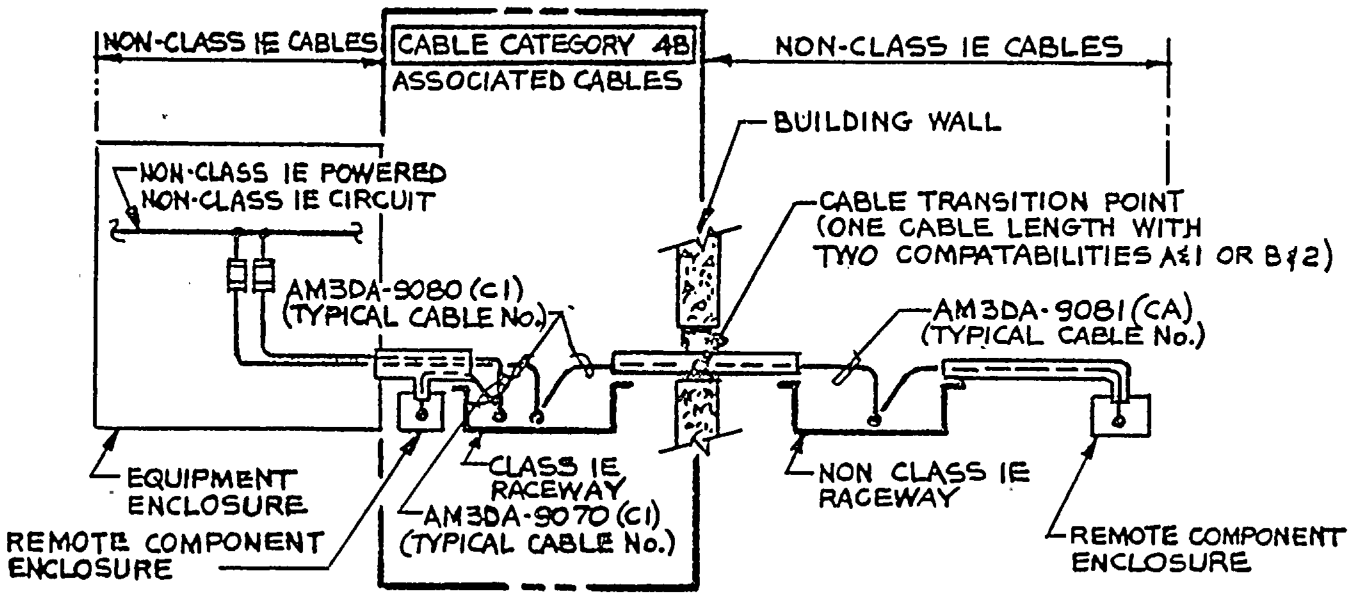
43c

[illegible]



ASSOCIATED (NON-CLASS 1E POWERED) INSTRUMENTATION & CONTROL CABLES

CABLE CATEGORY 4A (RACEWAY)



ASSOCIATED (NON-CLASS 1E POWERED) POWER CABLES (IN CLASS 1E RACEWAYS)

CABLE CATEGORY 4B

WASHINGTON PUBLIC POWER SUPPLY SYSTEM NUCLEAR PROJECT NO. 2	ASSOCIATED CIRCUIT CATEGORIES	FIGURE 8.3- 43d